FormationEval v0.1

Benchmark questions, answers, rationales, and sources.

Questions	505
Source IDs	3
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Sources used

Petroleum Geoscience: From Sedimentary Environments to Rock Physics (bjorlykke_petroleum_geoscience_2010) - 262 references
Well Logging for Earth Scientists, 2nd Edition (ellis_singer_well_logging_2007) - 219 references
Petroleum Geology (AES3820) - TU Delft Open CourseWare (tudelft_petroleum_geology_ocw) - 24 references

Question 1 of 505

ID	formationeval_v0.1_petrophysics_logging_principles_001
Domains	Petrophysics, Petroleum Geology
Topics	Well Logging History, Measurement Principles
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

The historical French term for well logging, 'carottage électrique' (electrical coring), implies what fundamental concept about the original application of the technology?

A	It was primarily used to measure the electrical potential of the drilling mud
B	It replaced the need for drilling by using surface electrical sensors
C	It physically extracted rock samples using electrical current
D	It provided a continuous record of formation characteristics comparable to a physical core

Correct answer:	D - It provided a continuous record of formation characteristics comparable to a physical core

Rationale

The term 'electrical coring' was a descriptive metaphor suggesting that the continuous electrical measurements provided a record of rock characteristics similar to extracting a physical core, allowing for correlation and evaluation without continuous mechanical coring.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 1 - 01_an_overview_of_well_logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Introduction (1.1).

Question 2 of 505

ID	formationeval_v0.1_drilling_engineering_lwd_data_acquisition_002
Domains	Drilling Engineering, Petrophysics
Topics	LWD, Data Acquisition
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Data acquired via Logging While Drilling (LWD) requires a specific processing step not typically needed for wireline logs. What is this step and why is it necessary?

A	Filtering out mud-pulse noise that obscures the formation signal
B	Manual correlation with offset wells to establish the true vertical depth
C	Depth-matching to the casing collar locator because LWD depth is less accurate
D	Converting time-referenced raw data to a depth-based log, because drilling speed varies
Correct answer:	D - Converting time-referenced raw data to a depth-based log, because drilling speed varies

Rationale

LWD sensors record measurements constantly as time passes. Since the rate of penetration (drilling speed) changes, these time-based records must be mapped to depth using a separate depth-time tracker to create a standard log.

Sources

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Reference	Chapter 1 - 01_an_overview_of_well_logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 1.2.2 (What is LWD?).

Question 3 of 505

ID	formationeval_v0.1_petrophysics_neutron_porosity_003
Domains	Petrophysics
Topics	Neutron Logging, Clay Effects, Porosity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Why does a standard neutron porosity log often overestimate porosity in clay-bearing formations?

A	Clay minerals absorb neutrons, preventing them from returning to the detector
B	The borehole diameter is typically washed out in clays, causing the tool to read 100% porosity
C	Clays have a high density that scatters neutrons more effectively than sand grains
D	The tool measures hydrogen index, and cannot distinguish between pore water and hydroxyls in the clay structure

Correct answer:	D - The tool measures hydrogen index, and cannot distinguish between pore water and hydroxyls in the clay structure

Rationale

Neutron tools function by interacting with hydrogen. They detect all hydrogen in the formation, whether it is in the pore fluid (water/oil) or chemically bound within the clay mineral structure (hydroxyls). Consequently, the tool interprets the hydrogen in the clay as porosity, leading to an overestimation of the effective pore space.

Sources

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Reference	Chapter 1 - 01_an_overview_of_well_logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 1.5 (Measurement Techniques).

Question 4 of 505

ID	formationeval_v0.1_petrophysics_resistivity_principles_004
Domains	Petrophysics
Topics	Electrical Logging, Saturation, Resistivity
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

What is the fundamental physical contrast that allows electrical resistivity logs to distinguish hydrocarbons from formation water?

A	Hydrocarbons are highly conductive while formation water is resistive
B	The rock matrix is conductive only when saturated with oil, as hydrocarbon molecules enhance the electrical pathway through the mineral grains
C	Formation water acts as a conductive electrolyte, whereas the rock matrix and hydrocarbons are generally non-conductive
D	Hydrocarbons induce a spontaneous potential that cancels out the conductivity of the water
Correct answer:	C - Formation water acts as a conductive electrolyte, whereas the rock matrix and hydrocarbons are generally non-conductive

Rationale

The rock matrix is typically non-conducting (insulator). Electrical current flows primarily through the saline formation water (brine) in the pore space. Because hydrocarbons are non-conductive, replacing brine with oil or gas reduces the conductivity (increases resistivity) of the formation, creating a measurable contrast.

Sources

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Reference	Chapter 1 - 01_an_overview_of_well_logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 1.5 (Measurement Techniques - Electrical).

Question 5 of 505

ID	formationeval_v0.1_petrophysics_formation_evaluation_005
Domains	Petrophysics, Reservoir Engineering
Topics	Permeability, Formation Evaluation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Among the primary questions answered by formation evaluation, which parameter is considered the most difficult to determine directly from standard logging measurements?

A	The depth of the hydrocarbon-bearing formation
B	The porosity of the formation
C	The producibility (permeability) of the hydrocarbons
D	The distinction between oil and gas

Correct answer: C - The producibility (permeability) of the hydrocarbons

Rationale

While porosity, depth, and fluid type can often be inferred from nuclear and electrical logs, permeability (producibility) is the most difficult to answer. It is a dynamic property governing flow, whereas most logs measure static properties. It is usually derived empirically or requires specialized tools like NMR or acoustic Stoneley wave analysis.

Sources

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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 1 - 01_an_overview_of_well_logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 1.4 (Well Logging: The Narrow View).

Question 6 of 505

ID	formationeval_v0.1_drilling_engineering_lwd_design_006
Domains	Drilling Engineering
Topics	LWD, Tool Design
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

To survive the mechanical realities of the drilling environment, how are LWD sensors packaged compared to standard wireline tools?

A	They are encased in shock-absorbing rubber sleeves attached to the drill bit
B	They are miniaturized and placed inside the hollow center of the drill pipe
C	They are integrated directly into the walls of rigid steel tubulars that form part of the bottom-hole assembly
D	They use wireless transmission to avoid physical connection with the drill string
Correct answer:	C - They are integrated directly into the walls of rigid steel tubulars that form part of the bottom-hole assembly

Rationale

Unlike wireline tools which are often distinct probes, LWD systems must bear the weight and torque of drilling. Therefore, sensors are engineered into the steel walls of the drill collars themselves, allowing mud to flow through the center while maintaining structural integrity.

Sources

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Reference	Chapter 1 - 01_an_overview_of_well_logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 1.2.2.

Question 7 of 505

ID	formationeval_v0.1_petrophysics_water_saturation_007
Domains	Petrophysics
Topics	Water Saturation, Rock Properties
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In the context of reservoir rock properties, how is water saturation defined?

A	The ratio of water volume to the total bulk volume of the rock
B	The percentage of the pore space volume that is occupied by brine
C	The percentage of the total rock weight attributed to fluid
D	The ratio of hydrocarbon volume to water volume
Correct answer:	B - The percentage of the pore space volume that is occupied by brine

Rationale

Water saturation describes the partitioning of fluids within the pore space. It is specifically defined as the percentage (or fraction) of the porosity that is occupied by brine rather than hydrocarbons.

Sources

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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 1.3 (Properties of Reservoir Rocks).

Question 8 of 505

ID	formationeval_v0.1_petrophysics_acoustic_logging_008
Domains	Petrophysics, Geophysics
Topics	Acoustic Logging, Fracture Detection
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Low-frequency monopole acoustic transmitters are capable of exciting Stoneley waves. What is the primary petrophysical utility of analyzing this specific wave mode?

A	It provides the only reliable measurement of formation temperature, since acoustic velocity has a unique thermal sensitivity at all frequencies
B	It is uniquely sensitive to fluid movement, aiding in permeability estimation and open fracture identification
C	It is used to calibrate the neutron porosity log in gas-bearing zones
D	It allows for the direct imaging of the borehole wall geometry
Correct answer:	B - It is uniquely sensitive to fluid movement, aiding in permeability estimation and open fracture identification

Rationale

Stoneley waves are interface waves that propagate along the borehole wall. Their attenuation and velocity are strongly affected by the ability of fluid to move in and out of the formation, making them excellent indicators of permeability and open fractures.

Sources

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Reference	Chapter 1 - 01_an_overview_of_well_logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 1.5 (Measurement Techniques - Acoustic).

Question 9 of 505

ID	formationeval_v0.1_petrophysics_gas_detection_001
Domains	Petrophysics
Topics	Gas Detection, Neutron-Density Log
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

When interpreting a combination neutron-density log calibrated to a sandstone matrix, what characteristic pattern indicates the presence of gas in the formation?

A	The neutron porosity reads significantly higher than the density porosity due to high hydrogen index
B	Both porosity curves track closely together with very low values
C	The density porosity reads higher than the neutron porosity, creating a crossover
D	Both curves read negative porosity values due to matrix density effects
Correct answer:	C - The density porosity reads higher than the neutron porosity, creating a crossover

Rationale

Gas has a lower density than oil or water, causing the density tool to calculate a falsely high porosity. Conversely, gas has a lower hydrogen concentration (hydrogen index) than liquid-filled pore space, causing the neutron tool to calculate a falsely low porosity. This divergence, where density porosity exceeds neutron porosity, creates the characteristic 'crossover' effect used to identify gas.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter Introduction to Well Log Interpretation: Finding the Hydrocarbon
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 2.5 on curve behavior.

Question 10 of 505

ID	formationeval_v0.1_petrophysics_invasion_profile_002
Domains	Petrophysics
Topics	Invasion, Resistivity Logging
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Under what specific condition does a low-resistivity 'annulus' typically form in the transition zone between the flushed zone and the uninvaded formation?

A	When the drilling mud filtrate is much more resistive than the formation water
B	When hydrocarbons in the formation are more mobile than the formation water
C	When the formation is entirely water-bearing and invaded by fresh mud
D	When gravity segregation separates gas from oil in a horizontal well
Correct answer:	B - When hydrocarbons in the formation are more mobile than the formation water

Rationale

An annulus forms when the hydrocarbons (oil or gas) are more mobile than the formation water. As the mud filtrate invades, it pushes the hydrocarbons out deeper, but the formation water is pushed ahead of the filtrate and accumulates in a 'bank' or transition zone between the flushed zone and the uninvaded zone. This concentration of formation water lowers the resistivity in that specific ring.

Sources

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Reference	Chapter Introduction to Well Log Interpretation: Finding the Hydrocarbon
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 2.3 describing the borehole environment.

Question 11 of 505

ID	formationeval_v0.1_petrophysics_quicklook_interpretation_003
Domains	Petrophysics
Topics	Quicklook Interpretation, Moveable Hydrocarbons
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a wellsite interpretation, comparing the ratio of flushed zone resistivity to true resistivity (R_xo/R_t) against the ratio of mud filtrate to formation water resistivity (R_mf/R_w) can indicate producibility. What does it suggest if R_xo/R_t is less than R_mf/R_w?

A	The formation is likely tight and no invasion has occurred
B	The zone contains hydrocarbons that have been moved by the drilling fluid
C	The formation contains only non-moveable residual oil that is trapped at pore surfaces and in dead-end pore spaces
D	The zone is water-bearing with no hydrocarbon saturation
Correct answer:	B - The zone contains hydrocarbons that have been moved by the drilling fluid

Rationale

The text states that if the ratio R_xo/R_t is the same as R_mf/R_w, then the flushed and uninvaded zones likely have the same hydrocarbon saturation (or none), implying no movement. However, if R_xo/R_t < R_mf/R_w, it indicates that some hydrocarbons were displaced (moved) by the invading filtrate, suggesting the hydrocarbons are producible.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter Introduction to Well Log Interpretation: Finding the Hydrocarbon
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 2.2 on rudimentary interpretation principles.

ID	formationeval_v0.1_petrophysics_lithology_004
Domains	Petrophysics
Topics	Lithology Identification, Clean Zones
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In a well drilled with fresh water-based mud into a formation containing saline pore water, which combination of Spontaneous Potential (SP) and Gamma Ray (GR) log responses typically identifies a 'clean' (low shale volume) permeable zone?

A	SP deflects to the right and GR reads high API values
B	SP tracks the shale baseline and GR reads high API values
C	SP deflects to the left (negative) and GR reads low API values
D	SP remains flat and GR shows maximum deflection to the right
Correct answer:	C - SP deflects to the left (negative) and GR reads low API values

Rationale

Shale indicators generally increase towards the right on standard log presentations. A clean zone (low shale) is characterized by a GR reading that is lower (left) than the shale sections. Similarly, the SP curve typically deflects to the left (becomes more negative) in clean, permeable formations compared to the shale baseline.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter Introduction to Well Log Interpretation: Finding the Hydrocarbon
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 2.2 and Section 2.5.

Question 13 of 505

ID	formationeval_v0.1_petrophysics_matrix_effects_005
Domains	Petrophysics
Topics	Matrix Effects, Density Log
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

If a formation consists of anhydrite streaks but the density log is processed assuming a sandstone matrix, what characteristic response will be observed on the porosity log?

A	The log will read essentially zero porosity
B	The log will indicate negative porosity values
C	The neutron and density curves will show a large positive separation
D	The log will show falsely high porosity due to low matrix density
Correct answer:	B - The log will indicate negative porosity values

Rationale

Anhydrite has a significantly higher matrix density than sandstone. When the tool is set to calculate porosity based on the lower density of a sandstone matrix, the higher measured bulk density of the anhydrite forces the calculation into negative numbers to satisfy the equation.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter Introduction to Well Log Interpretation: Finding the Hydrocarbon
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 2.5 (discussion of Fig 2.16).

Question 14 of 505

ID	formationeval_v0.1_petrophysics_shale_response_006
Domains	Petrophysics
Topics	Shale Effect, Neutron-Density Log
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

How do neutron and density porosity logs typically behave in shale sections when plotted on a compatible limestone or sandstone scale?

A	Neutron porosity reads significantly higher than density porosity
B	Both logs read very low porosity due to lack of permeability
C	Density porosity reads significantly higher than neutron porosity (crossover)
D	Both logs show identical high porosity values
Correct answer:	A - Neutron porosity reads significantly higher than density porosity

Rationale

In shales, the neutron tool detects hydrogen associated with the clay structure (bound water), leading to a high apparent porosity reading. The density tool reads a lower apparent porosity (relative to the neutron) due to the density of the shale/clay matrix. This results in a large separation where Neutron >> Density, which is the opposite of the gas effect.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Type	textbook
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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter Introduction to Well Log Interpretation: Finding the Hydrocarbon
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 2.5 (discussion of Fig 2.15).

Question 15 of 505

ID	formationeval_v0.1_petrophysics_borehole_environment_007
Domains	Petrophysics
Topics	Borehole Environment, LWD
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why might Logging While Drilling (LWD) measurements show a shallower depth of invasion compared to wireline logs recorded in the same well?

A	LWD tools have a physically shallower depth of investigation
B	LWD measurements are typically made shortly after drilling, before significant invasion occurs
C	LWD tools effectively remove mudcake during the logging process
D	LWD tools use different physics that are immune to invasion effects
Correct answer:	B - LWD measurements are typically made shortly after drilling, before significant invasion occurs

Rationale

LWD logs are usually recorded just a few hours after the formation is drilled. Invasion is a time-dependent process; because wireline logs are run days later, invasion has had much more time to progress deep into the formation compared to when the LWD sensors passed the zone.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter Introduction to Well Log Interpretation: Finding the Hydrocarbon
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 2.3.

Question 16 of 505

ID	formationeval_v0.1_petrophysics_formation_evaluation_008
Domains	Petrophysics
Topics	Resistivity Logging, Formation Evaluation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In a porous formation saturated with water, how does the True Formation Resistivity (R_t) generally change as porosity increases, assuming water salinity remains constant?

A	It decreases
B	It increases
C	It remains constant
D	It fluctuates randomly

Correct answer: A - It decreases

Rationale

The text explains that the formation resistivity is affected by porosity. Since the rock matrix is non-conductive and the electric current flows through the conductive electrolyte (brine) in the pore space, increasing the porosity provides more conductive paths, thereby decreasing the resistivity (R_t) of the formation.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Type	textbook
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Reference	Chapter Introduction to Well Log Interpretation: Finding the Hydrocarbon
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 2.2 on rudimentary interpretation principles.

Question 17 of 505

ID	formationeval_v0.1_petrophysics_log_presentation_009
Domains	Petrophysics
Topics	Log Presentation, Caliper Log
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What phenomenon often causes the caliper log to read a borehole diameter significantly larger than the bit size in shale sections compared to clean sand sections?

A	Shale swelling reduces the hole diameter
B	Washout of the shale due to structural weakness
C	Formation of thick mudcake on the shale wall
D	Equipment calibration error in conductive shales

Correct answer: B - Washout of the shale due to structural weakness

Rationale

Clean sand sections generally retain their structural integrity and hold gauge. However, shale sections often lose structural integrity during drilling and wash out, causing the caliper tool to measure a borehole diameter larger than the drill bit size.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter Introduction to Well Log Interpretation: Finding the Hydrocarbon
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 2.5.

Question 18 of 505

ID	formationeval_v0.1_petrophysics_fluid_saturation_010
Domains	Petrophysics
Topics	Fluid Saturation, Volumetrics
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In the volumetric definition of rock properties, how is the total fractional volume of oil in a formation expressed?

A	The product of porosity and water saturation (ϕ × Sw)
B	The product of porosity and oil saturation (ϕ × So)
C	The value of oil saturation (So) directly
D	The ratio of oil saturation to porosity (So / ϕ)

Correct answer: B - The product of porosity and oil saturation (ϕ × So)

Rationale

Porosity (ϕ) is the fraction of total rock volume that is pore space. Oil saturation (So) is the fraction of that pore space filled with oil. Therefore, the fraction of the total bulk volume occupied by oil is the product of the two: ϕ × So.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter Introduction to Well Log Interpretation: Finding the Hydrocarbon
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 2.2 and Fig 2.1.

Question 19 of 505

ID	formationeval_v0.1_petrophysics_resistivity_physics_001
Domains	Petrophysics
Topics	Resistivity, Formation Water Properties
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

According to standard physical models, what is the primary underlying mechanism responsible for the decrease in formation water resistivity as temperature increases?

A	Increased thermal agitation reduces the viscosity of the water, increasing ionic mobility
B	Increased temperature causes salt ions to dissociate more completely, increasing concentration
C	Thermal expansion of the water reduces the mean free path of the charge carriers
D	Higher temperatures strip the hydration water from ions, effectively reducing their charge

Correct answer: A - Increased thermal agitation reduces the viscosity of the water, increasing ionic mobility

Rationale

The text explains that electrolytic resistivity is proportional to viscosity. As temperature increases, the viscosity of the liquid decreases (due to overcoming intermolecular forces), which increases the mobility of the ions in solution. Higher mobility leads to higher conductivity and lower resistivity.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 3 Basic Resistivity and Spontaneous Potential
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on section 3.3 regarding temperature dependence of electrolytic conduction.

Question 20 of 505

ID	formationeval_v0.1_petrophysics_spontaneous_potential_002
Domains	Petrophysics
Topics	Spontaneous Potential, Liquid Junction Potential
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Which physical property difference between dissolved sodium (Na+) and chloride (Cl-) ions is the fundamental driver of the liquid-junction potential?

A	The difference in their ionic mobility
B	The difference in their atomic mass
C	The difference in their valence charge magnitude
D	The difference in their thermal stability
Correct answer:	A - The difference in their ionic mobility

Rationale

The liquid-junction potential arises from the diffusion of ions across a concentration gradient. Because Cl- ions have higher mobility than Na+ ions, they diffuse faster, creating a charge separation (dipole) that generates the potential.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 3 Basic Resistivity and Spontaneous Potential
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on the origin of liquid-junction potential.

Question 21 of 505

ID	formationeval_v0.1_petrophysics_ion_properties_003
Domains	Petrophysics
Topics	Basic Physics, Formation Water Properties
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why does the sodium ion (Na+) exhibit lower mobility than the chloride ion (Cl-) in formation waters, despite the sodium cation being physically smaller than the chloride anion?

A	The Na+ ion attracts a larger sphere of hydration water molecules due to its surface charge density
B	The Na+ ion is heavier than the Cl- ion, requiring more force to accelerate
C	The Na+ ion tends to form temporary bonds with the silicate rock matrix more often
D	The Na+ ion experiences greater repulsion from the water dipoles than the Cl- ion
Correct answer:	A - The Na+ ion attracts a larger sphere of hydration water molecules due to its surface charge density

Rationale

Although the Na+ cation is smaller than the Cl- anion, its smaller size creates a higher charge density that binds water molecules more strongly. This results in a much larger 'hydrated' radius for Na+, which increases drag and reduces mobility according to Stokes's law.

Sources

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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 3 Basic Resistivity and Spontaneous Potential
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Detail-oriented question on the Nernst-Einstein relation and hydration solvation numbers.

Question 22 of 505

ID	formationeval_v0.1_petrophysics_spontaneous_potential_004
Domains	Petrophysics
Topics	Spontaneous Potential, Shale Properties
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How do shale formations contribute to the generation of the Spontaneous Potential (SP) signal in a borehole?

A	They act as cation-selective membranes that allow Na+ to pass while excluding Cl-
B	They act as high-permeability filters that enhance the streaming potential of the mud filtrate
C	They generate a redox potential due to the presence of metallic sulfides and graphite
D	They function as anion-selective barriers that trap positive charges within the formation
Correct answer:	A - They act as cation-selective membranes that allow Na+ to pass while excluding Cl-

Rationale

Shales contain clay minerals with negatively charged surfaces. These surfaces repel anions (like Cl-) but allow cations (like Na+) to diffuse through the pore space. This ion selectivity generates the membrane potential component of the SP.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 3 Basic Resistivity and Spontaneous Potential
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on the membrane potential mechanism.

Question 23 of 505

ID	formationeval_v0.1_petrophysics_log_interpretation_005
Domains	Petrophysics
Topics	Spontaneous Potential, Log Interpretation
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a permeable sandstone formation where the drilling mud filtrate is saltier (lower resistivity) than the formation water, what is the expected deflection of the SP curve relative to the shale baseline?

A	It deflects to the right (positive direction)
B	It deflects to the left (negative direction)
C	It shows no deflection from the baseline
D	It fluctuates rapidly due to electrokinetic noise

Correct answer: A - It deflects to the right (positive direction)

Rationale

The direction of the SP deflection depends on the contrast between mud filtrate resistivity (Rmf) and formation water resistivity (Rw). When the mud filtrate is more saline than the formation water (Rmf < Rw), the electrochemical potential reverses polarity compared to the standard case, causing a positive (rightward) deflection.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 3 Basic Resistivity and Spontaneous Potential
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on Figure 3.11 and accompanying text regarding Rmf < Rw.

Question 24 of 505

ID	formationeval_v0.1_petrophysics_shaly_sand_006
Domains	Petrophysics
Topics	Spontaneous Potential, Shaly Sands
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the Pseudo Static Potential (PSP) in the context of SP log analysis?

A	The reduced SP amplitude observed in a shaly sand due to clay suppressing the liquid-junction potential
B	The theoretical maximum potential developed in a clean, thick, water-bearing sand
C	The component of the SP signal generated solely by streaming potentials across the mudcake
D	The baseline drift potential caused by changes in formation water salinity with depth
Correct answer:	A - The reduced SP amplitude observed in a shaly sand due to clay suppressing the liquid-junction potential

Rationale

In shaly sands, the presence of clay impedes the mobility of anions, which interferes with the development of the full liquid-junction potential. The resulting suppressed potential, which is lower than the Static Spontaneous Potential (SSP) of a clean sand, is termed the Pseudo Static Potential (PSP).

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 3 Basic Resistivity and Spontaneous Potential
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on PSP definition.

Question 25 of 505

ID	formationeval_v0.1_petrophysics_hydrocarbon_effect_007
Domains	Petrophysics
Topics	Spontaneous Potential, Hydrocarbon Detection
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

How does the presence of hydrocarbons typically affect the SP response in a shaly sand compared to a water-bearing shaly sand?

A	The SP deflection is further reduced because the influence of the clay's surface charge becomes proportionately stronger
B	The SP deflection increases to match that of a clean sand because hydrocarbons block the clay membrane
C	The SP reverses direction because hydrocarbons act as an insulator preventing ion diffusion
D	The SP response becomes erratic and noisy due to the immiscibility of oil and water

Correct answer: A - The SP deflection is further reduced because the influence of the clay's surface charge becomes proportionately stronger

Rationale

In a shaly sand, the presence of hydrocarbons reduces the volume of water available for ion transport. This makes the effect of the surface-charged clay particles proportionately higher, leading to a stronger suppression of the electrochemical potential and a smaller SP deflection compared to a wet shaly sand.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 3 Basic Resistivity and Spontaneous Potential
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on the section 'Log Example of the SP' discussing hydrocarbon effects in shaly sands.

Question 26 of 505

ID	formationeval_v0.1_petrophysics_archie_formation_factor_001
Domains	Petrophysics
Topics	Formation Factor, Archie Equation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

According to Archie's empirical observations on clean, water-saturated core samples, how does the formation resistivity factor (F) behave when the salinity of the saturating brine is changed?

A	It remains constant, as it is a property of the rock structure independent of fluid resistivity
B	It varies linearly with the resistivity of the water due to ion exchange
C	It increases as the salinity of the water increases due to surface conductance
D	It decreases significantly because the rock becomes more conductive
Correct answer:	A - It remains constant, as it is a property of the rock structure independent of fluid resistivity

Rationale

Archie found that for a given core sample, the formation factor F (defined as the ratio of the resistivity of the fully saturated rock to the resistivity of the saturating water) remains constant regardless of the water resistivity. This implies F is an intrinsic property of the pore geometry.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 4 Empiricism: The Cornerstone of Interpretation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on the definition and stability of Formation Factor.

Question 27 of 505

ID	formationeval_v0.1_petrophysics_cementation_exponent_002
Domains	Petrophysics
Topics	Cementation Exponent, Pore Structure
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the context of the Archie equation, how does the presence of open fractures typically affect the cementation exponent (m) compared to a rock with only intergranular porosity?

A	The exponent m decreases toward 1 because fractures provide straight, less tortuous current paths
B	The exponent m increases significantly because fractures isolate the matrix porosity
C	The exponent m remains at 2, as it is solely determined by total porosity volume
D	The exponent m approaches infinity because fractures do not contribute to electrical conductivity

Correct answer: A - The exponent m decreases toward 1 because fractures provide straight, less tortuous current paths

Rationale

The cementation exponent m is related to the tortuosity of the current path. Fractures offer a direct, straight path for current with minimal tortuosity, which drives the effective m value down toward 1.0, unlike intergranular porosity which typically has an m around 2.0.

Sources

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Reference	Chapter 4 Empiricism: The Cornerstone of Interpretation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on variations in 'm' due to fractures.

Question 28 of 505

ID	formationeval_v0.1_petrophysics_saturation_exponent_003
Domains	Petrophysics
Topics	Saturation Exponent, Wettability
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why does an oil-wet reservoir rock typically exhibit a saturation exponent (n) significantly larger than the standard value of 2?

A	Oil coats the grains and blocks pore throats even at low oil volumes, sharply increasing resistivity
B	Oil-wet rocks have higher water saturation for the same resistivity due to surface conductance
C	The oil in an oil-wet rock becomes conductive due to interaction with clay minerals
D	The water in an oil-wet rock forms continuous conductive films over the grain surfaces
Correct answer:	A - Oil coats the grains and blocks pore throats even at low oil volumes, sharply increasing resistivity

Rationale

In water-wet rocks, water coats grains and maintains conductive paths. In oil-wet rocks, the insulating oil coats the grains and blocks pore throats (constrictions) early in the saturation process. This disruption of the electrical path causes resistivity to rise much more sharply as water saturation decreases, resulting in a high n value.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Reference	Chapter 4 Empiricism: The Cornerstone of Interpretation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on wettability effects on 'n'.

Question 29 of 505

ID	formationeval_v0.1_petrophysics_clay_conductivity_004
Domains	Petrophysics
Topics	Shaly Sand, Clay Conductivity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

When plotting the conductivity of a fully water-saturated rock (Co) against the conductivity of the saturating water (Cw), how is the presence of clay minerals typically manifested?

A	By a positive intercept on the Co axis, representing an additional conductivity term
B	By a straight line passing exactly through the origin with a slope of 1
C	By a negative intercept indicating that clay absorbs ions and reduces conductivity
D	By a vertical line indicating that rock conductivity may be independent of water salinity
Correct answer:	A - By a positive intercept on the Co axis, representing an additional conductivity term

Rationale

In shaly sands, clay provides a secondary path for conduction (cation exchange) that acts in parallel with the pore water. On a Co vs. Cw plot, this appears as an additional conductivity component (positive intercept) when Cw approaches zero, unlike clean sands which pass through the origin.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Reference	Chapter 4 Empiricism: The Cornerstone of Interpretation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on the graphical identification of clay conductivity.

Question 30 of 505

ID	formationeval_v0.1_petrophysics_electrical_anisotropy_005
Domains	Petrophysics
Topics	Anisotropy, Laminated Sand Analysis
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a finely laminated sand-shale sequence where the shale is conductive and the sand is resistive, which statement correctly describes the horizontal conductivity (σh) measured parallel to the bedding?

A	It is dominated by the high conductivity of the shale layers
B	It is dominated by the high resistivity of the sand layers
C	It represents the harmonic mean of the individual layer conductivities
D	It is equal to the vertical conductivity due to averaging effects

Correct answer: A - It is dominated by the high conductivity of the shale layers

Rationale

When current flows parallel to bedding (horizontal conductivity), the layers act as resistors in parallel. The total conductivity is the volumetric average of the individual conductivities. Therefore, the highly conductive shale layers dominate the measurement, often masking the presence of resistive hydrocarbon-bearing sand.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 4 Empiricism: The Cornerstone of Interpretation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on electrical anisotropy in laminations.

Question 31 of 505

ID	formationeval_v0.1_petrophysics_water_saturation_calc_006
Domains	Petrophysics
Topics	Archie Calculation, Water Saturation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

A formation has a porosity of 20% and the standard Archie parameters m=2 and n=2 are applicable. If the formation water resistivity (Rw) is 0.08 ohm-m and the deep resistivity (Rt) reads 8.0 ohm-m, what is the estimated water saturation?

A	50%
B	25%
C	75%
D	100%
Correct answer:	A - 50%

Rationale

First, calculate Formation Factor F = 1 / (0.20)^2 = 1 / 0.04 = 25. Next, calculate the resistivity of the rock if 100% water saturated (Ro) = F * Rw = 25 * 0.08 = 2.0 ohm-m. Finally, calculate Sw using the Archie relation Sw = sqrt(Ro / Rt) = sqrt(2.0 / 8.0) = sqrt(0.25) = 0.50 or 50%.

Sources

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Reference	Chapter 4 Empiricism: The Cornerstone of Interpretation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Application of Archie's laws presented in the chapter.

Question 32 of 505

ID	formationeval_v0.1_petrophysics_tool_theory_007
Domains	Petrophysics
Topics	Resistivity Logging, Tool Theory
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In the idealized mono-electrode experiment, where current I is injected and voltage V is measured at a distance r, what determines the 'tool constant' k?

A	The geometric spacing between the current source and the measurement point (4πr)
B	The frequency of the injected current and the formation dielectric constant
C	The resistivity of the borehole fluid and the diameter of the electrode
D	The temperature of the formation and the salinity of the mud
Correct answer:	A - The geometric spacing between the current source and the measurement point (4πr)

Rationale

Based on the electrostatics derivation in the text, the potential V in a homogeneous medium is given by V = (Rt * I) / (4 * pi * r). Rearranging for Rt gives Rt = (4 * pi * r) * (V / I). The term (4 * pi * r) depends purely on the tool geometry (spacing r) and represents the tool constant k.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 4 Empiricism: The Cornerstone of Interpretation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Derivation of tool constant from basic electrostatics as presented in the text.

Question 33 of 505

ID	formationeval_v0.1_petrophysics_resistivity_logging_001
Domains	Petrophysics
Topics	Resistivity, Unfocused Devices
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

What is the primary limitation of the 'short normal' resistivity device when operating in a borehole filled with highly conductive mud?

A	The depth of investigation increases excessively, measuring only the uninvaded zone and bypassing the flushed region entirely in all formations
B	The tool generates excessive heat due to the high conductivity of the fluid
C	The tool becomes completely insensitive to formation porosity
D	Electrical current preferentially flows through the mud column rather than the formation, leading to inaccurate resistivity readings
Correct answer:	D - Electrical current preferentially flows through the mud column rather than the formation, leading to inaccurate resistivity readings

Rationale

In the presence of very conductive mud, the current from a short normal device tends to short-circuit through the mud column (the path of least resistance) rather than penetrating the formation. This results in an apparent resistivity measurement that is heavily influenced by the mud resistivity rather than the formation resistivity.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 5 Resistivity: Electrode Devices and How They Evolved
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 5.2.1 on short normal limitations.

Question 34 of 505

ID	formationeval_v0.1_petrophysics_focused_logging_002
Domains	Petrophysics
Topics	Focused Devices, Laterolog
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the fundamental operating principle of a 'guard' or 'laterolog' electrode system?

A	It utilizes a single electrode to measure the spontaneous potential generated by formation fluids
B	It measures the phase shift of the current to determine the dielectric constant of the rock
C	It uses high-frequency electromagnetic waves to induce currents in the formation
D	It employs bucking currents to prevent the measure current from flowing up or down the borehole, forcing it laterally into the formation

Correct answer: D - It employs bucking currents to prevent the measure current from flowing up or down the borehole, forcing it laterally into the formation

Rationale

Laterolog devices use focusing (or bucking) currents emitted from guard electrodes. These currents are adjusted to maintain the same potential as the central measure electrode, effectively blocking the vertical flow of the measure current through the borehole and forcing it to penetrate deep into the formation.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 5 Resistivity: Electrode Devices and How They Evolved
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 5.3.1 on the Laterolog principle.

Question 35 of 505

ID	formationeval_v0.1_petrophysics_dual_laterolog_003
Domains	Petrophysics
Topics	Dual Laterolog, Invasion
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a Dual Laterolog system, how does the 'deep' measurement (LLd) typically compare to the 'shallow' measurement (LLs) regarding sensitivity to the invaded zone?

A	Both measurements have identical sensitivity to invasion but operate at different frequencies
B	The LLs is designed to read the virgin zone resistivity while the LLd reads the invaded zone
C	The LLd is highly sensitive to the invaded zone, with 90% of its signal coming from the first few inches
D	The LLd has a lower pseudogeometric factor for the invaded zone than the LLs, meaning it is less influenced by invasion

Correct answer:	D - The LLd has a lower pseudogeometric factor for the invaded zone than the LLs, meaning it is less influenced by invasion

Rationale

The pseudogeometric factor (J) describes the relative contribution of the invaded zone to the total signal. The LLd has a slowly rising J curve, indicating that only a small fraction of its signal comes from the invaded zone (e.g., ~15% from a 20-inch diameter), whereas the LLs has a steeply rising curve, indicating high sensitivity to the region close to the borehole.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 5 Resistivity: Electrode Devices and How They Evolved
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on section 5.3.3 and Figure 5.18 regarding pseudogeometric factors.

Question 36 of 505

ID	formationeval_v0.1_petrophysics_borehole_correction_004
Domains	Petrophysics
Topics	Borehole Correction, Groningen Effect
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

The 'Groningen effect' creates a false increase in measured resistivity under specific conditions. Which of the following scenarios is most likely to produce this effect?

A	A short normal device traversing a washed-out borehole section with saline mud
B	An induction tool measuring a formation with very low resistivity and high magnetic permeability
C	A tool operating in a highly deviated well with oil-based mud
D	A dual laterolog tool located in a conductive bed, positioned below a thick, highly resistive bed containing casing

Correct answer: D - A dual laterolog tool located in a conductive bed, positioned below a thick, highly resistive bed containing casing

Rationale

The Groningen effect occurs when the current return path to the surface electrode is impeded by the skin effect in the formation and casing. AC currents flowing back to the surface are forced into a restricted cylinder around the borehole (and casing) when passing through a thick resistive bed. This creates a negative potential on the reference electrode (N), causing the apparent resistivity measured in the conductive zone below to be falsely high.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Type	textbook
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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 5 Resistivity: Electrode Devices and How They Evolved
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Derived from section 5.4.1 discussing reference electrode problems and the Groningen effect.

Question 37 of 505

ID	formationeval_v0.1_petrophysics_spherical_focusing_005
Domains	Petrophysics
Topics	Spherical Focusing, Tool Design
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What operational advantage did the Spherically Focused Log (SFL) offer over previous focused shallow resistivity devices like the LL3 or LL7?

A	It allowed for the use of direct current (DC) instead of alternating current (AC)
B	It eliminated the need for a surface reference electrode and the associated 'bridle' (insulated cable section)
C	It provided a depth of investigation significantly deeper than the deep laterolog
D	It was insensitive to the borehole diameter, requiring no borehole corrections

Correct answer: B - It eliminated the need for a surface reference electrode and the associated 'bridle' (insulated cable section)

Rationale

The SFL uses bucking currents to establish spherical equipotential surfaces and requires a current return (B) which can be at the surface, but crucially, it does not require a remote voltage reference electrode (N). Previous devices like the LL3 and LL7 required a bridle (insulated cable) to isolate the reference electrode N. The SFL eliminated the need for this bridle.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 5 Resistivity: Electrode Devices and How They Evolved
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept from section 5.3.2 on Spherical Focusing.

Question 38 of 505

ID	formationeval_v0.1_petrophysics_shoulder_bed_effects_006
Domains	Petrophysics
Topics	Shoulder Bed Effects, Laterolog
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

When a laterolog device measures a conductive bed situated between two highly resistive shoulder beds, what characteristic error is typically introduced?

A	The 'squeeze' effect, where the current beam is confined to the bed, causing the measured resistivity to be higher than true resistivity
B	The 'antisqueeze' effect, where current spreads into the shoulders, causing the measured resistivity to be lower than true resistivity
C	The 'Delaware' effect, where the potential reference drifts, causing a random noise signal
D	The 'skin' effect, where the current travels only on the borehole wall due to high-frequency limitations, reading the mud resistivity instead of formation

Correct answer:	A - The 'squeeze' effect, where the current beam is confined to the bed, causing the measured resistivity to be higher than true resistivity

Rationale

High-resistivity shoulder beds prevent the measure current from spreading vertically. This effectively 'squeezes' the current beam into the more conductive central bed. This confinement alters the tool constant (which assumes a homogeneous medium), resulting in an apparent resistivity reading that is artificially elevated (higher than the true resistivity of the bed).

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on section 5.3.4 and Figure 5.21 regarding squeeze/antisqueeze.

Question 39 of 505

ID	formationeval_v0.1_petrophysics_thin_bed_invasion_007
Domains	Petrophysics
Topics	Thin Beds, Invasion, Interpretation
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Why is it often difficult to observe separation between deep (LLd) and shallow (LLs) laterolog curves in thin beds with conductive invasion, even when a significant resistivity contrast exists?

A	The vertical resolution of the LLd improves in thin beds, matching the LLs exactly
B	The 'antisqueeze' effect is amplified by the conductive invaded zone, causing currents from both deep and shallow modes to escape into the shoulders
C	Thin beds do not allow enough space for the bucking currents to stabilize, causing both tools to read the mud resistivity
D	Invasion is physically impossible in beds thinner than the length of the tool's electrode array
Correct answer:	B - The 'antisqueeze' effect is amplified by the conductive invaded zone, causing currents from both deep and shallow modes to escape into the shoulders

Rationale

In a thin resistive bed with a conductive invaded zone and conductive shoulders, the current seeks the path of least resistance. It flows through the invaded zone and escapes into the conductive shoulders (antisqueeze). This effect is much stronger when invasion is present. As a result, the deep measurement loses its ability to penetrate deeply and reads similarly to the shallow measurement, masking the separation that would normally indicate invasion.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 5 Resistivity: Electrode Devices and How They Evolved
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5

Notes	Derived from section 5.4.2 discussing the combined effect of thin beds and invasion.

Question 40 of 505

ID	formationeval_v0.1_petrophysics_array_tools_008
Domains	Petrophysics
Topics	Array Tools, Tool Evolution
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

How does the design of the High Resolution Laterolog Array differ significantly from traditional Dual Laterolog tools regarding current return?

A	It requires a longer bridle to place the return electrode further up the cable
B	It uses a surface return electrode for all modes to maximize depth of investigation
C	All currents return to electrodes on the tool body itself, eliminating surface return electrodes
D	It uses a separate wireline cable conductor for the return path to avoid casing effects
Correct answer:	C - All currents return to electrodes on the tool body itself, eliminating surface return electrodes

Rationale

The High Resolution Laterolog Array is designed such that all currents return to the tool body. This configuration eliminates the need for a surface 'fish' (electrode B) and the associated bridle. By containing the current path within the tool/formation system, it avoids the Groningen effect and other reference electrode artifacts that plagued traditional laterologs.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Type	textbook
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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 5 Resistivity: Electrode Devices and How They Evolved
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on section 5.4.3 regarding array tools.

Question 41 of 505

ID	formationeval_v0.1_petrophysics_correction_methodology_009
Domains	Petrophysics
Topics	Data Correction, Inversion
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Traditional chartbook corrections for environmental effects on resistivity logs generally rely on which assumption?

A	That borehole, shoulder bed, and invasion effects are independent and can be corrected sequentially
B	That invasion is invariably deeper than the tool's depth of investigation in every formation, regardless of mud filtrate properties or formation permeability
C	That the formation is necessarily anisotropic with a dip of zero degrees, which simplifies the correction charts by assuming horizontal layering
D	That 2D inversion is performed prior to entering the charts
Correct answer:	A - That borehole, shoulder bed, and invasion effects are independent and can be corrected sequentially

Rationale

Traditional correction charts are constructed assuming that environmental effects are decoupled. For example, shoulder bed charts assume no invasion, and invasion charts assume thick beds (no shoulder effect). In reality, these effects are often linked (e.g., antisqueeze in invaded thin beds), which is a limitation of the sequential chart-based correction method.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 5 Resistivity: Electrode Devices and How They Evolved
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 5.3.4 (last paragraph) and 5.4.2.

Question 42 of 505

ID	formationeval_v0.1_petrophysics_delaware_effect_010
Domains	Petrophysics
Topics	Delaware Effect, Log Quality Control
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

The 'Delaware effect' observed in early laterolog tools was caused by the potential reference electrode (N) becoming negative. What was the physical cause of this phenomenon?

A	A short circuit in the cable armor near the tool head
B	Return currents flowing down the borehole past the reference electrode when the current return (B) was located on the bridle
C	Excessive formation temperature causing polarization of the lead electrodes
D	Spontaneous potential (SP) currents overwhelming the measure current in salt muds
Correct answer:	B - Return currents flowing down the borehole past the reference electrode when the current return (B) was located on the bridle

Rationale

The Delaware effect occurred when the current return electrode (B) was placed on the bridle (near the tool) rather than at the surface. When the B electrode entered a highly resistive bed, the return current was forced to flow down the borehole past the potential reference electrode (N) to find a path to the formation. This current flow created a potential drop that made N negative, resulting in erroneous resistivity calculations.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 5 Resistivity: Electrode Devices and How They Evolved
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on section 5.4.1 regarding reference electrode problems.

Question 43 of 505

ID	formationeval_v0.1_petrophysics_microresistivity_principles_001
Domains	Petrophysics
Topics	Microresistivity, Well Logging
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does the microlaterolog improve upon the measurement capabilities of the earlier microlog device?

A	It utilizes magnetic induction to measure resistivity in oil-based muds
B	It relies on two unfocused curves to qualitatively identify permeability
C	It uses a larger electrode spacing to read deep into the uninvaded zone
D	It employs bucking currents to focus the measure current through the mudcake
Correct answer:	D - It employs bucking currents to focus the measure current through the mudcake

Rationale

The microlog was an unfocused device susceptible to mudcake influence (reading mainly mudcake in conductive/thick cases). The microlaterolog introduced focusing (similar to the laterolog) using bucking currents from a guard electrode to force the measure current into the formation, thereby providing a better determination of the flushed zone resistivity (R_xo).

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 6 Other Electrode and Toroid Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 6.2 on Microelectrode Devices.

Question 44 of 505

ID	formationeval_v0.1_petrophysics_moveable_hydrocarbons_002
Domains	Petrophysics
Topics	Saturation, Movable Hydrocarbons
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the absence of other data, how can the ratio of flushed zone resistivity to true resistivity (R_xo/R_t) indicate the presence of movable hydrocarbons in a clean reservoir?

A	The ratio equals 1.0 regardless of fluid content
B	The ratio significantly exceeds the ratio of mud filtrate to formation water resistivity (R_mf/R_w)
C	The ratio drops below the theoretical water-bearing baseline of R_mf/R_w
D	The ratio becomes negative due to the high resistivity of oil
Correct answer:	C - The ratio drops below the theoretical water-bearing baseline of R_mf/R_w

Rationale

In a water zone, R_xo/R_t should equal R_mf/R_w. If movable hydrocarbons are present, they are flushed from the invaded zone (increasing S_xo) but remain in the uninvaded zone (keeping S_w low). This causes R_xo to be relatively lower compared to the high R_t of the hydrocarbon zone, decreasing the ratio below the water baseline.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Reference	Chapter 6 Other Electrode and Toroid Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 6.3 Uses for Rxo.

Question 45 of 505

ID	formationeval_v0.1_petrophysics_mcfl_focusing_003
Domains	Petrophysics
Topics	Microresistivity, Tool Physics
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

How does the Micro Cylindrically Focused Log (MCFL) achieve focusing in the horizontal plane (across the width of the pad) where space is limited?

A	It relies solely on the curvature of the borehole to focus the current naturally
B	It uses high-frequency alternating current to induce a magnetic field
C	It uses a passive system where the pad itself acts as the only guard electrode, with no external focusing mechanisms
D	It employs an active focusing system with side bucking electrodes to maintain potential

Correct answer: D - It employs an active focusing system with side bucking electrodes to maintain potential

Rationale

While vertical focusing in the MCFL is passive (using the metal pad as a guard similar to LL3), the limited width of the pad requires active focusing horizontally. Bucking electrodes on the sides of the pad emit current regulated to maintain the monitor electrodes at the same potential as the main pad (A_0), ensuring cylindrical equipotential lines.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Year	2007
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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 6 Other Electrode and Toroid Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 6.2 Microelectrode Devices.

Question 46 of 505

ID	formationeval_v0.1_drillingengineering_mwd_resistivity_004
Domains	Drilling Engineering, Petrophysics
Topics	LWD, Tool Physics
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the primary mechanism used by toroidal transmitters in Measurement While Drilling (MWD) resistivity tools to generate current in the formation?

A	Direct electrical contact using sharp scratchers to penetrate the mudcake
B	Capacitive coupling through the drilling fluid using high-frequency waves
C	Induction of a voltage difference along the drill collar, which acts as a transformer secondary
D	Injection of current solely through the drill bit without a return path
Correct answer:	C - Induction of a voltage difference along the drill collar, which acts as a transformer secondary

Rationale

The toroidal transmitter acts as the primary winding of a transformer. The drill collar (and the formation return path) acts as the secondary winding. An AC voltage applied to the toroid induces a voltage difference along the collar, driving current down the collar and out into the formation.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 6 Other Electrode and Toroid Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 6.5.1 Resistivity at the Bit.

Question 47 of 505

ID	formationeval_v0.1_petrophysics_borehole_imaging_005
Domains	Petrophysics
Topics	Borehole Imaging, Oil-Based Mud
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How do modern microresistivity imaging tools capable of working in oil-based muds (OBM) overcome the nonconductive nature of the fluid?

A	They use acoustic pulses that are unaffected by the fluid conductivity
B	They rely on the small inherent conductivity of the mudcake and formation to pass current
C	They use a specialized radioactive source to ionize the mud in front of the pad
D	They require the mud to be doped with conductive metallic particles
Correct answer:	B - They rely on the small inherent conductivity of the mudcake and formation to pass current

Rationale

The text explains that designs introduced in 2001 rely on the fact that both mudcake and formation have some small conductivity (due to clay content) and the pad is very close to the formation. This allows current to pass from the top/bottom of the pad through the formation to the buttons, despite the resistive environment.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 6 Other Electrode and Toroid Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 6.4 Azimuthal Measurements.

Question 48 of 505

ID	formationeval_v0.1_petrophysics_lwd_rab_tool_006
Domains	Petrophysics, Drilling Engineering
Topics	LWD, Invasion
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the Resistivity at the Bit (RAB) tool, what is the key functional difference between the ring electrode and the button electrodes?

A	The ring measures natural gamma radiation while buttons measure resistivity
B	The ring provides a deeply focused azimuthal average, while buttons provide shallower azimuthal images
C	The buttons are used for deep reading while the ring measures the mudcake only
D	The ring is only used for focusing the buttons and does not provide a measurement itself, serving a purely mechanical function

Correct answer:	B - The ring provides a deeply focused azimuthal average, while buttons provide shallower azimuthal images

Rationale

The ring electrode is cylindrically focused and provides a deep measurement of formation resistivity (averaged around the borehole). The buttons are placed closer to the transmitters, making them less focused (shallower), but they are small and discrete, allowing for azimuthal imaging as the tool rotates.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Reference	Chapter 6 Other Electrode and Toroid Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 6.5.2 Ring and Button Measurements.

Question 49 of 505

ID	formationeval_v0.1_petrophysics_cased_hole_resistivity_007
Domains	Petrophysics
Topics	Cased Hole, Resistivity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the physical principle underlying the measurement of formation resistivity through steel casing?

A	Detecting the magnetic permeability changes in the casing caused by formation fluids
B	Measuring the transit time of an acoustic pulse through the cement sheath
C	Measuring the small leakage current into the formation by detecting minute voltage drops along the casing
D	Using high-energy neutrons to activate chlorine in the formation water
Correct answer:	C - Measuring the small leakage current into the formation by detecting minute voltage drops along the casing

Rationale

The tool injects current into the casing. While most current stays in the steel, a small fraction leaks into the formation. This leakage causes a progressive reduction in the current flowing down the casing, which is detected by measuring voltage differences between electrodes spaced along the casing.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 6 Other Electrode and Toroid Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 6.6 Cased-Hole Resistivity Measurements.

Question 50 of 505

ID	formationeval_v0.1_petrophysics_cased_hole_limitations_008
Domains	Petrophysics
Topics	Cased Hole, Resistivity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Under what formation condition does the through-casing resistivity measurement become unreliable due to sensitivity to the cement sheath?

A	When the formation resistivity is very low (less than 1 ohm-m)
B	When the formation resistivity is very high (greater than 1000 ohm-m)
C	When the cement has a lower density than the drilling mud
D	When the formation contains high-viscosity heavy oil
Correct answer:	A - When the formation resistivity is very low (less than 1 ohm-m)

Rationale

The text states that the tool works best in the 1–100 ohm-m range. Below 1 ohm-m, the measurement becomes sensitive to the cement resistivity and thickness, which are often not well known, making the formation resistivity determination unreliable.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 6 Other Electrode and Toroid Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 6.6 Cased-Hole Resistivity Measurements.

Question 51 of 505

ID	formationeval_v0.1_petrophysics_resistivity_induction_001
Domains	Petrophysics
Topics	Induction Logging, Electromagnetic Theory
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

What is the fundamental physical mechanism that allows induction logging tools to measure formation properties in non-conductive borehole fluids?

A	The injection of current through electrodes that make direct contact with the borehole wall
B	The measurement of electrochemical potentials generated by ion exchange
C	The generation of eddy currents in the formation via an alternating magnetic field
D	The reflection of high-frequency acoustic waves at formation interfaces

Correct answer: C - The generation of eddy currents in the formation via an alternating magnetic field

Rationale

Induction tools utilize transmitter coils driven by alternating current to generate a magnetic field. This changing magnetic field induces eddy currents (ground loops) within the formation, which in turn generate a secondary magnetic field detected by the receiver coils. This process does not require conductive mud or direct electrical contact.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 7 Resistivity: Induction Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on induction tool operating principles.

Question 52 of 505

ID	formationeval_v0.1_petrophysics_resistivity_induction_002
Domains	Petrophysics
Topics	Induction Logging, Signal Processing
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the low-conductivity limit where skin effect is negligible, how does the voltage induced in the receiver coil of a two-coil induction sonde relate to the formation conductivity (σ) and the transmitter frequency (ω)?

A	It is inversely proportional to conductivity and linearly proportional to frequency
B	It is proportional to conductivity squared and linearly proportional to frequency
C	It is proportional to the square root of conductivity and the square root of frequency
D	It is linearly proportional to conductivity and proportional to the square of the frequency

Correct answer:	D - It is linearly proportional to conductivity and proportional to the square of the frequency

Rationale

According to Faraday's law derived for the two-coil device, the receiver voltage is proportional to the rate of change of the secondary magnetic field. Since the induced current density is proportional to frequency (ω) and the receiver voltage is a derivative of the field generated by that current (another factor of ω), the total response is proportional to ω^2. It is directly proportional to formation conductivity σ.

Sources

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Reference	Chapter 7 Resistivity: Induction Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Eq. 7.24.

Question 53 of 505

ID	formationeval_v0.1_petrophysics_resistivity_induction_003
Domains	Petrophysics
Topics	Induction Logging, Skin Effect
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does the "skin effect" influence the measurement of an induction tool in highly conductive formations?

A	It increases the signal strength exponentially, causing detector saturation
B	It causes the current to concentrate on the borehole wall, reading only mud resistivity instead of formation resistivity
C	It causes attenuation and phase shift of the magnetic field, reducing the linearity of the response
D	It eliminates the direct coupling signal between the transmitter and receiver
Correct answer:	C - It causes attenuation and phase shift of the magnetic field, reducing the linearity of the response

Rationale

In conductive media, electromagnetic waves suffer attenuation and phase shift as they penetrate the formation. This is known as the skin effect. It causes the received signal to be lower than the simple linear prediction would suggest (attenuation) and introduces a phase shift, necessitating corrections to recover true conductivity.

Sources

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Reference	Chapter 7 Resistivity: Induction Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on skin effect.

Question 54 of 505

ID	formationeval_v0.1_petrophysics_resistivity_induction_004
Domains	Petrophysics
Topics	Induction Logging, Tool Design
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the primary function of the "bucking" coils (additional receiver coils with reverse polarity) in multi-coil induction arrays?

A	To amplify the signal from the formation in high-resistivity zones
B	To induce a secondary magnetic field that penetrates deeper into the formation
C	To measure the spontaneous potential (SP) simultaneously with resistivity
D	To cancel the direct mutual coupling signal and focus the tool response
Correct answer:	D - To cancel the direct mutual coupling signal and focus the tool response

Rationale

Bucking coils are wound with reverse polarity to cancel the direct signal (mutual coupling) traveling directly from the transmitter to the receiver, which contains no formation information. By carefully selecting their position and turns, they also focus the tool response, minimizing sensitivity to the borehole and shoulder beds.

Sources

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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on focusing and tool design.

Question 55 of 505

ID	formationeval_v0.1_petrophysics_resistivity_induction_005
Domains	Petrophysics
Topics	Induction Logging, Signal Processing
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In the analysis of induction tool signals, which component represents the direct mutual coupling between the transmitter and receiver (often called the X-signal), and what is its phase relationship to the transmitter current?

A	It is the real component, 180° out of phase with the transmitter
B	It is the imaginary component, 90° out of phase with the transmitter
C	It is the real component, in phase with the transmitter
D	It is the imaginary component, 45° out of phase with the transmitter
Correct answer:	B - It is the imaginary component, 90° out of phase with the transmitter

Rationale

The direct coupling signal is independent of formation conductivity and is purely imaginary (reactive). It is 90° out of phase with the transmitter current. In contrast, the useful formation signal (R-signal) is real and 180° out of phase with the transmitter (in the standard sign convention used for logging).

Sources

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on signal phase relationships.

Question 56 of 505

ID	formationeval_v0.1_petrophysics_resistivity_induction_006
Domains	Petrophysics
Topics	Induction Logging, Log Interpretation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What geometric characteristic of the induction tool response is responsible for the "horns" or spikes often seen at bed boundaries on older induction logs?

A	The positive signal overshoot caused by skin effect correction
B	The large sonde error associated with temperature changes
C	The negative lobes in the vertical geometric factor response function
D	The excessive depth of investigation in resistive beds
Correct answer:	C - The negative lobes in the vertical geometric factor response function

Rationale

The vertical geometric factor of induction arrays (like the 6FF40) includes negative lobes near the center of the array. When a highly conductive bed boundary passes through these negative sensitivity zones, it can cause the total signal to momentarily spike or "horn," sometimes even producing negative conductivity readings if not processed.

Sources

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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on log artifacts (horns).

Question 57 of 505

ID	formationeval_v0.1_petrophysics_resistivity_induction_007
Domains	Petrophysics
Topics	Induction Logging, Tool Selection
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Under which specific borehole environment is an induction tool generally preferred over an electrode (laterolog) device for resistivity measurement?

A	In a borehole drilled with oil-based mud (non-conductive fluid)
B	In a borehole filled with highly conductive salt-saturated mud
C	In a borehole traversing extremely high-resistivity carbonate formations
D	In a cased hole environment with a steel liner

Correct answer: A - In a borehole drilled with oil-based mud (non-conductive fluid)

Rationale

Induction tools were originally designed for non-conductive environments (oil-based mud or air-filled holes) because they do not require electrical contact with the formation. Electrode tools (laterologs) require a conductive mud column to inject current. In non-conductive mud, laterologs will not function, making induction the standard choice.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 7 Resistivity: Induction Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on tool selection criteria.

Question 58 of 505

ID	formationeval_v0.1_petrophysics_induction_logging_001
Domains	Petrophysics
Topics	Induction Logging, Signal Processing, Phasor Induction
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the Phasor induction processing algorithm, what specific role does the measured X-signal (quadrature signal) play in improving the final log response?

A	It corrects for the vertical spatial distribution of the skin effect
B	It cancels out the borehole signal in conductive muds
C	It eliminates polarization horns at dipping bed boundaries
D	It provides the primary measurement of formation resistivity in resistive beds
Correct answer:	A - It corrects for the vertical spatial distribution of the skin effect

Rationale

The X-signal, or skin-effect signal, is used to account for the spatial distribution of skin effect. While simple boosting corrects skin effect in homogeneous media, the Phasor algorithm uses the X-signal to correctly place the skin-effect correction in layered media, as the vertical distribution of the X-signal resembles the vertical distribution of the skin effect error.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 8 Multi-Array and Triaxial Induction Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 8.2 on Phasor Induction.

Question 59 of 505

ID	formationeval_v0.1_petrophysics_induction_logging_002
Domains	Petrophysics
Topics	Induction Logging, Inverse Filtering, Resolution Enhancement
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why is it mathematically impossible to design a perfect inverse filter to fully sharpen the vertical resolution of a traditional deep induction (ILd) array?

A	The array response possesses a blind frequency at 0.2 cycles/ft where it captures no information
B	The skin effect introduces a non-linear phase shift that cannot be deconvolved
C	The sampling rate of the tool is insufficient to satisfy the Nyquist limit for thin beds
D	The borehole signal dominates the high-frequency response spectrum

Correct answer: A - The array response possesses a blind frequency at 0.2 cycles/ft where it captures no information

Rationale

The spatial frequency response of the ILd array drops to zero at 0.2 cycles/ft (corresponding to a bed thickness of 2.5 ft). This is a 'blind frequency' where the measurement contains no information. An inverse filter would require infinite weight at this frequency to reconstruct the formation profile, which is impossible.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 8 Multi-Array and Triaxial Induction Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 8.2.1 on Inverse Filtering.

Question 60 of 505

ID	formationeval_v0.1_petrophysics_induction_hardware_003
Domains	Petrophysics
Topics	Induction Logging, Tool Design, Sonde Error
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Modern multi-array induction tools (like the AIT) utilize a conductive metal mandrel rather than the fiberglass housing used in earlier tools. What is the primary technical advantage of this design?

A	It stabilizes the sonde error signal against temperature variations
B	It amplifies the magnetic field generated by the transmitter coils
C	It completely blocks the borehole signal from reaching the receiver coils
D	It allows the tool to measure formation density simultaneously

Correct answer: A - It stabilizes the sonde error signal against temperature variations

Rationale

A perfectly conducting mandrel forces the electric field on its surface to zero, generating no in-phase signal at the receiver. In practice, the metal mandrel produces a small, predictable sonde error that is thermally stable, unlike fiberglass sondes where thermal expansion could alter coil spacings and cause signal drift.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 8 Multi-Array and Triaxial Induction Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 8.4.1 Multi-Array Devices.

Question 61 of 505

ID	formationeval_v0.1_petrophysics_multi_array_processing_004
Domains	Petrophysics
Topics	Induction Logging, Multi-Array Processing, Log Generation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How do multi-array induction tools generate a specific output log, such as a curve with a 90-inch depth of investigation and 2-ft vertical resolution?

A	By combining weighted contributions from multiple coil arrays via a multichannel filter
B	By physically adjusting the spacing between the transmitter and receiver coils downhole
C	By applying a frequency-domain correction to the single deepest-reading array
D	By extrapolating the trend of the shallowest array using an invasion model

Correct answer: A - By combining weighted contributions from multiple coil arrays via a multichannel filter

Rationale

Multi-array tools use a set of simple coil arrays. The raw responses from these arrays are combined in software using a multichannel filter. Specific weights are applied to the data from different arrays to construct a log with the desired vertical resolution and radial depth of investigation.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 8 Multi-Array and Triaxial Induction Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 8.4 Multi-Array Inductions (Fig 8.6).

Question 62 of 505

ID	formationeval_v0.1_petrophysics_dipping_beds_005
Domains	Petrophysics
Topics	Induction Logging, Dipping Beds, Log Artifacts
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

When an induction tool crosses a bed boundary at a high relative dip angle, 'horns' or spikes often appear on the resistivity log. What physical phenomenon causes this artifact?

A	Electrical charge buildup at the boundary required to maintain continuity of eddy currents
B	Excessive skin effect concentrating current density within the conductive layer
C	Interference from the borehole acting as a waveguide for the induction signal
D	Resonance of the coil array blind frequency with the bed thickness

Correct answer: A - Electrical charge buildup at the boundary required to maintain continuity of eddy currents

Rationale

When eddy currents (which circulate coaxially with the tool) cross a bed boundary separating regions of different conductivity, Ohm's law requires a jump in the electric field to maintain current continuity. This jump is caused by a charge buildup or polarization at the boundary, which oscillates and acts as a secondary transmitter, creating the 'horn' artifact.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 8 Multi-Array and Triaxial Induction Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 8.4.5 Dipping Beds.

Question 63 of 505

ID	formationeval_v0.1_petrophysics_dipping_beds_006
Domains	Petrophysics
Topics	Induction Logging, Dipping Beds, Signal Processing
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

What is the primary operational advantage of using the 'Grimaldi' processing method for multi-array induction data in deviated wells?

A	It removes shoulder bed effects without requiring knowledge of the dip angle
B	It allows for the simultaneous calculation of formation density and resistivity
C	It significantly increases the depth of investigation beyond the invasion zone
D	It reconstructs the true formation dip angle using only coaxial coils, without requiring cross-component receivers

Correct answer: A - It removes shoulder bed effects without requiring knowledge of the dip angle

Rationale

The Grimaldi method utilizes the observation that shoulder contributions drop off as 1/z^2. By subtracting signals from two arrays centered at the same point (simulated using bucking coils), shoulder signals cancel out. This provides a log free of shoulder effect that is practically independent of dip angle, meaning the dip angle does not need to be known or input for processing.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 8 Multi-Array and Triaxial Induction Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 8.4.5 Dipping Beds.

Question 64 of 505

ID	formationeval_v0.1_petrophysics_triaxial_induction_007
Domains	Petrophysics
Topics	Triaxial Induction, Anisotropy, Coil Design
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does the skin effect observed in coplanar coil arrays (xx or yy) differ from that in standard coaxial (zz) arrays?

A	Coplanar arrays exhibit a much stronger skin effect, causing the R-signal to peak at lower conductivities
B	Coplanar arrays are immune to skin effect due to their orientation
C	Coplanar arrays show a skin effect that decreases as formation conductivity increases
D	Coplanar arrays have a skin effect that is identical to coaxial arrays in isotropic formations

Correct answer: A - Coplanar arrays exhibit a much stronger skin effect, causing the R-signal to peak at lower conductivities

Rationale

Coplanar coils have higher-order expansion terms for skin effect than coaxial coils. This results in a stronger skin effect where the R-signal peaks at a much lower conductivity value and decreases (potentially becoming negative) as conductivity increases further.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 8 Multi-Array and Triaxial Induction Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 8.5.1 Response of Coplanar Coils.

Question 65 of 505

ID	formationeval_v0.1_petrophysics_triaxial_induction_008
Domains	Petrophysics
Topics	Triaxial Induction, Borehole Effects
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why are coplanar coil measurements in triaxial tools significantly more sensitive to borehole conditions and tool eccentricity than standard coaxial measurements?

A	The induced current lines cross the borehole, allowing it to act as a waveguide
B	The coplanar coils operate at a frequency that resonates with the mud column
C	The depth of investigation of coplanar coils is restricted entirely to the borehole
D	The magnetic field of coplanar coils is parallel to the tool axis
Correct answer:	A - The induced current lines cross the borehole, allowing it to act as a waveguide

Rationale

For coplanar coils (axes perpendicular to the borehole), the induced current lines cross the axis between the coils and thus cross the borehole itself. This causes the borehole to act as a waveguide, accentuating the borehole signal and making the measurement highly sensitive to tool eccentering.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
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Reference	Chapter 8 Multi-Array and Triaxial Induction Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 8.5.1 Response of Coplanar Coils.

Question 66 of 505

ID	formationeval_v0.1_petrophysics_anisotropy_009
Domains	Petrophysics
Topics	Anisotropy, Reservoir Evaluation, Triaxial Induction
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the evaluation of thinly laminated sand-shale sequences using multicomponent induction data, what physical model is typically used to solve for the resistivity of the hydrocarbon-bearing sand?

A	Parallel sum for horizontal resistivity and series sum for vertical resistivity
B	Series sum for horizontal resistivity and parallel sum for vertical resistivity
C	Volumetric average of conductivities for both vertical and horizontal components
D	Standard Archie equation with a variable cementation exponent

Correct answer: A - Parallel sum for horizontal resistivity and series sum for vertical resistivity

Rationale

Horizontal resistivity (R_h) in laminated formations is modeled as the parallel sum of the sand and shale layers (dominated by the conductive shale). Vertical resistivity (R_v) is modeled as the series sum of the layers (sensitive to the resistive sand). These two equations are combined to solve for the sand resistivity (R_sd).

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
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License	Proprietary (Springer)
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Reference	Chapter 8 Multi-Array and Triaxial Induction Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 8.5.2 Multicomponent Devices (Eq 8.7-8.9).

Question 67 of 505

ID	formationeval_v0.1_petrophysics_dielectric_permittivity_001
Domains	Petrophysics
Topics	Dielectric Permittivity, Fluid Identification
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

What fundamental physical property contrast primarily allows dielectric logging tools to distinguish water from oil and rock matrix?

A	Water has a significantly higher dielectric permittivity than oil or rock matrix
B	Water has a much lower magnetic permeability than oil or rock matrix
C	Oil exhibits strong interfacial polarization while water does not
D	Rock matrix has a higher dielectric constant than both water and oil
Correct answer:	A - Water has a significantly higher dielectric permittivity than oil or rock matrix

Rationale

Water has a relative dielectric permittivity around 78 (at standard conditions), whereas oil and rock matrix typically have values between 2 and 9. This large order-of-magnitude difference allows dielectric tools to identify water volume even in low salinity environments where resistivity contrasts are low.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 9 Propagation Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Introduction and Table 9.1.

Question 68 of 505

ID	formationeval_v0.1_petrophysics_dielectric_polarization_002
Domains	Petrophysics
Topics	Dielectric Polarization, Frequency Dispersion
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the frequency range typically used for well logging (up to roughly 1 GHz), which polarization mechanism is primarily responsible for the dielectric permittivity of the rock matrix and pore geometry effects?

A	Molecular orientation
B	Ionic relaxation
C	Electronic polarization
D	Interfacial (Maxwell-Wagner) polarization

Correct answer: D - Interfacial (Maxwell-Wagner) polarization

Rationale

Interfacial (Maxwell-Wagner) polarization occurs due to charge build-up at interfaces between conductive and insulating components (e.g., pore water and grains). It dominates the rock permittivity response up to about 10^8 Hz. Molecular orientation governs water permittivity at higher frequencies, while electronic polarization operates at optical frequencies.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 9 Propagation Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 9.2.2 regarding interfacial polarization.

Question 69 of 505

ID	formationeval_v0.1_petrophysics_dielectric_salinity_003
Domains	Petrophysics
Topics	Dielectric Permittivity, Salinity Effects
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does an increase in formation water salinity affect the dielectric permittivity of the water phase?

A	It increases permittivity because salt ions add conductive pathways
B	It may have no effect on permittivity, only on conductivity, because dielectric polarization is independent of ionic concentration
C	It decreases permittivity due to the hydration of ions reducing water molecule polarization
D	It causes permittivity to fluctuate sinusoidally with frequency
Correct answer:	C - It decreases permittivity due to the hydration of ions reducing water molecule polarization

Rationale

Adding salt to water reduces its permittivity. This occurs because the concentration of water decreases, hydrated salt ions reduce the polarization of attached water molecules, and salt ions displace water molecules when moved by the electric field.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 9 Propagation Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 9.2.1 discussion on salt effects.

Question 70 of 505

ID	formationeval_v0.1_petrophysics_mixing_laws_004
Domains	Petrophysics
Topics	Mixing Laws, CRIM
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

The Complex Refractive Index Method (CRIM) used for dielectric interpretation assumes which relationship between the formation components?

A	Linear volumetric mixing of the square root of the complex permittivities
B	Linear volumetric mixing of the logarithms of the conductivities
C	A parallel resistor network model weighted by component volumes
D	A specialized form of the Archie equation with variable exponents

Correct answer: A - Linear volumetric mixing of the square root of the complex permittivities

Rationale

CRIM is based on a power law mixing equation with an exponent of 0.5 (square root). It states that the square root of the effective complex permittivity is the sum of the square roots of the component permittivities weighted by their volume fractions. This is equivalent to linear mixing of the refractive indices.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Year	2007
Type	textbook
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Reference	Chapter 9 Propagation Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 9.4 on Dielectric Mixing Laws.

Question 71 of 505

ID	formationeval_v0.1_petrophysics_lwd_propagation_005
Domains	Petrophysics, Drilling Engineering
Topics	LWD, Propagation Measurements, Resistivity
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In 2 MHz LWD propagation tools, how do the depths of investigation for phase-shift resistivity (R_ps) and attenuation resistivity (R_ad) typically compare?

A	Both measurements have identical depths of investigation
B	Depth of investigation is solely determined by the transmitter-receiver spacing, not the measurement type
C	R_ps reads deeper than R_ad
D	R_ad reads deeper than R_ps
Correct answer:	D - R_ad reads deeper than R_ps

Rationale

Attenuation resistivity (R_ad) consistently reads deeper than phase-shift resistivity (R_ps). The electromagnetic field patterns for amplitude (attenuation) are toroidal and penetrate further into the formation than the spherical constant-phase contours, resulting in a deeper investigation for attenuation measurements.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 9 Propagation Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 9.6.2 and 9.6.3 regarding radial response.

Question 72 of 505

ID	formationeval_v0.1_petrophysics_dielectric_assumption_006
Domains	Petrophysics
Topics	Propagation Measurements, LWD Processing
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Why is a 'dielectric assumption' necessary when converting raw 2 MHz propagation measurements (phase shift and attenuation) into resistivity values?

A	Because the phase shift is insensitive to resistivity at low values
B	Because attenuation cannot be measured accurately in conductive muds
C	Because the tool measures magnetic permeability, which must be converted to permittivity first
D	Because there are two unknowns (permittivity and conductivity) but the tool treats them as coupled to produce a single resistivity output

Correct answer: D - Because there are two unknowns (permittivity and conductivity) but the tool treats them as coupled to produce a single resistivity output

Rationale

Propagation tools measure phase shift and attenuation, which depend on both permittivity (ε) and conductivity (σ). To convert a single measurement (e.g., phase shift) into a resistivity (inverse of conductivity), one must assume a value for ε, or a relationship between ε and σ. This relationship is the 'dielectric assumption,' which allows the transformation of the raw signal into a resistivity log.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 9 Propagation Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 9.6.1.

Question 73 of 505

ID	formationeval_v0.1_petrophysics_anisotropy_007
Domains	Petrophysics
Topics	Anisotropy, LWD Interpretation, High Angle Wells
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In a horizontal well penetrating an anisotropic formation, how do the responses of 2 MHz phase-shift and attenuation resistivities typically differ?

A	Attenuation resistivity is affected significantly more than phase-shift resistivity
B	Phase-shift resistivity is affected significantly more than attenuation resistivity, often creating large separation
C	Both are affected equally, resulting in no separation between curves
D	Anisotropy only affects the 400 kHz measurements, not 2 MHz, because lower frequencies penetrate deeper into the formation

Correct answer:	B - Phase-shift resistivity is affected significantly more than attenuation resistivity, often creating large separation

Rationale

In horizontal wells (high relative dip), anisotropy has a much stronger effect on the phase shift than on attenuation. This often leads to a separation where the phase-shift resistivity reads significantly higher than the attenuation resistivity, an effect that increases with transmitter-receiver spacing.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Type	textbook
License	Proprietary (Springer)
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Reference	Chapter 9 Propagation Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 9.6.4 on Dip and Anisotropy.

Question 74 of 505

ID	formationeval_v0.1_petrophysics_polarization_horns_008
Domains	Petrophysics
Topics	LWD Response, Dipping Beds
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the primary cause of 'polarization horns' (sharp spikes in resistivity) observed on 2 MHz LWD logs?

A	Crossing bed boundaries with high resistivity contrast at high relative dip angles
B	Tool eccentricity in an enlarged borehole
C	Dielectric resonance of the drill collar at 2 MHz
D	Sudden changes in mud salinity during drilling
Correct answer:	A - Crossing bed boundaries with high resistivity contrast at high relative dip angles

Rationale

Polarization horns are sharp increases in resistivity readings that occur when the tool crosses a bed boundary with a significant resistivity contrast at a high relative dip angle (typically above 50 degrees). This is an artifact of the charge accumulation at the boundary affecting the electromagnetic propagation.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 9.6.4.

Question 75 of 505

ID	formationeval_v0.1_petrophysics_texture_effects_009
Domains	Petrophysics, Sedimentology
Topics	Dielectric Permittivity, Rock Texture
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In carbonate rocks, how does grain shape typically influence the dielectric permittivity measured at frequencies below 1 GHz?

A	Spherical grains cause higher permittivity than platy grains
B	Platy or disk-like grains cause higher permittivity due to increased interfacial polarization
C	Grain shape has no impact on permittivity; only porosity matters, as dielectric response is independent of internal surface area
D	Irregular grains eliminate all interfacial polarization effects

Correct answer: B - Platy or disk-like grains cause higher permittivity due to increased interfacial polarization

Rationale

Thin, platy grains increase interfacial (Maxwell-Wagner) polarization because they create larger electrostatic attraction across the grain and make it more difficult for charges to neutralize the polarization. This results in higher permittivity values compared to spherical grains, often correlating with higher cementation exponents (m).

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
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Reference	Chapter 9 Propagation Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 9.2.2 on Interfacial Polarization and Fig 9.8.

Question 76 of 505

ID	formationeval_v0.1_drillingengineering_lwd_design_010
Domains	Drilling Engineering, Petrophysics
Topics	LWD Tool Design, Induction vs Propagation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Why were 2 MHz propagation devices initially developed as the standard for LWD resistivity instead of traditional induction coils?

A	Induction coils cannot operate in oil-based muds
B	The steel drill collar made it difficult to control sonde error and maintain stability for induction measurements
C	2 MHz tools have a significantly deeper depth of investigation than induction tools
D	Propagation tools are insensitive to borehole rugosity

Correct answer: B - The steel drill collar made it difficult to control sonde error and maintain stability for induction measurements

Rationale

Standard induction measurements require accurate knowledge of the sonde error (signal generated within the tool). The steel drill collar is not a perfect conductor and contributes a significant, unpredictable signal. 2 MHz devices use differential measurements and higher frequencies (smaller skin depth in the collar), making the collar act more like a perfect shield and reducing sonde error issues.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
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Reference	Chapter 9 Propagation Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 9.6 Introduction.

Question 77 of 505

ID	formationeval_v0.1_petrophysics_nuclear_statistics_001
Domains	Petrophysics
Topics	Nuclear Statistics, Logging Speed
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

A logging engineer wishes to reduce the fractional statistical uncertainty of a nuclear measurement by a factor of two (e.g., from 10% to 5%). Assuming the source strength remains constant, how must the measurement time (or count accumulation time) change to achieve this improvement?

A	The measurement time must be squared
B	The measurement time must be increased by the square root of two
C	The measurement time must be doubled
D	The measurement time must be increased by a factor of four

Correct answer: D - The measurement time must be increased by a factor of four

Rationale

Nuclear decay follows Poisson statistics, where the fractional uncertainty (f) is inversely proportional to the square root of the total counts (N). Since N is linearly proportional to time (t), f is proportional to 1/sqrt(t). To reduce f by a factor of 2, the term sqrt(t) must increase by a factor of 2, which requires t to increase by a factor of 4.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 10.3 on radioactive decay and statistics.

Question 78 of 505

ID	formationeval_v0.1_petrophysics_gamma_interactions_002
Domains	Petrophysics
Topics	Photoelectric Effect, Lithology Identification
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Which characteristic of the photoelectric absorption process makes it the primary mechanism used for identifying formation lithology (rock matrix type) in gamma ray logging?

A	The cross-section is highly sensitive to the effective atomic number (Z) of the formation material
B	It is the only interaction that occurs at high gamma ray energies (> 1 MeV), since pair production requires much higher thresholds
C	The interaction probability depends solely on the hydrogen index of the pore fluids
D	It produces a linear response to the bulk density of the formation regardless of composition

Correct answer:	A - The cross-section is highly sensitive to the effective atomic number (Z) of the formation material

Rationale

The photoelectric absorption cross-section varies strongly with the atomic number (approximately Z^4.6). Since different rock matrices (sandstone, limestone, dolomite) have distinct average atomic numbers, the photoelectric factor (Pe) serves as a direct lithology indicator. Pore fluids generally have low Z and play a minor role.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 10 Basic Nuclear Physics for Logging Applications: Gamma Rays
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 10.5 on fundamental gamma ray interactions.

Question 79 of 505

ID	formationeval_v0.1_petrophysics_gamma_interactions_003
Domains	Petrophysics
Topics	Compton Scattering, Density Logging
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the energy range where Compton scattering is the dominant interaction, why is the attenuation of gamma rays considered a reliable proxy for formation bulk density?

A	The Compton cross-section increases exponentially with the atomic number (Z) of the matrix
B	Compton scattering may be independent of the number of electrons in the formation
C	Compton scattering only occurs with hydrogen atoms, which correlate to pore volume, as electrons from other elements do not participate
D	The ratio of atomic number to atomic mass (Z/A) is approximately constant for most rock-forming elements

Correct answer:	D - The ratio of atomic number to atomic mass (Z/A) is approximately constant for most rock-forming elements

Rationale

Compton scattering depends on the electron density of the material. Bulk density is derived from electron density using the relationship between atomic number (Z) and atomic mass (A). For most sedimentary minerals, the ratio Z/A is very close to 0.5, allowing a direct linear transform from electron density to bulk density.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 10 Basic Nuclear Physics for Logging Applications: Gamma Rays
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 10.6 on attenuation and density derivation.

Question 80 of 505

ID	formationeval_v0.1_petrophysics_gamma_detectors_004
Domains	Petrophysics
Topics	Gamma Ray Detectors, Semiconductors
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

What is the primary trade-off when selecting a germanium (Ge) semiconductor detector over a standard scintillation detector (like NaI) for downhole applications?

A	Ge detectors offer superior energy resolution but require cryogenic cooling to function
B	Ge detectors operate at higher temperatures but have very poor energy resolution
C	Ge detectors have much higher detection efficiency but cannot resolve different energy levels
D	Ge detectors are mechanically more rugged but require a radioactive source to operate
Correct answer:	A - Ge detectors offer superior energy resolution but require cryogenic cooling to function

Rationale

Germanium detectors have a small band gap (approx. 0.7 eV), allowing them to produce many charge carriers per event, which results in excellent energy resolution. However, this small band gap means electrons can cross it via thermal excitation at room temperature, necessitating cryogenic cooling to reduce noise.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 10 Basic Nuclear Physics for Logging Applications: Gamma Rays
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 10.7.3 on semiconductor detectors.

Question 81 of 505

ID	formationeval_v0.1_petrophysics_gamma_spectroscopy_005
Domains	Petrophysics
Topics	Gamma Ray Spectroscopy, Pair Production
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In a gamma ray energy spectrum, what physical process results in the appearance of 'single escape' and 'double escape' peaks?

A	The partial loss of energy due to Compton scattering within the formation fluids
B	The escape of one or two 511 keV annihilation photons from the detector following a pair production event
C	The photoelectric absorption of characteristic x-rays emitted by the tool housing
D	The backscattering of gamma rays from the borehole wall into the detector crystal

Correct answer: B - The escape of one or two 511 keV annihilation photons from the detector following a pair production event

Rationale

When a high-energy gamma ray (> 1.022 MeV) undergoes pair production in the detector, a positron is created which subsequently annihilates, producing two 511 keV photons. If one of these photons escapes the crystal without detection, a 'single escape' peak appears (E - 0.511 MeV). If both escape, a 'double escape' peak appears (E - 1.022 MeV).

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 10 Basic Nuclear Physics for Logging Applications: Gamma Rays
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 10.7.2.1 on spectroscopy artifacts.

Question 82 of 505

ID	formationeval_v0.1_petrophysics_gamma_interactions_006
Domains	Petrophysics
Topics	Pair Production, Nuclear Physics
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

What is the minimum threshold energy required for a gamma ray to undergo pair production?

A	0.511 MeV
B	1.022 MeV
C	2.22 MeV
D	100 keV

Correct answer: B - 1.022 MeV

Rationale

Pair production involves the creation of an electron-positron pair. The energy equivalent of the rest mass of an electron is 0.511 MeV. Since two particles (electron and positron) are created, the incident gamma ray must have an energy of at least 2 * 0.511 MeV, which is 1.022 MeV.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 10 Basic Nuclear Physics for Logging Applications: Gamma Rays
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 10.5 on pair production.

Question 83 of 505

ID	formationeval_v0.1_petrophysics_gamma_spectroscopy_007
Domains	Petrophysics
Topics	Compton Scattering, Gamma Ray Spectroscopy
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a gamma ray spectrum derived from a monoenergetic source, what does the "Compton edge" represent?

A	The minimum energy a gamma ray can possess after scattering
B	The full energy peak corresponding to photoelectric absorption
C	The maximum energy transferred to an electron during a 180-degree backscatter event
D	The threshold energy below which pair production cannot occur

Correct answer:	C - The maximum energy transferred to an electron during a 180-degree backscatter event

Rationale

The Compton edge is the upper limit of the energy distribution of recoil electrons. It corresponds to the maximum energy transfer from the incident gamma ray to the electron, which occurs when the gamma ray is backscattered (scattering angle of 180 degrees).

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 10 Basic Nuclear Physics for Logging Applications: Gamma Rays
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 10.5 and Figure 10.6 regarding electron energy distribution.

Question 84 of 505

ID	formationeval_v0.1_petrophysics_natural_radioactivity_001
Domains	Petrophysics, Petroleum Geology
Topics	Natural Radioactivity, Isotopes
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Which three radioactive isotopes are primarily responsible for the natural gamma radiation measured by logging tools in sedimentary formations?

A	Potassium-40, Thorium-232, and Uranium-238
B	Cesium-137, Cobalt-60, and Radium-226
C	Potassium-39, Thorium-230, and Uranium-235
D	Carbon-14, Radon-222, and Polonium-210
Correct answer:	A - Potassium-40, Thorium-232, and Uranium-238

Rationale

The text states that there are only three naturally occurring isotopes with half-lives comparable to the age of the earth that contribute significantly to formation radioactivity: Potassium-40 (^{40}K), Thorium-232 (^{232}Th), and Uranium-238 (^{238}U). Other isotopes mentioned like ^{137}Cs or ^{60}Co are contaminants or have too short half-lives to be primary natural sources.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 11 Gamma Ray Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 11.2 Sources of Natural Radioactivity.

Question 85 of 505

ID	formationeval_v0.1_petrophysics_tool_calibration_002
Domains	Petrophysics
Topics	Tool Calibration, API Units
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How is the standard API unit for gamma ray logging defined?

A	It corresponds to the radiation level of an average mid-continent shale, defined as 100 API units.
B	It is calibrated such that a clean water-bearing sandstone reads 0 API units and a pure kaolinite clay reads 100 API units.
C	It is based on the radiation flux of a 1-gram Radium equivalent source at 1 meter distance.
D	It is defined by an artificial formation at the University of Houston containing specific concentrations of K, Th, and U, set to read 200 API units.
Correct answer:	D - It is defined by an artificial formation at the University of Houston containing specific concentrations of K, Th, and U, set to read 200 API units.

Rationale

The API unit is defined using an artificial radioactive formation constructed at the University of Houston. This formation, containing approximately 4% Potassium, 24 ppm Thorium, and 12 ppm Uranium, is defined to equal 200 API units.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 11 Gamma Ray Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 11.3 Gamma Ray Devices.

Question 86 of 505

ID	formationeval_v0.1_petrophysics_spectral_gamma_ray_003
Domains	Petrophysics
Topics	Spectral Gamma Ray, Clay Estimation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the primary advantage of using the Computed Gamma Ray (CGR) curve instead of the total Gamma Ray (GR) curve for clay volume estimation?

A	The CGR includes uranium contribution, which is the most reliable indicator of clay cation exchange capacity.
B	The CGR curve corrects for borehole size and mud weight effects which distort the total GR signal.
C	The CGR excludes the uranium contribution, avoiding overestimation of shale volume in organic-rich or fractured zones.
D	The CGR provides a higher vertical resolution by utilizing only the high-energy thorium peaks, which have a narrower spectral window.
Correct answer:	C - The CGR excludes the uranium contribution, avoiding overestimation of shale volume in organic-rich or fractured zones.

Rationale

The Computed Gamma Ray (CGR) is the sum of thorium and potassium contributions, excluding uranium. Since uranium is often associated with organic matter or fractures rather than clay minerals, removing it provides a more accurate clay volume indicator (often called the 'uranium-free' gamma ray).

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 11 Gamma Ray Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 11.5 Spectral Gamma Ray Logging.

Question 87 of 505

ID	formationeval_v0.1_petrophysics_isotope_geochemistry_004
Domains	Petrophysics, Petroleum Geology
Topics	Isotope Geochemistry, Clay Mineralogy
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Why is uranium generally considered a poor indicator of clay mineral volume compared to thorium and potassium?

A	Uranium is only found in igneous rocks and does not occur in sedimentary environments due to its chemical immobility during weathering.
B	Uranium emits alpha particles which cannot be detected by standard scintillation crystals.
C	Uranium has a short half-life, making its radiation undetectable in older geologic formations.
D	Uranium compounds are soluble and mobile, often associating with organic matter rather than the clay lattice.
Correct answer:	D - Uranium compounds are soluble and mobile, often associating with organic matter rather than the clay lattice.

Rationale

Uranium compounds are soluble, allowing them to be transported and precipitated far from the site of clay formation. Uranium tends to associate with organic matter (e.g., in organic shales) or precipitate in fractures, unlike thorium and potassium which are chemically or structurally integral to clays and feldspars.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 11 Gamma Ray Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 11.2 Sources of Natural Radioactivity.

Question 88 of 505

ID	formationeval_v0.1_petrophysics_tool_physics_005
Domains	Petrophysics
Topics	Tool Physics, Gamma Ray Attenuation
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Does the gamma ray log respond to the volumetric concentration or the mass concentration of radioactive elements, and why?

A Volumetric concentration, because density effects are canceled out by the borehole fluid compensation.

B Mass concentration, but only if the formation density is assumed to be constant throughout the measurement interval at 2.65 g/cm^3.

C Volumetric concentration, because the detector measures counts per unit of formation volume.

D Mass concentration, because the mass absorption coefficient is effectively independent of bulk density.

Correct answer: D - Mass concentration, because the mass absorption coefficient is effectively independent of bulk density.

Rationale

The text explains that the total gamma ray flux is proportional to n/ρ_b (number of emitters divided by bulk density). Since the mass absorption coefficient (μ) is independent of bulk density, the count rate relates directly to the weight percent (mass concentration) of the radioactive isotope.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 11 Gamma Ray Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 11.3 Gamma Ray Devices (Eq 11.3).

ID	formationeval_v0.1_petrophysics_log_quality_control_006
Domains	Petrophysics, Drilling Engineering
Topics	LWD, Environmental Corrections
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

When comparing LWD and wireline gamma ray logs in the same well, what is the most significant source of observed discrepancies?

A	Intrinsic differences in detector sensitivity to formation radioactivity.
B	The variation in logging speed between drilling and wireline operations.
C	Differences in environmental corrections, particularly in barite-weighted muds.
D	The Doppler shift effect caused by the rotation of the LWD tool.

Correct answer: C - Differences in environmental corrections, particularly in barite-weighted muds.

Rationale

Monte Carlo simulations have shown that intrinsic sensitivity to formation radioactivity is very similar between wireline and LWD tools. The primary cause of discrepancies is the application (or failure to apply) accurate environmental corrections, especially for borehole size and mud constituents like barite.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 11 Gamma Ray Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 11.6 Developments in Spectral Gamma Ray Logging.

Question 90 of 505

ID	formationeval_v0.1_petrophysics_depth_of_investigation_007
Domains	Petrophysics
Topics	Depth of Investigation, Tool Physics
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

What is the approximate depth of investigation (providing 90% of the signal) for a standard gamma ray tool measuring unscattered gamma rays in a typical formation?

A	40–50 cm
B	90–100 cm
C	2–5 cm
D	15–18 cm
Correct answer:	D - 15–18 cm

Rationale

Monte Carlo simulations indicate that 90% of the signal for unscattered gamma rays comes from an annulus approximately 15 cm (6 inches) thick. Including multiply scattered rays increases this depth by only a few centimeters.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 11 Gamma Ray Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 11.7 A Note on Depth of Investigation.

Question 91 of 505

ID	formationeval_v0.1_petrophysics_data_processing_008
Domains	Petrophysics
Topics	Spectral Stripping, Data Processing
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Which mathematical method is used in 'spectral stripping' to calculate the concentrations of Thorium, Uranium, and Potassium from the raw window count rates?

A	Fourier transform analysis
B	Weighted least squares analysis using response standards
C	Simple algebraic subtraction of background radiation
D	Geometric averaging of peak amplitudes

Correct answer: B - Weighted least squares analysis using response standards

Rationale

The concentrations are determined by solving an overdetermined system of equations (where the number of energy windows exceeds the number of isotopes). This is done using a weighted least squares analysis that fits the measured spectrum to a set of standard response spectra (the response matrix).

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 11 Gamma Ray Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 11.5.1 Spectral Stripping.

Question 92 of 505

ID	formationeval_v0.1_petrophysics_lithology_identification_009
Domains	Petrophysics, Petroleum Geology
Topics	Lithology Identification, Mica
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does the presence of mica in a sandstone formation typically affect standard gamma ray and resistivity logs?

A	It causes low gamma ray readings and low resistivity, resembling a clean water sand.
B	It causes high gamma ray readings (resembling shale) but maintains high resistivity (resembling clean sand).
C	It causes high gamma ray readings and very low resistivity, indistinguishable from conductive shale.
D	It has no effect on the gamma ray log but significantly increases the neutron porosity.

Correct answer: B - It causes high gamma ray readings (resembling shale) but maintains high resistivity (resembling clean sand).

Rationale

Mica minerals (like muscovite and biotite) contain potassium, leading to high gamma ray readings that mimic shale. However, unlike clay minerals, micas are generally electrical insulators and have low cation exchange capacity, so they do not suppress resistivity like conductive clays do.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 11 Gamma Ray Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 11.5 Spectral Gamma Ray Logging.

Question 93 of 505

ID	formationeval_v0.1_petrophysics_log_interpretation_010
Domains	Petrophysics
Topics	Log Interpretation, Feldspar
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why is the identification of potassium feldspars using spectral gamma ray data important for density log interpretation?

A	Feldspars are highly radioactive and artificially increase the measured bulk density.
B	Feldspars affect the choice of matrix (grain) density used to calculate porosity from the density log.
C	Feldspars absorb gamma rays significantly, requiring a special barite correction factor.
D	Feldspars indicate the presence of high-density heavy minerals like monazite.

Correct answer: B - Feldspars affect the choice of matrix (grain) density used to calculate porosity from the density log.

Rationale

The text notes that excess potassium often indicates feldspars. Identifying feldspar is critical because it has a different grain density than quartz (e.g., 2.52–2.63 g/cm^3 depending on type). Using the wrong matrix density in the density-porosity equation will yield incorrect porosity values.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 11 Gamma Ray Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 11.5 Spectral Gamma Ray Logging (discussion of Fig 11.8).

Question 94 of 505

ID	formationeval_v0.1_petrophysics_environmental_effects_011
Domains	Petrophysics
Topics	Environmental Effects, Mud Additives
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

How does the presence of barite in drilling mud affect the gamma ray log?

A	It causes an artificially high reading because barite contains trace thorium.
B	It acts as a shield, absorbing low-energy formation gamma rays and lowering the measured count rate.
C	It has no effect on total gamma ray counts, only on the uranium spectral window, since organic matter does not absorb gamma rays.
D	It increases the depth of investigation by focusing the gamma rays.

Correct answer: B - It acts as a shield, absorbing low-energy formation gamma rays and lowering the measured count rate.

Rationale

Barium (in barite) is a heavy element that efficiently absorbs low-energy gamma rays emanating from the formation. This attenuation results in a lower measured count rate, requiring environmental corrections to restore the true formation radioactivity.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 11 Gamma Ray Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 11.3 Gamma Ray Devices.

Question 95 of 505

ID	formationeval_v0.1_petrophysics_density_logging_001
Domains	Petrophysics
Topics	Density Logging, Gamma Ray Physics
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

The conversion of gamma ray attenuation measurements to formation bulk density relies on the assumption that the ratio of atomic number to atomic mass (Z/A) is approximately constant (0.5) for most elements. Which common formation constituent possesses a Z/A ratio significantly different from this baseline, necessitating the definition of an electron density index?

A	Carbon in limestone matrices
B	Silicon in quartz sandstone
C	Hydrogen in pore fluids
D	Calcium in dolomite

Correct answer: C - Hydrogen in pore fluids

Rationale

Most elements in earth formations have a Z/A ratio of approximately 0.5. Hydrogen, however, has a Z/A ratio of nearly 1. This discrepancy causes the electron density index (measured by the tool) to differ from the actual bulk density, particularly in fluids like water or hydrocarbons, requiring a specific calibration (typically to water-filled limestone) to derive correct bulk density logs.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 12 Gamma Ray Scattering and Absorption Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Focuses on the physics of the Z/A ratio deviation.

Question 96 of 505

ID	formationeval_v0.1_petrophysics_mudcake_compensation_002
Domains	Petrophysics
Topics	Density Logging, Mudcake Compensation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In a dual-detector density logging tool, how is the presence of mudcake between the tool pad and the formation wall primarily addressed to determine the correct formation density?

A	By filtering out the low-energy gamma rays that are most affected by the mudcake layer
B	By assuming the mudcake density is equal to the mud filtrate density and applying a constant shift
C	By measuring the mudcake thickness with a caliper and subtracting its density value
D	By utilizing the difference in density sensitivity and depth of investigation between the short-spacing and long-spacing detectors

Correct answer: D - By utilizing the difference in density sensitivity and depth of investigation between the short-spacing and long-spacing detectors

Rationale

The compensation method relies on the fact that the short-spacing detector is more sensitive to the material immediately adjacent to the pad (mudcake) than the long-spacing detector. By comparing the apparent densities read by both detectors (using a 'spine and ribs' approach), a correction (Delta Rho) is derived to adjust the long-spacing measurement to the true formation density.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 12 Gamma Ray Scattering and Absorption Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Tests understanding of the dual-detector compensation principle.

Question 97 of 505

ID	formationeval_v0.1_petrophysics_photoelectric_effect_003
Domains	Petrophysics
Topics	Lithology Logging, Photoelectric Factor
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

While evaluating a formation, you observe a density log that appears normal, but the Photoelectric Factor (Pe) curve reads an extremely high value (>> 10). What is the most likely environmental cause for this response?

A	The borehole is severely washed out, causing the tool to read drilling fluid only
B	The formation is composed of pure halite (salt)
C	The formation contains significant amounts of gas, lowering the electron density
D	The drilling mud contains barite weighting material

Correct answer: D - The drilling mud contains barite weighting material

Rationale

The Photoelectric Factor (Pe) is highly sensitive to the atomic number (Z) of materials. Barite (Barium Sulfate) contains Barium (Z=56), which has a very high cross-section for photoelectric absorption. Even small amounts of barite in the mudcake or invasion fluid will cause the Pe reading to skyrocket, often rendering it useless for lithology identification.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 12 Gamma Ray Scattering and Absorption Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Applied question regarding environmental effects on Pe logs.

ID	formationeval_v0.1_petrophysics_porosity_sensitivity_004
Domains	Petrophysics
Topics	Porosity Calculation, Error Analysis
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

When converting bulk density to porosity, how does the impact of an error in the estimated fluid density parameter (rho_f) vary with formation porosity?

A	The error impact is constant regardless of the formation porosity
B	The error impact is most critical in low porosity formations
C	The error impact is most critical in high porosity formations
D	The error impact is negligible unless the formation contains gas
Correct answer:	C - The error impact is most critical in high porosity formations

Rationale

In the density-porosity relationship, the fluid density term scales with the volume of fluid (porosity). Therefore, an incorrect assumption for fluid density produces the largest error in calculated porosity when the porosity is high. Conversely, errors in matrix density are most critical in low-porosity formations where the matrix volume fraction is highest.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 12 Gamma Ray Scattering and Absorption Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Tests understanding of sensitivity analysis in porosity derivation.

Question 99 of 505

ID	formationeval_v0.1_petrophysics_lwd_density_005
Domains	Petrophysics, Drilling Engineering
Topics	LWD, Invasion
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why is it potentially erroneous to use the mud filtrate density as the fluid density parameter when calculating porosity from a Logging While Drilling (LWD) density tool located near the bit?

A	The rotation of the drill string centrifuges the mud filtrate away from the sensor
B	LWD density tools have a depth of investigation that is too shallow to see past the mudcake
C	LWD tools use a different gamma ray energy source that interacts differently with mud filtrate
D	The measurement often occurs before significant invasion, so the tool investigates virgin formation fluid rather than filtrate

Correct answer:	D - The measurement often occurs before significant invasion, so the tool investigates virgin formation fluid rather than filtrate

Rationale

LWD density sensors located near the bit measure the formation very shortly after it is drilled. In this timeframe, invasion of mud filtrate may not yet have proceeded significantly. Consequently, the fluid occupying the pore space within the tool's depth of investigation is likely the native formation fluid (e.g., oil or gas) rather than the mud filtrate.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 12 Gamma Ray Scattering and Absorption Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Distinguishes LWD interpretation context from wireline.

Question 100 of 505

ID	formationeval_v0.1_petrophysics_pe_mixing_law_006
Domains	Petrophysics
Topics	Lithology Logging, Rock Physics
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

When calculating the average Photoelectric Factor (Pe) for a rock mixture composed of different minerals, why is a simple volume-weighted average of the individual mineral Pe values incorrect?

A	Pe is a logarithmic measurement and must be averaged geometrically
B	Pe is proportional to cross-section per electron, so the mixing law must account for electron density (volumetric cross-section U)
C	Pe measurements are only valid for pure elements, not compounds or mixtures, due to fundamental limitations in the photoelectric absorption cross-section
D	The atomic number Z dominates the average linearly, ignoring density effects
Correct answer:	B - Pe is proportional to cross-section per electron, so the mixing law must account for electron density (volumetric cross-section U)

Rationale

The Photoelectric Factor (Pe) relates to the cross-section per electron. Mixing rules must be formulated in terms of electron density. The correct approach uses the volumetric cross-section parameter U (where U = Pe * electron density), which combines volumetrically. The final average Pe is then derived from the total U divided by the average electron density.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 12 Gamma Ray Scattering and Absorption Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Tests the specific physics of mixing laws for Pe.

Question 101 of 505

ID	formationeval_v0.1_petrophysics_density_correction_007
Domains	Petrophysics
Topics	Density Logging, Log Quality Control
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

On a compensated density log, what does a large positive value on the density correction curve (Delta Rho) typically indicate?

A	The tool is measuring through a mudcake that is significantly denser than the formation (e.g., barite mud)
B	The tool is measuring through a mudcake or standoff that is lighter than the formation (e.g., light mud or rugosity)
C	The photoelectric factor has been used to correct the bulk density for lithology effects
D	The detectors are saturated and the tool requires recalibration

Correct answer:	B - The tool is measuring through a mudcake or standoff that is lighter than the formation (e.g., light mud or rugosity)

Rationale

The correction Delta Rho is added to the long-spacing apparent density. If the mudcake is lighter than the formation (common with standard muds), the detectors read anomalously low densities (higher counts). A positive correction is required to bring the value back up to the true formation density. Conversely, heavy mudcake (barite) results in a negative correction.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 12 Gamma Ray Scattering and Absorption Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Practical interpretation of the correction curve sign.

Question 102 of 505

ID	formationeval_v0.1_petrophysics_spectrum_physics_008
Domains	Petrophysics
Topics	Gamma Ray Physics, Tool Design
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Modern density tools analyze scattered gamma rays in different energy windows. What physical interaction dominates the attenuation in the low-energy window compared to the high-energy window?

A	Compton scattering dominates the low-energy window, while Pair Production dominates the high-energy window
B	Photoelectric absorption dominates the low-energy window, while Compton scattering dominates the high-energy window
C	Both windows are dominated equally by Photoelectric absorption
D	Compton scattering dominates both, but the cross-section changes sign
Correct answer:	B - Photoelectric absorption dominates the low-energy window, while Compton scattering dominates the high-energy window

Rationale

Gamma ray attenuation is a sum of Compton scattering and Photoelectric absorption. Photoelectric absorption is strongly dependent on energy (inversely proportional) and atomic number (Z). It dominates at low energies, allowing for lithology (Pe) determination. High-energy attenuation is dominated by Compton scattering, which is proportional to electron density.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 12 Gamma Ray Scattering and Absorption Measurements
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Foundational physics of the measurement windows.

Question 103 of 505

ID	formationeval_v0.1_petrophysics_neutron_scattering_001
Domains	Petrophysics
Topics	Neutron Interactions, Elastic Scattering
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Why is hydrogen considered the most effective element for slowing down fast neutrons through elastic scattering?

A	Hydrogen nuclei have a high threshold for inelastic scattering, which dissipates energy more efficiently than elastic scattering
B	The hydrogen nucleus creates a magnetic field that significantly decelerates neutral particles
C	Hydrogen has an anomalously large capture cross-section that absorbs high-energy neutrons immediately
D	The mass of a hydrogen nucleus is nearly equal to that of a neutron, allowing for maximum energy transfer in a single collision

Correct answer: D - The mass of a hydrogen nucleus is nearly equal to that of a neutron, allowing for maximum energy transfer in a single collision

Rationale

In elastic scattering, energy loss is determined by the kinematics of the collision. Because the mass of a hydrogen nucleus (proton) is essentially the same as that of a neutron, a neutron can lose up to all of its energy in a single head-on collision. Heavier nuclei result in much smaller fractional energy losses per collision.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 13 Basic Neutron Physics for Logging Applications
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 13.2 regarding elastic scattering mechanics.

Question 104 of 505

ID	formationeval_v0.1_petrophysics_neutron_absorption_002
Domains	Petrophysics
Topics	Neutron Absorption, Thermal Neutrons
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does the presence of elements like chlorine or gadolinium in a formation primarily affect neutron logging measurements?

A	They act as strong moderators, reducing the slowing-down length of fast neutrons
B	They cause a significant increase in the inelastic scattering of high-energy neutrons
C	They act as strong thermal absorbers, reducing the thermal neutron flux and diffusion length
D	They emit additional neutrons through particle reactions, artificially increasing the count rate

Correct answer: C - They act as strong thermal absorbers, reducing the thermal neutron flux and diffusion length

Rationale

Chlorine and gadolinium have very large thermal absorption cross-sections. Their presence depresses the thermal neutron population by capturing thermalized neutrons, thereby reducing the distance neutrons diffuse before capture (diffusion length) and lowering the count rates seen by thermal detectors.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 13 Basic Neutron Physics for Logging Applications
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 13.2 on absorption and Table 13.1.

Question 105 of 505

ID	formationeval_v0.1_petrophysics_neutron_sources_003
Domains	Petrophysics
Topics	Neutron Sources, Logging Tools
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

What is a primary operational advantage of using a deuterium-tritium (D-T) accelerator source over a chemical source like AmBe?

A	The D-T source requires no high-voltage power supply, making it more reliable downhole
B	The D-T source produces neutrons at a much lower energy (thermal), reducing shielding requirements
C	The D-T source produces a wider spectrum of neutron energies, mimicking natural radiation
D	The D-T source can be switched off for safety and pulsed for timing measurements

Correct answer: D - The D-T source can be switched off for safety and pulsed for timing measurements

Rationale

Accelerator sources produce neutrons via electrically controlled nuclear reactions. This allows the tool to be turned off, improving safety during transport and handling, and enables pulsed operation for advanced timing measurements (like decay time), which is not possible with continuous chemical sources.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 13 Basic Neutron Physics for Logging Applications
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 13.3 on nuclear reactions and sources.

Question 106 of 505

ID	formationeval_v0.1_petrophysics_detectors_004
Domains	Petrophysics
Topics	Neutron Detectors, Instrumentation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

To modify a standard Helium-3 neutron detector to measure primarily epithermal neutrons, what physical alteration is typically applied?

A	Increasing the pressure of the Helium-3 gas to 100 atmospheres
B	Replacing the Helium-3 gas with Boron Trifluoride (BF3)
C	Surrounding the detector with a cadmium shield to absorb thermal neutrons
D	Using a scintillator crystal instead of a proportional counter gas
Correct answer:	C - Surrounding the detector with a cadmium shield to absorb thermal neutrons

Rationale

Standard Helium-3 detectors are sensitive to both thermal and epithermal neutrons. To isolate the epithermal response, a shield made of a strong thermal absorber (like cadmium) is wrapped around the detector. This shield absorbs neutrons with energies below the cadmium cutoff (~0.4 eV), allowing only higher-energy (epithermal) neutrons to pass through and be detected.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 13 Basic Neutron Physics for Logging Applications
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 13.5 regarding epithermal detectors.

Question 107 of 505

ID	formationeval_v0.1_petrophysics_inelastic_scattering_005
Domains	Petrophysics
Topics	Neutron Interactions, Inelastic Scattering
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Which of the following statements correctly describes inelastic neutron scattering?

A	It is the primary mechanism for slowing down neutrons in hydrogen-rich formations
B	It results in the neutron being absorbed by the nucleus and forming a compound isotope
C	It occurs at all neutron energies and results in the conservation of kinetic energy
D	It has a threshold energy below which it cannot occur and typically produces gamma rays

Correct answer: D - It has a threshold energy below which it cannot occur and typically produces gamma rays

Rationale

Inelastic scattering involves the neutron imparting energy to the nucleus, leaving it in an excited state. This reaction requires the incident neutron to have kinetic energy above a specific threshold (to bridge the energy gap to the excited state). The nucleus subsequently de-excites by emitting characteristic gamma rays.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 13 Basic Neutron Physics for Logging Applications
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 13.2 on inelastic scattering.

Question 108 of 505

ID	formationeval_v0.1_petrophysics_neutron_physics_006
Domains	Petrophysics
Topics	Neutron Physics, Slowing Down
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

What is the significance of the average logarithmic energy decrement (ζ) in neutron physics?

A	It represents the probability of a neutron being captured rather than scattered
B	It quantifies the average loss of the logarithm of neutron energy per collision
C	It is the ratio of the final thermal energy to the initial source energy
D	It describes the exponential decay of the neutron flux with distance from the source

Correct answer:	B - It quantifies the average loss of the logarithm of neutron energy per collision

Rationale

The average logarithmic energy decrement (ζ) is a parameter used to describe the efficiency of a moderator. It is defined as the average change in the natural logarithm of the neutron energy per collision. For hydrogen, ζ is 1, indicating very efficient slowing down.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 13 Basic Neutron Physics for Logging Applications
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 13.4.2 on lethargy and energy loss.

Question 109 of 505

ID	formationeval_v0.1_petrophysics_characteristic_lengths_007
Domains	Petrophysics
Topics	Characteristic Lengths, Slowing Down
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Which definitions correctly distinguish the slowing-down length (L_s) from the diffusion length (L_d)?

A	L_s characterizes the thermal phase until capture, while L_d characterizes the high-energy scattering phase
B	L_s is the total distance traveled, while L_d is the straight-line distance from the source
C	L_s relates to the transport from source energy to epithermal energy, while L_d relates to the distance traveled during the thermal phase
D	L_s depends only on the source type and its energy spectrum, while L_d depends only on the detector type and its efficiency characteristics
Correct answer:	C - L_s relates to the transport from source energy to epithermal energy, while L_d relates to the distance traveled during the thermal phase

Rationale

The slowing-down length (L_s) is proportional to the root-mean-square distance a neutron travels while losing energy from the source level down to the epithermal range. The diffusion length (L_d) describes the distance a neutron travels after it has become thermalized (at low energy) until it is eventually captured.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 13 Basic Neutron Physics for Logging Applications
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 13.4.4 on characteristic lengths.

Question 110 of 505

ID	formationeval_v0.1_petrophysics_hydrogen_index_008
Domains	Petrophysics
Topics	Hydrogen Index, Porosity
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

What is the definition of the Hydrogen Index (HI)?

A	The ratio of hydrogen atoms to oxygen atoms in a molecule
B	The concentration of hydrogen in a material compared to the hydrogen concentration of fresh water at standard conditions
C	The percentage of neutron energy lost in a single collision with a hydrogen nucleus
D	The mass of hydrogen in a formation divided by the bulk density of the rock matrix
Correct answer:	B - The concentration of hydrogen in a material compared to the hydrogen concentration of fresh water at standard conditions

Rationale

The Hydrogen Index (HI) is defined as the ratio of the hydrogen content (in grams per cubic centimeter) of a material or mixture to the hydrogen content of fresh water at standard temperature and pressure. Pure water has an HI of 1.0.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 13 Basic Neutron Physics for Logging Applications
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 13.4.1 regarding bulk parameters.

Question 111 of 505

ID	formationeval_v0.1_petrophysics_thermal_capture_009
Domains	Petrophysics
Topics	Neutron Interactions, Cross Sections
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

For most common formation elements, how does the radiative capture (thermal absorption) cross-section vary with neutron energy?

A	It is constant across all energy levels
B	It increases linearly with neutron energy
C	It varies inversely with the square root of the neutron energy (1/√E)
D	It is negligible at low energies and peaks at high energies

Correct answer: C - It varies inversely with the square root of the neutron energy (1/√E)

Rationale

The radiative capture cross-section is generally known as the thermal absorption cross-section. For most elements, this cross-section is largest at low energies and decreases as the neutron energy increases, following a 1/√E relationship.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 13 Basic Neutron Physics for Logging Applications
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 13.2 regarding thermal absorption.

Question 112 of 505

ID	formationeval_v0.1_petrophysics_slowing_down_collisions_010
Domains	Petrophysics
Topics	Slowing Down, Neutron Physics
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Comparing a 0 p.u. limestone to a water-saturated limestone, how does the number of collisions required to slow a neutron down to thermal energy change?

A	It is significantly higher in the 0 p.u. limestone because heavier elements are less efficient moderators
B	It is significantly lower in the 0 p.u. limestone because there is no hydrogen to absorb the neutrons
C	It is approximately the same because the rock matrix density compensates for the lack of fluid
D	It is higher in the water-saturated limestone because hydrogen increases the probability of collision
Correct answer:	A - It is significantly higher in the 0 p.u. limestone because heavier elements are less efficient moderators

Rationale

Hydrogen is a very efficient moderator; a neutron can lose half its energy in a single collision with hydrogen. In a 0 p.u. limestone (calcium/carbon/oxygen matrix), the nuclei are much heavier, resulting in small energy losses per collision. Therefore, many more collisions (e.g., ~138 vs ~23) are required to slow the neutron down in the absence of hydrogen.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 13 Basic Neutron Physics for Logging Applications
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 13.4.3 and Figure 13.8.

Question 113 of 505

ID	formationeval_v0.1_petrophysics_neutron_physics_001
Domains	Petrophysics
Topics	Neutron Porosity, Tool Physics
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

According to neutron transport theory, which physical parameter is most directly responsible for the count rate variations observed in an epithermal neutron porosity logging device?

A	The thermal diffusion length of the formation
B	The bulk density of the rock matrix
C	The slowing-down length of the formation
D	The thermal neutron capture cross-section

Correct answer: C - The slowing-down length of the formation

Rationale

The text explains that for an epithermal neutron device, the flux falls off exponentially with distance from the source based on a characteristic length called the slowing-down length (L_s). This parameter is determined by the ability of the formation (specifically hydrogen) to moderate high-energy neutrons to epithermal energy levels.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 14 Neutron Porosity Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 14.4 regarding the basis of measurement and Eq. 14.8.

Question 114 of 505

ID	formationeval_v0.1_petrophysics_neutron_detectors_002
Domains	Petrophysics
Topics	Neutron Porosity, Thermal Neutrons
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why is the response of a thermal neutron porosity tool significantly more complex to interpret than that of an epithermal tool?

A	Thermal neutrons are sensitive to strong absorbers in the formation, such as chlorine and boron
B	Thermal tools generally use weaker neutron sources that have shallow depth of investigation
C	Thermal neutrons cannot penetrate the steel pressure housing of the logging tool
D	Thermal detectors are insensitive to hydrogen concentration in the pore fluid
Correct answer:	A - Thermal neutrons are sensitive to strong absorbers in the formation, such as chlorine and boron

Rationale

Thermal neutron tools detect neutrons that have reached thermal equilibrium. Their population is strongly affected by the thermal absorption cross-section (Σ_a) of elements in the formation (like chlorine in brine or boron/gadolinium in shales), unlike epithermal neutrons which are primarily affected by the slowing-down process.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Type	textbook
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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 14 Neutron Porosity Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 14.3 on Types of Neutron Tools.

Question 115 of 505

ID	formationeval_v0.1_petrophysics_lithology_effect_003
Domains	Petrophysics
Topics	Neutron Porosity, Lithology Effect
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A neutron porosity tool is calibrated to a limestone matrix standard. If this tool is used to log a water-saturated, clean sandstone formation, how will the apparent porosity reading typically compare to the true formation porosity?

A	The tool will read a value significantly higher than the true porosity
B	The tool will read a value slightly lower than the true porosity
C	The tool will accurately read the true porosity without correction
D	The tool will read zero porosity due to the lack of calcium carbonate

Correct answer: B - The tool will read a value slightly lower than the true porosity

Rationale

Due to the lithology effect (matrix effect), a tool calibrated for limestone (grain density ~2.71 g/cm^3) will underestimate the porosity in sandstone (grain density ~2.65 g/cm^3). The text states that the ratio in sandstone lies below the limestone line, resulting in an apparent limestone porosity a few units less than the true porosity.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 14 Neutron Porosity Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 14.9.1 on Lithology Effect and Fig. 14.9.

Question 116 of 505

ID	formationeval_v0.1_petrophysics_gas_effect_004
Domains	Petrophysics
Topics	Neutron Porosity, Gas Effect
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

What is the primary physical reason that gas-bearing zones exhibit anomalously low apparent porosity on neutron logs?

A	Gas has a very high thermal absorption cross-section, which depresses the neutron flux
B	Gas reduces the bulk density of the formation, causing the tool to lose contact with the borehole wall
C	Gas has a significantly lower hydrogen density than water or oil, increasing the slowing-down length
D	Gas invades the formation deeper than water, making it invisible to the shallow neutron tool
Correct answer:	C - Gas has a significantly lower hydrogen density than water or oil, increasing the slowing-down length

Rationale

The gas effect occurs because gas has a much lower density and hydrogen concentration compared to liquid water or oil. This reduced hydrogen density makes the formation less efficient at slowing down neutrons, leading to a longer slowing-down length (L_s). A longer L_s corresponds to a lower apparent porosity reading.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 14 Neutron Porosity Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 14.9.3 on Gas Effect.

Question 117 of 505

ID	formationeval_v0.1_petrophysics_shale_effect_005
Domains	Petrophysics
Topics	Neutron Porosity, Shale Effect
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the main cause of the characteristically high apparent neutron porosity readings observed in shale formations?

A	The presence of hydrogen in the hydroxyl groups within the clay mineral structure
B	The high concentration of thermal absorbers like boron typically found in shales
C	The extremely high effective porosity and permeability of shale laminations
D	The presence of micro-fractures filled with high-salinity formation water
Correct answer:	A - The presence of hydrogen in the hydroxyl groups within the clay mineral structure

Rationale

While thermal absorbers can affect the reading, the primary cause of high neutron porosity in shales is the hydrogen content associated with the shale matrix itself, specifically the hydroxyls (OH-) in the clay mineral structure. The tool cannot distinguish this hydrogen from the hydrogen in pore fluids.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 14 Neutron Porosity Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 14.9.2 on Shale Effect.

Question 118 of 505

ID	formationeval_v0.1_petrophysics_salinity_effect_006
Domains	Petrophysics
Topics	Neutron Porosity, Environmental Corrections
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How do the competing physical effects of high formation water salinity typically influence the response of a thermal neutron porosity tool?

A The reduced hydrogen index lowers the apparent porosity, while the increased thermal absorption increases the ratio (raising apparent porosity)

B Both the reduced hydrogen index and the increased thermal absorption act to significantly lower the apparent porosity reading

C The increased density of salt water shortens the slowing-down length, causing the tool to overestimate porosity significantly

D Salinity may have no effect on the ratio measurement because the near and far detectors are affected equally

Correct answer:	A - The reduced hydrogen index lowers the apparent porosity, while the increased thermal absorption increases the ratio (raising apparent porosity)

Rationale

Salinity introduces two competing effects: 1) Dissolved salt displaces hydrogen, reducing the Hydrogen Index (HI), which would theoretically lower the porosity reading. 2) Chlorine is a strong thermal absorber, which depresses the thermal neutron flux and increases the Near/Far ratio (which correlates to higher porosity). The text notes that the absorption effect tends to counteract the loss of hydrogen.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 14 Neutron Porosity Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 14.8 on Environmental Effects.

ID	formationeval_v0.1_petrophysics_doi_007
Domains	Petrophysics
Topics	Neutron Porosity, Depth of Investigation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In a dual-detector neutron tool, how does the depth of investigation of the ratio measurement compare to that of the individual detectors?

A	The ratio measurement has a greater depth of investigation than either the near or far detector individually
B	The ratio measurement has a depth of investigation exactly equal to the far detector
C	The ratio measurement corresponds to the shallow depth of the near detector to ensure high vertical resolution
D	The ratio measurement averages the depths, falling strictly between the near and far detector values

Correct answer: A - The ratio measurement has a greater depth of investigation than either the near or far detector individually

Rationale

Taking the ratio of near and far detector count rates partially eliminates the response common to both detectors, which is the signal from the region closest to the borehole. This processing effectively weights the signal from deeper in the formation more strongly, resulting in a depth of investigation that is deeper than either single detector.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 14 Neutron Porosity Devices
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 14.10 on Depth of Investigation.

Question 120 of 505

ID	formationeval_v0.1_petrophysics_temperature_effect_008
Domains	Petrophysics
Topics	Neutron Porosity, Environmental Corrections
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the general effect of elevated downhole temperatures on the porosity reading of a thermal neutron device (assuming no other environmental corrections)?

A	The apparent porosity reading decreases as temperature increases
B	The apparent porosity reading increases as temperature increases
C	The reading remains unchanged as temperature effects are self-compensating
D	The porosity reads zero once the temperature exceeds the thermal threshold of the source

Correct answer: A - The apparent porosity reading decreases as temperature increases

Rationale

The text states that simply stated, the apparent thermal neutron porosity decreases as the formation and borehole temperature increase. This is related to the hardening of the neutron energy spectrum at higher temperatures, which reduces the detection efficiency of the thermal detectors.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from Section 14.8.1 on Temperature Effect.

Question 121 of 505

ID	formationeval_v0.1_petrophysics_pulsed_neutron_logging_001
Domains	Petrophysics
Topics	Thermal Neutron Die-Away, Saturation Determination
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In thermal neutron die-away logging, which element significantly dominates the macroscopic absorption cross-section of saline formation water, enabling the distinction between water and hydrocarbons?

A	Oxygen
B	Hydrogen
C	Chlorine
D	Carbon

Correct answer: C - Chlorine

Rationale

Chlorine has a very large thermal neutron absorption cross-section. In saline waters, the concentration of NaCl increases the macroscopic cross-section dramatically compared to fresh water or hydrocarbons, which have similar, much lower cross-sections.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 15 Pulsed Neutron Devices and Spectroscopy
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on the physical basis of sigma logging.

Question 122 of 505

ID	formationeval_v0.1_petrophysics_pulsed_neutron_physics_002
Domains	Petrophysics
Topics	Thermal Neutron Die-Away, Physics
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the mathematical relationship between the macroscopic thermal capture cross-section (Sigma) and the decay time constant of the thermal neutron population?

A	They are inversely proportional
B	They are directly proportional
C	They are related exponentially
D	They may be independent of each other

Correct answer: A - They are inversely proportional

Rationale

The decay time constant is equal to the inverse of the product of the neutron velocity and the macroscopic absorption cross-section. Therefore, a higher Sigma results in a shorter decay time (faster decay).

Sources

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Reference	Chapter 15 Pulsed Neutron Devices and Spectroscopy
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on decay time definitions.

Question 123 of 505

ID	formationeval_v0.1_petrophysics_neutron_diffusion_003
Domains	Petrophysics
Topics	Thermal Neutron Die-Away, Diffusion Effect
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does the diffusion of thermal neutrons typically affect the 'apparent' capture cross-section measured by a logging tool compared to the 'intrinsic' formation value?

A	Diffusion only affects epithermal neutrons and has no impact on the thermal Sigma measurement, since thermal neutrons are captured before they can diffuse.
B	Diffusion stabilizes the neutron cloud, ensuring the apparent Sigma matches the intrinsic value exactly.
C	Diffusion increases the neutron population locally, causing the apparent Sigma to read lower than the intrinsic value.
D	Diffusion causes neutrons to move away from the detector, making the population decay faster and the apparent Sigma read higher than the intrinsic value.
Correct answer:	D - Diffusion causes neutrons to move away from the detector, making the population decay faster and the apparent Sigma read higher than the intrinsic value.

Rationale

The local apparent time constant is the sum of the intrinsic decay rate and a diffusion term. Diffusion typically reduces the local neutron density (neutrons moving from high density near source to low density far away), which looks like faster absorption. Faster decay corresponds to a higher apparent Sigma.

Sources

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Source ID	ellis_singer_well_logging_2007
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Reference	Chapter 15 Pulsed Neutron Devices and Spectroscopy
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5

Notes	Concept-based item on diffusion corrections.

Question 124 of 505

ID	formationeval_v0.1_petrophysics_carbon_oxygen_logging_004
Domains	Petrophysics
Topics	Spectroscopy, Carbon/Oxygen Log
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Under what specific reservoir condition is the Carbon/Oxygen (C/O) ratio logging technique preferred over standard Thermal Neutron Die-Away (Sigma) logging for saturation determination?

A	When the formation water salinity is low, fresh, or unknown
B	When the formation contains high-pressure natural gas
C	When the borehole is filled with highly saline drilling fluid
D	When the porosity is extremely low (less than 5%)
Correct answer:	A - When the formation water salinity is low, fresh, or unknown

Rationale

Standard Sigma logging relies on the contrast in capture cross-section between saline water (high Sigma due to Cl) and oil (low Sigma). In fresh water, this contrast disappears. C/O logging measures the atomic ratio of Carbon to Oxygen, which distinguishes oil (Carbon-rich) from water (Oxygen-rich) regardless of salinity.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Reference	Chapter 15 Pulsed Neutron Devices and Spectroscopy
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on C/O logging applications.

Question 125 of 505

ID	formationeval_v0.1_petrophysics_spectroscopy_timing_005
Domains	Petrophysics
Topics	Spectroscopy, Inelastic Scattering
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

To measure inelastic gamma rays for Carbon/Oxygen analysis, during which part of the pulsed neutron cycle must the data acquisition occur?

A	During the neutron burst
B	During the thermal decay period (hundreds of microseconds after burst)
C	During the background measurement gate
D	Continuously throughout the entire cycle

Correct answer: A - During the neutron burst

Rationale

Inelastic scattering reactions occur only when neutrons have high energy (above the threshold energy for the reaction). High-energy neutrons are present primarily during the burst. Once the burst ends, neutrons rapidly thermalize (within microseconds), stopping inelastic reactions and initiating capture reactions.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 15 Pulsed Neutron Devices and Spectroscopy
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on spectroscopy timing gates.

Question 126 of 505

ID	formationeval_v0.1_petrophysics_water_flow_006
Domains	Petrophysics, Production Engineering
Topics	Water Flow Monitoring, Oxygen Activation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Which nuclear reaction mechanism is utilized by pulsed neutron tools to detect and measure water flow behind casing?

A	Inelastic scattering off Carbon atoms
B	Thermal neutron capture by Chlorine
C	Oxygen activation producing Nitrogen-16
D	Epithermal neutron slowing down
Correct answer:	C - Oxygen activation producing Nitrogen-16

Rationale

Water flow is monitored using Oxygen activation. High-energy neutrons interact with Oxygen-16 via an (n,p) reaction to produce unstable Nitrogen-16, which decays with a ~7-second half-life emitting high-energy gamma rays. Detecting these delayed gamma rays downstream indicates water movement.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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License	Proprietary (Springer)
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Reference	Chapter 15 Pulsed Neutron Devices and Spectroscopy
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on oxygen activation logging.

Question 127 of 505

ID	formationeval_v0.1_petrophysics_saturation_interpretation_007
Domains	Petrophysics
Topics	Thermal Neutron Die-Away, Interpretation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Which statement correctly describes the mixing law used to interpret water saturation from the macroscopic capture cross-section (Sigma) in a clean formation?

A	It is a linear volumetric sum of the cross-sections of the matrix and fluids.
B	It follows a non-linear relationship similar to the Archie equation exponents.
C	It depends primarily on the density difference between oil and water.
D	It requires a logarithmic transformation of the measured cross-section.
Correct answer:	A - It is a linear volumetric sum of the cross-sections of the matrix and fluids.

Rationale

Since Sigma is a macroscopic cross-section, it combines volumetrically. The total Sigma is the sum of the matrix Sigma weighted by (1-phi) and the fluid Sigma weighted by phi. The fluid Sigma is further split into water and hydrocarbon components based on saturation.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 15 Pulsed Neutron Devices and Spectroscopy
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on the mixing law for sigma.

Question 128 of 505

ID	formationeval_v0.1_petrophysics_geochemical_logging_008
Domains	Petrophysics
Topics	Spectroscopy, Geochemical Logging
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In geochemical logging based on capture spectroscopy, what is the 'oxide closure model' used for?

A	To convert relative elemental yields into absolute weight concentrations by assuming unmeasured elements are oxides.
B	To seal the detector housing against high-pressure borehole fluids.
C	To correct for the oxygen activation interference in the capture spectrum.
D	To determine the porosity by closing the gap between neutron and density logs.
Correct answer:	A - To convert relative elemental yields into absolute weight concentrations by assuming unmeasured elements are oxides.

Rationale

Capture spectroscopy measures relative yields of elements but not their absolute concentrations. Since Oxygen (the most abundant element) is not directly measured in capture mode, the closure model assumes elements exist as oxides (or carbonates) and sums them to 100% (or uses an approximate normalization factor) to solve for absolute weight fractions.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 15 Pulsed Neutron Devices and Spectroscopy
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on geochemical processing.

Question 129 of 505

ID	formationeval_v0.1_petrophysics_neutron_porosity_009
Domains	Petrophysics
Topics	Pulsed Neutron Porosity, Slowing Down Time
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Beyond estimating porosity or hydrogen index, what specific borehole parameter can be derived from the 'slowing-down time' measurement in an epithermal pulsed neutron tool?

A	Formation temperature
B	Tool standoff distance
C	Mud resistivity
D	Cement bond quality

Correct answer: B - Tool standoff distance

Rationale

The slowing-down time of epithermal neutrons is sensitive to the local hydrogen environment. Analysis of the early time decay allows the determination of tool standoff from the borehole wall, which is a critical environmental correction for neutron porosity tools.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
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Reference	Chapter 15 Pulsed Neutron Devices and Spectroscopy
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on slowing down time applications.

Question 130 of 505

ID	formationeval_v0.1_petrophysics_borehole_signal_010
Domains	Petrophysics
Topics	Thermal Neutron Die-Away, Tool Design
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a pulsed neutron capture log, how is the unwanted gamma ray signal from the borehole fluid typically distinguished from the desired formation signal?

A	By analyzing the decay curve components, as the borehole signal typically decays much faster than the formation signal.
B	By using a chemical neutron source instead of a pulsed generator to eliminate borehole activation.
C	By shielding the detectors with cadmium to filter out all borehole gamma rays.
D	By measuring only the inelastic gamma rays which are not produced in the borehole fluid, since hydrogen in mud does not interact with fast neutrons.

Correct answer: A - By analyzing the decay curve components, as the borehole signal typically decays much faster than the formation signal.

Rationale

The borehole signal (if the fluid is saline) typically has a much larger cross-section (shorter decay time) than the formation. By analyzing the time-decay of the gamma rays, the rapidly decaying borehole component can be separated from the slower decaying formation component, or specific time gates can be positioned after the borehole signal has died away.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on borehole signal correction.

Question 131 of 505

ID	formationeval_v0.1_petrophysics_nmr_physics_001
Domains	Petrophysics
Topics	NMR Physics, Larmor Frequency
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the context of Nuclear Magnetic Resonance (NMR) logging, what primary factors determine the Larmor frequency at which protons precess?

A	The porosity of the formation and the hydrogen index
B	The pulse echo spacing and the magnetic field gradient
C	The fluid viscosity and the formation temperature
D	The gyromagnetic ratio of the nucleus and the strength of the magnetic field

Correct answer:	D - The gyromagnetic ratio of the nucleus and the strength of the magnetic field

Rationale

The Larmor frequency is the rate at which the angular momentum vector of a nucleus precesses around an external magnetic field. It is mathematically defined as the product of the gyromagnetic ratio (a constant specific to the nuclear species, such as hydrogen) and the strength of the applied magnetic field.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 16 Nuclear Magnetic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.1.1 on Nuclear Resonance Magnetometers.

Question 132 of 505

ID	formationeval_v0.1_petrophysics_nmr_relaxation_002
Domains	Petrophysics
Topics	NMR Relaxation, Pulse Sequences
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the primary function of the CPMG (Carr-Purcell-Meiboom-Gill) pulse sequence in modern NMR logging?

A	To measure the longitudinal relaxation time (T1) by inverting the spin population
B	To eliminate the irreversible dephasing caused by molecular interactions
C	To mitigate the effect of static magnetic field inhomogeneities on spin dephasing
D	To polarize the protons in the formation using the earth's magnetic field
Correct answer:	C - To mitigate the effect of static magnetic field inhomogeneities on spin dephasing

Rationale

The CPMG sequence uses a series of 180-degree pulses to reverse the phase of precessing protons. This rephasing process generates spin echoes, effectively cancelling out the dephasing caused by fixed spatial inhomogeneities in the static magnetic field, allowing the measurement of the true transverse relaxation (T2) caused by molecular interactions.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 16 Nuclear Magnetic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.3.5 on Spin Echoes.

Question 133 of 505

ID	formationeval_v0.1_petrophysics_nmr_diffusion_003
Domains	Petrophysics
Topics	Diffusion, Tool Physics
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In an NMR tool with a magnetic field gradient, how does increasing the inter-echo spacing (Te) affect the observed transverse relaxation rate?

A	It decreases the relaxation rate linearly because protons have less time to diffuse
B	It may have no effect on the relaxation rate for bulk fluids, only for surface relaxation, since viscosity changes are negligible
C	It significantly increases the relaxation rate due to diffusion, proportional to the square of Te
D	It increases the signal-to-noise ratio but does not alter the decay rate
Correct answer:	C - It significantly increases the relaxation rate due to diffusion, proportional to the square of Te

Rationale

When a magnetic gradient exists, molecular diffusion causes protons to move into regions with different magnetic field strengths during the measurement, leading to irreversible dephasing. The decay rate contribution from this diffusion is proportional to the diffusion coefficient, the square of the gradient, and the square of the echo spacing (Te). Therefore, increasing Te drastically increases the diffusion-induced decay.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 16 Nuclear Magnetic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.3.6 on Relaxation and Diffusion in Magnetic Gradients.

Question 134 of 505

ID	formationeval_v0.1_petrophysics_porous_media_004
Domains	Petrophysics
Topics	Porous Media, Surface Relaxation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In water-wet sandstone pores, what is the dominant mechanism controlling the relaxation time of the water protons?

A	Diffusion relaxation caused by the earth's magnetic field gradient
B	Molecular shearing due to high fluid viscosity
C	Bulk fluid relaxation similar to that of water in a beaker
D	Surface relaxation caused by interactions with paramagnetic sites on grain walls
Correct answer:	D - Surface relaxation caused by interactions with paramagnetic sites on grain walls

Rationale

In porous media like sandstones, the relaxation of water is much faster than in bulk water. This is due to surface relaxation, where fluid molecules diffuse to the pore walls and interact with paramagnetic impurities (like iron). The rate of this relaxation is controlled by the surface relaxivity and the surface-to-volume ratio of the pores.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 16 Nuclear Magnetic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.5.1 on Surface Interactions.

Question 135 of 505

ID	formationeval_v0.1_petrophysics_pore_size_distribution_005
Domains	Petrophysics
Topics	Pore Size Distribution, Fast Diffusion Limit
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Under the fast diffusion limit assumption, how is the T2 distribution obtained from an NMR log interpreted?

A	As a direct mapping of the pore size distribution, where short T2 corresponds to small pores
B	As a measure of the chemical composition of the rock matrix
C	As a representation of the bulk fluid viscosity distribution only
D	As an indicator of the temperature gradient within the borehole

Correct answer: A - As a direct mapping of the pore size distribution, where short T2 corresponds to small pores

Rationale

In the fast diffusion limit, molecules diffuse across the pore space quickly enough to average the relaxation effects. Consequently, the decay rate is proportional to the surface-to-volume ratio. Since the surface-to-volume ratio is inversely related to pore size, the distribution of T2 relaxation times acts as a proxy for the pore size distribution, with shorter times indicating smaller pores.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Reference	Chapter 16 Nuclear Magnetic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.5.2 on Pore Size Distribution.

Question 136 of 505

ID	formationeval_v0.1_petrophysics_fluid_properties_006
Domains	Petrophysics
Topics	Fluid Properties, Viscosity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the general relationship between the viscosity of a crude oil and its NMR relaxation time (T1 or T2)?

A	Relaxation time increases as the square of viscosity
B	Relaxation time may be independent of viscosity and depends only on temperature
C	Relaxation time is inversely proportional to viscosity
D	Relaxation time is directly proportional to viscosity

Correct answer: C - Relaxation time is inversely proportional to viscosity

Rationale

For bulk fluids like crude oil, the relaxation rate (1/T1 or 1/T2) is controlled by the correlation time of molecular interactions, which relates to Brownian motion. Experimental correlations show that the relaxation time is inversely proportional to the viscosity of the oil; highly viscous oils have very short relaxation times, while light oils have longer relaxation times.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 16 Nuclear Magnetic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.4.2 on Bulk Relaxation.

Question 137 of 505

ID	formationeval_v0.1_petrophysics_permeability_007
Domains	Petrophysics
Topics	Permeability, Interpretation Models
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Which NMR-derived parameter is used in the SDR (Schlumberger-Doll Research) model to estimate formation permeability?

A	The diffusion coefficient of the gas phase
B	The hydrogen index of the pore fluid
C	The ratio of free fluid index (FFI) to bound fluid volume (BVI)
D	The logarithmic mean of the T2 distribution (T2,LM)
Correct answer:	D - The logarithmic mean of the T2 distribution (T2,LM)

Rationale

The SDR permeability model relies on the connection between pore size and relaxation time. It estimates permeability using the total porosity and the logarithmic mean of the T2 distribution (T2,LM), essentially treating T2,LM as a proxy for the average pore size.

Sources

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.8.3 on Permeability Estimation.

Question 138 of 505

ID	formationeval_v0.1_petrophysics_cutoff_values_008
Domains	Petrophysics
Topics	T2 Cutoff, Sandstone
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

What is the standard T2 cutoff value typically used to distinguish between capillary-bound water and producible fluids in sandstone formations?

A	3 ms
B	12 ms
C	33 ms
D	100 ms

Correct answer: C - 33 ms

Rationale

Based on comparisons between NMR data and centrifuge experiments, a T2 cutoff of approximately 33 ms is standard for partitioning the porosity of sandstones into capillary-bound water (below the cutoff) and producible free fluids (above the cutoff).

Sources

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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 16 Nuclear Magnetic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.8.2 on Porosity and Free-Fluid Porosity.

Question 139 of 505

ID	formationeval_v0.1_petrophysics_gas_detection_009
Domains	Petrophysics
Topics	Gas Detection, Porosity Deficit
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why does an NMR log typically underestimate porosity in a gas-bearing zone compared to a density/neutron cross-plot?

A	Gas causes extremely fast surface relaxation that cannot be detected by the tool
B	Gas has a low hydrogen index and a long T1 that may lead to incomplete polarization
C	Gas is highly viscous, pushing the signal into the clay-bound water region
D	Gas creates internal gradients that increase the signal amplitude artificially
Correct answer:	B - Gas has a low hydrogen index and a long T1 that may lead to incomplete polarization

Rationale

Gas affects the NMR porosity measurement in two ways: it has a low hydrogen density (Hydrogen Index < 1) compared to water/oil, reducing the signal amplitude per unit volume. Additionally, gas often has a very long T1 relaxation time; if the polarization wait time of the tool is too short, the hydrogen in the gas will not be fully polarized, further reducing the measured signal.

Sources

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Reference	Chapter 16 Nuclear Magnetic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.8.4.1 on Gas and Tar Determination.

Question 140 of 505

ID	formationeval_v0.1_petrophysics_heavy_oil_010
Domains	Petrophysics
Topics	Heavy Oil, Bitumen
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does bitumen or very heavy oil typically appear on a standard NMR log?

A	It appears as Free Fluid with a very long T2
B	It shows a distinct peak at 33 ms similar to capillary water
C	It may be invisible or appear as a porosity deficit because its T2 is extremely short
D	It causes a large shift in the neutron porosity but has no effect on NMR
Correct answer:	C - It may be invisible or appear as a porosity deficit because its T2 is extremely short

Rationale

Bitumen has extremely high viscosity, which results in a very short relaxation time (T2 often less than 1 ms). In many logging tools, this signal decays so fast it occurs during the tool's 'dead time' or is interpreted as part of the solid matrix/clay bound water. Consequently, bitumen is often 'missed', appearing as a deficit between NMR porosity and total porosity from nuclear logs.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 16 Nuclear Magnetic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.8.4.1 regarding Bitumen/Tar.

Question 141 of 505

ID	formationeval_v0.1_petrophysics_fluid_typing_011
Domains	Petrophysics
Topics	Fluid Typing, Diffusion Maps
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

When using a Diffusion-T2 (D-T2) map for fluid typing, how are water and medium-viscosity oil typically distinguished?

A	Water plots at a higher diffusion coefficient than oil for a given T2
B	Oil plots at a higher diffusion coefficient than water due to its hydrocarbon nature
C	Water and oil cannot be distinguished on a D-T2 map; gas is required
D	Oil plots on the gas trend line while water remains stationary
Correct answer:	A - Water plots at a higher diffusion coefficient than oil for a given T2

Rationale

On a D-T2 map, water plots along a line corresponding to the self-diffusion coefficient of bulk water (which is relatively high). Medium-viscosity oil generally has a lower diffusion coefficient than water. Therefore, oil signals cluster at lower D values compared to water signals, allowing for separation.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 16 Nuclear Magnetic Logging
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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.8.4.2 on Viscosity and D-T2 maps.

Question 142 of 505

ID	formationeval_v0.1_petrophysics_tool_physics_012
Domains	Petrophysics
Topics	Tool Design, Gradient Fields
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In modern NMR logging tools with permanent magnets that create a magnetic field gradient, what determines the depth of investigation (the distance into the formation where resonance occurs)?

A	The strength of the doping agent in the mud
B	The frequency of the operational RF pulse
C	The temperature of the formation fluids
D	The length of the wait time between pulse sequences

Correct answer: B - The frequency of the operational RF pulse

Rationale

Tools with gradient fields have a magnetic field strength that varies with distance from the tool. Since the resonance (Larmor) frequency is directly proportional to the magnetic field strength, tuning the tool to a specific RF frequency effectively selects a specific 'shell' or depth of investigation where the field strength matches that frequency.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 16 Nuclear Magnetic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.7.3 on CMR and Gradient Tools.

Question 143 of 505

ID	formationeval_v0.1_petrophysics_permeability_models_013
Domains	Petrophysics
Topics	Permeability, Coates Model
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

The Coates-Timur permeability equation estimates permeability based on porosity and which other ratio?

A	The ratio of Free Fluid Index (FFI) to Bound Volume Irreducible (BVI)
B	The ratio of Hydrogen Index (HI) to Bulk Density
C	The ratio of T1 relaxation to T2 relaxation
D	The ratio of diffusion coefficient to viscosity

Correct answer: A - The ratio of Free Fluid Index (FFI) to Bound Volume Irreducible (BVI)

Rationale

The Coates-Timur relationship calculates permeability as a function of porosity raised to a power (typically 4) and the square of the ratio of free fluid volume (FFI) to bound fluid volume (BVI). This attempts to capture the relationship between pore throat size and the proportion of movable to immovable fluids.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.8.3 on Permeability Estimation.

Question 144 of 505

ID	formationeval_v0.1_petrophysics_internal_gradients_014
Domains	Petrophysics
Topics	Relaxation Mechanisms, Internal Gradients
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In clay-rich sandstones, what phenomenon can cause water signals on a D-T2 map to appear at apparent diffusion coefficients higher than bulk water?

A	Restricted diffusion in small pores
B	Internal magnetic gradients caused by magnetic susceptibility contrast between fluid and rock
C	The presence of dissolved gas in the water phase
D	Temperature effects reducing the viscosity of the water

Correct answer:	B - Internal magnetic gradients caused by magnetic susceptibility contrast between fluid and rock

Rationale

Internal magnetic gradients arise from the magnetic susceptibility contrast between the pore fluid and the rock matrix (often due to iron in clays). These internal gradients add to the tool's applied gradient, causing increased dephasing. On a D-T2 map, this excess dephasing is interpreted as a higher diffusion coefficient, pushing the water signal above the standard water line.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 16 Nuclear Magnetic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.8.4.2 and Fig 16.41.

Question 145 of 505

ID	formationeval_v0.1_petrophysics_carbonate_interpretation_015
Domains	Petrophysics
Topics	Carbonates, T2 Cutoff
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why is the application of a standard T2 cutoff for bound water often less reliable in carbonates than in sandstones?

A	Carbonates never contain paramagnetic impurities to cause surface relaxation
B	Carbonates often exhibit weak diffusional coupling between micropores and macropores
C	Carbonates have a uniform pore size distribution unlike sandstones
D	Carbonate pore structures are often complex with variable surface relaxivity and unconnected vugs

Correct answer: D - Carbonate pore structures are often complex with variable surface relaxivity and unconnected vugs

Rationale

Carbonates have complex pore systems ranging from micropores to large vugs, often with variable surface relaxivity. Unlike sandstones where pore size correlates well with T2, carbonates may show unimodal distributions even with wide pore size variations due to diffusional coupling or isolated vugs, making a single T2 cutoff (like the 93 ms often cited) less universally applicable.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Reference	Chapter 16 Nuclear Magnetic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 16.8.3 on Pore Size Distribution.

Question 146 of 505

ID	formationeval_v0.1_petrophysics_acoustic_logging_history_001
Domains	Petrophysics, Geophysics
Topics	Acoustic Logging History, Seismic Correlation
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

What was the primary driver for the initial development of acoustic logging technologies in the petroleum industry?

A	The necessity of evaluating cement bond quality behind casing
B	The demand for detecting fractures in carbonate reservoirs
C	The need to directly measure formation porosity for reservoir evaluation
D	The requirement to correlate surface seismic time measurements with depth

Correct answer:	D - The requirement to correlate surface seismic time measurements with depth

Rationale

Acoustic logging initially originated as a companion to seismic exploration (velocity surveys) to solve the problem of correlating seismic travel time with actual depth. The application for porosity determination came later with the development of the Wyllie time-average relationship.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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License	Proprietary (Springer)
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Reference	Chapter 17 Introduction to Acoustic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from the history of acoustic measurements section.

Question 147 of 505

ID	formationeval_v0.1_petrophysics_tool_design_002
Domains	Petrophysics
Topics	Tool Design, Borehole Compensation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

The Borehole Compensated (BHC) sonic tool design, incorporating pairs of transmitters and receivers, was developed to address which specific logging environment challenge?

A	Loss of signal amplitude in gas-filled boreholes
B	Interference from direct mud arrivals in large holes
C	Erroneous travel time readings caused by borehole enlargements or washouts
D	Inability to measure shear wave velocities in soft formations
Correct answer:	C - Erroneous travel time readings caused by borehole enlargements or washouts

Rationale

The BHC design was introduced after correlations were found between bad logs and washed-out boreholes. The multi-transmitter/receiver arrangement compensates for irregularities in the borehole size (caving/washouts) that affect the path length through the mud.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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License	Proprietary (Springer)
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Reference	Chapter 17 Introduction to Acoustic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 17.2 on tool evolution.

Question 148 of 505

ID	formationeval_v0.1_petrophysics_rock_mechanics_003
Domains	Petrophysics, Geophysics
Topics	Elastic Properties, Poisson's Ratio
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the context of elastic properties of materials, what does Poisson's ratio describe?

A	The ratio of shear stress to shear strain during deformation
B	The relationship between applied pressure and fractional volume change
C	The ratio of transverse contraction to longitudinal extension under uniform stress
D	The velocity difference between compressional and shear waves

Correct answer: C - The ratio of transverse contraction to longitudinal extension under uniform stress

Rationale

Poisson's ratio (nu) characterizes the geometric deformation of a material. When a sample is stretched in one direction (longitudinal extension), it contracts in the perpendicular directions (transverse contraction). Poisson's ratio is the constant relating these two strains.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 17 Introduction to Acoustic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Definition derived from section 17.4 Review of Elastic Properties.

Question 149 of 505

ID	formationeval_v0.1_petrophysics_wave_propagation_004
Domains	Geophysics, Petrophysics
Topics	Wave Propagation, Elastic Constants
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Based on the wave equation derivation for elastic media, how does the velocity of a compressional wave depend on the density of the material (assuming elastic moduli remain constant)?

A	Velocity is inversely proportional to the square root of the density
B	Velocity increases linearly with increasing density
C	Velocity is directly proportional to the square of the density
D	Velocity may be independent of density
Correct answer:	A - Velocity is inversely proportional to the square root of the density

Rationale

The velocity of wave propagation (both compressional and shear) is given by the square root of the ratio of elastic constants to density (e.g., v = sqrt(Y/rho)). Therefore, if the modulus is constant, an increase in density results in a decrease in velocity.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 17 Introduction to Acoustic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on equations 17.25 and 17.26.

Question 150 of 505

ID	formationeval_v0.1_petrophysics_wave_velocities_005
Domains	Geophysics, Petrophysics
Topics	Acoustic Velocities, Rock Physics
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What fundamental constraint governs the relationship between compressional velocity (Vc) and shear velocity (Vs) in any elastic material with a positive bulk modulus?

A	Vc and Vs must be equal in isotropic media
B	Vs approaches Vc as Poisson's ratio approaches 0.5
C	Vs must necessarily be greater than Vc in any consolidated sedimentary formation
D	Vc must exceed Vs by at least 15 percent

Correct answer: D - Vc must exceed Vs by at least 15 percent

Rationale

Since the bulk modulus must be positive, the relationship between velocities implies that Vc^2 - (4/3)Vs^2 > 0. This mathematical constraint dictates that the compressional velocity must exceed the shear velocity. Specifically, Vc is expected to exceed Vs by at least roughly 15% (limit where Poisson's ratio is negative) or significantly more for real rocks (approx 40% at Poisson's ratio of 0).

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 17 Introduction to Acoustic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Derived from section 17.5 and Equation 17.28 discussion.

Question 151 of 505

ID	formationeval_v0.1_petrophysics_logging_principles_006
Domains	Petrophysics, Geophysics
Topics	Wave Propagation, Refraction
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Which acoustic phenomenon allows a logging tool centered in a fluid-filled borehole to detect energy that has propagated primarily through the surrounding formation?

A	Direct fluid arrival through the mud column
B	Reflection of acoustic waves off the borehole wall
C	Generation of head waves at the critical angle of refraction
D	Attentuation of shear waves at the transmitter
Correct answer:	C - Generation of head waves at the critical angle of refraction

Rationale

The detection of formation velocity relies on Snell's law. When the angle of incidence reaches the critical angle, the wave is critically refracted and travels along the boundary (borehole wall) as a head wave, continuously radiating energy back into the borehole fluid where it is detected by the receiver.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Reference	Chapter 17 Introduction to Acoustic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 17.5 on wave propagation.

Question 152 of 505

ID	formationeval_v0.1_petrophysics_tool_physics_007
Domains	Petrophysics
Topics	Tool Design, Signal Processing
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a rudimentary acoustic logging tool, why is there a minimum required spacing between the transmitter and the receiver?

A	To ensure the acoustic energy traveling through the formation arrives before the direct signal traveling through the mud
B	To allow sufficient time for the transmitter crystals to stop ringing before the signal returns
C	To prevent the formation signal from being attenuated below the detection threshold of the receiver
D	To ensure the shear wave arrives before the compressional wave for easier separation
Correct answer:	A - To ensure the acoustic energy traveling through the formation arrives before the direct signal traveling through the mud

Rationale

The tool relies on the first arrival of the signal to measure transit time. Since sound travels in the mud (approx 5000 ft/s) and typically faster in the formation (10,000+ ft/s), the spacing must be large enough to ensure the longer path through the formation (refraction) is still faster than the shorter, direct path through the mud.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 17.6 Rudimentary Acoustic Logging.

Question 153 of 505

ID	formationeval_v0.1_petrophysics_porosity_evaluation_008
Domains	Petrophysics
Topics	Porosity Evaluation, Wyllie Equation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

What is the fundamental assumption of the Wyllie time-average equation regarding the relationship between interval transit time and porosity?

A	Transit time may be independent of porosity but highly sensitive to pore pressure
B	Transit time is related to the square root of the porosity value
C	Transit time decreases exponentially as porosity increases
D	Transit time is a linear function of porosity, interpolating between matrix and fluid values

Correct answer: D - Transit time is a linear function of porosity, interpolating between matrix and fluid values

Rationale

The Wyllie time-average equation (Equation 17.36) assumes a linear mixing law where the total transit time is the sum of the transit time in the rock matrix and the transit time in the fluid, each weighted by their respective volume fractions (1-phi and phi).

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Notes	Concept derived from section 17.7 Rudimentary Acoustic Interpretation.

Question 154 of 505

ID	formationeval_v0.1_petrophysics_rock_physics_009
Domains	Petrophysics, Reservoir Engineering
Topics	Rock Physics, Pressure Effects
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does increasing the differential pressure (effective stress) typically affect the interval transit time measured in a sedimentary rock?

A	It has no measurable effect on transit time
B	It causes the transit time to increase significantly
C	It causes the transit time to decrease (velocity increases)
D	It causes the transit time to fluctuate randomly
Correct answer:	C - It causes the transit time to decrease (velocity increases)

Rationale

As illustrated in the discussion of laboratory data (Fig 17.14), confining pressure or differential pressure affects acoustic properties. Higher pressure compacts the rock and closes microcracks, leading to higher velocity, which corresponds to a lower interval transit time.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 17.7 and Figure 17.14.

Question 155 of 505

ID	formationeval_v0.1_petrophysics_applications_010
Domains	Petrophysics
Topics	Acoustic Imaging, Fracture Detection
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Which acoustic logging method typically utilizes high frequencies (around 500 kHz) to generate images of the borehole wall?

A	The transmission method measuring interval transit time
B	The reflection method measuring echo transit time and attenuation
C	The long-spaced sonic method for deep investigation
D	The dipole shear wave method for anisotropy analysis
Correct answer:	B - The reflection method measuring echo transit time and attenuation

Rationale

The reflection mode of borehole acoustic measurement uses much higher frequencies (on the order of 500 kHz) compared to standard transmission logging. This mode is used to obtain acoustic images of the borehole wall and evaluate fractures and cement bonding.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Reference	Chapter 17 Introduction to Acoustic Logging
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Notes	Concept derived from section 17.3 Applications.

Question 156 of 505

ID	formationeval_v0.1_petrophysics_elastic_constants_011
Domains	Petrophysics, Geophysics
Topics	Elastic Moduli, Bulk Modulus
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Which elastic constant is defined as the measure of a material's compressibility when subjected to a uniform confining pressure?

A	Young's Modulus (Y)
B	Shear Modulus (mu)
C	Bulk Modulus (B)
D	Poisson's Ratio (nu)

Correct answer: C - Bulk Modulus (B)

Rationale

The bulk modulus (B or K) relates the applied pressure to the fractional change in volume (dV/V) of a material. It specifically describes the resistance to compression under uniform pressure.

Sources

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Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 17 Introduction to Acoustic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Definition derived from section 17.4 Review of Elastic Properties.

Question 157 of 505

ID	formationeval_v0.1_petrophysics_wave_physics_012
Domains	Geophysics, Petrophysics
Topics	Wave Physics, Shear Waves
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

What distinguishes the particle motion of a shear wave from that of a compressional wave?

A	Shear wave particles move parallel to the direction of wave propagation
B	Shear wave particles move at right angles (perpendicular) to the direction of propagation
C	Shear wave particles undergo volumetric expansion and contraction only
D	Shear wave particles move in a retrograde elliptical orbit

Correct answer:	B - Shear wave particles move at right angles (perpendicular) to the direction of propagation

Rationale

In a shear wave, the particle displacement is perpendicular (at right angles) to the direction of the disturbance propagation. In contrast, compressional waves involve particle motion in the same direction as propagation.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 17 Introduction to Acoustic Logging
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept derived from section 17.4 Review of Elastic Properties.

Question 158 of 505

ID	formationeval_v0.1_petrophysics_elastic_limit_013
Domains	Geophysics, Petrophysics
Topics	Rock Physics, Poisson's Ratio
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the theoretical upper limit for Poisson's ratio in a stable isotropic elastic material, derived from the requirement that the bulk modulus must be positive?

A	0.25
B	0.5
C	1.0
D	0.0
Correct answer:	B - 0.5

Rationale

The relationship between Bulk Modulus (B), Young's Modulus (Y), and Poisson's ratio (nu) is given by B = Y / [3(1 - 2*nu)]. For the Bulk Modulus to remain positive (a physical requirement for stability), the term (1 - 2*nu) must be positive, which implies that Poisson's ratio must be less than 0.5.

Sources

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Derived from Equation 17.9 and 17.29 discussion.

Question 159 of 505

ID	formationeval_v0.1_petrophysics_acoustic_stress_001
Domains	Petrophysics, Petroleum Geology
Topics	Acoustic Velocity, Stress Effects
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In laboratory acoustic measurements, how does the compressional velocity of a porous rock typically respond to changes in confining pressure and pore fluid pressure?

A	Velocity decreases with confining pressure and increases with pore pressure
B	Velocity is independent of pressure and depends only on lithology, since pore compression has no effect on acoustic wave speed
C	Velocity increases with confining pressure and decreases with pore pressure
D	Velocity increases with both confining pressure and pore pressure equally

Correct answer:	C - Velocity increases with confining pressure and decreases with pore pressure

Rationale

Acoustic velocity is a function of the effective stress on the rock framework. Increasing the confining (overburden) pressure compacts the rock, stiffening the frame and increasing velocity. Increasing the pore fluid pressure counteracts this compaction, reducing the effective stress and thereby decreasing the velocity.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Type	textbook
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Reference	Chapter 18 Acoustic Waves in Porous Rocks and Boreholes
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept based on Section 18.2 review of laboratory measurements.

Question 160 of 505

ID	formationeval_v0.1_petrophysics_gas_effect_002
Domains	Petrophysics
Topics	Gas Effect, Fluid Substitution
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

When water in a porous sandstone is replaced by gas, how do the compressional (P-wave) and shear (S-wave) velocities typically change?

A	P-wave velocity increases due to lower density, while S-wave velocity decreases
B	Both P-wave and S-wave velocities increase due to the lower density of the gas
C	Both P-wave and S-wave velocities decrease significantly
D	P-wave velocity decreases significantly, while S-wave velocity remains constant or increases slightly

Correct answer: D - P-wave velocity decreases significantly, while S-wave velocity remains constant or increases slightly

Rationale

Replacing water with gas drastically reduces the bulk modulus of the rock-fluid system, causing a significant drop in P-wave velocity. However, the shear modulus is unaffected by the fluid change. Since gas density is lower than water density, the S-wave velocity (dependent on shear modulus divided by density) may actually increase slightly or remain relatively stable, creating a distinct separation between the two behaviors.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept based on Section 18.2 regarding fluid effects.

Question 161 of 505

ID	formationeval_v0.1_petrophysics_rock_physics_models_003
Domains	Petrophysics, Geophysics
Topics	Rock Physics Models, Gassmann Equation
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the primary difference between the Biot theory of poroelasticity and the Gassmann fluid substitution model?

A	Gassmann accounts for fluid viscosity while Biot ignores it
B	Biot theory assumes the rock skeleton is rigid, whereas Gassmann assumes it is compliant
C	Gassmann applies to the low-frequency limit where relative fluid-solid motion is negligible, whereas Biot accounts for frequency dependence and relative motion
D	Biot theory is empirical, while Gassmann theory is derived purely from quantum mechanics
Correct answer:	C - Gassmann applies to the low-frequency limit where relative fluid-solid motion is negligible, whereas Biot accounts for frequency dependence and relative motion

Rationale

Gassmann's model assumes that the relative motion between the fluid and the rock skeleton is negligible, which is valid at low frequencies (like seismic or standard logging in some contexts). Biot's theory extends this to allow for relative motion between the fluid and the frame (governed by Darcy's law), predicting frequency-dependent velocity and attenuation. In the low-frequency limit, Biot theory reduces to Gassmann.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Derived from Section 18.3 discussion on porolelastic models.

Question 162 of 505

ID	formationeval_v0.1_petrophysics_lithology_id_004
Domains	Petrophysics, Petroleum Geology
Topics	Lithology Identification, Pickett Plot
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

When utilizing a Pickett plot (compressional vs. shear velocity ratio) for lithology identification, which rock type is characterized by the highest Vp/Vs ratio (typically around 1.9)?

A	Clean sandstone
B	Dolomite
C	Gas-bearing sandstone
D	Limestone

Correct answer: D - Limestone

Rationale

According to Pickett's laboratory and field data, limestones typically exhibit a Vp/Vs ratio of approximately 1.9. Dolomites are lower (around 1.8), and sandstones are lower still (1.6 to 1.75). Gas-bearing sandstones show even lower ratios (around 1.6 or less).

Sources

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Reference	Chapter 18 Acoustic Waves in Porous Rocks and Boreholes
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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on Section 18.4.1 Lithology and Pickett's findings.

Question 163 of 505

ID	formationeval_v0.1_petrophysics_borehole_acoustics_005
Domains	Petrophysics
Topics	Borehole Acoustics, Waveforms
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In a 'fast' formation (where formation shear velocity exceeds mud compressional velocity) logged with a monopole source, what is the typical temporal order of wave arrivals at the receiver?

A	Stoneley, Shear, Compressional
B	Shear, Compressional, Stoneley
C	Compressional, Shear, Stoneley
D	Compressional, Stoneley, Shear
Correct answer:	C - Compressional, Shear, Stoneley

Rationale

The compressional wave (P-wave) is the fastest and arrives first. It is followed by the shear wave (S-wave), which is slower. The Stoneley wave (tube wave) is a guided wave in the borehole fluid and arrives last due to its velocity being slower than both formation body waves and typically slightly slower than the fluid velocity.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 18 Acoustic Waves in Porous Rocks and Boreholes
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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on Section 18.5 Acoustic Waves in Boreholes and Figure 18.17/18.20.

Question 164 of 505

ID	formationeval_v0.1_petrophysics_slow_formation_006
Domains	Petrophysics
Topics	Slow Formations, Head Waves
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why is a shear head wave typically absent in monopole acoustic logs recorded in 'slow' formations?

A	The formation shear velocity is lower than the borehole fluid velocity, preventing the formation of a critical angle for refraction
B	The monopole source frequency is too high to excite shear modes in soft rock
C	Slow formations are inherently too fractured to support shear wave propagation, as the extensive fracture networks dissipate elastic wave energy
D	The Stoneley wave interferes constructively and cancels out the shear signal
Correct answer:	A - The formation shear velocity is lower than the borehole fluid velocity, preventing the formation of a critical angle for refraction

Rationale

For a head wave (refracted wave) to be generated and travel along the borehole wall, the formation velocity must be higher than the fluid velocity (Snell's law condition for critical refraction). In 'slow' formations, the formation shear velocity is less than the mud velocity, so the shear wave is refracted into the formation rather than traveling along the interface, and no head wave 'wake' is radiated back to the receivers.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on Section 18.5 regarding ray tracing and slow formations.

Question 165 of 505

ID	formationeval_v0.1_petrophysics_dipole_logging_007
Domains	Petrophysics
Topics	Dipole Sonic, Flexural Waves
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does a dipole sonic tool determine shear velocity in slow formations where standard monopole tools fail?

A	It measures the high-frequency compressional wave and divides by a constant factor of 1.6
B	It excites a flexural wave in the borehole wall whose low-frequency velocity limit approximates the formation shear velocity
C	It uses a radioactive source to induce shear vibrations in the rock matrix
D	It generates a Stoneley wave and calculates shear velocity using the mud density alone
Correct answer:	B - It excites a flexural wave in the borehole wall whose low-frequency velocity limit approximates the formation shear velocity

Rationale

Dipole tools shake the borehole sideways, creating a flexural wave that travels along the borehole wall. This wave is dispersive (velocity changes with frequency), but at low frequencies, its velocity approaches the true formation shear velocity. Processing algorithms are used to extract this shear velocity from the dispersive signal.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on Section 18.5.1 Borehole Flexural Waves.

Question 166 of 505

ID	formationeval_v0.1_petrophysics_stoneley_waves_008
Domains	Petrophysics
Topics	Stoneley Waves, Permeability
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In addition to borehole wall rigidity, what formation property significantly affects the velocity and attenuation of low-frequency Stoneley waves in porous rocks?

A	Fluid mobility (ratio of permeability to viscosity)
B	Radioactive isotope concentration
C	Formation temperature gradient
D	Magnetic susceptibility of the matrix
Correct answer:	A - Fluid mobility (ratio of permeability to viscosity)

Rationale

In permeable formations, the Stoneley wave causes fluid movement between the borehole and the formation. This fluid exchange attenuates the wave and slows it down. Models based on Biot theory link this attenuation and velocity decrease to the fluid mobility, which is the formation permeability divided by the fluid viscosity.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on Section 18.5.2 Stoneley Waves and fluid mobility discussion.

Question 167 of 505

ID	formationeval_v0.1_rock_mechanics_failure_009
Domains	Reservoir Engineering, Petrophysics
Topics	Rock Mechanics, Acoustic Velocity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

According to triaxial stress tests, how do acoustic velocities typically behave as a rock sample approaches catastrophic failure (fracture)?

A	Velocities increase exponentially until the moment of failure
B	Velocities remain constant until the sample shatters
C	Velocities level off and then decrease due to the formation of microfissures
D	Shear velocity drops to zero while compressional velocity doubles
Correct answer:	C - Velocities level off and then decrease due to the formation of microfissures

Rationale

In the elastic region, velocities generally increase with stress. However, as the rock enters the region of plastic yielding or ductile deformation, microfissures begin to form. These defects cause the velocities (both P and S) to level off and then decrease prior to the ultimate failure of the sample.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Reference	Chapter 18 Acoustic Waves in Porous Rocks and Boreholes
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on Section 18.2 and Figure 18.10 discussion on rock failure.

Question 168 of 505

ID	formationeval_v0.1_petrophysics_porosity_transform_010
Domains	Petrophysics
Topics	Porosity Evaluation, Wyllie Time Average
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

The Wyllie time-average equation estimates porosity based on the linear interpolation between which two parameters?

A	Matrix transit time and fluid transit time
B	Shear modulus and Bulk modulus
C	Formation density and mud density
D	Resistivity of the flushed zone and resistivity of the uninvaded zone

Correct answer: A - Matrix transit time and fluid transit time

Rationale

The Wyllie time-average equation is an empirical relationship that treats the total transit time as the sum of the transit time through the matrix fraction and the transit time through the fluid fraction. Porosity is calculated by interpolating the measured transit time between the matrix value (0% porosity) and the fluid value (100% porosity).

Sources

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Based on Section 18.3 Porolelastic Models of Rocks.

Question 169 of 505

ID	formationeval_v0.1_petrophysics_acoustic_transducers_001
Domains	Petrophysics
Topics	Acoustic Logging, Shear Wave Logging
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why are dipole acoustic sources preferred over monopole sources for measuring shear velocity in "slow" formations?

A	Monopole sources create a quadrupole moment that interferes with the compressional arrival in slow rocks
B	Dipole sources operate at a much higher frequency, avoiding the dispersion effects common in slow formations
C	Monopole sources cannot generate enough energy to penetrate the mudcake in slow formations
D	Dipole sources generate a borehole flexural wave that allows shear determination even when fluid velocity exceeds formation shear velocity

Correct answer: D - Dipole sources generate a borehole flexural wave that allows shear determination even when fluid velocity exceeds formation shear velocity

Rationale

In slow formations, where the shear velocity is less than the borehole fluid velocity, refracted shear waves cannot exist (Snell's law). Monopole sources rely on refracted waves. Dipole sources, however, excite a flexural mode in the borehole. At low frequencies, the speed of this flexural wave approaches the true formation shear speed, allowing measurement in slow formations.

Sources

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Notes	Concept-based item on transducer selection for slow formations.

Question 170 of 505

ID	formationeval_v0.1_petrophysics_borehole_compensation_002
Domains	Petrophysics
Topics	Borehole Compensation, Sonic Logging
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

How does the borehole compensated (BHC) sonic tool design specifically address the issue of varying borehole diameter and tool tilt?

A	It increases the transmitter power automatically when caliper readings indicate a washout to ensure signal strength
B	It relies on a separate caliper measurement to mathematically subtract the mud travel time from the total travel time
C	It uses a single transmitter with multiple receivers to calculate an average velocity that ignores the mud path
D	It averages the transit times from an up-going and a down-going measurement array to cancel out unequal mud path lengths

Correct answer: D - It averages the transit times from an up-going and a down-going measurement array to cancel out unequal mud path lengths

Rationale

The BHC system uses two transmitter-receiver sets (or equivalent switching) to measure travel times in opposite directions (up-going and down-going). By averaging these intervals, the geometric errors caused by the tool being tilted or the hole size changing (which affects the path length through the mud) effectively cancel each other out.

Sources

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Notes	Concept-based item on BHC principles.

Question 171 of 505

ID	formationeval_v0.1_petrophysics_log_quality_control_003
Domains	Petrophysics
Topics	Log Quality Control, Cycle Skipping
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the primary cause of "cycle skipping" often observed as sharp spikes on a sonic log transit time curve?

A	The receiver detects the shear wave before the compressional wave
B	The formation velocity is faster than the casing velocity, causing interference
C	The signal amplitude is too low, causing the detector to trigger on a subsequent wave cycle rather than the first arrival
D	The borehole fluid is highly aerated, causing the acoustic pulse to travel backward

Correct answer:	C - The signal amplitude is too low, causing the detector to trigger on a subsequent wave cycle rather than the first arrival

Rationale

Cycle skipping occurs when the arrival signal is weak (perhaps due to attenuation or noise). The detection threshold is not met by the first cycle of the wave, so the tool triggers on the second or third cycle. This adds integer multiples of the wave period to the transit time, appearing as sudden, large spikes on the log.

Sources

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Notes	Concept-based item on identifying log artifacts.

Question 172 of 505

ID	formationeval_v0.1_petrophysics_depth_of_investigation_004
Domains	Petrophysics
Topics	Depth of Investigation, Long Spacing Sonic
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the primary advantage of using a long-spacing sonic tool (e.g., 8-10 ft spacing) compared to a conventional short-spacing tool (e.g., 3-5 ft spacing) in formations with significant near-borehole alteration?

A	It increases the frequency of the signal to better resolve micro-fractures in the altered zone
B	It reduces the effect of cycle skipping by generating a stronger shear wave component
C	It provides a higher vertical resolution for detecting thin beds
D	It allows the acoustic wave to penetrate deeper, ensuring the measured velocity represents the undisturbed formation

Correct answer: D - It allows the acoustic wave to penetrate deeper, ensuring the measured velocity represents the undisturbed formation

Rationale

Alteration near the borehole (like shale swelling or stress relief) typically slows down acoustic waves. A short-spacing tool may only measure this slower, altered zone. Increasing the transmitter-receiver spacing forces the refracted wave path deeper into the formation, allowing it to bypass the altered zone and measure the velocity of the virgin formation.

Sources

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Notes	Concept-based item on tool physics and alteration.

Question 173 of 505

ID	formationeval_v0.1_petrophysics_anisotropy_005
Domains	Petrophysics
Topics	Anisotropy, Geomechanics
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

When analyzing cross-dipole sonic data, what characteristic feature in the dispersion curves indicates the presence of stress-induced anisotropy around the borehole?

A	The Stoneley wave dispersion curve merges with the fast shear curve at high frequencies
B	Both shear waves show zero slowness at the low-frequency limit
C	The fast and slow shear dispersion curves run parallel to each other across all frequencies
D	The dispersion curves for both polarizations exhibit a distinct crossover at intermediate frequencies

Correct answer:	D - The dispersion curves for both polarizations exhibit a distinct crossover at intermediate frequencies

Rationale

Stress-induced anisotropy creates a specific stress distribution near the borehole (concentrations of tension and compression). At low frequencies, shear waves probe deep into the formation (far-field stress). At high frequencies, they sense the near-wellbore altered stress field. This difference in probing depth causes the fast and slow polarization curves to cross over, a signature unique to stress-induced (as opposed to intrinsic) anisotropy.

Sources

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on advanced anisotropy interpretation.

Question 174 of 505

ID	formationeval_v0.1_petrophysics_porosity_evaluation_006
Domains	Petrophysics, Reservoir Engineering
Topics	Secondary Porosity, Carbonate Evaluation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a carbonate reservoir, a significant discrepancy is observed where the neutron and density logs indicate high porosity, but the sonic log indicates low porosity. What is the most likely explanation?

A	The formation contains gas, which affects the neutron log more than the sonic log
B	The reservoir contains secondary porosity (vugs or fractures) which the sonic tool tends to bypass
C	The sonic tool is decentralizing, causing it to read the transit time of the steel casing
D	The presence of shale is suppressing the sonic response while boosting density porosity
Correct answer:	B - The reservoir contains secondary porosity (vugs or fractures) which the sonic tool tends to bypass

Rationale

Acoustic energy tends to travel through the continuous rock matrix, bypassing vugs, fractures, or other secondary porosity features. Neutron and density tools, however, measure bulk volumetric properties and will see the fluid in these vugs. Therefore, a lower sonic porosity compared to total (neutron/density) porosity is a standard indicator of secondary porosity.

Sources

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on secondary porosity identification.

Question 175 of 505

ID	formationeval_v0.1_drilling_engineering_lwd_sonic_007
Domains	Drilling Engineering, Petrophysics
Topics	LWD, Acoustic Sources
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Why are quadrupole acoustic sources particularly advantageous for Logging While Drilling (LWD) shear wave measurements compared to dipole sources?

A	Quadrupole sources generate a higher frequency signal that is immune to drilling noise
B	Quadrupole sources can couple energy into the formation below a certain cut-off frequency without exciting flexural modes in the drill collar
C	Quadrupole sources provide a direct measurement of permeability which corrects the shear velocity for fluid mobility
D	Quadrupole sources are mechanically simpler and do not require slotting of the drill collar
Correct answer:	B - Quadrupole sources can couple energy into the formation below a certain cut-off frequency without exciting flexural modes in the drill collar

Rationale

In LWD, the stiff drill collar is a major noise source. Dipole sources tend to excite flexural waves in the collar that interfere with formation signals. Quadrupole physics dictates that collar modes have a low-frequency cutoff. By operating below this cutoff, quadrupole sources can excite formation waves without exciting the interfering collar modes.

Sources

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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 19 Acoustic Logging Methods
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on LWD physics.

Question 176 of 505

ID	formationeval_v0.1_petrophysics_permeability_stoneley_008
Domains	Petrophysics
Topics	Permeability, Stoneley Waves
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does formation permeability affect the propagation of Stoneley waves in a borehole?

A	Permeability causes the Stoneley wave to accelerate and increase in amplitude due to better coupling
B	Permeability may have no effect on Stoneley waves; they are only sensitive to shear modulus and formation density, not fluid mobility
C	Permeability allows fluid movement between the borehole and formation, causing attenuation and slowing of the Stoneley wave
D	Permeability causes the Stoneley wave to reflect back to the source, creating a standing wave pattern
Correct answer:	C - Permeability allows fluid movement between the borehole and formation, causing attenuation and slowing of the Stoneley wave

Rationale

Stoneley waves are interface waves that move fluid. When the formation is permeable, the pressure pulse forces fluid into the pore space (and back out). This fluid movement dissipates energy (attenuation) and slows the wave propagation compared to a non-permeable formation. This effect is the basis for Stoneley-derived permeability logs.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 19 Acoustic Logging Methods
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on acoustic permeability.

Question 177 of 505

ID	formationeval_v0.1_petroleum_geology_overpressure_009
Domains	Petroleum Geology, Drilling Engineering
Topics	Overpressure Detection, Sonic Trends
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a normally compacted shale sequence, transit time typically decreases with depth. What is the characteristic acoustic signature of an overpressured shale zone?

A	The transit time decreases more rapidly than the normal trend
B	The transit time remains constant regardless of depth
C	The transit time deviates from the normal trend, showing higher values (slower velocity)
D	The acoustic signal is completely lost due to gas saturation
Correct answer:	C - The transit time deviates from the normal trend, showing higher values (slower velocity)

Rationale

Overpressured shales are under-compacted because the trapped pore fluid supports part of the overburden weight, preventing normal porosity reduction. Higher porosity (and fluid support) leads to slower acoustic velocities, which corresponds to higher transit times compared to the expected normal compaction trend line.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 19 Acoustic Logging Methods
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on pore pressure prediction.

Question 178 of 505

ID	formationeval_v0.1_production_engineering_cement_evaluation_010
Domains	Production Engineering
Topics	Cement Bond Log, Casing Evaluation
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

On a traditional Cement Bond Log (CBL), what does a very low amplitude of the first casing arrival (E1) indicate?

A	Free pipe with no cement behind the casing
B	Good bonding where cement attenuates the casing vibration
C	A micro-annulus exists between the casing and the cement
D	The tool is decentralized and reading the mud signal
Correct answer:	B - Good bonding where cement attenuates the casing vibration

Rationale

The CBL measures the amplitude of the acoustic wave traveling along the casing. If cement is well-bonded to the casing, it mechanically couples with the pipe and dampens (attenuates) this vibration rapidly. Therefore, a low amplitude signal indicates good cement bonding, while high amplitude indicates free, unbonded pipe.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 19 Acoustic Logging Methods
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on CBL interpretation.

Question 179 of 505

ID	formationeval_v0.1_production_engineering_ultrasonic_imaging_011
Domains	Production Engineering
Topics	Ultrasonic Imaging, Casing Inspection
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In ultrasonic pulse-echo casing evaluation, how is the casing thickness determined?

A	By measuring the time it takes for the echo to return from the formation wall
B	By analyzing the resonant frequency of the casing's thickness mode vibration
C	By comparing the amplitude of the first reflection to a calibration in water
D	By measuring the attenuation of the flexural wave traveling along the casing axis
Correct answer:	B - By analyzing the resonant frequency of the casing's thickness mode vibration

Rationale

The ultrasonic pulse excites a thickness resonance in the casing wall. The frequency of this resonance is determined by the casing thickness and the speed of sound in steel. By analyzing the reverberation frequency in the return signal, the tool can compute the casing thickness.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 19 Acoustic Logging Methods
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on ultrasonic physics.

Question 180 of 505

ID	formationeval_v0.1_petrophysics_alteration_shale_012
Domains	Petrophysics
Topics	Borehole Alteration, Shale Swelling
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What effect does the hydration and swelling of clays near the borehole wall typically have on the measured acoustic transit time?

A	It decreases the transit time because hydrated clays are denser
B	It has no effect on transit time, only on the caliper log, since acoustic waves bypass the damaged zone entirely
C	It increases the transit time because the altered zone has a lower velocity than the virgin formation
D	It causes the shear wave to disappear but leaves the compressional wave unaffected
Correct answer:	C - It increases the transit time because the altered zone has a lower velocity than the virgin formation

Rationale

When clays swell (hydrate), they generally become less dense and mechanically weaker, which reduces their acoustic velocity. A lower velocity corresponds to a higher transit time. If the alteration zone is deep enough, the acoustic tool measures this slower zone rather than the faster, undisturbed formation.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 19 Acoustic Logging Methods
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on environmental effects on logs.

Question 181 of 505

ID	formationeval_v0.1_petrophysics_well_classification_001
Domains	Petrophysics, Drilling Engineering
Topics	Well Classification, High Angle Wells
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

According to the classification by Passey et al., at what inclination angle is a well considered "Horizontal" (HZ), requiring accurate angle knowledge for quantitative interpretation?

A	Greater than 60 degrees
B	Greater than 90 degrees only
C	Greater than 80 degrees
D	Between 45 and 60 degrees
Correct answer:	C - Greater than 80 degrees

Rationale

The text defines four groups: Vertical (<30°), Moderately Deviated (30°–60°), High Angle (60°–80°), and Horizontal (>80°). Horizontal wells are characterized as those where all logs are affected by the angle and accurate knowledge of the angle is required for quantitative interpretation.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 20 High Angle and Horizontal Wells
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on well classification definitions.

Question 182 of 505

ID	formationeval_v0.1_petrophysics_resistivity_anisotropy_002
Domains	Petrophysics
Topics	Resistivity Logging, Anisotropy
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does the current path of a standard induction or propagation tool differ in a horizontal well compared to a vertical well, assuming horizontal bedding?

A	In a vertical well, the current loop is elongated and measures vertical resistivity exclusively
B	The current path is identical in both orientations due to azimuthal focusing
C	In a horizontal well, the current loop is circular and only encounters horizontal resistivity, with no vertical component contribution
D	In a horizontal well, the current flows horizontally at the top/bottom of the loop but vertically on the sides

Correct answer: D - In a horizontal well, the current flows horizontally at the top/bottom of the loop but vertically on the sides

Rationale

In a vertical well, the induced current loop is horizontal and remains within the bedding plane, measuring horizontal resistivity (R_h). In a horizontal well, the loop is perpendicular to the bedding; the current travels horizontally at the top and bottom of the loop but must cross bedding planes (flowing vertically) on the sides, making the measurement sensitive to both R_h and R_v.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 20 High Angle and Horizontal Wells
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on physics of resistivity tools in HA/HZ wells.

Question 183 of 505

ID	formationeval_v0.1_petrophysics_density_logging_003
Domains	Petrophysics
Topics	Density Logging, Thin Bed Analysis
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why might a density log in a horizontal well accurately resolve the density of a bed only a few inches thick, whereas a vertical log in the same formation would read an average value?

A	Horizontal wells use slower logging speeds, allowing for higher sampling rates
B	The density tool focuses deeper in horizontal wells due to gravity acting on the gamma rays
C	In horizontal wells, resolution is controlled by depth of investigation rather than detector spacing
D	Vertical wells suffer from greater standoff which degrades thin bed resolution
Correct answer:	C - In horizontal wells, resolution is controlled by depth of investigation rather than detector spacing

Rationale

In a vertical well, resolution is determined by the source-detector spacing (30-40 cm), causing the tool to average thin beds. In a horizontal well running parallel to the beds, the tool measures the formation directly alongside it. As long as the bed thickness exceeds the tool's shallow depth of investigation (a few inches), the tool will read the true density of that layer.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 20 High Angle and Horizontal Wells
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on geometrical response of density tools.

Question 184 of 505

ID	formationeval_v0.1_petrophysics_neutron_logging_004
Domains	Petrophysics
Topics	Neutron Logging, LWD Response
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

When interpreting LWD neutron logs in horizontal wells, what phenomenon causes the tool to be essentially "blind" to a water-bearing sand when approaching it from an overlying gas zone?

A	The low hydrogen index of the gas zone prevents neutrons from effectively penetrating and streaming into the water zone
B	The high density of the water zone absorbs all neutrons before they reach the detectors
C	Gas zones cause excessive standoff which decouples the neutron tool from the formation
D	Neutrons stream easily through the water zone but are scattered back by the gas interface
Correct answer:	A - The low hydrogen index of the gas zone prevents neutrons from effectively penetrating and streaming into the water zone

Rationale

Neutrons travel or "stream" furthest in formations with long slowing-down lengths (like gas zones). When the tool is in a gas zone (low Hydrogen Index), neutrons struggle to penetrate the nearby high-HI water zone, making the tool blind to the approaching bed. Conversely, if the tool is in the water zone, neutrons can easily stream into a nearby gas zone, making the tool highly sensitive to gas even at a distance.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 20 High Angle and Horizontal Wells
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on neutron streaming effects.

Question 185 of 505

ID	formationeval_v0.1_drilling_engineering_geosteering_005
Domains	Drilling Engineering, Petrophysics
Topics	Geosteering, Log Interpretation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the primary limitation of using non-azimuthal measurements (like standard Gamma Ray) for geosteering when a horizontal well exits a reservoir sand into a shale?

A	They are too slow to transmit data to the surface in real-time
B	They are unaffected by the dip of the formation boundaries
C	They cannot determine the mineralogical composition of the shale
D	They provide no information on whether the well exited through the top or the bottom of the reservoir
Correct answer:	D - They provide no information on whether the well exited through the top or the bottom of the reservoir

Rationale

Non-azimuthal tools provide a scalar value representing the formation properties around the borehole. When the log indicates a transition from sand to shale, the response looks identical whether the well has drilled up into the overlying shale or down into the underlying shale. Azimuthal measurements or images are required to resolve this ambiguity.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 20 High Angle and Horizontal Wells
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on geosteering ambiguities.

Question 186 of 505

ID	formationeval_v0.1_petrophysics_deep_resistivity_006
Domains	Petrophysics, Drilling Engineering
Topics	Deep Directional Resistivity, LWD
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Modern deep-reading LWD tools can determine the direction to a conductive boundary (up vs. down) independent of formation anisotropy. What hardware configuration enables this capability?

A	A single axial transmitter and receiver operating at multiple frequencies
B	Receivers oriented at an angle (e.g., 45 degrees) to the tool axis combined with axial transmitters
C	Using only attenuation measurements while discarding phase shift data, since phase shift contains no useful formation information
D	Placing the transmitter and receiver at the exact same location on the drill collar
Correct answer:	B - Receivers oriented at an angle (e.g., 45 degrees) to the tool axis combined with axial transmitters

Rationale

To distinguish the direction of a boundary, the tool must have azimuthal sensitivity. This is achieved by using tilted receivers (e.g., at 45 degrees). This configuration creates cross-dipole couplings (V_zx and V_xz). The difference between these cross-dipole signals allows the tool to determine the distance and direction to the boundary using a mirror-image principle, which effectively cancels out the effects of anisotropy and dip.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 20 High Angle and Horizontal Wells
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on deep directional resistivity physics.

Question 187 of 505

ID	formationeval_v0.1_petrophysics_cuttings_accumulation_008
Domains	Petrophysics
Topics	Borehole Environmental Effects, Density Logging
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What common drilling-related artifact often affects density logs in the bottom quadrant of a horizontal well?

A	Gas accumulation preventing pad contact
B	A dune-like layer of cuttings accumulating on the low side of the hole
C	Excessive heating of the tool due to friction with the borehole wall
D	Invasion of heavy mud filtrate causing erroneously high density readings
Correct answer:	B - A dune-like layer of cuttings accumulating on the low side of the hole

Rationale

In horizontal wells, drill cuttings tend to settle on the bottom (low side) of the borehole, often forming dune-like structures. A density tool's pad sliding along the bottom will measure this layer of cuttings, which typically has higher porosity (lower density) than the formation rock, leading to erroneous measurements.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 20 High Angle and Horizontal Wells
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on LWD environmental effects.

Question 188 of 505

ID	formationeval_v0.1_petrophysics_clay_mineralogy_001
Domains	Petrophysics
Topics	Clay Mineralogy, Cation Exchange Capacity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Which of the following statements correctly describes the structural and electrical differences between kaolinite and montmorillonite?

A	Both minerals share a 2:1 sheet structure, but kaolinite has significantly higher potassium content
B	Both minerals have negligible cation exchange capacities because they are electrically neutral aluminosilicates
C	Kaolinite has a 2:1 sheet structure with high cation exchange capacity, while montmorillonite has a 1:1 structure with low capacity
D	Kaolinite has a 1:1 sheet structure with low cation exchange capacity, while montmorillonite has a 2:1 structure with high capacity
Correct answer:	D - Kaolinite has a 1:1 sheet structure with low cation exchange capacity, while montmorillonite has a 2:1 structure with high capacity

Rationale

Kaolinite consists of a simple 1:1 stacking of octahedral and tetrahedral sheets with low isomorphic substitution, resulting in a low Cation Exchange Capacity (CEC) (3-5 meq/100g). Montmorillonite has a 2:1 structure with significant substitution and a large interlayer space that allows for swelling and a high CEC (80-150 meq/100g).

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 21 Clay Quantification
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 21.2 on clay structure and properties.

Question 189 of 505

ID	formationeval_v0.1_petrophysics_porosity_definitions_002
Domains	Petrophysics
Topics	Porosity, Clay Bound Water
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In the context of log analysis, how is 'effective porosity' typically distinguished from 'total porosity' regarding clay content?

A	Effective porosity includes unconnected pores, while total porosity excludes them
B	Effective porosity is measured on crushed samples, while total porosity is measured on whole cores
C	Effective porosity excludes all water, whereas total porosity includes free and bound water
D	Effective porosity is the total porosity minus the volume of clay bound water
Correct answer:	D - Effective porosity is the total porosity minus the volume of clay bound water

Rationale

For log analysts, effective porosity is defined as the total porosity less the clay bound water (V_cbw), which corresponds to the water held in the electrical double layer and is assumed not to move during production.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 21 Clay Quantification
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 21.2.2 on porosity definitions.

Question 190 of 505

ID	formationeval_v0.1_petroleum_geology_formation_damage_003
Domains	Petroleum Geology, Production Engineering
Topics	Formation Damage, Clay Mineralogy
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why is the presence of iron-rich chlorite in a reservoir a specific concern for production stimulation operations involving acid?

A	Chlorite forms migratory fines that block pore throats when the pH is lowered
B	Chlorite dissolves completely, causing the formation framework to collapse
C	Chlorite swells significantly when in contact with acid, reducing permeability
D	Chlorite reacts with acid to precipitate a gelatinous iron compound that blocks pores

Correct answer:	D - Chlorite reacts with acid to precipitate a gelatinous iron compound that blocks pores

Rationale

Iron-rich chlorite is sensitive to acid, which is often used to dissolve carbonate cements. Exposing chlorite to acid causes the precipitation of a gelatinous iron compound that can permanently halt production.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 21 Clay Quantification
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 21.2.3 on dispersed shale and formation damage.

Question 191 of 505

ID	formationeval_v0.1_petrophysics_neutron_log_004
Domains	Petrophysics
Topics	Neutron Porosity, Shale Effect
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the primary physical cause for the large separation between density porosity and thermal neutron porosity observed in shales?

A	The high concentration of hydroxyls (OH^-) in the clay mineral structure
B	The presence of thermal neutron absorbers like boron and gadolinium
C	The extremely high density of the clay matrix compared to quartz
D	The presence of micro-porosity filled with irreducible hydrocarbons
Correct answer:	A - The high concentration of hydroxyls (OH^-) in the clay mineral structure

Rationale

While thermal absorbers like boron contribute a small amount (6-8 p.u.) to the separation, the largest part of the separation in shales is caused by the hydrogen associated with the hydroxyls (OH^-) in the clay mineral lattice, which the neutron tool interprets as porosity.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 21 Clay Quantification
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 21.3.2 on neutron response to shale.

ID	formationeval_v0.1_petrophysics_pe_log_005
Domains	Petrophysics
Topics	Photoelectric Factor, Clay Indicators
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

When using the Photoelectric Factor (P_e) log as a clay indicator in shaly sands, which element is primarily responsible for the 'excess P_e' observed in the shale compared to clean sand?

A	Aluminum (Al)
B	Silicon (Si)
C	Potassium (K)
D	Iron (Fe)

Correct answer: D - Iron (Fe)

Rationale

The P_e of aluminosilicates (clays) would be similar to sand if determined only by silicon and aluminum. The increased P_e in shales is primarily due to the presence of iron in the clay minerals. Iron has a higher atomic number (Z=26) compared to Si (14) or Al (13), strongly affecting the photoelectric absorption.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 21 Clay Quantification
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 21.3.1 on interpretation of Pe in shaly sands.

Question 193 of 505

ID	formationeval_v0.1_petrophysics_elemental_analysis_006
Domains	Petrophysics
Topics	Geochemical Logging, Clay Quantification
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Although Aluminum is theoretically the best single element for clay indication, it is difficult to measure directly. What practical alternative using elemental analysis is often employed to estimate clay volume?

A	A direct measurement of the Calcium content
B	A measurement of Gadolinium concentration
C	A correlation based on the ratio of Iron to Potassium
D	An anti-correlation with Silicon, often corrected for carbonates and iron-rich minerals
Correct answer:	D - An anti-correlation with Silicon, often corrected for carbonates and iron-rich minerals

Rationale

A practical method relies on the strong anti-correlation between clay content and Silicon. As clay content increases, Silicon decreases (quartz is replaced by aluminosilicates). The estimate is improved by subtracting contributions from carbonates (Ca, Mg) and heavy minerals (Fe).

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 21 Clay Quantification
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 21.5 on elemental analysis.

Question 194 of 505

ID	formationeval_v0.1_petrophysics_neutron_density_crossplot_007
Domains	Petrophysics
Topics	Neutron-Density Crossplot, Clay Quantification
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a neutron-density crossplot analysis, what is the key difference between using a 'shale point' versus a 'dry clay point'?

A	The shale point represents the specific clay mineral without any water, while the dry clay point includes bound water
B	The shale point is empirically picked from massive shales including their bound and pore water, while the dry clay point is a theoretical value for the mineral matrix alone
C	The shale point leads to a calculation of total porosity, while the dry clay point leads to effective porosity
D	There is no difference; the terms are used interchangeably in modern software

Correct answer: B - The shale point is empirically picked from massive shales including their bound and pore water, while the dry clay point is a theoretical value for the mineral matrix alone

Rationale

The traditional 'shale point' is picked from log readings in massive shales, which contain wet clay and some silt/pore water. The 'dry clay point' is calculated based on the chemical composition of the clay mineral (e.g., kaolinite) excluding the bound water but including hydroxyls. Using the dry clay point typically yields total porosity, whereas the shale point method yields effective porosity.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 21.4 on neutron-density plots.

Question 195 of 505

ID	formationeval_v0.1_petrophysics_cec_surface_area_008
Domains	Petrophysics
Topics	Cation Exchange Capacity, Surface Area
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

What is the relationship between specific surface area and Cation Exchange Capacity (CEC) for standard clay minerals?

A	They are inversely related; higher surface area means lower CEC
B	They show a direct linear correlation; higher surface area corresponds to higher CEC
C	There is no correlation; CEC depends only on isomorphous substitution, not size or surface area of clay particles
D	They are exponentially related; CEC increases as the square of surface area

Correct answer: B - They show a direct linear correlation; higher surface area corresponds to higher CEC

Rationale

Data from Patchett and others demonstrate a direct linear link between specific surface area and CEC. Since the negative surface charge (which drives CEC) is partly due to broken bonds on the sheet structure and the platy nature of clays, the larger the surface area (as seen in Montmorillonite), the higher the CEC.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 21 Clay Quantification
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 21.2.1 and Fig 21.2.

Question 196 of 505

ID	formationeval_v0.1_petrophysics_clay_typing_009
Domains	Petrophysics
Topics	Clay Typing, Sigma Logging
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Which combination of log responses best distinguishes Illite from Kaolinite?

A	Illite has a high capture cross-section (Sigma) and low neutron-density separation; Kaolinite has low Sigma and high separation
B	Illite has low Sigma and high separation; Kaolinite has high Sigma and low separation
C	Both have identical responses and can only be distinguished by Potassium content, as their nuclear properties are otherwise indistinguishable
D	Both appear as clean sands on neutron-density logs but differ in Photoelectric factor
Correct answer:	A - Illite has a high capture cross-section (Sigma) and low neutron-density separation; Kaolinite has low Sigma and high separation

Rationale

Illite is an (OH)4 clay (lower hydrogen/hydroxyl content) but typically contains Potassium and Iron (and potentially Boron), leading to a high capture cross-section (Σ) and relatively lower neutron-density separation. Kaolinite is an (OH)8 clay (high hydroxyl content) with generally lower neutron absorbers, leading to a low Σ but a very high neutron-density separation.

Sources

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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 21.3.3 and Fig 21.13.

Question 197 of 505

ID	formationeval_v0.1_petrophysics_shale_distribution_010
Domains	Petrophysics
Topics	Shale Distribution, Porosity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does the addition of 'dispersed' shale affect the total porosity of a clean sand compared to 'structural' shale?

A	Dispersed shale replaces sand grains, keeping porosity constant; Structural shale fills pores, reducing porosity
B	Dispersed shale fills pore space, reducing porosity; Structural shale replaces sand grains, leaving original porosity largely unaltered
C	Both reduce porosity at the exact same rate per unit volume
D	Dispersed shale increases porosity due to micro-fractures; Structural shale decreases it
Correct answer:	B - Dispersed shale fills pore space, reducing porosity; Structural shale replaces sand grains, leaving original porosity largely unaltered

Rationale

Dispersed shale resides in the pore space between sand grains, directly reducing the original porosity. Structural shale is part of the rock framework (replacing sand grains), so the original intergranular porosity is not initially altered, though the bulk composition changes.

Sources

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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from section 21.2.3 and Fig 21.4.

Question 198 of 505

ID	formationeval_v0.1_petrophysics_porosity_lithology_001
Domains	Petrophysics
Topics	Neutron-Density Crossplot, Lithology Identification
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

When using a standard neutron-density crossplot constructed for a limestone matrix to interpret a log where the neutron porosity is recorded in sandstone units, what is the correct procedure for plotting the data points?

A	Plot the sandstone unit values directly as they appear on the log
B	Convert the density log to sandstone units before plotting
C	Use the porosity markings along the sandstone lithology line to guide the horizontal positioning
D	Subtract the matrix difference (approx. 6 p.u.) from the neutron reading before plotting
Correct answer:	C - Use the porosity markings along the sandstone lithology line to guide the horizontal positioning

Rationale

Standard neutron-density crossplots often use a limestone porosity axis. When data is recorded in other units (like sandstone), one must use the porosity markings along the specific lithology line (e.g., the sandstone curve) on the chart to find the correct horizontal position corresponding to that unit value.

Sources

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Reference	Chapter 22 Lithology and Porosity Estimation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on crossplot unit handling.

Question 199 of 505

ID	formationeval_v0.1_petrophysics_gas_indication_003
Domains	Petrophysics
Topics	Gas Effect, Log Interpretation
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In a gas-bearing zone, how does the separation between neutron and density porosity curves (plotted on a limestone scale) typically appear?

A	The neutron porosity reads higher than the density porosity
B	Both curves read significantly higher than the actual porosity
C	The curves track each other closely with no separation
D	The density porosity reads higher than the neutron porosity
Correct answer:	D - The density porosity reads higher than the neutron porosity

Rationale

Gas has a low hydrogen index (lowering neutron porosity) and low bulk density (increasing density porosity). This causes the curves to cross over or separate such that density porosity is higher than neutron porosity.

Sources

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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on gas crossover.

Question 200 of 505

ID	formationeval_v0.1_petrophysics_mn_plot_003
Domains	Petrophysics
Topics	M-N Plot, Secondary Porosity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is a primary diagnostic application of the M-N crossplot in complex lithologies?

A	Calculating water saturation without resistivity logs
B	Differentiating between oil and water zones
C	Determining the exact clay volume in shaly sands
D	Identifying the presence of secondary porosity
Correct answer:	D - Identifying the presence of secondary porosity

Rationale

The M-N plot is designed to eliminate porosity effects to focus on lithology. Secondary porosity increases the parameter 'M' (because density decreases while sonic transit time remains relatively unaffected) without changing 'N' significantly, making it useful for identifying secondary porosity.

Sources

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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on M-N plot utility.

Question 201 of 505

ID	formationeval_v0.1_petrophysics_mid_plot_004
Domains	Petrophysics
Topics	Matrix Identification, MID Plot
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In the Matrix Identification (MID) plot method, how are the apparent matrix parameters (density and transit time) derived?

A	They are assumed based on regional geological knowledge
B	They are determined solely from the Photoelectric Factor (Pe) log
C	They are measured directly by geochemical logging tools
D	They are back-calculated using crossplot porosity values derived from neutron-density and neutron-sonic combinations

Correct answer: D - They are back-calculated using crossplot porosity values derived from neutron-density and neutron-sonic combinations

Rationale

The MID method uses a 'crossplot porosity' (often the neutron-density average) to back-calculate the apparent matrix density (ρ_maa) and apparent matrix travel time (t_maa) from the bulk density and measured transit time, respectively.

Sources

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Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on MID plot mechanics.

Question 202 of 505

ID	formationeval_v0.1_petrophysics_photoelectric_factor_005
Domains	Petrophysics
Topics	Photoelectric Factor, Lithology Identification
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why is the Photoelectric Factor (P_e) versus Density crossplot particularly effective for resolving limestone/dolomite mixtures compared to the standard Neutron-Density crossplot?

A	The P_e plot eliminates the need for any fluid corrections
B	Neutron-Density plots cannot differentiate between calcite and dolomite
C	The P_e measurement is completely unaffected by porosity
D	The ordering of the lithology lines is different: Dolomite lies between Sandstone and Limestone on the P_e plot
Correct answer:	D - The ordering of the lithology lines is different: Dolomite lies between Sandstone and Limestone on the P_e plot

Rationale

On a standard Neutron-Density plot, the lithology lines are ordered Sandstone-Limestone-Dolomite. On a P_e-Density plot, the order changes to Sandstone-Dolomite-Limestone. This reordering adds a new dimension that helps resolve ambiguities, such as distinguishing a dolomitic sand from a limestone.

Sources

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on Pe log benefits.

Question 203 of 505

ID	formationeval_v0.1_petrophysics_electrofacies_006
Domains	Petrophysics, Petroleum Geology
Topics	Electrofacies, Log Analysis
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

How is an 'electrofacies' defined in the context of well log analysis?

A	A formation layer that conducts electricity due to high water saturation
B	The electrical resistivity profile of the invaded zone
C	A geological facies identified solely by core visual inspection
D	A set of log responses that characterizes a bed and distinguishes it from others
Correct answer:	D - A set of log responses that characterizes a bed and distinguishes it from others

Rationale

An electrofacies is defined as a set of log responses that characterizes a specific bed or interval, allowing it to be distinguished from other beds. It serves as a bridge between log data and geological lithofacies.

Sources

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on electrofacies definition.

Question 204 of 505

ID	formationeval_v0.1_petrophysics_clustering_classification_007
Domains	Petrophysics
Topics	Clustering, Classification, Data Analysis
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

What is the key difference between 'classification' and 'clustering' methods for lithology identification?

A	Classification uses prior knowledge of log responses, while clustering relies only on data grouping without prior labels
B	Clustering is only used for image logs due to pixel resolution requirements, while classification is used for standard logs
C	Classification requires neural networks, while clustering uses linear equations
D	Clustering is a quantitative method, while classification is purely qualitative
Correct answer:	A - Classification uses prior knowledge of log responses, while clustering relies only on data grouping without prior labels

Rationale

Classification (discriminant analysis) assigns data to predefined classes based on known log responses. Clustering ignores prior knowledge and identifies natural groupings (clusters) within the dataset itself, which must then be identified/labeled by the user.

Sources

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Reference	Chapter 22 Lithology and Porosity Estimation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on statistical methods.

Question 205 of 505

ID	formationeval_v0.1_petrophysics_inverse_modeling_008
Domains	Petrophysics
Topics	Quantitative Evaluation, Inversion
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In quantitative evaluation using simultaneous equations, what mathematical approach is typically used when the system is 'overdetermined' (more logging measurements than unknown mineral volumes)?

A	Simple matrix inversion
B	Least-squares solution
C	Nonlinear optimization
D	Reducing the number of logs used
Correct answer:	B - Least-squares solution

Rationale

When the number of measurements exceeds the number of unknowns (overdetermined), a unique exact solution may not exist due to measurement errors. A least-squares solution is used to find the result that minimizes the error between measured and reconstructed logs, often incorporating weighting based on measurement uncertainty.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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License	Proprietary (Springer)
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Reference	Chapter 22 Lithology and Porosity Estimation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on inversion mathematics.

Question 206 of 505

ID	formationeval_v0.1_petrophysics_underdetermined_systems_009
Domains	Petrophysics
Topics	Complex Lithology, Modeling
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How is the problem of 'underdetermination' (more potential minerals than available log measurements) typically handled in quantitative log analysis?

A	By inventing theoretical logs to fill the gaps
B	By grouping minor minerals with major ones or restricting the model to geologically significant minerals
C	By using only the density log for all calculations, since density provides sufficient information to resolve all mineral components
D	By allowing the computer to select random minerals until a fit is found
Correct answer:	B - By grouping minor minerals with major ones or restricting the model to geologically significant minerals

Rationale

When there are too many unknowns, the system cannot be solved uniquely. The standard solution is to reduce the number of unknowns by grouping chemically/physically similar minerals (e.g., feldspar with quartz) or by limiting the model to only those minerals known to be geologically significant in the area.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 22 Lithology and Porosity Estimation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on modeling constraints.

Question 207 of 505

ID	formationeval_v0.1_petrophysics_simultaneous_methods_010
Domains	Petrophysics
Topics	Simultaneous Inversion, Log Analysis
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

What is a primary advantage of using simultaneous inversion methods over sequential logic for formation evaluation?

A	They are computationally faster and require less processing power
B	They provide the most coherent agreement between all results and measurements by treating the problem globally
C	They avoid the need for any matrix or fluid parameters
D	They are specifically designed for simple lithologies like clean sandstone

Correct answer: B - They provide the most coherent agreement between all results and measurements by treating the problem globally

Rationale

Simultaneous methods solve for all unknowns (porosity, saturation, lithology) at once, ensuring that the results are consistent with all input measurements (balance/coherence). Sequential methods may propagate errors or fail to capture interdependencies.

Sources

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Reference	Chapter 22 Lithology and Porosity Estimation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on inversion benefits.

Question 208 of 505

ID	formationeval_v0.1_petrophysics_false_gas_indication_011
Domains	Petrophysics
Topics	Log Quality Control, Gas Detection
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What can cause a 'false' gas indication (crossover) on a neutron-density log in a water-filled tight sandstone formation?

A	Presentation of the logs on a limestone porosity scale
B	Presence of heavy minerals like pyrite
C	Use of a density tool with a short spacing
D	High salinity of the formation water
Correct answer:	A - Presentation of the logs on a limestone porosity scale

Rationale

If a tight sandstone is plotted on a limestone porosity scale, the matrix settings are incorrect for the rock type. This can create an artifact where the curves separate or crossover, mimicking the response of gas, even when the formation is water-filled.

Sources

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on log presentation artifacts.

Question 209 of 505

ID	formationeval_v0.1_petrophysics_volumetric_pe_012
Domains	Petrophysics
Topics	Photoelectric Factor, Volumetric Analysis
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the context of multi-mineral analysis, why is the volumetric cross section U often preferred over the standard P_e measurement for mixing calculations?

A	Because U scales linearly with volume, whereas P_e is an average weighted by electron density
B	Because U may be independent of fluid content, unlike P_e
C	Because U can be measured directly by the sonic tool
D	Because P_e values are not available for common evaporites
Correct answer:	A - Because U scales linearly with volume, whereas P_e is an average weighted by electron density

Rationale

The standard P_e of a mixture is not a simple linear average of the components; it is weighted by electron density. The volumetric cross section U ($P_e \times \rho_e$) scales linearly with the volume fractions of the constituents, making it mathematically simpler for volumetric inversion models.

Sources

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item on U factor properties.

Question 210 of 505

ID	formationeval_v0.1_petrophysics_clean_formations_001
Domains	Petrophysics
Topics	Hingle Plot, Water Saturation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the construction of a Hingle plot for water saturation estimation, which relationship allows for the identification of the 100% water saturation line (Ro) as a straight line?

A	Porosity is plotted against the logarithm of resistivity
B	Porosity is plotted against the inverse square root of resistivity
C	Logarithm of porosity is plotted against the logarithm of resistivity
D	Resistivity is plotted linearly against the bulk density

Correct answer: B - Porosity is plotted against the inverse square root of resistivity

Rationale

The Hingle plot relies on the logic that for a fixed water saturation (and assuming m=n=2), porosity varies as the inverse square root of Rt. Therefore, 100% water-saturated points fall on a straight line when plotting porosity against 1/sqrt(Rt).

Sources

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Source ID	ellis_singer_well_logging_2007
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Reference	Chapter 23 Saturation and Permeability Estimation
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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from the section on Clean Formations.

Question 211 of 505

ID	formationeval_v0.1_petrophysics_clean_formations_002
Domains	Petrophysics
Topics	Pickett Plot, Cementation Exponent
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

When utilizing a Pickett plot (log-log plot of porosity versus resistivity) to evaluate a formation, what parameter is represented by the negative slope of the line corresponding to 100% water saturation?

A	The saturation exponent (n)
B	The tortuosity factor (a)
C	The formation water resistivity (Rw)
D	The cementation exponent (m)

Correct answer: D - The cementation exponent (m)

Rationale

On a Pickett plot, the power law expression of the Archie equation is exploited by taking the logarithm of both sides. This results in a linear equation where the slope of the line representing constant water saturation is the negative of the cementation exponent (m).

Sources

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from the section on Clean Formations.

Question 212 of 505

ID	formationeval_v0.1_petrophysics_shaly_sands_003
Domains	Petrophysics
Topics	Shaly Sand Analysis, Clay Conductivity
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In shaly formations, why does the plot of formation conductivity (Co) versus water conductivity (Cw) exhibit non-linear behavior at low water salinities?

A	The tortuosity of the formation increases significantly as the salt concentration decreases
B	The excess conductivity from the clay electrical double layer becomes dominant over the electrolyte conductivity
C	The formation factor becomes unstable due to the swelling of structural clays in fresh water
D	The presence of hydrocarbons suppresses the electrical continuity of the pore water network

Correct answer: B - The excess conductivity from the clay electrical double layer becomes dominant over the electrolyte conductivity

Rationale

At high salinities, clay conductivity appears as a linear offset. However, at low salinities (fresh water), the conductivity of ions in the electrical double layer varies with Cw, and this excess conductivity dominates the total response, creating a non-linear relationship.

Sources

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URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from the section on Shaly Formations.

Question 213 of 505

ID	formationeval_v0.1_petrophysics_saturation_models_004
Domains	Petrophysics
Topics	Dual-Water Model, Waxman-Smits
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

What is the fundamental conceptual difference between the Dual-Water model and the Waxman-Smits model regarding how they handle pore water?

A	Dual-Water treats the clay conductivity as an interactive term, while Waxman-Smits treats it as an independent parallel resistor
B	Waxman-Smits assumes effective porosity, while Dual-Water ignores porosity in favor of bulk volume water
C	Dual-Water divides pore space into clay-bound water and free water volumes with different conductivities, while Waxman-Smits uses a single equivalent water conductivity influenced by Qv
D	Waxman-Smits accounts for the difference in tortuosity between surface and bulk conductivity, whereas Dual-Water assumes they are identical

Correct answer:	C - Dual-Water divides pore space into clay-bound water and free water volumes with different conductivities, while Waxman-Smits uses a single equivalent water conductivity influenced by Qv

Rationale

The Clavier et al. Dual-Water model separates the pore space into two distinct volumes: clay-bound water (conducting via counterions) and free water (containing electrolyte). Waxman-Smits treats the excess cations (Qv) as contributing to the conductivity of the entire pore space without volume segmentation.

Sources

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Notes	Concept-based item derived from the section on Double Layer Models.

Question 214 of 505

ID	formationeval_v0.1_petrophysics_laminated_sands_005
Domains	Petrophysics
Topics	Laminated Sands, Resistivity Anisotropy
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In a laminated sand-shale sequence where laminations are below log resolution, why does the standard horizontal resistivity (Rt or Rh) often yield pessimistic water saturation calculations?

A	The measurement is dominated by the highly conductive shale layers acting in parallel with the resistive sand
B	The sand layers act as insulators in the vertical direction, preventing the current from entering the formation
C	The tool averages the porosity of the sand and shale arithmetically, leading to an overestimation of pore volume
D	The invasion profile in laminated sands is invariably deep due to enhanced lateral permeability, thereby masking the true formation resistivity

Correct answer: A - The measurement is dominated by the highly conductive shale layers acting in parallel with the resistive sand

Rationale

In laminated sequences, the sand and shale layers act electrically in parallel for horizontal currents (standard induction/laterolog). Since the current follows the path of least resistance, the measured conductivity is dominated by the conductive shale, often masking the presence of resistive, hydrocarbon-bearing sand streaks.

Sources

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Reference	Chapter 23 Saturation and Permeability Estimation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from the section on Laminated Sands.

Question 215 of 505

ID	formationeval_v0.1_petrophysics_carbonates_006
Domains	Petrophysics
Topics	Carbonate Evaluation, Archie Parameters
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does the presence of water-filled fractures in a carbonate formation typically affect the saturation exponent (n) compared to a formation with only intergranular porosity?

A	The exponent n increases because fractures create a longer path for current flow
B	The exponent n decreases because fractures provide a short-circuit path for current
C	The exponent n remains unchanged as it is a property of the fluid, not the rock structure
D	The exponent n becomes negative due to the capacitive effect of the fracture surfaces
Correct answer:	B - The exponent n decreases because fractures provide a short-circuit path for current

Rationale

Water-filled fractures act as a highly conductive path (a 'short circuit') through the rock. This allows current to flow easily even as the matrix desaturates, leading to a lower rate of resistivity increase and consequently a lower saturation exponent (n).

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 23 Saturation and Permeability Estimation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from the section on Carbonates and Heterogeneous Rocks.

Question 216 of 505

ID	formationeval_v0.1_petrophysics_kozeny_carman_008
Domains	Petrophysics, Reservoir Engineering
Topics	Permeability Estimation, Kozeny-Carman
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

According to the Kozeny-Carman relationship, which two factors primarily determine the permeability of a porous medium?

A	Porosity and the formation water resistivity
B	Porosity and the specific surface area (or hydraulic radius) of the pores
C	The cementation exponent and the saturation exponent
D	The bulk density and the photoelectric factor
Correct answer:	B - Porosity and the specific surface area (or hydraulic radius) of the pores

Rationale

The Kozeny-Carman equation models the pore space as a bundle of tubes. It defines permeability as a function of porosity (representing the volume available for flow) and the specific surface area or hydraulic radius (representing the drag or friction against flow walls).

Sources

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Year	2007
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License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 23 Saturation and Permeability Estimation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from the section on Petrophysical Models.

Question 217 of 505

ID	formationeval_v0.1_petrophysics_permeability_008
Domains	Petrophysics
Topics	Permeability Estimation, Timur Equation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In permeability models based on water saturation, such as the Timur equation, how does the irreducible water saturation (Swirr) influence the calculated permeability?

A	Permeability increases as Swirr increases, because more water indicates better connectivity
B	Permeability is independent of Swirr and relies only on porosity, as pore throat size does not affect water distribution
C	Permeability decreases as Swirr increases, because high Swirr implies high surface area and smaller pores
D	Permeability decreases as Swirr decreases, because dry rocks are tighter
Correct answer:	C - Permeability decreases as Swirr increases, because high Swirr implies high surface area and smaller pores

Rationale

High irreducible water saturation generally indicates a large pore surface-to-volume ratio (small pores or high clay content), which creates more resistance to flow. Therefore, models like Timur's place Swirr in the denominator, meaning permeability decreases as Swirr increases.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

Source ID	ellis_singer_well_logging_2007
Year	2007
Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 23 Saturation and Permeability Estimation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from the section on Petrophysical Models.

Question 218 of 505

ID	formationeval_v0.1_petrophysics_shaly_sands_009
Domains	Petrophysics
Topics	Indonesia Equation, Saturation Models
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Which characteristic distinguishes the Indonesia saturation equation from standard parallel-conductivity shaly sand models?

A	It mathematically ignores the presence of shale to focus on clean sand streaks
B	It includes a mathematical cross-term (interaction term) between the shale and water conductivities
C	It assumes that the formation factor for shale is exactly equal to the formation factor for sand
D	It is derived purely from theoretical physics rather than empirical observations
Correct answer:	B - It includes a mathematical cross-term (interaction term) between the shale and water conductivities

Rationale

The Indonesia equation (Poupon and Leveaux) was developed empirically and includes an interactive cross-term (2 * sqrt(term1 * term2)). This term helps model the non-linear relationship between Co and Cw observed in fresh water environments, unlike simple parallel resistor models.

Sources

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Type	textbook
License	Proprietary (Springer)
Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 23 Saturation and Permeability Estimation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from the section on Saturation Equations.

Question 219 of 505

ID	formationeval_v0.1_petrophysics_heterogeneous_rocks_010
Domains	Petrophysics
Topics	Maxwell-Garnett, Vugs
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

When modeling connected vugs in a carbonate reservoir as spherical inclusions within a host matrix, which theoretical approach is often applied to determine conductivity?

A	The Wyllie Time-Average equation
B	The Maxwell-Garnett effective medium equation
C	The Kozeny-Carman flow relationship
D	The Hingle plot graphical method

Correct answer: B - The Maxwell-Garnett effective medium equation

Rationale

The Maxwell-Garnett equation is a type of effective medium theory used to calculate the conductivity of a host material containing scattered spherical inclusions (such as vugs). It accounts for the volume fraction and conductivities of both the host and the inclusions.

Sources

Source 1: Well Logging for Earth Scientists, 2nd Edition

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Attribution	Darwin V. Ellis and Julian M. Singer
Reference	Chapter 23 Saturation and Permeability Estimation
Retrieved	2025-12-21
URL	https://doi.org/10.1007/978-1-4020-4602-5
Notes	Concept-based item derived from the section on Carbonates and Heterogeneous Rocks.

Question 220 of 505

ID	formationeval_v0.1_petroleumgeology_sedimentary_facies_models_001
Domains	Petroleum Geology, Sedimentology
Topics	Sedimentary Facies, Play Fairway Analysis
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A basin screening team wants a geology-driven way to predict where petroleum system elements are likely to occur before drilling. What is the main value of sedimentary facies models for this purpose?

A	They replace the need for geophysical interpretation by directly imaging reservoir bodies at depth
B	They help anticipate the spatial patterns of source, reservoir, and seal rocks based on depositional setting
C	They provide the chemical composition of generated hydrocarbons from each stratigraphic unit
D	They determine the exact production rate by prescribing permeability from first principles
Correct answer:	B - They help anticipate the spatial patterns of source, reservoir, and seal rocks based on depositional setting

Rationale

Facies and depositional-environment concepts are used to infer where organic-rich muds, porous sands/carbonates, and sealing shales/evaporites are likely to be deposited and how they are geometrically arranged. This predictive framework is essential because petroleum is overwhelmingly hosted in sedimentary successions, and the geometry of reservoirs and seals depends on depositional processes.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 1 - Introduction to Petroleum Geology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Derived from the chapter’s discussion of sedimentology, facies prediction, and the distribution of source/reservoir/cap rocks.

Question 221 of 505

ID	formationeval_v0.1_petroleumgeology_biostratigraphy_in_wells_002
Domains	Petroleum Geology
Topics	Biostratigraphy, Micropalaeontology
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

During drilling, only small rock fragments are routinely recovered as cuttings. Why is micropalaeontology (including palynology) generally more practical than macrofossils for correlating strata between wells?

A	Microfossils are typically abundant in tiny samples and can yield finer stratigraphic resolution than large fossils
B	Microfossils are resistant to all drilling-fluid contamination, unlike macrofossils
C	Macrofossils occur only in igneous and metamorphic rocks due to preservation requirements, so they are rarely present in wells
D	Macrofossils are only useful offshore due to their marine origin, whereas microfossils are only useful on land for correlation
Correct answer:	A - Microfossils are typically abundant in tiny samples and can yield finer stratigraphic resolution than large fossils

Rationale

Cuttings provide small amounts of material, making large fossils unlikely to be recovered, even when core is available. In contrast, a small mass of cuttings can contain many microfossils or palynomorphs, which commonly improves correlation and stratigraphic precision.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 1 - Introduction to Petroleum Geology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter’s explanation of well-based stratigraphic correlation using microfossils from cuttings.

ID	formationeval_v0.1_geophysics_4d_seismic_monitoring_003
Domains	Geophysics, Production Engineering
Topics	4D Seismic, Reservoir Monitoring
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A producing offshore field repeats the same 3D seismic survey at several times during depletion. What is the primary goal of this time-lapse (4D) seismic approach?

A	To measure the chemical maturity of kerogen without requiring core or cuttings
B	To determine grain-size distributions of reservoir sands from seismic amplitudes alone
C	To track changes in fluid distribution, such as movement of gas/oil and oil/water contacts, through time
D	To directly measure absolute permeability in Darcy units across the reservoir
Correct answer:	C - To track changes in fluid distribution, such as movement of gas/oil and oil/water contacts, through time

Rationale

Repeating a 3D survey introduces time as an additional dimension, allowing interpreters to observe how seismic responses shift as fluids move during production. The chapter describes this as a way to monitor changing contacts while the reservoir is being depleted.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 1 - Introduction to Petroleum Geology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept drawn from the section describing 3D seismic imaging and time-lapse (4D) seismic during reservoir depletion.

ID	formationeval_v0.1_petroleumgeology_anoxic_basin_source_rocks_004
Domains	Petroleum Geology, Sedimentology
Topics	Source Rock Formation, Redox Conditions
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two marine basins have similarly high surface-water biological productivity. In which basin would you most expect the sediment to end up with higher preserved organic content and thus better source-rock potential?

A	A basin with strong bottom-water ventilation that continuously replenishes oxygen at the seabed
B	A basin where bottom waters are stagnant due to density stratification, limiting oxygen supply to the seafloor
C	A basin with persistent traction currents that keep particles suspended and well-oxygenated
D	A basin where sediments are coarse sand, allowing deep oxygen penetration into porewater
Correct answer:	B - A basin where bottom waters are stagnant due to density stratification, limiting oxygen supply to the seafloor

Rationale

Preservation depends strongly on how much organic matter escapes oxidation and biological reworking after production in the photic zone. Restricted circulation and anoxic/toxic bottom waters suppress oxidation and bioturbation, allowing more organic matter to remain in laminated muds that can become source rocks.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 1 - Introduction to Petroleum Geology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Based on discussion of restricted basins, oxygen depletion, H2S formation, reduced bioturbation, and enhanced organic preservation.

Question 224 of 505

ID	formationeval_v0.1_sedimentology_sedimentation_rate_source_rock_quality_005
Domains	Sedimentology, Petroleum Geology
Topics	Source Rock Formation, Sedimentation Rate
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A shelf margin receives organic debris and mineral grains at the same time. Which sedimentation-rate scenario is expected to most favor formation of a high-quality source rock, assuming organic productivity is significant?

A	Very slow sedimentation, because longer residence time near the seabed increases organic preservation
B	Very rapid sedimentation, because it intrinsically produces the highest organic concentration regardless of dilution
C	Intermediate sedimentation rates, because preservation improves without excessive dilution by mineral matter
D	Any sedimentation rate, because source-rock quality depends only on surface-water productivity and not on accumulation rate

Correct answer: C - Intermediate sedimentation rates, because preservation improves without excessive dilution by mineral matter

Rationale

If sedimentation is too slow, deposited organic matter spends more time exposed to oxygenated conditions and biological reworking, reducing preservation. If sedimentation is too fast, more organic matter may be buried but becomes heavily diluted by mineral grains. The chapter emphasizes that an intermediate rate (on the order of tens of mm per thousand years) best balances these effects.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 1 - Introduction to Petroleum Geology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Item derived from the chapter's trade-off between oxidation/bioturbation at low rates and mineral dilution at high rates.

Question 225 of 505

ID	formationeval_v0.1_petroleumgeology_hydrocarbon_transport_phase_behavior_006
Domains	Petroleum Geology, Petrophysics
Topics	Hydrocarbon Migration, Solubility and Phase Transport
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A modeler proposes that crude oil generated in a shale is mainly transported to traps as dissolved components in formation water, rather than migrating as a separate hydrocarbon phase. What is the strongest conceptual objection to this dissolved transport hypothesis for most crude oils?

A	Typical oil components have low aqueous solubility and water flow rates are too small to move enough oil, and it would also be difficult to explain systematic release into traps
B	Oil would dissolve readily, but dissolved oil would chemically transform into kerogen before reaching a reservoir
C	Formation water is consistently less dense than oil due to its lower molecular weight and lack of heavy compounds, so dissolved transport would force oil components to migrate downward
D	Dissolved transport would be faster than buoyant flow, so it would prevent any accumulation in structural closures

Correct answer:	A - Typical oil components have low aqueous solubility and water flow rates are too small to move enough oil, and it would also be difficult to explain systematic release into traps

Rationale

The chapter argues that most oil is poorly soluble in water, making dissolved transport inefficient at realistic flow rates, and it is also hard to explain how large volumes would consistently come out of solution in traps. It contrasts this with methane, which can be relatively soluble at high pressure and may exsolve as pressure drops, highlighting why oil and gas can behave differently.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 1 - Introduction to Petroleum Geology

Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Built from the migration section contrasting separate-phase oil transport with limited aqueous solubility, and noting higher methane solubility at pressure.

Question 226 of 505

ID	formationeval_v0.1_petroleumgeology_kerogen_oil_window_007
Domains	Petroleum Geology
Topics	Kerogen, Thermal Maturity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two source-rock packages reach similar maximum burial temperatures, but one basin subsides much faster than the other. Given that petroleum generation depends on temperature integrated over time, how does rapid subsidence tend to affect the temperature at which oil generation begins?

A	Oil generation tends to start at a higher temperature because there is less time for cracking reactions at any given temperature
B	Oil generation tends to start at a lower temperature because rapid burial consistently increases reaction time by maintaining the source rock in the oil window zone longer
C	Oil generation temperature is unchanged because it depends only on present-day depth and geothermal gradient, not on time or burial history
D	Oil generation begins only after kerogen becomes fully soluble as bitumen at shallow depth, prior to any significant thermal stress

Correct answer: A - Oil generation tends to start at a higher temperature because there is less time for cracking reactions at any given temperature

Rationale

The chapter describes petroleum generation as dependent on temperature integrated over time. With rapid subsidence, the source spends less time at moderate temperatures, so generation may be delayed until higher temperatures are reached compared with slowly subsiding settings.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 1 - Introduction to Petroleum Geology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based question from the kerogen cracking discussion relating reaction progress to temperature-time exposure and subsidence rate.

Question 227 of 505

ID	formationeval_v0.1_petrophysics_porosity_from_density_008
Domains	Petrophysics
Topics	Porosity, Bulk Density Mixing Law
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

A clean water-saturated sandstone has mineral grain density 2.65 g/cm³, pore-fluid density 1.00 g/cm³, and measured bulk (wet) density 2.10 g/cm³. Using the volume-weighted density mixing relationship (ρ_bulk = $\phi\rho$_fluid + (1−ϕ)ρ_grain), what is the porosity (as a fraction)?

A	0.33
B	0.21
C	0.45
D	0.12
Correct answer:	A - 0.33

Rationale

Using $\rho s = \phi\rho f + \rho m(1-\phi)$, rearrange to $\phi = (\rho m-\rho s)/(\rho m-\rho f) = (2.65-2.10)/(2.65-1.00) = 0.55/1.65 \approx 0.33$. This applies the chapter's mixing relationship between grain density, fluid density, and bulk density.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 1 - Introduction to Petroleum Geology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical application of the porosity–density mixing equation introduced in the porosity and permeability section.

Question 228 of 505

ID	formationeval_v0.1_petroleumgeology_trap_timing_vs_migration_009
Domains	Petroleum Geology
Topics	Hydrocarbon Traps, Timing of Trap Formation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A prospect is a fault-bounded anticline that formed after the main phase of oil generation and expulsion in the basin. Considering the critical relationship between trap formation timing and hydrocarbon migration, what outcome is most consistent with this scenario?

A	The structure is likely to be ineffective for capturing most oil because the key migration pulse occurred before closure existed
B	The structure will necessarily be fully oil-filled because buoyancy invariably finds the newest closure regardless of the timing relationship between trap formation and hydrocarbon migration
C	The structure will only trap petroleum if it is a stratigraphic pinchout rather than a fold, because structural closures cannot retain hydrocarbons
D	The structure cannot trap gas under any circumstance because gas migrates earlier than oil

Correct answer: A - The structure is likely to be ineffective for capturing most oil because the key migration pulse occurred before closure existed

Rationale

The chapter stresses that a structural trap must exist when hydrocarbons migrate; late trap formation can miss the main oil charge. It also notes that in some settings late-formed traps may still capture gas, because gas generation and migration can occur later than oil, but late formation generally reduces trapping effectiveness for earlier oil migration.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 1 - Introduction to Petroleum Geology
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Drawn from the discussion of structural trap formation timing relative to maturation-driven migration, and the contrasting timing sensitivity of stratigraphic traps.

Question 229 of 505

ID	formationeval_v0.1_petroleumgeology_growth_fault_rollover_traps_010
Domains	Petroleum Geology
Topics	Fault Traps, Growth Faults, Deltaic Systems
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In a deltaic succession, a curved normal fault shows decreasing throw upward, and stratigraphic units are thicker on the downthrown side than on the upthrown side. What interpretation and trapping style best fits these syn-sedimentary fault characteristics?

A	A reverse fault system; traps mainly form by compressional duplexing below the fault
B	A strike-slip fault; traps mainly form where lateral offsets create pull-apart basins
C	A growth fault active during deposition; traps often occur in rollover anticlines adjacent to the fault and/or where the fault seals against shale
D	A post-depositional joint set; traps mainly form because joints increase seal capacity
Correct answer:	C - A growth fault active during deposition; traps often occur in rollover anticlines adjacent to the fault and/or where the fault seals against shale

Rationale

Thickness increase on the downthrown side and diminishing displacement upward indicate syn-sedimentary fault motion, which the chapter associates with growth faults in rapidly deposited settings like deltas. The chapter further notes that traps can be created by sealing behavior along the fault and very commonly by rollover anticlines formed on the hangingwall geometry near listric faults.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 1 - Introduction to Petroleum Geology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the growth fault description: syn-depositional thickening on the downthrown side, listric geometry, sealing behavior, and rollover anticline trapping.

ID	formationeval_v0.1_sedimentology_sedimentary_nomenclature_001
Domains	Sedimentology
Topics	Sedimentary Rock Description, Nomenclature
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A geologist describes a sandstone as “well sorted, fine grained, and quartz rich,” and later labels the same unit as “fluvial.” What best distinguishes these two styles of naming?

A	Both are descriptive terms; they differ only in whether grain size or minerals are emphasized, with no implications for depositional environment
B	The first is descriptive (based on observable properties), while the second is genetic (based on interpreted origin)
C	The first is genetic (based on interpreted origin), while the second is descriptive (based on observable properties)
D	Both are genetic terms; they differ only in whether the environment is on land or in the sea, with no mineralogical implications
Correct answer:	B - The first is descriptive (based on observable properties), while the second is genetic (based on interpreted origin)

Rationale

Descriptive nomenclature summarizes directly observed attributes such as texture and composition. Genetic nomenclature assigns a name based on an interpretation of the processes or environment that produced the deposit, and is generally used when confidence in origin is high.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 2 - Introduction to Sedimentology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Focuses on the conceptual difference between descriptive and genetic naming in sedimentology.

Question 231 of 505

ID	formationeval_v0.1_sedimentology_uniformitarianism_002
Domains	Sedimentology, Petroleum Geology
Topics	Uniformitarianism, Paleoenvironment Reconstruction
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A team uses modern river deltas to interpret ancient deltaic strata, but also expects some ancient systems to have no close modern analogue. What reasoning best reflects the principle of uniformitarianism as applied with appropriate caveats?

A	Modern environments are irrelevant because ancient Earth conditions were invariably fundamentally different from those observed today
B	Ancient environments can be inferred without uncertainty because processes never change through time
C	Modern-process studies are useful, but only if fossils provide absolute proof of the exact environment and depositional conditions
D	Modern observations guide interpretation, but changing climate, oceans, and atmosphere mean the approach has limits

Correct answer: D - Modern observations guide interpretation, but changing climate, oceans, and atmosphere mean the approach has limits

Rationale

The chapter presents uniformitarian reasoning as a powerful way to interpret old rocks using modern process understanding. It also stresses that surface conditions have varied through geologic time, so interpretations may sometimes require explanations beyond direct modern analogues.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 2 - Introduction to Sedimentology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Derived from the discussion of uniformitarianism and why it cannot be applied without qualification.

Question 232 of 505

ID	formationeval_v0.1_sedimentology_lamination_bedding_003
Domains	Sedimentology
Topics	Sedimentary Structures, Stratigraphic Description
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

While logging a core, you need to decide whether a 6 mm-thick layer should be recorded as lamination or as a bed. Using the standard sedimentological thickness criterion (1 cm boundary), how should it be classified?

A	Lamination, because it is thinner than 1 cm
B	A bed, because any distinct layer is a bed regardless of thickness
C	A bed, because lamination is only used for clay-rich sediments
D	Lamination, because beds must be thicker than 10 cm
Correct answer:	A - Lamination, because it is thinner than 1 cm

Rationale

The chapter defines laminae by a thickness threshold of less than 1 cm, with thicker units described as beds. A 6 mm layer falls below that boundary and should be logged as lamination.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 2 - Introduction to Sedimentology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Targets the lamina-versus-bed thickness distinction used in sedimentary logging.

Question 233 of 505

ID	formationeval_v0.1_sedimentology_trace_fossil_position_004
Domains	Sedimentology
Topics	Trace Fossils, Facies Indicators
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A burrow trace is visible on the underside of a sandstone bed, preserved as a relief cast. Which positional category of trace fossils does this correspond to?

A	Epichnia
B	Endichnia
C	Hypichnia
D	Exichnia

Correct answer: C - Hypichnia

Rationale

The chapter classifies traces by where they occur relative to a bed surface. Traces on the lower surface of a bed are categorized as hypichnia, consistent with a structure exposed on the underside of sandstone.

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URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Uses the positional classification scheme for trace fossils relative to bedding surfaces.

Question 234 of 505

ID	formationeval_v0.1_sedimentology_phi_scale_005
Domains	Sedimentology
Topics	Grain-Size Distribution, Phi Scale
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

A sand sample has a representative grain diameter of 0.25 mm. Using the definition ϕ = −log2(d) with d in millimetres, what is the corresponding ϕ value?

A	2
B	-2
C	0.25
D	4

Correct answer: A - 2

Rationale

Because 0.25 mm equals 2^{-2} mm, $\log_2(0.25) = -2$. Applying the minus sign in the definition gives $\phi = -(-2) = 2$.

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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 2 - Introduction to Sedimentology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Applies the chapter’s ϕ-scale definition to convert diameter in mm to a logarithmic size value.

Question 235 of 505

ID	formationeval_v0.1_sedimentology_grain_size_methods_006
Domains	Sedimentology
Topics	Grain-Size Analysis, Laboratory Methods
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

You need to quantify the size distribution of a clay-rich sediment where particles are too fine to pass reliably through standard sieves. Which measurement principle is most appropriate for such fine-grained material?

A	Measuring settling behavior in a fluid using Stokes' law assumptions for small grains
B	Estimating size from the color changes produced during chemical staining of the sample
C	Inferring size from the compressive strength of a dried pellet under uniaxial loading
D	Using only hand-lens visual classification because instrumentation is unreliable for fine grains

Correct answer: A - Measuring settling behavior in a fluid using Stokes' law assumptions for small grains

Rationale

For very fine fractions such as silt and clay, the chapter emphasizes methods based on settling velocity in a liquid, linked to Stokes' law when flow around grains is laminar and concentrations are low. Standard dry sieve methods have a practical lower size limit because fine particles tend to stick together.

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URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter's comparison of sieving limits and settling-based approaches for fine-grained material.

Question 236 of 505

ID	formationeval_v0.1_sedimentology_sorting_skewness_007
Domains	Sedimentology
Topics	Grain-Size Parameters, Depositional Environments
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A grain-size curve shows a clear lower limit on fine particles but a 'tail' extending toward coarser sizes (granules/pebbles). Which depositional setting is most consistent with this negative skewness pattern?

A	Aeolian dunes, because wind transport preferentially adds very coarse particles
B	Turbidites, because suspension settling commonly yields a coarse tail with sharp fine cutoff
C	Beach sand, because wave action tends to winnow fines while occasional high-energy events add coarse clasts
D	Deep pelagic mud, because it commonly contains pebbles transported as bedload by weak currents
Correct answer:	C - Beach sand, because wave action tends to winnow fines while occasional high-energy events add coarse clasts

Rationale

The chapter links beach deposits to negative skewness: fines are readily kept in suspension and moved offshore, creating a lower-size cutoff, while coarser particles can remain as a coarse tail. Aeolian and many suspension-dominated deposits more commonly show tails toward finer sizes.

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Reference	Chapter 2 - Introduction to Sedimentology
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URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Interprets skewness in terms of selective transport and deposition at beaches versus other environments.

Question 237 of 505

ID	formationeval_v0.1_sedimentology_reynolds_number_008
Domains	Sedimentology
Topics	Flow Regimes, Reynolds Number
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Consider water flowing in an open channel 0.50 m deep with a mean velocity of 0.20 m/s. Using the Reynolds number rule-of-thumb that laminar flow requires (velocity in cm/s) × (depth in cm) ≤ 20, what flow regime is expected?

A	Laminar, because the velocity is far below 1 m/s
B	Laminar, because depth does not affect the transition
C	Transitional, because open channels rarely become fully turbulent
D	Turbulent, because the velocity–depth product greatly exceeds the laminar threshold
Correct answer:	D - Turbulent, because the velocity–depth product greatly exceeds the laminar threshold

Rationale

Converting units gives 0.20 m/s = 20 cm/s and 0.50 m = 50 cm, so the product is 1000, much larger than 20. The chapter uses this criterion to show that natural channels (rivers) are essentially always turbulent under realistic depths and velocities.

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Reference	Chapter 2 - Introduction to Sedimentology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Uses the chapter's Reynolds-number-based velocity–depth rule to classify channel flow regime.

Question 238 of 505

ID	formationeval_v0.1_sedimentology_froude_flow_regimes_009
Domains	Sedimentology
Topics	Bedforms, Froude Number, Flow Regimes
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In shallow water, flow reaches conditions where the Froude number exceeds about 0.8, marking the transition to upper flow regime. Which bedform style is most associated with these upper-regime conditions?

A	Antidunes with low-angle laminae that dip upstream
B	Current ripples producing cross-lamination that dips downstream
C	Large dunes producing thick cross-bedded sets with lee-side foresets
D	Flaser bedding formed by alternating mud drapes and ripple migration
Correct answer:	A - Antidunes with low-angle laminae that dip upstream

Rationale

The chapter ties the upper flow regime at high Froude numbers to standing-wave effects that can create antidunes. These bedforms can generate low-angle cross-lamination that dips in the up-current direction, unlike typical ripples and dunes that migrate downstream.

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Reference	Chapter 2 - Introduction to Sedimentology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Connects the chapter’s Froude-number discussion to expected bedforms in upper flow regime conditions.

Question 239 of 505

ID	formationeval_v0.1_sedimentology_turbidity_current_initiation_010
Domains	Sedimentology
Topics	Turbidity Currents, Gravity Flows
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A river enters (i) a saltwater marine basin and (ii) a freshwater lake. In which setting is river inflow more likely to generate a bottom-hugging turbidity current directly, and why?

A	Marine basin, because saltwater increases the density of the river plume immediately
B	Freshwater lake, because river water can more easily become denser than the basin water and flow downslope along the bed
C	Marine basin, because tides inherently force the river plume downward along the delta slope due to tidal mixing and density inversion
D	Freshwater lake, because clay cohesion prevents overflow plumes from forming
Correct answer:	B - Freshwater lake, because river water can more easily become denser than the basin water and flow downslope along the bed

Rationale

The chapter explains that in marine basins the density contrast between fresh and salt water makes river water commonly less dense than seawater, favoring an overflow plume rather than an underflow. In lakes, colder and/or sediment-laden river water can be denser than the surface lake water, allowing it to follow the bottom and form a turbid underflow.

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Reference	Chapter 2 - Introduction to Sedimentology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Assesses understanding of density contrasts controlling whether river inflow forms turbidity currents in lakes versus marine basins.

Question 240 of 505

ID	formationeval_v0.1_sedimentology_liquefaction_susceptibility_011
Domains	Sedimentology
Topics	Liquefaction, Pore Pressure, Slope Stability
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Silt and fine sand are especially prone to generating high-velocity sediment gravity flows via liquefaction. Which explanation best accounts for this susceptibility?

A	They have high cohesion like clay, so they can store elastic strain energy that later releases as flow
B	They are so permeable that any excess pore pressure persists for long periods during rapid loading
C	They combine low cohesion with permeability low enough that excess pore pressure can build and temporarily reduce effective stress
D	They undergo rapid chemical cementation at deposition, creating a brittle fabric that fails suddenly
Correct answer:	C - They combine low cohesion with permeability low enough that excess pore pressure can build and temporarily reduce effective stress

Rationale

Liquefaction occurs when pore pressure rises toward the overburden stress, reducing effective stress and therefore frictional strength. The chapter contrasts coarse sand/gravel, where water escapes quickly so overpressure cannot persist, with clay, where cohesion can inhibit mobilization. Silt and fine sand occupy the vulnerable middle ground: weak cohesion but not enough permeability to instantly dissipate overpressure during rapid loading or shaking.

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URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Integrates effective-stress reduction with permeability/cohesion contrasts to explain liquefaction susceptibility.

Question 241 of 505

ID	formationeval_v0.1_sedimentology_barrier_island_traps_012
Domains	Sedimentology, Petroleum Geology
Topics	Barrier Islands, Stratigraphic Traps, Seal-Reservoir Geometry
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A barrier-island sand body becomes drowned during a transgression and is overlain by fine-grained sediment. In terms of stratigraphic trap geometry and the distribution of reservoir, seal, and source facies, what makes this setting particularly favorable for hydrocarbon accumulation?

A	Barrier sands are commonly cemented at deposition, so they act as impermeable seals to deeper reservoirs
B	Tidal inlets necessarily erode down to basement through the underlying sedimentary section, creating structural traps independent of later sedimentation or burial history
C	Barrier sands typically contain abundant marine sulphate minerals that generate hydrocarbons during burial
D	A laterally elongated sand body can be sealed by overlying mud, while lagoonal mudstones can provide close-by source rock and lateral seal through interfingering

Correct answer: D - A laterally elongated sand body can be sealed by overlying mud, while lagoonal mudstones can provide close-by source rock and lateral seal through interfingering

Rationale

The chapter emphasizes barrier islands as long, thin sand bodies that can be capped by mud when sea level rises, creating an effective top seal. It also highlights muddy lagoonal deposits adjacent to the barrier that can act as source and seal, with geometries that allow pinch-out style trapping within surrounding fine-grained facies.

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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 2 - Introduction to Sedimentology
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Applies the chapter’s barrier-island facies geometry and transgressive sealing concept to petroleum trapping.

Question 242 of 505

ID	formationeval_v0.1_sedimentology_water_chemistry_001
Domains	Sedimentology
Topics	Water Chemistry, Surface Tension
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Several sedimentary-geochemical processes depend on water's ability to surround ions and to generate capillary rise in fine pores. Which molecular property of water best explains both behaviors?

A	Water is strongly polar, so its dipole aligns toward ions and also creates high surface tension
B	Water has a low boiling point, so it readily evaporates and concentrates ions in soils
C	Water has weak intermolecular forces, so it cannot hold a stable meniscus in pores
D	Water is nonpolar, so it does not interact with charged mineral surfaces
Correct answer:	A - Water is strongly polar, so its dipole aligns toward ions and also creates high surface tension

Rationale

A strong molecular dipole makes water orient its negative side toward cations, producing hydration shells that keep ions dispersed in solution. The same polarity leads to strong cohesion between molecules, which contributes to high surface tension and capillary effects in fine-grained sediments. The other options contradict water's observed polarity-driven behavior.

Sources

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Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 3 - Sedimentary Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item derived from discussion of water dipole effects on hydration, surface tension, and capillary forces.

Question 243 of 505

ID	formationeval_v0.1_sedimentology_ionic_potential_002
Domains	Sedimentology
Topics	Ionic Potential, Mineral Solubility
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

An ion has valence Z = +3 and ionic radius R = 0.30 Å. Using ionic potential IP = Z/R, which outcome is most consistent with its expected behavior in low-temperature water–mineral systems?

A	It mainly stays in solution as a hydrated cation because its ionic potential is very low
B	It tends to form very low-solubility hydroxide-type precipitates because its ionic potential is intermediate
C	It mainly forms soluble anion complexes because its ionic potential is very high
D	It remains chemically inert because ionic potential only matters at metamorphic temperatures when crystal lattice mobility increases

Correct answer:	B - It tends to form very low-solubility hydroxide-type precipitates because its ionic potential is intermediate

Rationale

The ionic potential is 3/0.30 = 10, which lies in the intermediate range described for ions that hydrolyze and form poorly soluble hydroxide phases. Low-IP ions remain hydrated and stay in solution, while very high-IP ions form soluble anion complexes and release H+. The concept is explicitly framed for low-temperature sedimentary environments, not only metamorphic conditions.

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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 3 - Sedimentary Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item derived from the definition of ionic potential and the low/intermediate/high-IP behavior categories.

Question 244 of 505

ID	formationeval_v0.1_sedimentology_ion_hydration_003
Domains	Sedimentology
Topics	Ion Hydration, Clay Adsorption
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two alkali ions are released during weathering and delivered to the ocean in similar amounts. Over time, one ion remains relatively abundant in seawater while the other is efficiently removed by adsorption onto clays. Which mechanism best explains this contrast?

A	The more abundant ion is less soluble, so it precipitates as a hydroxide before reaching the ocean
B	The more strongly hydrated ion is more easily captured by negatively charged clay surfaces
C	The more strongly hydrated ion is better shielded by water molecules, reducing its adsorption onto clay minerals
D	The ion with larger ionic radius forms stronger hydration shells, keeping it longer in rivers
Correct answer:	C - The more strongly hydrated ion is better shielded by water molecules, reducing its adsorption onto clay minerals

Rationale

Strong hydration increases the effective (hydrated) size and shields the positive charge, which reduces the ability of the ion to adsorb onto negatively charged clay surfaces. Less hydrated ions retain a more effective surface charge and are removed more readily by adsorption during transport and after entering seawater. This framework explains why some alkali ions have much shorter marine residence times than others.

Sources

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Reference	Chapter 3 - Sedimentary Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based item derived from the discussion of hydration strength, effective surface charge, and clay adsorption controlling seawater composition.

Question 245 of 505

ID	formationeval_v0.1_sedimentology_carbonate_precipitation_004
Domains	Sedimentology
Topics	Carbonate Precipitation, Temperature Effects
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Seawater can have a Mg/Ca ratio greater than 1, yet calcium carbonate commonly forms before magnesium carbonates under typical surface conditions. What is the best explanation given for this behavior?

A	Magnesium carbonates require strongly acidic water, which is uncommon in the ocean
B	Calcium has a higher ionic potential than magnesium due to its larger atomic mass, so it inherently bonds more strongly to carbonate ions and precipitates preferentially
C	Magnesium carbonates precipitate only in the presence of abundant evaporites and hypersaline conditions, regardless of temperature, burial depth, or groundwater chemistry
D	Strong hydration of Mg^{2+} hinders its incorporation at low temperature, but reduced hydration at higher temperature promotes Mg-bearing carbonates during diagenesis

Correct answer: D - Strong hydration of Mg^{2+} hinders its incorporation at low temperature, but reduced hydration at higher temperature promotes Mg-bearing carbonates during diagenesis

Rationale

Mg^{2+} is small and strongly hydrated, which makes it less available to enter carbonate crystal structures at low temperature even when dissolved Mg is abundant. With increasing temperature, hydration weakens, making Mg more readily incorporated and allowing magnesium carbonates to precipitate more easily during burial/diagenesis. Explanations based solely on ionic potential or acidity do not match the chapter's hydration-focused mechanism.

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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 3 - Sedimentary Geochemistry
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item derived from the link between hydration strength, temperature, and carbonate mineral stability/precipitation.

ID	formationeval_v0.1_sedimentology_ph_005
Domains	Sedimentology
Topics	pH, Water Ionization
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

At 125°C, the ionization product of water is given as [H+]·[OH−] = 10−12. What pH corresponds to neutral water at this temperature?

A	pH = 6
B	pH = 7
C	pH = 8
D	pH = 5
Correct answer:	A - pH = 6

Rationale

Neutrality implies [H+] = [OH−], so each equals √(10−12) = 10−6. pH is −log10[H+], giving pH = 6. This highlights that “neutral pH” changes with temperature because water’s ionization product changes.

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Reference	Chapter 3 - Sedimentary Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item derived from the temperature dependence of water ionization and the definition of pH.

ID	formationeval_v0.1_sedimentology_weathering_processes_006
Domains	Sedimentology
Topics	Weathering, Sediment Production
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A field area shows extensive dissolution of primary minerals and formation of new low-temperature phases that are stable in the presence of water. Which sediment-producing process does this describe?

A	Mechanical weathering, because it breaks rock by fracturing without changing mineralogy
B	Chemical weathering, because it transforms minerals and exports part of the rock mass in dissolved form
C	Erosion, because it only refers to transport and deposition after weathering stops and mechanical breakdown is complete
D	Metamorphism, because it is the dominant process in near-surface environments

Correct answer:	B - Chemical weathering, because it transforms minerals and exports part of the rock mass in dissolved form

Rationale

Chemical weathering involves mineral dissolution and precipitation of new minerals that are stable at low temperature and high water availability. Mechanical weathering mainly reduces grain size without fundamentally changing mineral chemistry. Erosion combines breakdown and removal, while metamorphism is associated with much higher temperatures than typical surface environments.

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Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based item derived from the definitions of mechanical weathering, chemical weathering, and erosion.

Question 248 of 505

ID	formationeval_v0.1_sedimentology_distribution_coefficients_007
Domains	Sedimentology
Topics	Distribution Coefficients, Trace Elements in Carbonates
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

During calcite precipitation, manganese can be strongly concentrated relative to seawater. If Mn^{2+}/Ca^{2+} in the solution is 1.0×10^{-5} and the distribution coefficient for Mn in calcite is k = 17, what Mn^{2+}/Ca^{2+} ratio is expected in the calcite?

A	5.9×10^{-7}
B	1.0×10^{-5}
C	1.7×10^{-4}
D	1.7×10^{-6}
Correct answer:	C - 1.7×10^{-4}

Rationale

With constant temperature and pressure, the mineral/solution ratio follows Mn/Ca(mineral) = k·Mn/Ca(solution). Multiplying 17 by 1.0×10^{-5} gives 1.7×10^{-4}, meaning calcite is enriched in Mn relative to the water. The other values correspond to ignoring k or applying it incorrectly.

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Reference	Chapter 3 - Sedimentary Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item derived from the definition of distribution coefficients and the Mn-in-calcite example.

Question 249 of 505

ID	formationeval_v0.1_sedimentology_clay_minerals_008
Domains	Sedimentology
Topics	Clay Minerals, Smectite Swelling, XRD Identification
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A clay separates into layers that expand noticeably when exposed to glycol vapor, while a related clay type shows little to no expansion under the same treatment. Which interpretation best matches this observation?

A	Kaolinite expands strongly because it has exchangeable interlayers that open in glycol vapor
B	Chlorite expands strongly because its octahedral sheets detach when glycol is present
C	Illite expands strongly because K+ weakens bonding between stacked layers during glycol treatment
D	Smectite expands because its interlayer region can take up water/other species, whereas illite is held more tightly by interlayer cations

Correct answer: D - Smectite expands because its interlayer region can take up water/other species, whereas illite is held more tightly by interlayer cations

Rationale

Smectite has a structure that permits interlayer uptake (including water and other molecules), producing measurable expansion under glycol treatment. Illite's layers are more effectively bound by interlayer cations and stacked packets, limiting expansion. Kaolinite and chlorite are not described as showing this strong glycol-driven swelling behavior in the chapter.

Sources

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Reference	Chapter 3 - Sedimentary Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item derived from clay-mineral structure and glycol expansion behavior used for identification.

Question 250 of 505

ID	formationeval_v0.1_sedimentology_quick_clay_009
Domains	Sedimentology, Petroleum Geology
Topics	Clay Electrochemistry, Quick Clay, Effective Stress
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Marine clays deposited in saltwater can later become “quick” after uplift and prolonged infiltration of freshwater. Which mechanism best explains both the loss of shear strength and why adding NaCl or KCl can re-stabilize the ground?

A	Freshwater removes ions that previously reduced electrostatic repulsion between negatively charged clay particles, allowing the open fabric to collapse; added salt restores ionic screening and particle bonding
B	Freshwater increases the clay’s permeability, accelerating drainage and raising the effective stress until failure occurs; added salt blocks pore throats and prevents drainage
C	Freshwater causes immediate cementation by iron hydroxides, creating brittle failure; added salt dissolves the cement and makes the clay ductile
D	Freshwater raises temperature and drives clay dehydration, producing shrinkage cracks; added salt provides heat of dissolution that closes the cracks
Correct answer:	A - Freshwater removes ions that previously reduced electrostatic repulsion between negatively charged clay particles, allowing the open fabric to collapse; added salt restores ionic screening and particle bonding

Rationale

In the chapter’s description, saline porewater helps neutralize negative charges and supports an open, porous “card-house” fabric. When freshwater gradually leaches salts, repulsion increases and the structure becomes unstable; collapse releases porewater and the material can flow with very low viscosity. Reintroducing salt increases ionic strength, reducing repulsion and increasing shear strength through renewed electrochemical stabilization.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 3 - Sedimentary Geochemistry

Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item derived from the quick-clay example linking salinity, double-layer effects, overpressure/low effective stress, and stabilization by salt addition.

Question 251 of 505

ID	formationeval_v0.1_sedimentology_basin_stratification_010
Domains	Sedimentology
Topics	Ocean Stratification, Redox Conditions, Water Circulation
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A semi-enclosed basin receives large freshwater input and has limited exchange with the open ocean. Over time, what water-column structure and bottom-water chemistry is most expected, based on density-driven circulation principles?

A	Dense, salty surface water sinks, creating strong vertical mixing and oxygenated bottom waters
B	A low-salinity surface layer overlies denser saline water, weakening vertical circulation and promoting reducing conditions at depth
C	Uniform salinity develops quickly, so temperature alone controls density and bottom waters remain fully oxygenated
D	Evaporation-driven salinity increases at depth, causing deep water to rise and ventilate the seabed continuously
Correct answer:	B - A low-salinity surface layer overlies denser saline water, weakening vertical circulation and promoting reducing conditions at depth

Rationale

When freshwater caps denser marine water, the salinity-related density contrast inhibits overturning and reduces oxygen delivery to deeper layers. Continuous oxygen consumption by respiration and organic-matter oxidation then drives bottom waters toward anoxic/reducing conditions. The chapter contrasts this with evaporative settings where dense surface brines can sink and enhance circulation.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 3 - Sedimentary Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based item derived from basin circulation models (freshwater surplus vs evaporation surplus) and implications for redox state of bottom waters.

Question 252 of 505

ID	formationeval_v0.1_sedimentology_sandstone_grain_size_001
Domains	Sedimentology, Petroleum Geology
Topics	Sandstone Classification, Grain Size
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A clastic rock is dominated by sand-sized grains but also contains a substantial fraction of pebble-sized clasts (>2 mm). What is the most appropriate descriptive name for this rock in a sandstone classification context?

A	Conglomeratic sandstone
B	Quartz arenite
C	Greywacke
D	Subarkose

Correct answer: A - Conglomeratic sandstone

Rationale

Sand-sized particles define sandstone, but a notable amount of pebble-sized material warrants the modifier “conglomeratic.” Quartz arenite and subarkose describe sand-grain composition, while greywacke is defined by high matrix content rather than pebbles.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 4 - Sandstones and Sandstone Reservoirs
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item derived from the sandstone grain-size definitions and naming conventions.

Question 253 of 505

ID	formationeval_v0.1_sedimentology_sandstone_classification_002
Domains	Sedimentology
Topics	Sandstone Classification, Provenance
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A sandstone has abundant feldspar grains (well above a quarter of the sand fraction) and only minor rock fragments. Which classification term best fits this composition?

A	Lithic sandstone
B	Arkose
C	Quartz arenite
D	Greywacke
Correct answer:	B - Arkose

Rationale

Arkose is defined by high feldspar content when rock fragments are not dominant. Lithic sandstones are characterized by abundant rock fragments, quartz arenites are nearly pure quartz, and greywackes are identified mainly by high matrix content and poor sorting.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 4 - Sandstones and Sandstone Reservoirs
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item derived from compositional classification thresholds (feldspar vs rock fragments).

ID	formationeval_v0.1_sedimentology_matrix_rich_sandstones_003
Domains	Sedimentology, Petroleum Geology
Topics	Matrix Content, Sandstone Classification
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A sandstone contains about 20% fine-grained matrix (silt + clay) between sand grains. In common sandstone classification, what term is most appropriate for this matrix-rich sandstone?

A	Subarkose
B	Quartz arenite
C	Greywacke
D	Orthoquartzite

Correct answer: C - Greywacke

Rationale

Matrix-rich sandstones are termed greywackes when the fine-grained matrix exceeds the threshold described in the chapter. Quartz arenite/orthoquartzite imply very clean quartz-rich sand with little matrix, and subarkose refers to moderate feldspar content rather than matrix abundance.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 4 - Sandstones and Sandstone Reservoirs
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item derived from the matrix threshold used to identify greywacke-type sandstones.

ID	formationeval_v0.1_petroleumgeology_provenance_weathering_004
Domains	Petroleum Geology, Sedimentology
Topics	Provenance, Weathering and Climate, Sandstone Maturity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Which geological setting most strongly favors deposition of feldspar-rich sandstones, assuming the source area includes granitic/gneissic rocks?

A	A stable craton where sediment is repeatedly reworked over long time spans
B	A coastline where wave action removes nearly all clay and silt during transport
C	A deep-marine setting dominated by slow settling of very fine particles
D	A tectonically active basin with rapid erosion, short transport, and quick burial
Correct answer:	D - A tectonically active basin with rapid erosion, short transport, and quick burial

Rationale

Feldspar survives best when erosion and delivery outpace chemical breakdown, which is most typical of rapid sediment supply and short transport paths. Long residence times in transport/reworking (common in stable settings) promote mineralogical “maturity” by removing unstable grains like feldspar, leading to quartz-rich sands instead.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 4 - Sandstones and Sandstone Reservoirs
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item linking tectonic setting, transport time, and feldspar preservation (arkosic tendency).

Question 256 of 505

ID	formationeval_v0.1_sedimentology_redox_boundary_005
Domains	Sedimentology, Geophysics
Topics	Early Diagenesis, Redox Boundary, Diffusion
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two seafloor sediments receive similar organic-matter input: a clean sand bed and a muddy bed. Based on early diagenetic redox behavior, which statement best describes how the depth to the redox boundary typically differs between them?

A	The redox boundary is typically deeper in mud because oxygen diffuses faster through fine pores
B	The redox boundary is typically deeper in sand because oxygen diffuses more efficiently in coarse sediment
C	The redox boundary is controlled only by seawater oxygen level, so both beds are similar in depth regardless of sedimentation rate
D	The redox boundary is typically deeper in sand because bacteria consume oxygen more slowly in coarse grains

Correct answer: B - The redox boundary is typically deeper in sand because oxygen diffuses more efficiently in coarse sediment

Rationale

Oxygen supply into sediment is governed by diffusion, which is more effective in coarse-grained sands than in muds. With faster diffusion, oxygen can penetrate farther before being consumed, placing the redox transition deeper in sand for comparable consumption rates.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 4 - Sandstones and Sandstone Reservoirs
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based item on why coarse-grained sediment tends to have a deeper redox boundary than mud.

Question 257 of 505

ID	formationeval_v0.1_petrophysics_gamma_ray_uranium_enrichment_006
Domains	Petrophysics, Sedimentology
Topics	Gamma Ray Log Response, Redox Processes, Source Rocks
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A shale interval shows strong gamma ray peaks. The shale was deposited with abundant organic matter and limited water circulation. Which mechanism best explains why this setting can yield unusually high gamma ray readings?

A	Organic matter raises clay content, and clay minerals necessarily contain fixed uranium that cannot move or be mobilized regardless of redox conditions
B	Restricted circulation increases quartz precipitation, and quartz is strongly radioactive at burial temperature
C	Uranium carried in oxidized seawater is removed from solution and concentrated where reducing conditions and organic matter are present
D	Sulphate reduction directly produces radioactive sulphides that dominate the gamma ray signal

Correct answer:	C - Uranium carried in oxidized seawater is removed from solution and concentrated where reducing conditions and organic matter are present

Rationale

Uranium is mobile in oxidizing seawater but tends to be captured and precipitated when conditions become reducing, especially where organic matter is available. This concentrating process can enrich certain organic-rich shales in uranium, producing gamma ray peaks.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 4 - Sandstones and Sandstone Reservoirs
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based item derived from uranium redox behavior and its link to gamma ray log anomalies in organic-rich shales.

Question 258 of 505

ID	formationeval_v0.1_sedimentology_meteoric_flushing_kaolinite_007
Domains	Sedimentology, Petroleum Geology
Topics	Meteoric Water Flushing, Kaolinite Formation, Mineral Dissolution
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A reservoir model assumes extensive feldspar alteration to kaolinite during shallow burial. Which condition is most critical for that alteration to progress rather than self-arrest?

A	High salinity water that quickly reaches equilibrium with feldspar
B	A closed porewater system where reaction products accumulate locally
C	Rapid quartz precipitation near the surface that removes silica from solution
D	Sustained through-flow of meteoric water that continually removes dissolved ions and silica

Correct answer:	D - Sustained through-flow of meteoric water that continually removes dissolved ions and silica

Rationale

Feldspar-to-kaolinite alteration requires that dissolved reaction products (notably alkali cations and silica) do not build up to suppress further reaction. Continuous meteoric flushing supplies fresh undersaturated water and exports the products, allowing alteration to continue.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 4 - Sandstones and Sandstone Reservoirs
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item derived from the requirement of through-flow for continued feldspar/mica leaching and kaolinite precipitation.

Question 259 of 505

ID	formationeval_v0.1_petrophysics_kaolinite_reservoir_quality_008
Domains	Petrophysics, Reservoir Engineering
Topics	Reservoir Quality, Authigenic Clays, Capillary Effects
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A sandstone experienced meteoric flushing that dissolved feldspar and precipitated pore-filling kaolinite. Which outcome best describes the net effect on reservoir performance?

A	Permeability typically decreases because pore-filling clay creates finer pore throats even if some secondary pore space formed
B	Permeability typically increases because feldspar dissolution dominates and clay precipitation is negligible
C	Oil saturation typically increases because kaolinite reduces water wetness on grain surfaces
D	Oil saturation typically increases because smaller pores lower capillary entry pressure for oil
Correct answer:	A - Permeability typically decreases because pore-filling clay creates finer pore throats even if some secondary pore space formed

Rationale

Although dissolving feldspar can create secondary pores, kaolinite commonly occupies pore space and especially constricts pore throats, which reduces permeability. Very small pores associated with clay aggregates can also be difficult for oil to enter, tending to raise water saturation rather than lower it.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 4 - Sandstones and Sandstone Reservoirs
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based item on how kaolinite precipitation can offset secondary porosity gains and degrade permeability/oil saturation.

Question 260 of 505

ID	formationeval_v0.1_petrophysics_quartz_cementation_temperature_scaling_009
Domains	Petrophysics, Petroleum Geology
Topics	Quartz Cementation, Temperature Sensitivity, Diagenetic Kinetics
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

Quartz cementation rate increases exponentially with temperature, with an empirical factor of about 1.7× per 10°C rise (Walderhaug 1996). Approximately how many times faster would quartz cementation be at 150°C than at 110°C, if other factors are unchanged?

A	About 3×
B	About 5×
C	About 8×
D	About 16×

Correct answer: C - About 8×

Rationale

A 40°C increase corresponds to four 10°C steps, so the multiplier is about 1.7^4. That equals roughly 8.3, so “about 8×” is the closest option. This captures the strong temperature control emphasized for quartz cementation kinetics.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 4 - Sandstones and Sandstone Reservoirs
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based quantitative item derived from the stated exponential temperature sensitivity of quartz cementation rate.

ID	formationeval_v0.1_petroleumgeology_illitization_k_supply_010
Domains	Petroleum Geology, Petrophysics
Topics	Illitization, Provenance Controls, Reservoir Quality Prediction
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Two sandstones are buried to ~4 km and heated above ~130°C. Sandstone X contains abundant kaolin minerals and significant K-feldspar; Sandstone Y contains kaolin minerals but feldspar is dominated by plagioclase with little K-feldspar. Given that illitization of kaolinite requires a local potassium source, which outcome is most likely for pore-filling illite development?

A	Sandstone X is more likely to form pore-filling illite (and quartz) because it can supply potassium locally, while Sandstone Y is less likely to illitize kaolin due to limited potassium
B	Sandstone Y is more likely to form pore-filling illite because plagioclase supplies potassium more effectively than K-feldspar at high temperature
C	Both sandstones will form similar amounts of pore-filling illite because temperature alone controls illitization once 130°C is exceeded
D	Neither sandstone will form pore-filling illite because illite can only form by alteration of smectite through mixed-layer clay intermediates, not from kaolin minerals regardless of potassium supply
Correct answer:	A - Sandstone X is more likely to form pore-filling illite (and quartz) because it can supply potassium locally, while Sandstone Y is less likely to illitize kaolin due to limited potassium

Rationale

Illite formation at these conditions requires both a suitable precursor (often kaolinite/dickite) and a potassium source, with K-feldspar highlighted as the key supplier. If potassium is scarce (e.g., feldspar assemblage dominated by plagioclase with low K-feldspar), kaolin minerals can persist and permeability is less harmed by pore-filling illite.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 4 - Sandstones and Sandstone Reservoirs

Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item derived from thermodynamic instability of K-feldspar + kaolinite above ~130°C and provenance control on K availability.

Question 262 of 505

ID	formationeval_v0.1_sedimentology_carbonate_geochemistry_001
Domains	Sedimentology, Petroleum Geology
Topics	Carbonate Geochemistry, Carbon Cycle
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Over geologic time, what factor most directly limits how fast carbonate burial can remove CO_2 from the atmosphere–ocean system?

A	Delivery of Ca^{2+} and Mg^{2+} to the ocean from weathering of Ca-bearing silicates
B	Weathering rate of limestone on continents supplying carbonate ions to rivers
C	Rate of volcanic degassing of CO_2 from contact-metamorphosed limestones
D	Global abundance of carbonate-secreting organisms, independent of seawater chemistry

Correct answer:	A - Delivery of Ca^{2+} and Mg^{2+} to the ocean from weathering of Ca-bearing silicates

Rationale

The chapter links long-term carbonate accumulation to the availability of cations (especially Ca^{2+} and Mg^{2+}) supplied to seawater by rivers. That supply is tied to weathering of Ca-bearing silicates (e.g., plagioclase), which provides the ions needed to precipitate carbonates. Weathering of limestone does not represent a net sink for CO_2 in the same way described here.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 5 - Carbonate Sediments
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the chapter discussion of carbonate burial as a CO_2 sink and the role of riverine Ca^{2+}/Mg^{2+} supply from silicate weathering.

Question 263 of 505

ID	formationeval_v0.1_sedimentology_stromatolites_002
Domains	Sedimentology
Topics	Stromatolites, Depositional Structures
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A carbonate outcrop shows laminated microbial layers that build mounded forms with noticeable relief above the bedding surface. What is the most appropriate descriptive term for this fabric?

A	Oolite, because concentric layers record agitation-driven growth
B	Stromatolite, because lamination forms three-dimensional buildups
C	Chalk, because fine carbonate particles accumulate as a mud-supported deposit
D	Hardground, because early marine cementation produces a firm seafloor surface

Correct answer: B - Stromatolite, because lamination forms three-dimensional buildups

Rationale

In the chapter, flat microbial laminae are described as algal laminated sediments, while laminae that create structures with vertical relief are termed stromatolites. Ooids are coated grains produced by rolling and precipitation, not microbial mats building relief. Hardgrounds are cemented seafloor surfaces recognized by borings/encrustations rather than by laminated microbial buildups.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 5 - Carbonate Sediments
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item from the stromatolite section distinguishing planar microbial lamination from relief-forming stromatolites.

Question 264 of 505

ID	formationeval_v0.1_sedimentology_ooids_003
Domains	Sedimentology
Topics	Ooids, Depositional Environment
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Which set of conditions best explains why ooids typically develop in only a narrow range of shallow-marine settings?

A	Cold water temperatures and weak currents that allow mud to settle and coat grains
B	Deep-water conditions below storm wave base with little particle motion
C	Very warm water, near-carbonate saturation, and frequent agitation that keeps grains rolling
D	High siliciclastic influx that provides abundant nuclei and increases alkalinity

Correct answer: C - Very warm water, near-carbonate saturation, and frequent agitation that keeps grains rolling

Rationale

The chapter emphasizes that ooids require warm waters close to carbonate saturation and persistent wave/tidal agitation to rotate grains so coatings grow evenly. These requirements restrict ooids mainly to very shallow, energetic environments. Deep, cold, or muddy settings do not provide the chemistry and grain motion needed for ooid growth.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 5 - Carbonate Sediments
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Built from the ooid section describing temperature/saturation constraints and the need for agitation to maintain concentric coatings.

Question 265 of 505

ID	formationeval_v0.1_sedimentology_dunham_classification_004
Domains	Sedimentology
Topics	Carbonate Rock Classification, Dunham Classification
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A limestone is mud-supported but contains clearly more than 10% grains dispersed in the mud-sized matrix. Under Dunham's depositional-texture scheme, what is the correct name?

A	Mudstone
B	Packstone
C	Grainstone
D	Wackestone

Correct answer: D - Wackestone

Rationale

Dunham classification uses support fabric and a grain-percentage threshold: mud-supported with fewer than ~10% grains is mudstone, while mud-supported with more than ~10% grains is wackestone. Packstone and grainstone are grain-supported categories, so they do not fit a mud-supported description.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 5 - Carbonate Sediments
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based question on Dunham mud-supported categories and the >10% grain criterion.

ID	formationeval_v0.1_sedimentology_carbonate_mineralogy_005
Domains	Sedimentology, Petrophysics
Topics	Carbonate Mineralogy, Diagenesis
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

During burial diagenesis of skeletal grains originally made of high-Mg calcite, which outcome best describes the typical alteration process?

A	Mg2+ is removed from the crystal lattice while the grain's fine internal architecture can remain recognizable
B	The grain typically converts to aragonite because it is the stable burial phase of CaCO3
C	The grain must dissolve completely before any low-Mg calcite can precipitate in its place
D	Sr2+ is preferentially enriched as Mg2+ is expelled, producing strontianite cement

Correct answer: A - Mg2+ is removed from the crystal lattice while the grain's fine internal architecture can remain recognizable

Rationale

The text describes conversion of high-Mg calcite to more stable low-Mg calcite by leaching/removal of Mg2+, with the microarchitecture commonly preserved. Complete dissolution and re-precipitation is presented as an alternative pathway mainly for aragonitic grains (mould formation), not as the defining mechanism for high-Mg calcite stabilization. Strontium enrichment leading to strontianite is not the described outcome for this transformation.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 5 - Carbonate Sediments
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the stabilization of high-Mg calcite during diagenesis and its implications for texture preservation.

Question 267 of 505

ID	formationeval_v0.1_sedimentology_algal_facies_006
Domains	Sedimentology
Topics	Carbonate Factories, Algal Facies
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Along a profile from open basin to a reef margin and then into a protected lagoon, which biological carbonate producers are most likely to dominate each environment based on their ecological tolerances?

A	Basin: green algae; reef: coccolithophores; lagoon: red algae
B	Basin: coccolithophores; reef: red algae; lagoon: green algae
C	Basin: cyanobacteria mats; reef: green algae; lagoon: coccolithophores
D	Basin: red algae; reef: cyanobacteria; lagoon: planktonic algae

Correct answer: B - Basin: coccolithophores; reef: red algae; lagoon: green algae

Rationale

The chapter describes planktonic algae (notably coccolithophores) as key contributors basinward, red algae as major robust reef-associated builders, and green algae as common in protected lagoonal settings where wave energy is moderate. Cyanobacteria are emphasized mainly for tidal-zone mats and stromatolite-related settings rather than as the dominant basin producer.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 5 - Carbonate Sediments
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Drawn from the cross-basin ecological distribution of algae and associated carbonate production roles.

Question 268 of 505

ID	formationeval_v0.1_petrophysics_chalk_reservoirs_007
Domains	Petrophysics, Petroleum Geology
Topics	Chalk Reservoirs, Porosity-Permeability
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why can a coccolith-rich chalk interval show very high porosity but still behave as a low-permeability reservoir unless another pore system is present?

A	Because chalk porosity is dominated by large vugs that tend to be isolated by early cement
B	Because chalk pores are mainly fracture-like and therefore contribute little to storage
C	Because much of the pore space is microporous with very small pore throats, so flow capacity is limited without fractures
D	Because chalk is typically cemented by ankerite at shallow depth, blocking nearly all pore volume

Correct answer:	C - Because much of the pore space is microporous with very small pore throats, so flow capacity is limited without fractures

Rationale

The chapter notes that chalk porosity can be extremely high as interparticle microporosity, yet permeability is low due to very small pore-throat sizes. Productivity commonly improves when fractures add a connected flow network. The text does not describe shallow, dominant ankerite cementation as the main reason for chalk tightness.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 5 - Carbonate Sediments
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item from the chalk reservoir discussion linking microporosity to low permeability and the role of fractures.

Question 269 of 505

ID	formationeval_v0.1_sedimentology_micritisation_008
Domains	Sedimentology
Topics	Micritisation, Peloids
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A skeletal grain from a shallow photic-zone setting shows a dark micritic rim that obscures original texture, and the rim is interpreted as highly stable during later burial. Which process best explains the formation of this rim?

A	Pressure solution at grain contacts followed by stylolite development along the rim
B	Mechanical abrasion producing a micrite coating by grinding in the surf zone
C	Direct precipitation of low-Mg calcite cement from seawater without biological mediation
D	Microboring organisms create tiny tunnels that later become filled by fine carbonate crystals, progressively forming a micritic envelope

Correct answer: D - Microboring organisms create tiny tunnels that later become filled by fine carbonate crystals, progressively forming a micritic envelope

Rationale

The chapter attributes micritic envelopes to microboring algae/cyanobacteria/fungi that dissolve small tubular holes near the grain surface; after the borers die, the holes become infilled with fine carbonate (micrite), and repetition produces a stable micritic coating. Abrasion can make lime mud but is not described as producing the characteristic microbore-and-infill texture that forms envelopes.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 5 - Carbonate Sediments
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the micritisation mechanism and the development of micritic envelopes/peloids in the photic zone.

Question 270 of 505

ID	formationeval_v0.1_sedimentology_redox_cements_009
Domains	Sedimentology
Topics	Carbonate Cement, Redox Geochemistry
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A calcite cement contains a few thousand ppm iron, implying substitution of Fe^{2+} into the carbonate structure. Considering the competition between sulphide precipitation and carbonate incorporation of dissolved iron in diagenetic porewaters, which setting most plausibly allowed this ferroan cement to form?

A	Reducing porewater below the microbial sulphate-reduction zone, where Fe remains available as Fe2+
B	Oxidizing seawater at the sediment surface, where Fe3+ is highly soluble and readily enters calcite
C	The active sulphate-reduction zone itself, where dissolved Fe2+ remains abundant and unreacted
D	A fully evaporitic brine at the seafloor, where Fe is concentrated by halite precipitation
Correct answer:	A - Reducing porewater below the microbial sulphate-reduction zone, where Fe remains available as Fe2+

Rationale

The chapter explains that iron enters calcite mainly as Fe2+ under reducing conditions, but within the sulphate-reduction zone Fe2+ is typically captured by sulphide minerals, leaving little for carbonate incorporation. Therefore, ferroan calcite formation is most consistent with reducing porewater below that zone, where Fe2+ can persist and substitute into the calcite lattice.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 5 - Carbonate Sediments
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Item derived from the redox control on Fe availability (Fe^{2+} vs Fe^{3+}) and the conditions needed for ferroan calcite.

ID	formationeval_v0.1_sedimentology_carbonate_compensation_depth_010
Domains	Sedimentology, Petroleum Geology
Topics	Pelagic Carbonate, Carbonate Compensation Depth
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two deep-ocean basins have similar surface productivity of planktonic carbonate but different water-mass properties. Which basin would be expected to have the shallower carbonate compensation depth (CCD)?

A	A low-latitude basin with warm deep water and lower dissolved CO_2
B	A high-latitude basin with colder deep water that can hold more dissolved CO_2
C	A basin where deep water has lower pressure due to lower sea level
D	A basin with abundant terrigenous clay input that buffers seawater acidity

Correct answer: B - A high-latitude basin with colder deep water that can hold more dissolved CO_2

Rationale

The chapter ties CCD depth to dissolution controlled by temperature, pressure, and dissolved CO_2, with cold waters being more corrosive to $CaCO_3$. It states that CCD can be as shallow as ~1–2 km at higher latitudes (colder waters) and deeper (~4–5 km) in warm equatorial regions. Therefore, the colder high-latitude deep water setting should have the shallower CCD.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 5 - Carbonate Sediments
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Built from the pelagic carbonate section describing why CCD is shallower in colder, higher-latitude waters.

Question 272 of 505

ID	formationeval_v0.1_sedimentology_dolomitisation_controls_011
Domains	Sedimentology, Petroleum Geology
Topics	Dolomitisation, Geochemical Controls
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Extensive dolomitisation of $CaCO_3$ sediments requires both an elevated Mg^{2+}/Ca^{2+} ratio and a sustained supply of Mg^{2+}. Which scenario best satisfies these geochemical requirements?

A	Fresh meteoric groundwater flushing alone, because low sulphate guarantees immediate dolomite precipitation
B	Normal seawater circulating slowly through limestone, because seawater is inherently sufficient to form dolomite regardless of inhibitors
C	Reducing, sulphate-depleted seawater circulating through a reef/atoll where Mg supply is large and inhibition is minimized
D	Deep-basin compaction water as the dominant Mg source, because Mg increases strongly with burial depth in most basins
Correct answer:	C - Reducing, sulphate-depleted seawater circulating through a reef/atoll where Mg supply is large and inhibition is minimized

Rationale

The chapter lists three key conditions: CaCO3 must be unstable relative to dolomite, Mg must be supplied to maintain a high Mg/Ca ratio, and inhibitors (especially sulphate) must be low. It also notes that seawater is the only practical magnesium source for large-scale dolomitisation and that reducing, low-sulphate seawater in reefs/atolls provides favorable chemistry. Meteoric water alone generally lacks enough magnesium, and deep-basin porewaters are described as typically Mg-poor except near evaporites.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 5 - Carbonate Sediments
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept integration across dolomitisation prerequisites (Mg supply, Mg/Ca ratio, sulphate inhibition) and the reef/atoll circulation discussion.

Question 273 of 505

ID	formationeval_v0.1_sedimentology_meteoric_diagenesis_012
Domains	Sedimentology, Petroleum Geology
Topics	Meteoric Diagenesis, Freshwater Lens
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

A permeable carbonate sand island has freshwater (density 1.00 g/cm³) overlying saline porewater (density 1.025 g/cm³). Using the Ghyben-Herzberg hydrostatic relationship (depth ratio = 1/(ρ_saline − ρ_fresh)), approximately how deep below sea level can freshwater penetrate if the freshwater head above sea level is 6 m?

A	About 60 m
B	About 120 m
C	About 180 m
D	About 240 m

Correct answer: D - About 240 m

Rationale

The chapter gives the relationship depth ≈ head/(ρsaline−ρfresh), which for densities 1.025 and 1.00 implies a factor of 1/0.025 = 40. With a 6 m head, penetration depth is about 6 × 40 = 240 m. This illustrates why modest hydraulic heads can drive deep freshwater flushing in coastal carbonates.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 5 - Carbonate Sediments
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical application of the freshwater-lens depth relationship described for meteoric water flow beneath carbonate islands.

ID	formationeval_v0.1_sedimentology_mudrock_properties_001
Domains	Sedimentology
Topics	Mudrocks, Clay Matrix Effects
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A fine-grained sediment contains a noticeable silt fraction, but the silt grains are dispersed within a continuous clay-rich matrix. Which component most strongly controls the rock's bulk behavior (e.g., cohesion and fluid sensitivity)?

A	The silt-sized grains, because they contribute most of the grain-to-grain contacts
B	The clay-sized fraction, because the matrix dominates how the material behaves
C	The sand-sized grains, because even a small amount determines mechanical strength
D	The pore fluid alone, because mineralogy has little influence at small grain sizes
Correct answer:	B - The clay-sized fraction, because the matrix dominates how the material behaves

Rationale

When larger grains are effectively "floating" in a finer clay matrix, the clay fraction governs key properties such as cohesion and sensitivity to pore-fluid chemistry. Clay minerals also have large specific surface area and surface charge effects that strongly influence behavior. Coarser grains matter more when they form the load-bearing framework.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 6 - Shales, Silica Deposits and Evaporites
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Focuses on how a clay-dominated matrix controls mudrock properties even when coarser grains are present.

Question 275 of 505

ID	formationeval_v0.1_sedimentology_weathering_clay_assemblages_002
Domains	Sedimentology, Petroleum Geology
Topics	Clay Mineral Origin, Weathering and Climate
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a humid climate, intense chemical weathering affects a granitic or gneissic source area. What sediment output is most consistent with the expected mineral breakdown and residue?

A	Mostly smectite clay plus abundant volcanic glass shards
B	Mostly chlorite clay with little change to feldspar and mica
C	Only clay minerals with essentially no sand-sized quartz present
D	Quartz-rich sand plus kaolinite-rich clay, producing a strongly bimodal mix
Correct answer:	D - Quartz-rich sand plus kaolinite-rich clay, producing a strongly bimodal mix

Rationale

Under humid conditions, silicate minerals like feldspar and mica are strongly altered, and Al–Si products can form kaolinite while quartz survives as sand. This naturally yields a mixture dominated by quartz sand and kaolinitic clay. A “clay-only” product is more characteristic of basic source rocks that lack quartz.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 6 - Shales, Silica Deposits and Evaporites
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from discussion of climate-controlled weathering products and resulting grain-size/mineral distributions.

Question 276 of 505

ID	formationeval_v0.1_sedimentology_clay_flocculation_003
Domains	Sedimentology
Topics	Clay Transport, Flocculation in Seawater
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

River-borne clay commonly settles rapidly near a delta front after mixing with seawater. Which dissolved species is identified as especially effective at promoting the aggregation that speeds up settling?

A	K^+, because it is less strongly hydrated and neutralizes clay surface charge efficiently
B	CO_3^{2-}, because it creates buoyant carbonate coatings on clay particles
C	SO_4^{2-}, because it increases electrostatic repulsion between clay platelets
D	H_4SiO_4, because dissolved silica acts as a glue between mineral surfaces
Correct answer:	A - K^+, because it is less strongly hydrated and neutralizes clay surface charge efficiently

Rationale

Clay platelets carry negative surface charge, which helps keep them dispersed in freshwater. In seawater, cations reduce that electrostatic repulsion and promote denser aggregates that sink faster; K^+ is highlighted as particularly effective due to its hydration behavior. The other listed species do not play the same charge-neutralization role described for seawater cations.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 6 - Shales, Silica Deposits and Evaporites
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Targets the mechanism linking seawater ions to clay aggregation and limited offshore transport from deltas.

ID	formationeval_v0.1_sedimentology_clay_sorting_marine_004
Domains	Sedimentology
Topics	Clay Mineral Sorting, Delta to Basin Transects
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Along a marine shelf profile from nearshore delta/shoreface to more offshore settings, which clay-mineral pattern best matches grain-size sorting described for common clay types?

A	Illite is deposited closest to shore, while kaolinite dominates the deepest basin
B	Smectite settles nearest the river mouth because it is the coarsest clay mineral
C	Kaolinite tends to be more proximal, while illite and smectite are carried farther offshore
D	All clay minerals deposit at the same distance because flocculation removes sorting effects

Correct answer:	C - Kaolinite tends to be more proximal, while illite and smectite are carried farther offshore

Rationale

The chapter links clay sorting to grain size, noting kaolinite as the coarser clay mineral that tends to accumulate nearer to sediment sources. Finer clays like illite and smectite can be transported to more distal settings. Flocculation speeds settling near the mouth but does not eliminate all size-related sorting patterns within marine basins.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 6 - Shales, Silica Deposits and Evaporites
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Uses the clay-mineral sorting concept along proximal–distal depositional environments.

Question 278 of 505

ID	formationeval_v0.1_sedimentology_biogenic_silica_ocean_005
Domains	Sedimentology
Topics	Silica Cycle, Biogenic Silica
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Large amounts of dissolved silica are supplied to the oceans by rivers, yet surface seawater can still be undersaturated with respect to quartz. What process best explains this undersaturation in the upper ocean?

A	Quartz dissolves so rapidly in seawater that it overwhelms any precipitation pathway
B	Silica is efficiently removed by organisms that build amorphous silica skeletons, even at very low SiO_2 levels
C	Silica is mainly consumed by halite precipitation during evaporation on continental shelves
D	Silica is permanently locked into mid-ocean ridge sulphide deposits before reaching surface waters
Correct answer:	B - Silica is efficiently removed by organisms that build amorphous silica skeletons, even at very low SiO_2 levels

Rationale

The chapter emphasizes that organisms such as diatoms and radiolaria can precipitate silica from seawater at concentrations far below those needed for quartz saturation. This biological uptake helps keep surface waters undersaturated with respect to quartz despite continual continental input. Evaporite precipitation is not presented as the dominant control on open-ocean dissolved silica levels.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 6 - Shales, Silica Deposits and Evaporites
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Conceptual item on why biological silica precipitation can keep surface waters undersaturated with quartz.

Question 279 of 505

ID	formationeval_v0.1_geophysics_silica_diagenesis_reflectors_006
Domains	Geophysics, Sedimentology
Topics	Silica Diagenesis, Seismic Reflectivity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A seismic interpreter observes a laterally extensive, nearly horizontal reflector within a silica-rich sedimentary interval. Which explanation is most consistent with the diagenetic behavior of biogenic silica during burial?

A	A laterally uniform gas cap, because hydrocarbons invariably create horizontal reflections in shale sequences regardless of structure
B	A sudden increase in clay content, because clay-to-sand transitions are invariably horizontal and parallel to bedding surfaces
C	A carbonate cementation front, because calcite nucleates at a fixed depth in all basins
D	A temperature-controlled silica phase change that alters acoustic impedance at a predictable burial window
Correct answer:	D - A temperature-controlled silica phase change that alters acoustic impedance at a predictable burial window

Rationale

The chapter links strong impedance contrasts to the transformation of biogenic silica phases (opal A to opal CT to quartz) during burial. Because these transformations are primarily temperature-driven, they tend to occur at similar thermal conditions and can appear as subhorizontal “fronts.” Such reflectors can be mistaken for fluid contacts if the diagenetic origin is not considered.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 6 - Shales, Silica Deposits and Evaporites
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Connects burial-controlled silica phase transformations to acoustic impedance contrasts and seismic interpretation pitfalls.

Question 280 of 505

ID	formationeval_v0.1_geophysics_silica_reflector_vs_fluid_contact_007
Domains	Geophysics, Sedimentology
Topics	Silica Diagenesis, Fluid Contacts vs Diagenetic Fronts
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In a basin with diatom-rich sediments, a strong reflector cuts across stratigraphy and remains nearly horizontal over a wide area. Well data show no systematic change in pore-fluid type at that level. What is the most defensible interpretation given that silica phase transformations are temperature-controlled?

A	A diagenetic boundary related to silica transformations, which can mimic a fluid contact in seismic data
B	A regional unconformity produced by subaerial exposure, which must be planar and horizontal
C	A uniform gas-water contact, because gas contacts do not require a log response change
D	A fault-related reflector, because faults typically produce broad horizontal reflections
Correct answer:	A - A diagenetic boundary related to silica transformations, which can mimic a fluid contact in seismic data

Rationale

The chapter notes that opal A, opal CT, and quartz transitions can generate a marked impedance change and tend to form horizontal zones because they are temperature controlled. This creates reflectors that may resemble hydrocarbon contacts even when fluids do not change. A stratigraphic unconformity or fault explanation is not the most consistent with the described temperature-governed silica diagenesis behavior.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 6 - Shales, Silica Deposits and Evaporites
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Hard interpretation item contrasting fluid contacts with temperature-driven silica diagenetic fronts that generate seismic reflections.

Question 281 of 505

ID	formationeval_v0.1_sedimentology_marine_evaporite_sequence_008
Domains	Sedimentology
Topics	Evaporites, Marine Evaporation Sequence
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In a restricted marine basin undergoing progressive evaporation, which mineral is expected to precipitate only after seawater volume has been reduced to roughly one-tenth of its original amount?

A	Calcite/aragonite ($CaCO_3$), because carbonates require extreme concentration to form
B	Gypsum ($CaSO_4 \cdot 2H_2O$), because sulphate minerals are the most soluble major salts
C	Halite (NaCl), because chlorides become saturated late compared with carbonates and gypsum
D	Sylvite (KCl), because potassium salts saturate early due to high seawater K content
Correct answer:	C - Halite (NaCl), because chlorides become saturated late compared with carbonates and gypsum

Rationale

The chapter outlines an evaporation-driven sequence in which carbonates and gypsum precipitate earlier, while halite becomes a dominant precipitate only after much stronger concentration (around a 1/10 remaining volume). Potassium salts and bromides are described as among the last to precipitate because they remain soluble to higher concentrations. This makes halite the best match to the one-tenth criterion.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 6 - Shales, Silica Deposits and Evaporites
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Targets the conceptual precipitation order of major evaporite minerals during seawater concentration.

ID	formationeval_v0.1_sedimentology_gypsum_anhydrite_compaction_009
Domains	Sedimentology, Drilling Engineering
Topics	Evaporite Diagenesis, Gypsum–Anhydrite Transformation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

A 10.0 m thick gypsum bed is converted to anhydrite during burial. Given that the dehydration of gypsum to anhydrite results in a 38% volume reduction, what thickness is expected if lateral area is unchanged?

A	3.8 m
B	6.2 m
C	10.0 m
D	16.0 m

Correct answer: B - 6.2 m

Rationale

The chapter states that the gypsum-to-anhydrite transition involves a 38% volume reduction. If area is constant, thickness scales with volume, so the remaining thickness is 10.0 m × (1 − 0.38) = 6.2 m. The larger thickness would correspond to hydration (anhydrite to gypsum), not dehydration.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 6 - Shales, Silica Deposits and Evaporites
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Simple quantitative application of the reported compaction associated with gypsum dehydration to anhydrite.

Question 283 of 505

ID	formationeval_v0.1_sedimentology_sabkha_halite_preservation_010
Domains	Sedimentology
Topics	Sabkha Model, Evaporite Preservation
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In sabkha-type coastal flats, halite may form but is often missing from the preserved stratigraphic record. What mechanism best explains the poor preservation of halite in these settings?

A	Halite cannot crystallize from marine-derived brines in shallow coastal environments
B	Halite is converted into gypsum during early diagenesis as pore waters cool
C	Halite is mechanically removed by strong bioturbation that disrupts all lamination
D	Halite readily dissolves during later flooding events or from atmospheric moisture, removing it after deposition

Correct answer:	D - Halite readily dissolves during later flooding events or from atmospheric moisture, removing it after deposition

Rationale

The chapter describes sabkhas as settings that can precipitate halite during intense evaporation, but subsequent marine flooding or even humidity can redissolve it. This repeated dissolution prevents halite from being reliably preserved as distinct beds. Gypsum/dolomite lamination can persist because it is less prone to rapid surface dissolution under the described conditions.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 6 - Shales, Silica Deposits and Evaporites
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Sabkha-focused item on why highly soluble chlorides are commonly removed after deposition.

Question 284 of 505

ID	formationeval_v0.1_sedimentology_redox_boundary_mn_fe_011
Domains	Sedimentology, Petroleum Geology
Topics	Redox Boundary, Iron and Manganese Geochemistry
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In marine sediments, porewater becomes sulphate-reducing below the shallow oxidized layer. Considering the contrasting stability of Fe and Mn sulphides in reducing porewaters, which element is more likely to escape trapping as a sulphide and instead be preferentially deposited in the oxidized zone above the redox boundary?

A	Iron, because Fe^{2+} does not form stable sulphides in sediments
B	Sulphur, because sulphur oxidizes and precipitates as metal oxides at the boundary
C	Manganese, because Mn^{2+} forms comparatively less stable sulphides than Fe^{2+}
D	Aluminium, because Al^{3+} becomes highly soluble under oxidizing marine conditions

Correct answer: C - Manganese, because Mn^{2+} forms comparatively less stable sulphides than Fe^{2+}

Rationale

The chapter contrasts Fe and Mn behavior, emphasizing that Fe^{2+} readily forms low-solubility sulphides in reducing, sulphide-producing zones, while manganese sulphides are more soluble. As a result, Mn has a greater tendency to be fixed as oxidized phases in the oxygenated zone near/above the redox boundary. This makes manganese the better answer for preferential oxidized-zone deposition.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 6 - Shales, Silica Deposits and Evaporites
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Integrates redox zoning with differential sulphide stability to predict Fe vs Mn trapping locations.

Question 285 of 505

ID	formationeval_v0.1_sedimentology_phosphorite_upwelling_conditions_012
Domains	Sedimentology, Petroleum Geology
Topics	Phosphorites, Upwelling Systems
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Which depositional scenario is most favorable for forming marine phosphorite beds?

A	Strong upwelling with high biological productivity and very low clastic sediment input, often during slow or interrupted sedimentation
B	High-energy shoreface sand deposition with rapid burial that prevents any chemical replacement
C	Deep-basin turbidite systems where repeated sand pulses dilute biogenic material
D	Humid continental floodplains where heavy rainfall concentrates phosphate by leaching

Correct answer: A - Strong upwelling with high biological productivity and very low clastic sediment input, often during slow or interrupted sedimentation

Rationale

Marine phosphorite formation is tied in the chapter to slow sedimentation (minimal clastic dilution) combined with nutrient-rich upwelling that drives high organic production. These conditions allow phosphorus to be concentrated and apatite to precipitate and/or replace other minerals. Rapid clastic burial or high clastic flux works against phosphate enrichment by dilution.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 6 - Shales, Silica Deposits and Evaporites
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Assesses understanding of environmental prerequisites for phosphorite enrichment in marine settings.

Question 286 of 505

ID	formationeval_v0.1_petroleumgeology_stratigraphy_scope_001
Domains	Petroleum Geology, Sedimentology
Topics	Stratigraphy Concepts, Stratigraphic Correlation
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Which description best matches how stratigraphy is used in geological work?

A	A method limited to sedimentary basins that assigns rock names mainly from fossil assemblages
B	A technique restricted to sedimentary rocks that relies on radiometric ages to order beds
C	An approach that uses layered rocks to establish relative ages and interpret how strata are arranged through time, most often in sedimentary successions
D	A classification system for igneous intrusions that focuses on magma composition rather than layering

Correct answer: C - An approach that uses layered rocks to establish relative ages and interpret how strata are arranged through time, most often in sedimentary successions

Rationale

Stratigraphy treats layered successions as records that can be ordered and interpreted in time, and it is used primarily in sedimentary studies even though layering can occur in other rock types. Fossils and radiometric ages can support stratigraphy, but stratigraphy is not limited to either of those data types.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 7 - Stratigraphy
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on the practical scope and meaning of stratigraphy versus other classification approaches.

Question 287 of 505

ID	formationeval_v0.1_petroleumgeology_lithostratigraphy_correlation_002
Domains	Petroleum Geology, Sedimentology
Topics	Lithostratigraphy, Correlation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A subsurface team wants to trace a laterally continuous sandstone package across several wells, even though its age may vary slightly from place to place due to shoreline migration. Which stratigraphic approach is most directly aligned with this goal?

A	Lithostratigraphy, because it groups strata using rock characteristics that can be mapped even when boundaries are time-transgressive
B	Chronostratigraphy, because it requires every mapped boundary to represent an isochronous time surface
C	Geochronology, because it subdivides Earth history into time intervals independent of rock bodies
D	Magnetostratigraphy, because it relies on polarity intervals rather than the physical properties of the rock unit

Correct answer:	A - Lithostratigraphy, because it groups strata using rock characteristics that can be mapped even when boundaries are time-transgressive

Rationale

Lithostratigraphy is built around rock properties such as lithology and log-recognizable character, making it suitable for mapping a sandstone body as a unit even if it is not the same age everywhere. Chronostratigraphy focuses on synchronous time-rock units, which conflicts with the stated possibility of age variation across the mapped sandstone.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 7 - Stratigraphy
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Derived from discussion of lithostratigraphic correlation and time-transgressive lithologic units.

Question 288 of 505

ID	formationeval_v0.1_petroleumgeology_lithostratigraphic_units_003
Domains	Sedimentology, Petroleum Geology
Topics	Lithostratigraphic Hierarchy, Formations
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In a well, a 200 m thick sandstone interval is clearly distinguishable from the shale above and limestone below and can be consistently picked on logs across an area. What is the most appropriate lithostratigraphic rank for this sandstone interval?

A	Bed
B	Member
C	Group
D	Formation

Correct answer: D - Formation

Rationale

A formation is the basic mappable lithostratigraphic unit and is intended to be readily recognizable in outcrop or in boreholes based on lithology. A member is a subdivision of a formation, while a group combines multiple formations, and a bed is a much smaller depositional unit.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 7 - Stratigraphy
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on identifying the formation as the fundamental lithostratigraphic mapping unit.

Question 289 of 505

ID	formationeval_v0.1_petroleumgeology_bed_vs_lamina_004
Domains	Sedimentology
Topics	Lithostratigraphic Units, Beds and Laminae
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A shale-dominated core contains a single, laterally continuous 5 mm volcanic ash layer between much thicker shale beds. How should this thin layer most reasonably be treated in stratigraphic description?

A	It must be ignored because layers under 1 cm cannot be distinguished stratigraphically
B	It can be logged and potentially named as a distinct layer even though its thickness places it in the lamina size range
C	It should automatically be defined as a member because ash differs from shale
D	It should be defined as a group because it is a key marker horizon
Correct answer:	B - It can be logged and potentially named as a distinct layer even though its thickness places it in the lamina size range

Rationale

A lamina is defined by thickness (<1 cm), but thin layers can still be individually recognized and even named when they are isolated and compositionally distinctive relative to surrounding strata. A member and a group are much higher hierarchical ranks than a single thin layer.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 7 - Stratigraphy
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Item based on the size-based term 'lamina' and when thin layers are treated as distinct stratigraphic units.

Question 290 of 505

ID	formationeval_v0.1_petroleumgeology_biostratigraphy_cuttings_005
Domains	Petroleum Geology
Topics	Biostratigraphy, Interval Zones, Well Cuttings
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In industrial biostratigraphy using drill cuttings, which fossil event is generally more reliable for defining zone boundaries when downhole caving can contaminate samples?

A	The first appearance of a taxon, because it is unaffected by mixing during drilling
B	The peak abundance of a taxon, because abundance is independent of environment
C	The last appearance of a taxon, because older material is less likely to be transported upward into younger samples
D	The midpoint of a taxon’s range, because it averages out sampling errors
Correct answer:	C - The last appearance of a taxon, because older material is less likely to be transported upward into younger samples

Rationale

Cuttings are vulnerable to contamination by older material falling into the wellbore and being carried upward, which can create false early appearances. Disappearances (last occurrences) are therefore typically more dependable in such datasets, which is why interval zones based on successive last appearances are widely used in industry.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 7 - Stratigraphy
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the discussion of interval-zone types and why last-appearance events are preferred with drilling cuttings.

Question 291 of 505

ID	formationeval_v0.1_petroleumgeology_pelagic_vs_benthic_biostrat_006
Domains	Petroleum Geology, Sedimentology
Topics	Biostratigraphy, Microfossils, Facies Dependence
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Which microfossil lifestyle most often provides higher long-distance correlation potential, and what is the main reason?

A	Pelagic (planktonic/nektonic), because it is typically less restricted to specific facies and can disperse widely
B	Benthic (bottom-dwelling), because it is controlled mainly by global ocean circulation rather than local conditions
C	Endobenthic (burrowing), because preservation is usually perfect in all sediment types
D	Epibenthic (surface-dwelling), because it is independent of water depth and oxygenation
Correct answer:	A - Pelagic (planktonic/nektonic), because it is typically less restricted to specific facies and can disperse widely

Rationale

Pelagic organisms are less tied to local depositional environments than many benthic groups, so their fossils tend to be more useful for broad regional correlation. Benthic assemblages often reflect specific bottom conditions and thus commonly have stronger facies control.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 7 - Stratigraphy
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on ethology (pelagic vs benthic) and implications for stratigraphic applicability.

Question 292 of 505

ID	formationeval_v0.1_petroleumgeology_biozone_vs_chronozone_007
Domains	Petroleum Geology
Topics	Biostratigraphy, Chronostratigraphy, Chronozones
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A marker species is known (from evolutionary first appearance to extinction) to define a specific time interval, but in a marginal-marine facies the species is absent even though deposition continued during that interval. What stratigraphic unit concept is intended to include those marginal-marine rocks as part of the same time slice?

A	Acme (abundance) zone
B	Assemblage zone
C	Local biozone based on the marker species
D	Taxon chronozone (biochronozone) representing the taxon’s total time range

Correct answer: D - Taxon chronozone (biochronozone) representing the taxon’s total time range

Rationale

A biozone is defined only where the fossil content is observed at a specific locality, so it cannot be extended through facies where the marker is missing. A taxon chronozone is intended to represent the entire interval between evolutionary appearance and extinction and can be applied as a time-rock concept even where the marker is not present.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 7 - Stratigraphy
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Built from the distinction between local biozones and total-range chronozones and the role of facies control.

Question 293 of 505

ID	formationeval_v0.1_petroleumgeology_geochronology_vs_chronostratigraphy_008
Domains	Petroleum Geology
Topics	Chronostratigraphy, Geochronology, Stratigraphic Hierarchy
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Which pairing correctly links a geochronological time unit to its corresponding chronostratigraphic rock unit?

A	Epoch ↔ Stage
B	Period ↔ System
C	Age ↔ Series
D	Era ↔ Stage
Correct answer:	B - Period ↔ System

Rationale

Geochronological units describe time intervals (e.g., a period), while chronostratigraphic units describe the rocks formed during those intervals (e.g., a system). The chapter explicitly uses Jurassic period (time) versus Jurassic system (rocks) as the example relationship.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 7 - Stratigraphy
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based check on the time-unit vs time-rock-unit correspondence (period/system).

Question 294 of 505

ID	formationeval_v0.1_petroleumgeology_radiometric_half_life_009
Domains	Petroleum Geology
Topics	Radiometric Dating, Half-life, Radioactive Decay
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

A radioactive parent nuclide has a decay constant of $\lambda = 1.0 \times 10^{-9}\ yr^{-1}$. Using the relationship T1/2 = 0.693/λ, what is its half-life?

A	6.93×10^{8} years
B	1.31×10^{9} years
C	4.89×10^{10} years
D	5.73×10^{3} years

Correct answer: A - 6.93×10^{8} years

Rationale

The half-life is computed directly from T1/2 = 0.693/λ. Substituting $\lambda = 1.0 \times 10^{-9}\ yr^{-1}$ gives T1/2 = 0.693 $\times 10^{9}$ years = 6.93×10^{8} years. The other values are half-lives mentioned for specific isotopic systems in the chapter and serve as plausible distractors.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 7 - Stratigraphy
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical application of the half-life relationship provided in the radiometric dating section.

Question 295 of 505

ID	formationeval_v0.1_petroleumgeology_rb_sr_isochron_010
Domains	Petroleum Geology, Geophysics
Topics	Radiometric Dating, Rubidium-Strontium, Isochrons
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the rubidium–strontium dating approach, multiple samples of the same age are plotted on a graph of $^{87}Rb/^{86}Sr$ versus $^{87}Sr/^{86}Sr$. What is the main interpretation if the data form a straight line?

A	The intercept of the line directly gives the half-life of ^{87}Rb
B	The scatter around the line proves the system stayed open to argon loss
C	The slope of the line can be used to infer the age of the rock or mineral system
D	The line indicates the rock must be volcanic because only lavas form linear trends

Correct answer:	C - The slope of the line can be used to infer the age of the rock or mineral system

Rationale

The chapter describes that same-age samples define an isochron (a straight line) on the $^{87}Rb/^{86}Sr$–$^{87}Sr/^{86}Sr$ plot, and that the line's slope reflects the time since formation. This method leverages ratios rather than absolute amounts and is distinct from argon-based systems.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 7 - Stratigraphy
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Item derived from the explanation of Rb–Sr isochron construction and the meaning of its slope.

Question 296 of 505

ID	formationeval_v0.1_sedimentology_sequence_stacking_patterns_011
Domains	Sedimentology, Petroleum Geology
Topics	Sequence Stratigraphy, Accommodation Space, Parasequence Stacking
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a basin analysis, relative sea level rise is creating accommodation faster than sediment is being supplied to the shoreline system. What stacking style should dominate the resulting parasequence set architecture?

A	Progradational stacking, with shoreline bodies stepping basinward through time
B	Retrogradational stacking, with shoreline bodies stepping landward through time
C	Aggradational stacking, with shoreline bodies staying fixed while only thickening vertically
D	Chaotic stacking, because sequence stratigraphy cannot be applied when sea level is rising

Correct answer: B - Retrogradational stacking, with shoreline bodies stepping landward through time

Rationale

When accommodation creation outpaces sediment supply, the system cannot build seaward effectively and the shoreline tends to backstep, producing retrogradational geometry. Progradation requires sediment supply to exceed available accommodation, while aggradation reflects a rough balance between the two.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 7 - Stratigraphy
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based question on accommodation–supply balance and resulting stacking geometries in sequence stratigraphy.

ID	formationeval_v0.1_geophysics_magnetostratigraphy_polarity_age_012
Domains	Geophysics, Petroleum Geology
Topics	Magnetostratigraphy, Palaeomagnetism, Polarity Reversals
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A near-surface lava flow records reversed remanent polarity. If the most recent ~700,000 years are described as dominantly normal polarity, what is the most reasonable age implication for this flow (ignoring short exceptions)?

A	It is very likely younger than 700,000 years because reversals are random at outcrop scale
B	It is most likely exactly 700,000 years old because polarity fixes an absolute date
C	It must be Quaternary because only Quaternary time contains reversals and normal polarity intervals in the geologic record
D	It is highly likely older than 700,000 years because it formed during an interval of reversed polarity

Correct answer: D - It is highly likely older than 700,000 years because it formed during an interval of reversed polarity

Rationale

Magnetostratigraphy uses globally synchronous polarity intervals, so a reversed signature in a context dominated by recent normal polarity implies formation before that normal interval. Polarity alone does not give an exact numerical date, but it provides a strong relative age constraint.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 7 - Stratigraphy
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the discussion of polarity reversals as correlation tools and the recent normal-polarity interval example.

Question 298 of 505

ID	formationeval_v0.1_geophysics_seismic_waves_001
Domains	Geophysics
Topics	Seismic Waves, Rock Physics
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A seismic survey records both compressional (P) and shear (S) arrivals. Which statement best describes how these wave types interact with pore fluids in sedimentary rocks?

A	Both P-waves and S-waves travel mainly through pore fluids, so they are equally sensitive to water or gas
B	P-waves can propagate through the rock frame and pore fluids, while S-waves require a solid framework
C	P-waves require a solid framework, while S-waves can travel through both solids and pore fluids
D	Neither P-waves nor S-waves can propagate through porous rocks because pores disrupt continuity
Correct answer:	B - P-waves can propagate through the rock frame and pore fluids, while S-waves require a solid framework

Rationale

Compressional waves involve volumetric strain and can pass through both solids and fluids, so they are recorded in fluid-saturated rocks. Shear waves require resistance to shear deformation, which fluids cannot provide, so they only propagate through the solid skeleton. This difference is central to how fluids influence seismic responses.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 8 - Sequence Stratigraphy, Seismic Stratigraphy and Basin Analysis
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based item derived from the discussion of P- versus S-wave propagation in porous media.

Question 299 of 505

ID	formationeval_v0.1_geophysics_seismic_velocity_002
Domains	Geophysics, Petrophysics
Topics	Seismic Velocity, Cementation Effects
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two sandstone intervals have similar porosity at the same burial depth, but one has strong carbonate cement at grain contacts. Compared with the weakly cemented interval, what seismic-velocity effect is most likely and why?

A	Lower velocity, because cement increases the amount of pore space that the wave must cross
B	Lower velocity, because carbonate minerals necessarily slow down elastic waves relative to quartz grains
C	Similar velocity, because porosity alone controls velocity once the rock is water-saturated
D	Higher velocity, because cement strengthens grain coupling and increases the rock's stiffness
Correct answer:	D - Higher velocity, because cement strengthens grain coupling and increases the rock's stiffness

Rationale

Cement that binds grains into a stiffer framework increases elastic stiffness and therefore raises wave speed, even when porosity remains relatively high. The chapter also emphasizes that rocks with the same porosity can show different velocities because grain contacts and cement distribution matter. Porosity is important, but it is not the only control.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 8 - Sequence Stratigraphy, Seismic Stratigraphy and Basin Analysis
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based item on how cementation and grain-contact stiffness affect seismic velocity beyond porosity alone.

Question 300 of 505

ID	formationeval_v0.1_geophysics_reflection_coefficient_003
Domains	Geophysics
Topics	Reflection Coefficient, Acoustic Impedance
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

A normal-incidence seismic wave encounters a boundary where Layer 1 has density 2300 kg/m³ and P-wave velocity 3000 m/s, and Layer 2 has density 2500 kg/m³ and P-wave velocity 5000 m/s. Using the reflection-coefficient relationship based on acoustic impedance, what is the approximate reflection coefficient magnitude?

A	0.29
B	0.06
C	0.41
D	0.86
Correct answer:	A - 0.29

Rationale

Acoustic impedance is Z = ρv. Here Z1 = 2300×3000 = 6.9×10^6 and Z2 = 2500×5000 = 12.5×10^6, so R = (Z2−Z1)/(Z2+Z1) ≈ 5.6/19.4 ≈ 0.29. The other values are inconsistent with the relative impedance contrast implied by the numbers.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 8 - Sequence Stratigraphy, Seismic Stratigraphy and Basin Analysis
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based calculation using the chapter's reflection-coefficient definition in terms of impedance contrast.

Question 301 of 505

ID	formationeval_v0.1_geophysics_seismic_resolution_004
Domains	Geophysics
Topics	Seismic Resolution, Stratigraphic Imaging
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A reservoir contains thin interbeds of sand and shale, each much thinner than the vertical resolution of the seismic data. What is the most likely outcome on the seismic section?

A	Each thin bed will appear as a separate reflector because impedance contrast alone controls resolution
B	The reflector spacing will directly equal the true bed thickness regardless of the seismic wavelength
C	Individual beds will not be distinctly separated; the response will be dominated by the wavelet and an averaged impedance effect
D	The seismic record will show no reflections at all because thin beds absorb all seismic energy
Correct answer:	C - Individual beds will not be distinctly separated; the response will be dominated by the wavelet and an averaged impedance effect

Rationale

The chapter notes that there is a practical lower limit to resolvable thickness tied to the wavelength (on the order of about half a wavelength). When beds are thinner than this limit, reflections from closely spaced boundaries interfere and do not form clearly separated events. The result is a blended or composite seismic response rather than bed-by-bed imaging.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 8 - Sequence Stratigraphy, Seismic Stratigraphy and Basin Analysis
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based item on vertical resolution limits and the role of seismic wavelength/pulse width.

Question 302 of 505

ID	formationeval_v0.1_geophysics_flat_spots_005
Domains	Geophysics, Petroleum Geology
Topics	Direct Hydrocarbon Indicators, Flat Spots
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

On a seismic section, a strong reflection event is nearly horizontal and cuts across dipping stratigraphic reflections. In the context of hydrocarbon interpretation, what is the most likely explanation for this 'flat spot'?

A	A lithologic boundary that must parallel bedding because depositional layering inherently controls seismic reflections
B	A fluid contact that can remain level and generate a strong impedance contrast, producing a so-called flat spot
C	A fault plane, because steep discontinuities commonly reflect seismic energy back to the source
D	A purely processing artifact that cannot be distinguished from geology even after filtering

Correct answer:	B - A fluid contact that can remain level and generate a strong impedance contrast, producing a so-called flat spot

Rationale

The chapter describes a horizontal reflector that does not follow stratigraphy as a potential indicator of a fluid contact (often gas-related) because it can create a strong impedance contrast and stays level. It also warns that near-horizontal multiple reflections can mimic this appearance, but those can be addressed during processing. Fault planes themselves are typically too steep to act as clear reflectors.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 8 - Sequence Stratigraphy, Seismic Stratigraphy and Basin Analysis
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based item on interpreting horizontal crosscutting reflections as potential fluid contacts (flat spots) versus other causes.

ID	formationeval_v0.1_petroleumgeology_seismic_stratigraphy_006
Domains	Petroleum Geology, Sedimentology
Topics	Seismic Stratigraphy, Stratal Termination Patterns
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A seismic package shows clinoform reflections that build basinward across a surface, with the youngest reflectors stepping progressively farther into the basin. Which stratal termination pattern best fits this geometry?

A	Baselap, because reflectors gradually accumulate above the basal surface without basinward stepping
B	Onlap, because nearly horizontal reflectors terminate against a sloping surface during transgression
C	Toplap, because reflectors are truncated at an upper erosional surface
D	Downlap, associated with basinward progradation (offlap) where younger beds extend farther seaward

Correct answer:	D - Downlap, associated with basinward progradation (offlap) where younger beds extend farther seaward

Rationale

The chapter links basinward-stepping progradation across a surface to downlap, and describes the overall basinward building as offlap. Onlap instead describes beds terminating landward against an inclined surface during transgression. Toplap concerns termination against an upper boundary, commonly involving truncation.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 8 - Sequence Stratigraphy, Seismic Stratigraphy and Basin Analysis
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on interpreting basinward progradation in terms of downlap/offlap terminology.

Question 304 of 505

ID	formationeval_v0.1_petroleumgeology_sea_level_change_007
Domains	Petroleum Geology
Topics	Sea Level Change, Coastal Onlap Interpretation, Isostasy
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A geoscientist uses the vertical range of coastal onlap on a seismic profile to estimate sea-level rise. What is the key reason this estimate cannot be treated as purely eustatic without further analysis?

A	Onlap geometry is controlled only by changes in sediment grain size, not by water depth or relative sea level changes
B	Eustatic sea level cannot create onlap patterns because onlap requires tectonic uplift
C	Local subsidence and isostatic adjustment to water and sediment loading can modify the relative sea-level signal
D	The onlap height range equals the compaction-corrected thickness of the entire basin fill
Correct answer:	C - Local subsidence and isostatic adjustment to water and sediment loading can modify the relative sea-level signal

Rationale

The chapter emphasizes that onlap reflects relative sea level, which combines sea-level change with local tectonic subsidence/uplift and isostatic responses to loading. Increased water depth adds load and can increase subsidence, while sediment deposition adds further load. Therefore, the observed onlap height is not a direct measure of global (eustatic) sea level by itself.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 8 - Sequence Stratigraphy, Seismic Stratigraphy and Basin Analysis
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on interpreting onlap as relative sea-level change and the need to consider subsidence/isostasy.

Question 305 of 505

ID	formationeval_v0.1_petroleumgeology_isostatic_loading_008
Domains	Petroleum Geology
Topics	Isostatic Compensation, Sea Level Loading
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	low

A 100 m eustatic sea-level rise increases water loading on the crust and causes an additional 43.5 m of isostatic subsidence. What is the resulting equilibrium increase in water depth?

A	143.5 m
B	100 m
C	43.5 m
D	250 m
Correct answer:	A - 143.5 m

Rationale

The equilibrium change combines the primary sea-level rise (100 m) and the additional subsidence driven by the added water load (43.5 m). Adding these gives 143.5 m total increase in water depth at isostatic equilibrium. The 250 m figure relates to subsequent added accommodation when sediment infills the basin, not the water-only step.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 8 - Sequence Stratigraphy, Seismic Stratigraphy and Basin Analysis
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical item derived from the chapter’s example of water loading and isostatic amplification of sea-level rise.

Question 306 of 505

ID	formationeval_v0.1_petroleumgeology_backstripping_009
Domains	Petroleum Geology
Topics	Backstripping, Basin Subsidence History, Thermal Maturity
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In basin analysis, why is backstripping applied to well/stratigraphic data, and which uncertainty can strongly limit the reliability of the reconstructed burial/temperature history?

A	It is used to convert seismic time directly into lithology, and the main uncertainty is clay-mineral type
B	It is used to recover primary tectonic/eustatic components of subsidence by removing compaction and load effects, and a major uncertainty is how geothermal gradient changed through time
C	It is used to identify strike-slip fault offsets, and the main uncertainty is the salinity of formation water
D	It is used to compute reflection coefficients from density logs, and the main uncertainty is the seismic wavelet shape

Correct answer:	B - It is used to recover primary tectonic/eustatic components of subsidence by removing compaction and load effects, and a major uncertainty is how geothermal gradient changed through time

Rationale

The chapter describes backstripping as a way to work backward from observed stratigraphy to infer the primary subsidence signal by accounting for compaction and loading influences. It also stresses that estimating how geothermal gradient evolved over geological time is crucial yet difficult, and it strongly impacts modeled temperature histories and maturity. Palaeowater depth estimates are also challenging, but the geothermal-gradient history is explicitly flagged as critical for maturity modeling.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 8 - Sequence Stratigraphy, Seismic Stratigraphy and Basin Analysis
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on the purpose of backstripping and key uncertainties (especially geothermal-gradient history) in basin modeling.

ID	formationeval_v0.1_petroleumgeology_rift_basins_010
Domains	Petroleum Geology, Sedimentology
Topics	Rift Basins, Evaporites, Salt Tectonics
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A rift basin develops in an arid climate and becomes partly isolated from open marine circulation. Considering the depositional and structural characteristics of such restricted rift settings, what outcome is most likely for the sedimentary fill and petroleum system evolution?

A	Glacioeustatic carbonates dominate, and sealing capacity is usually poor because carbonates necessarily fracture under burial stress
B	Deep-marine pelagic limestones dominate, and structural traps are unlikely because rifts have no faulting
C	Smectite-rich shale dominates, and salt-related structures are not expected because evaporites require humid climates
D	Evaporites are likely to accumulate and can form effective seals; thick salt may later create domes that generate traps

Correct answer: D - Evaporites are likely to accumulate and can form effective seals; thick salt may later create domes that generate traps

Rationale

The chapter links arid, restricted basins during rifting to evaporite deposition and notes that thick salt can behave as an excellent seal. It also describes how sufficiently thick salt may rise to form domes that create structural traps and influence sediment distribution. These behaviors are part of why some rift-related evaporite systems become prolific petroleum provinces.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 8 - Sequence Stratigraphy, Seismic Stratigraphy and Basin Analysis
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based item on arid rift settings, evaporite deposition, sealing behavior, and salt-dome trap development.

Question 308 of 505

ID	formationeval_v0.1_geophysics_seismic_migration_011
Domains	Geophysics
Topics	Fault Imaging, Seismic Migration, 3D Seismic Interpretation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In conventional reflection seismic data, why can faults be difficult to position accurately, and what processing approach helps correct mispositioning related to edge/diffraction effects?

A	Fault planes are commonly too steep to return energy as a clear reflector, and migration processing can reposition events to better represent true structure
B	Fault planes inherently reflect strongly due to their planar geometry, but interpreters mis-pick them because density logs are unavailable; the solution is to run a neutron log
C	Faults are invisible because seismic velocity is independent of stress; the solution is to increase shot energy only
D	Faults disappear only in carbonates due to high rigidity and low acoustic impedance contrast; the preferred solution is to avoid 3D surveys and use 2D lines only

Correct answer: A - Fault planes are commonly too steep to return energy as a clear reflector, and migration processing can reposition events to better represent true structure

Rationale

The chapter notes that fault surfaces are commonly too steep to reflect energy back to the receivers, and that terminations can generate diffraction/edge effects that distort apparent fault location. Migration is specifically identified as a processing step that can correct many of these positioning errors. The chapter also highlights that dense 3D seismic helps map faults by enabling flexible section orientations and horizontal time-slices.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 8 - Sequence Stratigraphy, Seismic Stratigraphy and Basin Analysis
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on why faults may not appear as reflectors and how migration/3D methods improve structural imaging.

Question 309 of 505

ID	formationeval_v0.1_geophysics_wyllie_equation_012
Domains	Geophysics, Petrophysics
Topics	Wyllie Equation, Velocity-Porosity Relationship
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

A water-saturated sandstone has measured P-wave velocity Vr = 3.0 km/s. Assume matrix velocity Vm = 5.8 km/s and pore-fluid velocity Vf = 1.5 km/s. Using the time-average (Wyllie) relation, what is the approximate porosity?

A	0.10
B	0.20
C	0.33
D	0.45

Correct answer: C - 0.33

Rationale

Using $1/V_r = (1-\phi)/V_m + \phi/V_f$ gives $0.333 \approx 0.172 + \phi(0.667-0.172)$, so $\phi \approx (0.333-0.172)/0.494 \approx 0.33$. The chapter also cautions that this equation is a simplification because rocks with the same porosity can have different velocities depending on contacts and cement distribution. Even so, it provides an approximate porosity estimate from velocity when matrix and fluid velocities are assumed.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 8 - Sequence Stratigraphy, Seismic Stratigraphy and Basin Analysis
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based calculation applying the chapter's presentation of Wyllie's time-average equation and its limitations.

Question 310 of 505

ID	formationeval_v0.1_geophysics_heat_transport_001
Domains	Geophysics, Petroleum Geology
Topics	Heat Transport, Conduction vs Advection
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In most sedimentary basins (away from special settings), which process is expected to carry the majority of heat upward through the stratigraphic section?

A	Thermal conduction through rocks and pore fluids
B	Heat advection by rapid basin-wide porewater flow
C	Radiative heat transfer through pore space
D	Latent heat transfer dominated by hydrocarbon phase changes

Correct answer: A - Thermal conduction through rocks and pore fluids

Rationale

The chapter describes upward heat flow in sedimentary basins as being dominated by conduction (thermal diffusion). It also notes that porewater flow can transport heat, but typical basin flow rates are usually too small to matter except in settings like intrusions or high-flux meteoric systems.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 9 - Heat Transport in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Focuses on the dominant heat-transport mechanism in typical basin conditions.

Question 311 of 505

ID	formationeval_v0.1_geophysics_heat_production_002
Domains	Geophysics, Petroleum Geology
Topics	Radiogenic Heat, Basement Composition
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A basin overlies two different basement types: granite in one area and gabbro in another. Based on radiogenic heat production, which area is more likely to have higher background heat input from the basement?

A	The gabbro-dominated basement because mafic rocks conduct heat better
B	The granite-dominated basement because it is commonly enriched in radioactive elements
C	Both areas because heat production depends mainly on present-day temperature
D	Neither area because radioactive heat production is negligible in continental crust
Correct answer:	B - The granite-dominated basement because it is commonly enriched in radioactive elements

Rationale

The chapter attributes much of crustal heat to radioactive processes and emphasizes that granitic rocks tend to be enriched in uranium, thorium, and potassium. Mafic rocks like gabbro are described as having much lower contributions from these elements in this context.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 9 - Heat Transport in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Uses basement-rock composition to test understanding of radiogenic heat sources.

Question 312 of 505

ID	formationeval_v0.1_geophysics_geothermal_gradient_003
Domains	Geophysics
Topics	Geothermal Gradient, Heat Flow Equation
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

If the vertical heat flow is similar in two adjacent stratigraphic intervals, which interval should show the larger geothermal gradient?

A	The interval with higher thermal conductivity (e.g., salt)
B	The interval with higher porosity regardless of mineralogy
C	The interval with lower thermal conductivity (e.g., shale-rich rock)
D	Both intervals should have identical geothermal gradients if heat flow matches
Correct answer:	C - The interval with lower thermal conductivity (e.g., shale-rich rock)

Rationale

From the relationship $\nabla T = Q/c$, the gradient increases when conductivity decreases for the same heat flux. The chapter explicitly contrasts low-conductivity mudstones/shales (steeper gradients) with highly conductive salt (gentler gradients).

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 9 - Heat Transport in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Targets the inverse link between conductivity and gradient when heat flow is steady.

Question 313 of 505

ID	formationeval_v0.1_geophysics_heat_flow_calculation_004
Domains	Geophysics
Topics	Heat Flow Equation, Geothermal Gradient
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

Assume 1-D conductive heat transport where heat flow Q = c(dT/dz). If heat flow is 60 mW/m² and thermal conductivity is 2.0 W/mK, what geothermal gradient is implied?

A	12 °C/km
B	20 °C/km
C	24 °C/km
D	30 °C/km
Correct answer:	D - 30 °C/km

Rationale

Convert 60 mW/m² to 0.060 W/m², then compute dT/dz = Q/c = 0.060/2.0 = 0.030 K/m. Converting 0.030 K/m to per kilometer gives 30 K/km (same increment as °C for a gradient).

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 9 - Heat Transport in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical application of Q = c(dT/dz) using typical basin-scale units.

Question 314 of 505

ID	formationeval_v0.1_geophysics_effective_conductivity_005
Domains	Geophysics, Petrophysics
Topics	Thermal Conductivity, Porosity Effects
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

Using the porosity-weighted approximation (k_bulk = ϕ·k_fluid + (1−ϕ)·k_matrix) for a water-saturated rock, estimate the bulk thermal conductivity if porosity is 0.25, matrix conductivity is 5.5 W/mK, and porewater conductivity is 0.6 W/mK.

A	About 1.8 W/mK
B	About 3.0 W/mK
C	About 4.3 W/mK
D	About 5.1 W/mK

Correct answer: C - About 4.3 W/mK

Rationale

Apply the weighted sum: Cbulk ≈ Cr(1-ϕ) + ϕCf = 5.5(0.75) + 0.25(0.6) = 4.125 + 0.15 = 4.275 W/mK. That rounds to about 4.3 W/mK.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 9 - Heat Transport in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Computes an approximate bulk conductivity from porosity and phase conductivities.

Question 315 of 505

ID	formationeval_v0.1_geophysics_thermal_anisotropy_006
Domains	Geophysics, Sedimentology
Topics	Thermal Anisotropy, Shale Conductivity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A shale interval shows direction-dependent heat conduction. Which statement best describes shale thermal conductivity relative to bedding?

A	Conductivity is higher perpendicular to bedding because compaction closes pores along laminae
B	Conductivity can be substantially higher parallel to bedding than perpendicular to bedding
C	Conductivity is direction-independent because heat diffusion is isotropic in sedimentary rocks
D	Conductivity is controlled only by salinity, so bedding orientation is irrelevant to the measured resistivity value

Correct answer: B - Conductivity can be substantially higher parallel to bedding than perpendicular to bedding

Rationale

The chapter notes that shale conductivity measured along bedding can be much higher (up to ~70%) than measurements taken across bedding. This reflects anisotropy tied to fabric and layering, not only fluid properties.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 9 - Heat Transport in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Assesses understanding of conductivity anisotropy in shales.

Question 316 of 505

ID	formationeval_v0.1_geophysics_blanketing_effect_007
Domains	Geophysics, Petroleum Geology
Topics	Blanketing Effect, Geothermal Gradient
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A low-conductivity mudstone package overlies older rocks while the regional basement heat flux remains similar. What is the most likely thermal consequence?

A	Lower temperatures at depth because low-conductivity rocks dissipate heat more efficiently
B	No effect on subsurface temperatures because only heat production controls the gradient, not crustal thickness or conductivity
C	A steeper near-surface gradient that makes deeper units warmer than they otherwise would be
D	A reversal of the geothermal gradient because heat is trapped and forced downward
Correct answer:	C - A steeper near-surface gradient that makes deeper units warmer than they otherwise would be

Rationale

With roughly constant heat flux over a vertical interval, lowering conductivity increases the required temperature gradient. The chapter describes this as an insulating (blanketing) behavior: the shallow low-conductivity layer forces higher gradients and can raise temperatures in underlying sediments.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 9 - Heat Transport in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Conceptual consequence of placing low-conductivity strata near the surface.

Question 317 of 505

ID	formationeval_v0.1_geophysics_salt_thermal_effect_008
Domains	Geophysics, Petroleum Geology, Reservoir Engineering
Topics	Salt Conductivity Effects, Thermal Maturity, Reservoir Quality
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A thick salt layer overlies a potential reservoir and source-rock system. Given that salt has much higher thermal conductivity than typical sediments, which temperature pattern and petroleum-system implication is most consistent?

A	Temperatures increase below the salt because salt amplifies the geothermal gradient at depth, accelerating cracking to gas
B	Temperatures are uniform across the salt because salt blocks heat flow entirely, halting maturation above and below
C	Temperatures are lower below the salt than typical for that depth, which can help preserve oil/condensate and limit quartz cementation
D	Temperatures are lower above the salt because high conductivity cools the overburden, improving maturity beneath the salt

Correct answer: C - Temperatures are lower below the salt than typical for that depth, which can help preserve oil/condensate and limit quartz cementation

Rationale

The chapter explains that high-conductivity salt supports a low gradient within the salt, producing relatively higher temperatures at the top and lower temperatures at the base (below the salt). The source explicitly states that temperatures below the salt will be significantly lower than normal at that depth, which means better reservoir quality due to less quartz cement, and preservation of oil/condensate due to less thermal cracking to gas.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 9 - Heat Transport in Sedimentary Basins
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Links conductive effects of salt to maturation and sandstone reservoir quality outcomes.

ID	formationeval_v0.1_geophysics_sedimentation_cooling_009
Domains	Geophysics, Petroleum Geology
Topics	Subsidence, Transient Heat Flow, Cold Basins
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two basins have similar basement heat input and similar lithologies, but Basin A has very rapid sedimentation and subsidence. Based on transient heat-flow principles, what is the best expectation for Basin A during active subsidence?

A	Lower effective heat flow and reduced geothermal gradients because energy is diverted into warming newly buried rocks
B	Higher effective heat flow and increased geothermal gradients because compaction releases heat to the surface
C	Unchanged geothermal gradients because heat flow is invariably constant regardless of burial history or sedimentation rate effects on thermal equilibration
D	Higher gradients because rapid burial increases radiogenic heat production in sediments immediately
Correct answer:	A - Lower effective heat flow and reduced geothermal gradients because energy is diverted into warming newly buried rocks

Rationale

The chapter states that heat flux is only constant at equilibrium; during subsidence some of the background heat is consumed by heating the sinking sediments and basement. This leads to reduced geothermal gradients, producing comparatively cold basins during periods of rapid sedimentation.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 9 - Heat Transport in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Integrates burial history with non-equilibrium heat flow and geothermal-gradient behavior.

Question 319 of 505

ID	formationeval_v0.1_geophysics_advective_heat_transport_010
Domains	Geophysics, Reservoir Engineering
Topics	Advection, Isotherms, Fluid Flow Direction
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Advective heat transport by water flow includes a factor of sinα where α is the angle between the flow direction and isotherms. What situation minimizes advective heat transport even if the Darcy velocity is large?

A	Flow is perpendicular to isotherms so water crosses many temperature contours
B	Flow is parallel to isotherms so water tends to stay at the same temperature
C	Flow occurs in highly saline water so the conductivity of the fluid dominates
D	Flow occurs in low-porosity rock so the water phase stores most of the heat
Correct answer:	B - Flow is parallel to isotherms so water tends to stay at the same temperature

Rationale

The chapter notes that advective heat transport depends on the component of flow that cuts across temperature contours; the sinα term goes to zero when flow is parallel to isotherms. In that case, moving fluid does not transport heat across the temperature field in the model sense, even if the volumetric flux is high.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 9 - Heat Transport in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Tests interpretation of the flow-direction term (sinα) in advective heat transport.

Question 320 of 505

ID	formationeval_v0.1_reservoirengineering_formation_water_chemistry_001
Domains	Reservoir Engineering, Production Engineering
Topics	Formation Water, Water Injection Monitoring
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

During offshore waterflooding, seawater is injected into a reservoir whose original formation water has a different chemistry. What is a practical reason to analyze the produced water chemistry during production?

A	To detect whether injected seawater has reached the producing well
B	To determine the burial temperature history of the source rock directly
C	To calculate the vertical stress (overburden) at the perforation depth
D	To estimate grain density for converting porosity to void ratio

Correct answer: A - To detect whether injected seawater has reached the producing well

Rationale

Injected seawater typically has a distinct ionic composition compared with in-situ formation water. Tracking produced-water composition can therefore indicate breakthrough of injected water at the producer. The other options are not objectives that produced-water chemistry alone can directly deliver in this context.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 10 - Subsurface Water and Fluid Flow in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from discussion of using produced-water composition to identify injected-water breakthrough.

Question 321 of 505

ID	formationeval_v0.1_petroleumgeology_effective_stress_002
Domains	Petroleum Geology, Drilling Engineering
Topics	Effective Stress, Pore Pressure
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In a sedimentary basin, which expression best represents the effective stress carried by the solid framework of a fluid-saturated rock?

A	P − ρfgh, where ρf is the pore-fluid density
B	ρrgh − P, where ρrgh is the lithostatic (total) stress
C	P + ρrgh, where P is pore pressure and ρrgh is total stress
D	ρfgh − P, where ρfgh is the hydrostatic pressure
Correct answer:	B - ρrgh − P, where ρrgh is the lithostatic (total) stress

Rationale

Effective stress is the portion of total (lithostatic) stress that is not supported by pore pressure; it is total stress minus pore pressure. The other expressions either use the wrong density term or combine pressure and stress in a way that does not represent stress transmitted through the grains.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 10 - Subsurface Water and Fluid Flow in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item from the section defining lithostatic stress, pore pressure, and effective stress.

Question 322 of 505

ID	formationeval_v0.1_petrophysics_relative_permeability_003
Domains	Petrophysics, Reservoir Engineering
Topics	Permeability, Multiphase Flow
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

When two immiscible fluids occupy the pore space (e.g., water and oil), what does “relative permeability” describe?

A	The rock’s resistance to flow expressed only in square meters, independent of fluids
B	The ratio of pore pressure to lithostatic stress in the flowing interval
C	The ability of the rock to transmit one fluid phase compared with the single-phase case
D	The density contrast between two fluids that determines buoyancy forces
Correct answer:	C - The ability of the rock to transmit one fluid phase compared with the single-phase case

Rationale

Relative permeability refers to how easily one phase flows when another immiscible phase is also present, compared to the permeability at 100% saturation of that phase. Absolute (intrinsic) permeability is a rock property defined without reference to multiphase effects.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 10 - Subsurface Water and Fluid Flow in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter’s distinction between intrinsic (absolute) permeability and relative permeability.

Question 323 of 505

ID	formationeval_v0.1_petroleumgeology_overpressure_definition_004
Domains	Petroleum Geology, Drilling Engineering
Topics	Overpressure, Potentiometric Surface
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A permeable interval is tested with an open pipe connected to a reference datum at sea level. Which observation most directly indicates the interval is overpressured?

A	The water level in the pipe stabilizes exactly at sea level
B	The water level in the pipe stabilizes below sea level
C	The water level in the pipe fluctuates because of tidal loading
D	The water level in the pipe rises and stabilizes above sea level
Correct answer:	D - The water level in the pipe rises and stabilizes above sea level

Rationale

Overpressure is associated with a potentiometric (piezometric) surface that would stand above the reference datum (e.g., sea level). If the stabilized water level is near sea level, the interval is normally pressured relative to that datum.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 10 - Subsurface Water and Fluid Flow in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	From the discussion linking potentiometric surfaces to normal pressure versus overpressure.

Question 324 of 505

ID	formationeval_v0.1_petrophysics_conservative_ions_005
Domains	Petrophysics, Petroleum Geology
Topics	Formation Water Chemistry, Fluid Flow Tracers
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A geoscientist wants ions that best reflect transport and mixing rather than water–rock reactions. Which pair is most suitable as a tracer in many sedimentary basins?

A	Cl^- and Br^-
B	Ca^{2+} and Mg^{2+}
C	HCO_3^- and CO_3^{2-}
D	K^+ and Fe^{2+}

Correct answer: A - Cl^- and Br^-

Rationale

Chloride and bromide tend to be comparatively conservative because they react only weakly with common basin minerals, so their distribution more directly reflects fluid movement. Many other ions can be buffered by mineral equilibria or strongly affected by ion exchange and redox reactions.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 10 - Subsurface Water and Fluid Flow in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based question derived from the chapter’s discussion of conservative ions for tracing flow.

Question 325 of 505

ID	formationeval_v0.1_petrophysics_salt_sieving_006
Domains	Petrophysics, Sedimentology
Topics	Clay Membranes, Salt Sieving, pH Effects
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A compacted clay-rich layer behaves as a semi-permeable membrane during burial. Which ion movement is most associated with charge balancing in a way that can lower pH on one side of the membrane?

A	Upward migration of Cl^-, increasing alkalinity
B	Counter-migration of H^+, increasing acidity
C	Preferential retention of Na^+, increasing pH
D	Downward migration of SO42−, buffering acidity
Correct answer:	B - Counter-migration of H^+, increasing acidity

Rationale

Negatively charged clay surfaces tend to hinder anions and promote selective ion behavior, so small ions such as H^+ can migrate to maintain electroneutrality. This can raise the hydrogen ion activity (lower pH) and also contribute to concentration effects often described as salt sieving.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 10 - Subsurface Water and Fluid Flow in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the membrane behavior of compacted clays, selective ion transport, and pH change described in the chapter.

ID	formationeval_v0.1_petroleumgeology_clay_dehydration_007
Domains	Petroleum Geology, Sedimentology
Topics	Clay Mineral Diagenesis, Salinity Evolution
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

During burial heating, certain clay transformations release water and bind cations. What is a likely consequence for porewater salinity in shale relative to adjacent sandstone at the same depth?

A	Shale porewater becomes consistently more saline because clays dissolve halite
B	Shale porewater becomes identical to sandstone porewater due to rapid mixing
C	Shale porewater can be less saline because relatively fresh water is released during clay reactions
D	Shale porewater becomes more saline because HCO_3^- is removed by oxidation
Correct answer:	C - Shale porewater can be less saline because relatively fresh water is released during clay reactions

Rationale

Burial reactions such as smectite-to-illite (and other clay-related transformations) release crystal-bound water and can sequester cations, which can dilute porewater. The chapter notes that shales may therefore show lower salinity than sandstones at comparable depth, reflecting diagenetic water release and limited mixing.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 10 - Subsurface Water and Fluid Flow in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the discussion of clay mineral instability ranges, water release, and shale–sand salinity contrasts.

Question 327 of 505

ID	formationeval_v0.1_petrophysics_permeability_averaging_008
Domains	Petrophysics, Reservoir Engineering
Topics	Permeability Upscaling, Layered Media
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A stratified interval contains several sandstone beds separated by thin, very tight shale layers. To estimate vertical leakage across bedding, which permeability average is most appropriate, and what typically dominates the result?

A	Arithmetic mean, dominated by the most permeable sandstone
B	Geometric mean, dominated by the median permeability bed
C	Thickness-weighted mean, dominated equally by all layers
D	Harmonic mean, dominated by the lowest-permeability layers
Correct answer:	D - Harmonic mean, dominated by the lowest-permeability layers

Rationale

For flow perpendicular to bedding, the effective permeability corresponds to a harmonic mean, which is strongly controlled by the tightest layers. Even thin low-permeability shales or cemented streaks can severely limit vertical flow and therefore control the upscaled value.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 10 - Subsurface Water and Fluid Flow in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Conceptual question based on the chapter’s treatment of harmonic versus arithmetic means for permeability in layered sequences.

Question 328 of 505

ID	formationeval_v0.1_petroleumgeology_connate_water_sulphate_009
Domains	Petroleum Geology, Sedimentology
Topics	Redox Boundary, Marine Porewater Evolution
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Marine porewater shortly after burial can differ from seawater in key ions. What best explains why deep marine-derived porewater can have very low sulphate while chlorinity stays close to the original seawater value?

A	Bacteria consume sulphate during reduction, while chloride is largely unaffected by diagenetic reactions
B	Sulphate is added by oxidation of hydrocarbons, while chloride is removed by carbonate precipitation
C	Sulphate and chloride are both strongly absorbed by clay surfaces, reducing both equally
D	Sulphate is diluted by evaporation, while chloride is consumed during pyrite formation
Correct answer:	A - Bacteria consume sulphate during reduction, while chloride is largely unaffected by diagenetic reactions

Rationale

Just below the seabed, sulphate can be reduced by microbial processes and therefore becomes depleted with burial, whereas chloride is generally conservative and not significantly consumed by common diagenetic reactions. This combination produces a typical “low sulphate, similar chlorinity” signature for modified marine porewater.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 10 - Subsurface Water and Fluid Flow in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the description of oxygen loss, sulphate reduction, and conservative behavior of chloride below the seafloor.

Question 329 of 505

ID	formationeval_v0.1_reservoirengineering_meteoric_water_penetration_010
Domains	Reservoir Engineering, Petroleum Geology
Topics	Meteoric Water Flow, Freshwater Wedge
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

A coastal aquifer has a groundwater table 10 m above sea level. Using ρsw = 1.025 g/cm³ for saline water and ρmw = 1.000 g/cm³ for meteoric water, what is the approximate depth (below sea level) to the base of the freshwater wedge predicted by D = H·ρmw/(ρsw − ρmw)?

A	About 40 m
B	About 400 m
C	About 4,000 m
D	About 40,000 m

Correct answer: B - About 400 m

Rationale

With the given densities, (ρsw − ρmw) ≈ 0.025 g/cm³, so D ≈ 10 × 1.0 / 0.025 ≈ 400 m. The result reflects that a relatively small freshwater head can balance a much thicker column because the density difference is modest.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 10 - Subsurface Water and Fluid Flow in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Calculation item based on the density-balance estimate for meteoric-water penetration beneath coasts/islands.

ID	formationeval_v0.1_petroleumgeology_thermal_convection_stability_011
Domains	Petroleum Geology, Geophysics
Topics	Thermal Convection, Salinity Stratification, Density Effects
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In a basin with a normal geothermal gradient, formation-water data show salinity increasing downward at roughly 30 ppm/m and remaining stratified over large depth intervals. What is the most consistent implication for large-scale convective overturning of porewater?

A	Convection should be vigorous because higher salinity lowers density at depth
B	Convection should be vigorous because the salinity gradient guarantees density inversion
C	Convection is strongly suppressed because the salinity-related density increase can outweigh thermal expansion
D	Convection is unaffected because salinity has negligible influence on porewater density
Correct answer:	C - Convection is strongly suppressed because the salinity-related density increase can outweigh thermal expansion

Rationale

Increasing temperature tends to decrease water density and can drive instability, but increasing salinity raises density and can stabilize the water column. The chapter notes that a sufficiently strong salinity gradient can more than compensate for thermal expansion, and persistent stratification is evidence that convection has not mixed the system on a large scale.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 10 - Subsurface Water and Fluid Flow in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Hard integration item combining density effects of temperature and salinity with the inference of limited vertical mixing.

Question 331 of 505

ID	formationeval_v0.1_petroleumgeology_faults_conduit_barrier_012
Domains	Petroleum Geology, Reservoir Engineering
Topics	Fault Hydraulics, Fracture Permeability, Overpressure
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Which situation most favors a fault acting as a long-lived conduit for basin fluids rather than a barrier?

A	A fault in ductile, actively subsiding mud-rich sediments where fractures readily stay open
B	A fault where clay smearing is absent because shale cannot be incorporated into the fault zone
C	A fault in a porous, weakly cemented sandstone where matrix flow is negligible compared to fracture flow
D	A fault in well-cemented or uplifted brittle rocks where open/brecciated fractures can persist, at least until cementation reduces permeability
Correct answer:	D - A fault in well-cemented or uplifted brittle rocks where open/brecciated fractures can persist, at least until cementation reduces permeability

Rationale

The chapter emphasizes that sustained flow along a fault requires the fracture system to remain open, which is more feasible in strong, brittle, well-cemented or uplifted rocks. In subsiding, weaker sediments, faults and fractures are more likely to close or become sealing (e.g., via clay smear or cementation), making them barriers or only transient conduits.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 10 - Subsurface Water and Fluid Flow in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item from the chapter’s discussion of when faults behave as conduits versus barriers and the role of rock strength and cementation.

Question 332 of 505

ID	formationeval_v0.1_petroleumgeology_effective_stress_001
Domains	Petroleum Geology
Topics	Effective Stress, Pore Pressure
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A sandstone layer is buried deeper so the overburden (total vertical stress) increases, but the pore pressure also increases by the same amount. In this situation, what happens to the effective vertical stress that controls mechanical compaction?

A	It increases by the same amount as the overburden
B	It stays approximately unchanged because total stress and pore pressure rise together
C	It drops to zero because the pores carry all the load
D	It becomes equal to the pore pressure because fluids transmit stress

Correct answer: B - It stays approximately unchanged because total stress and pore pressure rise together

Rationale

Effective vertical stress is defined as total vertical stress minus pore pressure. If both increase by the same increment, their difference remains roughly constant. Mechanical compaction in weakly cemented sediments is governed primarily by this effective stress rather than total stress alone.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 11 - Introduction to Geomechanics: Stress and Strain in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on the effective stress definition and its implication for compaction.

Question 333 of 505

ID	formationeval_v0.1_sedimentology_compaction_processes_002
Domains	Sedimentology, Petroleum Geology
Topics	Mechanical vs Chemical Compaction, Overpressure
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two mudstone intervals have the same present-day porosity, but one is strongly overpressured while the other is normally pressured. Considering that mechanical compaction is controlled by effective stress while chemical compaction is primarily temperature-driven, which interpretation best explains how high overpressure influences these compaction mechanisms during burial?

A	High overpressure speeds up mechanical compaction because pore fluids carry more load
B	High overpressure speeds up chemical compaction because it increases effective stress
C	High overpressure stops both mechanical and chemical compaction by eliminating grain contact stress
D	High overpressure mainly slows mechanical compaction, while temperature-driven chemical compaction can still continue
Correct answer:	D - High overpressure mainly slows mechanical compaction, while temperature-driven chemical compaction can still continue

Rationale

Overpressure reduces effective stress, so it tends to delay mechanically driven porosity loss. Chemical compaction (dissolution, precipitation, cementation) is described as strongly controlled by burial temperature and time, so it may proceed even when effective stress is lowered. The two processes therefore respond differently to overpressure.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 11 - Introduction to Geomechanics: Stress and Strain in Sedimentary Basins
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the discussion of how overpressure changes effective stress and the relative roles of mechanical vs chemical compaction.

Question 334 of 505

ID	formationeval_v0.1_petroleumgeology_hydrostatic_pressure_003
Domains	Petroleum Geology
Topics	Hydrostatic Pressure, Pressure Gradient
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

Assume freshwater with a hydrostatic pressure gradient of 10 kPa/m. What hydrostatic pore pressure corresponds to 1500 m below the water table (ignore any overpressure contribution)?

A	15 MPa
B	10 MPa
C	150 MPa
D	1.5 MPa

Correct answer: A - 15 MPa

Rationale

With a constant hydrostatic gradient, pressure increases linearly with depth: 10 kPa/m × 1500 m = 15,000 kPa. Converting kPa to MPa gives 15 MPa. This corresponds to the chapter's freshwater hydrostatic gradient value.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 11 - Introduction to Geomechanics: Stress and Strain in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical application of the stated freshwater hydrostatic pressure gradient.

ID	formationeval_v0.1_sedimentology_overconsolidation_004
Domains	Sedimentology, Petroleum Geology
Topics	Normally Consolidated vs Overconsolidated, OCR
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A shale experienced deeper burial in the past, followed by erosion that reduced its present burial depth. Which statement best describes the shale's consolidation state today?

A	It is normally consolidated because present depth controls consolidation state
B	It is normally consolidated unless pore pressure is above hydrostatic
C	It is overconsolidated because it has previously experienced higher effective vertical stress than today
D	It is underconsolidated because erosion increases present-day pore pressure
Correct answer:	C - It is overconsolidated because it has previously experienced higher effective vertical stress than today

Rationale

Overconsolidation refers to a sediment that has been subjected to a higher effective vertical stress in the past than it currently experiences. Erosion reduces the present overburden, so the present effective stress can be below the historical maximum. That history makes the unit overconsolidated (preloaded).

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 11 - Introduction to Geomechanics: Stress and Strain in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Item based on the definitions of NC/OC sediments and how erosion/unloading affects OCR.

ID	formationeval_v0.1_petroleumgeology_k0nc_friction_angle_005
Domains	Petroleum Geology
Topics	Horizontal Stress (K0), Mohr-Coulomb Friction Angle
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

For a normally consolidated, uncemented sediment, a semi-empirical relationship relates the effective stress ratio K0 to the friction angle (ϕ′) using a semi-empirical expression. If ϕ′ increases while other conditions are similar, how does K0 for the normally consolidated state tend to change?

A	K0 decreases because a larger sin(ϕ′) is subtracted from 1
B	K0 increases because a larger sin(ϕ′) adds lateral support
C	K0 becomes independent of ϕ′ because pore pressure dominates
D	K0 approaches 1 because horizontal and vertical effective stresses equalize
Correct answer:	A - K0 decreases because a larger sin(ϕ′) is subtracted from 1

Rationale

The chapter gives K0 for normally consolidated sediments as 1 − sin(ϕ′) (for c = 0). Increasing ϕ′ increases sin(ϕ′), which reduces K0. Physically, a higher frictional resistance is associated with a lower ratio of lateral to vertical effective stress in that formulation.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
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Type	textbook
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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 11 - Introduction to Geomechanics: Stress and Strain in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept check on the NC K0 relationship and how friction angle affects horizontal effective stress.

Question 337 of 505

ID	formationeval_v0.1_petroleumgeology_k0oc_locked_in_stress_006
Domains	Petroleum Geology
Topics	Overconsolidation, Horizontal Stress (K0)
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A sediment package becomes overconsolidated due to unloading (erosion). Considering the behavior of the lateral stress ratio K0 during such unloading, what outcome is most consistent with the expected change in effective horizontal stress relative to effective vertical stress?

A	The effective horizontal stress must fall in the same proportion as the effective vertical stress
B	The effective horizontal stress becomes zero because pore pressure supports the overburden
C	The effective horizontal stress becomes equal to the effective vertical stress for any OCR
D	The ratio K0 can increase and may exceed 1 because lateral stresses are partly retained during unloading

Correct answer:	D - The ratio K0 can increase and may exceed 1 because lateral stresses are partly retained during unloading

Rationale

The chapter emphasizes that unloading does not behave as a purely elastic reversal for sediments; lateral stresses can be “locked in.” It then uses a semi-empirical form in which K0 grows with OCR, and values above 1 have been observed. This implies that horizontal effective stress can become larger than vertical effective stress in overconsolidated materials.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 11 - Introduction to Geomechanics: Stress and Strain in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Harder item integrating overconsolidation history with semi-empirical K0 increase and the concept of locked-in horizontal stress.

Question 338 of 505

ID	formationeval_v0.1_drillingengineering_leak_off_test_007
Domains	Drilling Engineering
Topics	Leak-Off Test, Fracture Pressure
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

During a leak-off test just below a casing shoe, mud is pumped into a closed well and pressure is tracked against injected volume. Which observation most directly indicates that the formation has started to fracture and leak-off has begun?

A	Pressure drops abruptly to hydrostatic because fractures short-circuit the wellbore
B	The pressure–volume trend changes slope because additional injected mud begins entering newly created fractures
C	Pressure remains perfectly linear because fracture creation requires constant pressure
D	The test only becomes diagnostic after the well is flowed back to surface and pressure behavior is analyzed at atmospheric conditions

Correct answer: B - The pressure–volume trend changes slope because additional injected mud begins entering newly created fractures

Rationale

Before fracturing, the closed system shows a near-linear pressure rise with injected volume because little fluid enters the formation. Once a fracture initiates, some injected mud is accommodated by the fracture, so the incremental pressure increase per added volume decreases, producing a slope break. This is the operational signature used to infer the leak-off (fracture) pressure.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 11 - Introduction to Geomechanics: Stress and Strain in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the LOT description: pressure buildup, onset of fracture, and the diagnostic slope change.

Question 339 of 505

ID	formationeval_v0.1_drillingengineering_hydrofracture_orientation_008
Domains	Drilling Engineering
Topics	Hydraulic Fracturing Test, Stress Orientation
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In a vertical borehole where the vertical stress is the largest principal stress, a hydraulic fracture opens when wellbore pressure is raised sufficiently. How will the fracture plane orient relative to the minimum horizontal effective stress direction?

A	The fracture plane will be horizontal and parallel to the minimum horizontal stress
B	The fracture plane will be horizontal and perpendicular to the minimum horizontal stress
C	The fracture plane will be vertical and perpendicular to the minimum horizontal effective stress
D	The fracture plane will be vertical and parallel to the minimum horizontal effective stress

Correct answer: C - The fracture plane will be vertical and perpendicular to the minimum horizontal effective stress

Rationale

Hydraulic fractures open perpendicular to the least effective principal stress. In the stated stress regime, the least effective principal stress is horizontal, so the fracture plane is vertical. Its normal points in the minimum horizontal effective stress direction, meaning the plane is perpendicular to that direction.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Type	textbook
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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 11 - Introduction to Geomechanics: Stress and Strain in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Conceptual item on fracture orientation in hydrofracturing/leak-off contexts and the role of the least effective stress.

Question 340 of 505

ID	formationeval_v0.1_geophysics_brittle_ductile_transition_009
Domains	Geophysics, Petroleum Geology
Topics	Brittle-Ductile Transition, Confining Stress Effects
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A sedimentary rock shows a peak strength followed by a rapid stress drop as strain continues in a triaxial test, but the same rock shows no stress drop when the lateral effective stress is higher. Which interpretation best explains this behavior in terms of brittle-ductile transition?

A	Increasing lateral effective stress can shift behavior from brittle (strain-softening) to ductile response
B	Increasing lateral effective stress forces pore pressure to rise, which intrinsically causes brittle failure at depth
C	Higher lateral effective stress lowers shear resistance by reducing grain-to-grain contact stress
D	Ductile behavior requires zero lateral effective stress so the sample can expand freely

Correct answer: A - Increasing lateral effective stress can shift behavior from brittle (strain-softening) to ductile response

Rationale

The chapter describes brittle behavior as having a peak followed by strain-softening toward a residual strength, and notes that sufficiently high effective horizontal (confining) stress can lead to ductile behavior. The confining stress suppresses the abrupt post-peak strength loss. This is framed as a brittle-to-ductile transition controlled in part by the magnitude of horizontal effective stress.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 11 - Introduction to Geomechanics: Stress and Strain in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Based on the triaxial stress–strain descriptions and how confining stress influences brittle vs ductile response.

Question 341 of 505

ID	formationeval_v0.1_petrophysics_sand_grain_crushing_010
Domains	Petrophysics, Sedimentology
Topics	Sand Compaction, Grain Crushing, Sorting Effects
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Two clean, well-sorted sands have similar mineralogy, but one is coarse-grained and the other is fine-grained. Under the same effective stress increase, which outcome is most consistent with the theory of grain-contact stresses and mechanical compaction?

A	The fine-grained sand is more likely to fracture grains because smaller grains create higher contact stress
B	The coarse-grained sand is more likely to experience grain fracturing and larger porosity loss because it has fewer contacts and higher stress per contact
C	Both sands should fracture equally because effective stress is independent of grain size for natural sands
D	Neither sand will compact mechanically unless quartz cement exceeds several tens of percent

Correct answer: B - The coarse-grained sand is more likely to experience grain fracturing and larger porosity loss because it has fewer contacts and higher stress per contact

Rationale

The chapter links grain crushing to very high local contact stresses transmitted through the load-bearing framework. Coarser sands tend to have fewer contact points and smaller effective contact areas per grain, concentrating stress and promoting grain breakage at lower effective stresses than in fine sand. This leads to greater mechanical compaction and porosity reduction in coarse, well-sorted sand under comparable loading.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 11 - Introduction to Geomechanics: Stress and Strain in Sedimentary Basins
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Integrates the discussion of intergranular contact stress concentration with grain-size dependence of sand compaction behavior.

Question 342 of 505

ID	formationeval_v0.1_geophysics_smectite_vpvs_011
Domains	Geophysics, Petrophysics
Topics	Rock Physics, Clay Mineralogy, Vp/Vs
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

You are comparing two brine-saturated mudstone intervals with similar depth and stress. One interval is smectite-rich and the other is kaolinite-rich. Which seismic-velocity pattern is most consistent with laboratory trends for clay minerals?

A	Smectite-rich: higher Vp and higher Vs, giving a lower Vp/Vs than kaolinite-rich
B	Smectite-rich: similar Vp but much higher Vs, giving a lower Vp/Vs than kaolinite-rich
C	Smectite-rich: lower Vp and lower Vs, with a higher Vp/Vs ratio than kaolinite-rich
D	Smectite-rich: higher Vp but lower Vs, with a lower Vp/Vs ratio than kaolinite-rich
Correct answer:	C - Smectite-rich: lower Vp and lower Vs, with a higher Vp/Vs ratio than kaolinite-rich

Rationale

The chapter notes that smectitic clays retain higher porosity and are associated with low velocities and low density, and it highlights that smectite shows a higher Vp/Vs ratio compared with kaolinite. Lower shear velocity combined with overall lower velocities is consistent with a higher Vp/Vs ratio. This makes smectite-rich intervals stand out in rock-physics/seismic attributes.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 11 - Introduction to Geomechanics: Stress and Strain in Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the clay-mineral compaction/velocity trends emphasizing smectite’s high Vp/Vs and low velocities.

Question 343 of 505

ID	formationeval_v0.1_petroleumgeology_stress_regimes_001
Domains	Petroleum Geology
Topics	Plate Boundaries, Stress Regimes
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

At a plate boundary where two plates mainly slide past one another laterally and no lithosphere is created or destroyed, which principal deformation regime is most consistent with that setting?

A	Strike-slip regime
B	Extensional regime
C	Contractional regime
D	Thermal subsidence regime

Correct answer: A - Strike-slip regime

Rationale

A conservative (transform) plate margin is dominated by lateral motion, so the associated principal stress configuration corresponds to a strike-slip regime. Extensional and contractional regimes instead align with divergent and convergent boundaries, respectively. Thermal subsidence is a basin-stage process, not a plate-margin stress regime.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 12 - The Structure and Hydrocarbon Traps of Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Item derived from the chapter’s link between plate-margin types and principal stress regimes.

Question 344 of 505

ID	formationeval_v0.1_petroleumgeology_far_field_vs_local_stress_002
Domains	Petroleum Geology
Topics	Stress Components, Basin Stress
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A reservoir is influenced by plate-scale forces and also by conditions specific to its burial and geometry. Which situation best represents a local stress contribution rather than a far-field (plate-margin) contribution?

A	Compression transmitted into a basin from a nearby convergent margin
B	Stress changes caused by variations in basement relief and basin-scale inhomogeneities
C	Shear stress associated with a transform plate boundary
D	Regional tension driven by a plate-divergence setting
Correct answer:	B - Stress changes caused by variations in basement relief and basin-scale inhomogeneities

Rationale

The chapter distinguishes far-field stresses originating from plate-margin processes from local stresses superimposed due to factors like burial, erosion, topography, basement relief, and structural inhomogeneities. Basement relief and basin inhomogeneities are explicitly local contributors. The other options are examples of plate-boundary or plate-scale forcing.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 12 - The Structure and Hydrocarbon Traps of Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept check on the chapter’s decomposition of basin stress into far-field and local components.

Question 345 of 505

ID	formationeval_v0.1_petroleumgeology_lithostatic_stress_003
Domains	Petroleum Geology
Topics	Lithostatic Stress, Stress Calculation
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

Using the lithostatic reference stress relation σv = ρgz, what is σv at 3,000 m depth for rock density 2,500 kg/m³ and g = 9.81 m/s² (report in MPa)?

A	36.8 MPa
B	61.3 MPa
C	73.6 MPa
D	98.1 MPa
Correct answer:	C - 73.6 MPa

Rationale

From σv = ρgz, σv = 2500 × 9.81 × 3000 Pa ≈ 7.36 × 10^7 Pa. Converting to MPa gives approximately 73.6 MPa. The other options reflect common arithmetic or unit-conversion errors.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 12 - The Structure and Hydrocarbon Traps of Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical application of the chapter’s lithostatic reference stress definition.

Question 346 of 505

ID	formationeval_v0.1_petroleumgeology_anderson_stress_orders_004
Domains	Petroleum Geology
Topics	Anderson Stress Regimes, Principal Stresses
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In Anderson's framework, which principal stress ordering corresponds to a contractional (shortening) regime?

A	σv > σH > σh
B	σh > σv > σH
C	σv > σh > σH
D	σH > σh > σv
Correct answer:	D - σH > σh > σv

Rationale

A contractional regime requires horizontal compression to dominate, so the maximum horizontal stress exceeds the minimum horizontal stress, and both exceed the vertical stress. The chapter expresses this as σH > σh > σv. The other orderings correspond to extension, strike-slip, or non-standard permutations.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 12 - The Structure and Hydrocarbon Traps of Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Tests the chapter's mapping between stress ordering and deformation regime (Anderson-type classification).

ID	formationeval_v0.1_petroleumgeology_synrift_postrift_transition_005
Domains	Petroleum Geology, Geophysics
Topics	Rift Evolution, Seismic Interpretation
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A basin analyst wants an operational criterion for identifying the syn-rift to post-rift transition when timing varies across the basin. What criterion and geometric signal best define that transition?

A	Cooling dominates heating (net heat loss exceeds net heat gain), and regional tilting switches from rotating away from the basin axis to tilting toward the axis
B	Sediment supply exceeds subsidence everywhere, and fault blocks uniformly rotate away from the basin axis
C	Magmatism reaches its maximum intensity, and layers begin to tilt away from the basin axis as the basin widens
D	The first appearance of marine deposits, and the fault-controlled depocentres become more isolated

Correct answer: A - Cooling dominates heating (net heat loss exceeds net heat gain), and regional tilting switches from rotating away from the basin axis to tilting toward the axis

Rationale

The chapter notes that the transition is hard to pick purely geometrically because it is often diachronous, so it recommends defining it by the point when net heat flow out exceeds net heat flow in. A basin-scale consequence is a reversal in tilt: syn-rift fault-block rotation away from the axis gives way to post-rift tilting toward the axis driven by contraction during cooling and loading. The other options describe processes that may occur but are not given as the defining criterion and signal.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 12 - The Structure and Hydrocarbon Traps of Sedimentary Basins
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Integration item on rift staging, heat-flow logic, and the tilt reversal visible in reflection seismic data.

ID	formationeval_v0.1_petroleumgeology_extensional_basin_models_006
Domains	Petroleum Geology
Topics	Extensional Basin Models, Crustal Thinning
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two end-member models commonly describe lithospheric thinning during rifting. Which statement correctly contrasts the pure-shear and simple-shear end members?

A	Pure shear produces a strongly asymmetric basin controlled by a single throughgoing inclined detachment, whereas simple shear produces a symmetric basin
B	Pure shear tends toward a symmetric basin geometry, whereas simple shear concentrates extension along one or more inclined fault zones that yield an asymmetric basin
C	Both pure shear and simple shear require identical fault geometries in the upper crust and therefore produce the same basin architecture
D	Pure shear and simple shear differ only in sediment transport directions and accommodation space timing, not in overall crustal deformation geometry or basin architecture
Correct answer:	B - Pure shear tends toward a symmetric basin geometry, whereas simple shear concentrates extension along one or more inclined fault zones that yield an asymmetric basin

Rationale

The chapter presents pure shear as a symmetric thinning style, with brittle faulting in the upper crust accompanying ductile stretching at depth. Simple shear is described as extension localized along inclined fault zone(s) affecting the crust, producing an asymmetric basin architecture. The other options contradict these geometric distinctions.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 12 - The Structure and Hydrocarbon Traps of Sedimentary Basins
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the section comparing end-member rift-basin thinning geometries (pure vs simple shear).

Question 349 of 505

ID	formationeval_v0.1_petroleumgeology_trap_style_rift_stage_007
Domains	Petroleum Geology, Sedimentology
Topics	Trap Types, Post-rift Development
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

During the thermal subsidence stage of an extensional basin, major rift-border faulting becomes relatively quiet. Given the reduced structural activity and continued sedimentation during this post-rift phase, what trap style is expected to become more common than strongly fault-bounded structural traps?

A	Traps dominated by active growth-fault displacement and rollover formation
B	Traps dominated by new steep planar normal faults cutting the basin fill
C	Traps dominated by stratigraphic pinch-outs and basin-fill geometry
D	Traps dominated by thrust-related duplexes and fault-propagation folds
Correct answer:	C - Traps dominated by stratigraphic pinch-outs and basin-fill geometry

Rationale

In the thermal subsidence stage, subsidence is driven largely by cooling contraction and sediment loading, while the main syn-rift fault systems are largely inactive. The chapter therefore emphasizes that stratigraphic traps are expected to be more prevalent than structural traps tied to active faulting. Thrust duplexes relate to contractional settings, not post-rift subsidence.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 12 - The Structure and Hydrocarbon Traps of Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on how basin stage influences the dominant style of hydrocarbon trapping.

Question 350 of 505

ID	formationeval_v0.1_petroleumgeology_strikeslip_stepovers_008
Domains	Petroleum Geology
Topics	Strike-slip Systems, Releasing vs Restraining Bends
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Consider a right-lateral (dextral) strike-slip fault system with overlapping fault branches. Which arrangement produces extension in the overlap zone, favoring features like pull-apart basins?

A	Dextral motion with a left-stepping arrangement of segments
B	Sinistral motion with a left-stepping arrangement of segments
C	Dextral motion with a planar, unsegmented fault trace
D	Dextral motion with a right-stepping arrangement of segments

Correct answer: D - Dextral motion with a right-stepping arrangement of segments

Rationale

The chapter explains that for a dextral system, right-stepping overlaps create releasing zones where extension develops between the segments. The opposite stepping sense produces contractional overlap zones (restraining bends) for the same shear sense. A perfectly planar, unsegmented fault does not create step-over overlap zones.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 12 - The Structure and Hydrocarbon Traps of Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter’s discussion of step-over geometry and local extension/contraction in strike-slip systems.

Question 351 of 505

ID	formationeval_v0.1_petroleumgeology_strain_partitioning_009
Domains	Petroleum Geology
Topics	Transpression/Transtension, Strain Partitioning
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a shear zone where strike-slip motion is accompanied by a compressional component (transpression), what is meant by strain partitioning?

A	Different components of deformation are taken up in separate structural systems, effectively separating contractional and strike-slip strain
B	The total strain is accommodated only by rotating Riedel shears until they become parallel to the main fault, with no slip on the principal plane
C	The deformation remains fully distributed, so discrete faults and folds do not develop
D	The shear zone evolves into a purely extensional regime as displacement accumulates
Correct answer:	A - Different components of deformation are taken up in separate structural systems, effectively separating contractional and strike-slip strain

Rationale

The chapter describes strain partitioning as the tendency for a combined stress state (like dextral transpression) to be expressed through distinct structural domains, where contraction is accommodated in one system and strike-slip in another. This explains how, in an example cited, collision-related shortening and lateral shear can occur in adjacent structures. The other options either describe specific fracture evolution or contradict the chapter's definition.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 12 - The Structure and Hydrocarbon Traps of Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Integrative question on how oblique deformation is expressed as separate contractional and strike-slip structures.

Question 352 of 505

ID	formationeval_v0.1_petroleumgeology_structural_inversion_mechanics_010
Domains	Petroleum Geology
Topics	Structural Inversion, Fault Reactivation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

When an extensional fault system later experiences contraction (structural inversion), what outcome is most likely regarding how shortening is accommodated?

A	The original steep normal faults necessarily take up nearly all later shortening because they already exist as weaknesses with established low-friction slip planes
B	New low-angle faults are commonly initiated, while pre-existing extensional faults may reactivate but usually cannot accommodate all the strain
C	Shortening is mainly accommodated by new vertical strike-slip faults because σ2 becomes horizontal
D	The basin responds only by thermal contraction and isostatic rebound, with negligible faulting or folding during the inversion phase of structural evolution

Correct answer:	B - New low-angle faults are commonly initiated, while pre-existing extensional faults may reactivate but usually cannot accommodate all the strain

Rationale

The chapter notes that inversion changes the stress configuration and the orientation of the maximum shear plane, making it difficult for the original extensional faults to absorb large amounts of the new shortening. As a result, reverse reactivation may occur, but new, lower-angle contractional faults and related folds are expected. The other options contradict the described mechanical consequence of inversion.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 12 - The Structure and Hydrocarbon Traps of Sedimentary Basins
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the inversion section emphasizing stress-axis change and the frequent need for new low-angle faults.

Question 353 of 505

ID	formationeval_v0.1_petroleumgeology_salt_margin_kinematics_011
Domains	Petroleum Geology
Topics	Salt Tectonics, Gravity-driven Deformation
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In gravity-driven deformation on a salt-bearing continental margin, what large-scale kinematic pairing is typical along the slope direction?

A	Upslope contraction paired with downslope extension
B	Uniform extension from shelf to deep basin with no contractional domain
C	Upslope extension paired with downslope contraction
D	Uniform contraction from shelf to deep basin with no extensional domain

Correct answer: C - Upslope extension paired with downslope contraction

Rationale

The chapter characterizes gravity spreading on a margin as producing extension in the upslope domain and shortening in the downslope domain, driven by the regional gradient and mobile salt. This pairing explains why linked extensional structures (e.g., growth faults) can coexist with distal contractional folds and thrusts. The other options reverse or remove one of the paired domains.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 12 - The Structure and Hydrocarbon Traps of Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept check on the margin-scale extensional–contractional partitioning in salt-related gravity tectonics.

Question 354 of 505

ID	formationeval_v0.1_petroleumgeology_fault_zone_architecture_012
Domains	Petroleum Geology, Reservoir Engineering
Topics	Fault Zone Architecture, Fractures and Flow
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A subsurface model represents an extensional fault zone as a core with lenses (horses) separated by high-strain zones plus damage zones on either side. Which statement best characterizes these structural elements based on field observations?

A Damage zones are typically symmetric around the core, and footwall and hangingwall fracture patterns are usually indistinguishable

B Fault core lenses are typically chaotic in shape, so their size ratios cannot be generalized for modelling purposes

C The hangingwall damage zone typically builds fracture intensity more abruptly than the footwall as the fault is approached

D Fault core lenses commonly have length-to-thickness ratios on the order of about ten-to-one, and fracture intensity tends to rise more sharply toward the core on the footwall side than on the hangingwall side

Correct answer: D - Fault core lenses commonly have length-to-thickness ratios on the order of about ten-to-one, and fracture intensity tends to rise more sharply toward the core on the footwall side than on the hangingwall side

Rationale

The chapter describes fault zones as internally zoned, with a fault core containing lozenge-like lenses/horses and adjacent damage zones. It reports that lens geometry can be approximated with length-to-thickness ratios around an order of magnitude, and that damage-zone fracture frequency is commonly asymmetric, increasing more steeply toward the core in the footwall than in the hangingwall. These properties matter because permeability contrasts between lenses and high-strain zones can govern along-fault and cross-fault flow.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)

Reference	Chapter 12 - The Structure and Hydrocarbon Traps of Sedimentary Basins
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter’s fault-zone subdivision (core + damage zones) and asymmetry/lens-geometry observations relevant to reservoir communication.

Question 355 of 505

ID	formationeval_v0.1_sedimentology_burial_compaction_trends_001
Domains	Sedimentology, Petrophysics
Topics	Burial Compaction, Porosity Trends, Rock Physics
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

For a single lithology tracked through progressive burial in a basin (ignoring short intervals of changing lithology), which trend is most consistent with compaction?

A	Porosity tends to rise, while density and seismic velocity tend to fall
B	Porosity tends to remain constant, while density and seismic velocity tend to rise
C	Porosity tends to fall, while density and seismic velocity tend to rise
D	Porosity tends to fall, while density and seismic velocity tend to fall
Correct answer:	C - Porosity tends to fall, while density and seismic velocity tend to rise

Rationale

Burial increases stress and temperature, driving compaction and diagenesis that typically reduce pore space in a given lithology. As porosity decreases, bulk density increases, and the rock frame stiffens, leading to higher seismic velocity. Apparent reversals can occur across lithologic changes, but not as the dominant trend within one lithology.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 13 - Compaction of Sedimentary Rocks Including Shales, Sandstones and Carbonates
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the chapter’s general burial trend linking porosity loss to increases in density and velocity.

Question 356 of 505

ID	formationeval_v0.1_sedimentology_mechanical_compaction_002
Domains	Sedimentology, Petrophysics
Topics	Mechanical Compaction, Porosity-Volume Relationship
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A sediment compacts purely mechanically, with no dissolution or precipitation and an unchanged volume of solid grains. Which statement best describes the relationship between bulk-volume strain and porosity change?

A	The reduction in bulk volume is equal to the porosity loss, because the solid volume stays constant
B	The reduction in bulk volume mainly reflects loss of solid volume, while porosity is nearly unchanged
C	Porosity decreases, but bulk volume does not change because grains only rearrange internally without any compaction
D	Bulk volume decreases, but porosity increases because pore fluid is expelled

Correct answer: A - The reduction in bulk volume is equal to the porosity loss, because the solid volume stays constant

Rationale

In the mechanical-compaction case described, the solid fraction is treated as constant, so any decrease in bulk volume must come from a reduction of the pore volume. That means volumetric strain corresponds directly to porosity loss. Chemical reactions would break this link by changing the solid volume through dissolution/precipitation.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Type	textbook
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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 13 - Compaction of Sedimentary Rocks Including Shales, Sandstones and Carbonates
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept item reflecting the chapter’s definition of mechanical compaction with constant solids and porosity-driven volume reduction.

Question 357 of 505

ID	formationeval_v0.1_petrophysics_bulk_modulus_strain_003
Domains	Petrophysics, Reservoir Engineering
Topics	Bulk Modulus, Stress-Strain, Rock Shrinkage
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

Assume a rock behaves elastically with bulk modulus K = 50 GPa. If chemical compaction produces a volumetric strain of 0.001 (0.1%), what magnitude of effective stress reduction is associated with this strain using K = stress/strain?

A	0.05 MPa
B	5 MPa
C	500 MPa
D	50 MPa
Correct answer:	D - 50 MPa

Rationale

Using K = stress/strain, the stress change is K·strain = 50 GPa × 0.001 = 0.05 GPa. Converting 0.05 GPa gives 50 MPa. The chapter uses this example to illustrate how even small strain can substantially relax stress.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Type	textbook
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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 13 - Compaction of Sedimentary Rocks Including Shales, Sandstones and Carbonates
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical concept check based on the chapter’s stress/strain (bulk modulus) example tied to compaction-driven shrinkage.

Question 358 of 505

ID	formationeval_v0.1_drillingengineering_clay_stabilization_004
Domains	Drilling Engineering, Sedimentology
Topics	Clay Mineralogy, Wellbore Stability, Porewater Chemistry
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A well is drilled through smectite-rich clay intervals that are sensitive to porewater chemistry. Which explanation best accounts for why adding salts such as KCl to drilling mud can improve stability in these clays?

A	It raises the formation temperature, accelerating quartz cementation and strengthening the rock
B	It modifies the porewater chemistry so the clay mass becomes mechanically stronger and less prone to weakening
C	It increases shale permeability so pore pressure dissipates rapidly and compaction stops
D	It removes carbonate cement by dissolution, which reduces brittleness and prevents breakouts

Correct answer:	B - It modifies the porewater chemistry so the clay mass becomes mechanically stronger and less prone to weakening

Rationale

Smectite has a very high specific surface area and responds strongly to porewater composition. The chapter notes that adding salts (including KCl) is used to stabilize soft clays by increasing their compressive and shear strengths. The other options describe mechanisms not presented as the reason for salt addition in the chapter.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 13 - Compaction of Sedimentary Rocks Including Shales, Sandstones and Carbonates
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Drawn from the discussion of smectite sensitivity and the operational use of KCl/NaCl to stabilize clays during drilling.

Question 359 of 505

ID	formationeval_v0.1_geophysics_shale_anisotropy_005
Domains	Geophysics, Sedimentology
Topics	Seismic Velocity, Anisotropy, Shales
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A bedded mudstone becomes more anisotropic during burial because sheet minerals become more aligned. Which seismic-velocity pattern is most consistent with this type of anisotropy?

A	P-wave velocity measured parallel to bedding is higher than P-wave velocity measured perpendicular to bedding
B	P-wave velocity measured perpendicular to bedding is higher than P-wave velocity measured parallel to bedding
C	P-wave velocity is the same in all directions because compaction removes layering effects
D	P-wave velocity depends only on pore-fluid salinity, not on measurement orientation or the alignment of clay platelets

Correct answer:	A - P-wave velocity measured parallel to bedding is higher than P-wave velocity measured perpendicular to bedding

Rationale

The chapter describes mudstones/shales as anisotropic and notes that with burial they can show higher velocity along bedding than vertically. This follows from increased alignment of platy minerals and fabric development. Orientation-independent velocity is not consistent with the stated behavior of shales.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 13 - Compaction of Sedimentary Rocks Including Shales, Sandstones and Carbonates
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter’s explanation that mudstones can become increasingly anisotropic with burial, affecting velocity relative to bedding.

Question 360 of 505

ID	formationeval_v0.1_geophysics_vp_vs_interpretation_006
Domains	Geophysics, Petrophysics
Topics	Vp/Vs Ratio, Gas Effects, Shales
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A team uses a Vp/Vs-based workflow to infer fluid content in thin sand beds. The interval is dominated by mudstone, and the mudstone contains a non-negligible amount of gas in its pore space. What is the most likely interpretation risk in this scenario?

A	The Vp/Vs ratio becomes insensitive to clay mineralogy, so shale properties can be ignored
B	The presence of gas forces Vp/Vs to a universal constant, making fluid discrimination easier
C	A Vp/Vs anomaly may be driven by gas-bearing mudstone rather than by fluid changes in the thin sands
D	Vp/Vs changes only when carbonates are present, so gas in mudstone cannot affect the result or alter the velocity contrast
Correct answer:	C - A Vp/Vs anomaly may be driven by gas-bearing mudstone rather than by fluid changes in the thin sands

Rationale

The chapter states that Vp/Vs varies with clay mineralogy and that gas in mudstones/shales can also change Vp/Vs. If the seismic response is dominated by mudstone, a gas-related shale effect can be mistaken for a sand-fluid signal. Therefore, shale composition and gas content must be considered when using Vp/Vs for fluid inference.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
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Type	textbook
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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 13 - Compaction of Sedimentary Rocks Including Shales, Sandstones and Carbonates
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Integrative item connecting shale gas effects and clay-mineral controls on Vp/Vs to fluid interpretation workflows.

Question 361 of 505

ID	formationeval_v0.1_sedimentology_smectite_illite_reaction_007
Domains	Sedimentology, Petrophysics
Topics	Clay Diagenesis, Quartz Cementation, Temperature Controls
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a smectite-rich mudstone heated into the range where smectite becomes unstable and illite forms, what factor most directly governs how rapidly the transformation can proceed?

A	The magnitude of tectonic stress, because stress alone controls the transformation rate
B	The temperature-dependent rate of quartz precipitation that removes released silica from porewater
C	The amount of upward porewater flow, because advection is required to cool the system
D	The degree of carbonate cementation, because calcite is the principal sink for silica
Correct answer:	B - The temperature-dependent rate of quartz precipitation that removes released silica from porewater

Rationale

The chapter links smectite breakdown and illite formation to the need for silica to be removed from solution by quartz precipitation. Because quartz cementation rate depends on temperature, it becomes the practical rate control on the overall reaction sequence. Stress and large-scale advective flow are not presented as the controlling factor for this reaction in mudstones.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 13 - Compaction of Sedimentary Rocks Including Shales, Sandstones and Carbonates
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter’s coupling of smectite→illite reaction progress to the presence of a silica sink via quartz precipitation.

Question 362 of 505

ID	formationeval_v0.1_sedimentology_silica_migration_008
Domains	Sedimentology, Petrophysics
Topics	Silica Mass Balance, Diffusion in Shales, Authigenic Quartz
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A hypothesis proposes that silica released during clay-mineral reactions in shale diffuses into adjacent sandstones and forms major quartz cement there. Which statement best aligns with current understanding of silica transport in sedimentary systems?

A	It is likely, because diffusion through shale is efficient and silica is routinely exported over large distances
B	It is likely, because compaction-driven flow can transport enough silica to explain extensive quartz cementation
C	It is unlikely, because most silica is lost to the basin-scale hydrologic system during burial heating
D	It is unlikely, because shale diffusion is inefficient and micro-scale authigenic quartz indicates silica is largely retained locally

Correct answer: D - It is unlikely, because shale diffusion is inefficient and micro-scale authigenic quartz indicates silica is largely retained locally

Rationale

The chapter argues that diffusion through shales is very inefficient and points to observations of small authigenic quartz crystals in heated smectite-rich mudstones as evidence of local silica retention. It also notes that at greater depth, quartz cement is mainly sourced from pressure solution of detrital quartz rather than long-distance export from shale. Therefore, basin-scale diffusive transfer from shale to sandstone is not supported as a dominant mechanism here.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 13 - Compaction of Sedimentary Rocks Including Shales, Sandstones and Carbonates
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Integrates the chapter’s discussion of local micro-quartz formation, diffusion limitations in shales, and deep quartz cement sourcing.

Question 363 of 505

ID	formationeval_v0.1_sedimentology_pressure_solution_009
Domains	Sedimentology, Reservoir Engineering
Topics	Pressure Solution, Quartz Cementation, Chemical Compaction
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In quartz-rich sandstones undergoing pressure solution at grain contacts, chemical compaction as relatively insensitive to stress. What explanation best matches this description?

A	Pressure solution cannot occur in quartz sandstones, so stress is irrelevant
B	Stress controls dissolution, but cement precipitation is rapid and never limits compaction
C	Cement precipitation is the slow step and depends mainly on temperature, so stress changes have limited influence on overall compaction rate
D	Upward-moving porewater cools rapidly, so precipitation occurs only near the seafloor regardless of stress, depth conditions, or temperature gradients
Correct answer:	C - Cement precipitation is the slow step and depends mainly on temperature, so stress changes have limited influence on overall compaction rate

Rationale

The chapter presents pressure dissolution as driven by stress at grain contacts, but emphasizes that the rate-limiting step is typically the precipitation of authigenic quartz, which depends on temperature. If precipitation controls the overall pace, then changing stress has a weaker impact than changing temperature/time. This is why chemical compaction in siliceous rocks is framed as temperature-controlled at greater depth.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 13 - Compaction of Sedimentary Rocks Including Shales, Sandstones and Carbonates
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Based on the chapter’s statement that quartz precipitation controls chemical compaction rate in sandstones and reduces stress sensitivity.

Question 364 of 505

ID	formationeval_v0.1_sedimentology_carbonate_cementation_010
Domains	Sedimentology, Petrophysics
Topics	Carbonate Compaction, Early Cementation, Aragonite to Calcite
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Compared with quartz-dominated mudstones and sandstones, why can carbonate sediments become cemented into hard rock at very shallow burial depths?

A	Because carbonate reactions are slow, so they require high temperatures to proceed
B	Because carbonate compaction is controlled mainly by long-distance silica diffusion
C	Because carbonate sediments start with no porosity, so cementation is unnecessary
D	Because carbonate dissolution/precipitation is fast and unstable aragonite provides a strong drive toward calcite cementation

Correct answer: D - Because carbonate dissolution/precipitation is fast and unstable aragonite provides a strong drive toward calcite cementation

Rationale

The chapter emphasizes that carbonate reaction kinetics are much faster than in siliceous sediments, making temperature less of a controlling variable. It also highlights the role of aragonite instability as an important driver for early cement formation. These factors allow cementation to occur close to the surface in carbonate systems.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 13 - Compaction of Sedimentary Rocks Including Shales, Sandstones and Carbonates
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept check based on carbonate-specific compaction controls: fast kinetics and aragonite-driven early cementation.

Question 365 of 505

ID	formationeval_v0.1_reservoirengineering_overpressure_compaction_011
Domains	Reservoir Engineering, Sedimentology
Topics	Overpressure, Effective Stress, Mechanical vs Chemical Compaction
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

How does overpressure most differently affect compaction in siliceous sediments when comparing shallow mechanical compaction to deeper chemical compaction?

A	It accelerates both types of compaction because pore pressure increases mineral solubility
B	It reduces mechanical compaction by lowering effective stress, but has little influence on chemical compaction that is mainly temperature/time controlled
C	It stops chemical compaction by preventing pressure solution at grain contacts under all conditions
D	It may have no influence on any type of compaction because porosity loss depends only on mineralogy and grain-size distribution, not on fluid pressure or effective stress

Correct answer:	B - It reduces mechanical compaction by lowering effective stress, but has little influence on chemical compaction that is mainly temperature/time controlled

Rationale

The chapter distinguishes mechanical compaction as an effective-stress-driven process, so increased pore pressure can reduce it by lowering effective stress. In contrast, chemical compaction in siliceous rocks is presented as being controlled largely by temperature (and time/kinetics), making it comparatively insensitive to stress changes. Thus, overpressure mainly alters the mechanical part of the compaction history.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 13 - Compaction of Sedimentary Rocks Including Shales, Sandstones and Carbonates
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the chapter’s contrast between effective-stress-controlled mechanical compaction and temperature-controlled chemical compaction, including the stated minor impact of overpressure on chemical compaction.

Question 366 of 505

ID	formationeval_v0.1_sedimentology_uplift_chemical_compaction_012
Domains	Sedimentology, Petrophysics
Topics	Uplift, Chemical Compaction, Fracture Healing
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A quartz-rich sedimentary rock is uplifted and unloaded, but its temperature remains above roughly 70–80°C for a prolonged period. What outcome is most consistent with the known behavior of quartz-rich rocks during such conditions?

A	Chemical compaction can continue and quartz cement can progressively seal fractures, partly offsetting mechanical opening from unloading
B	All compaction stops immediately because decreasing stress intrinsically prevents mineral reactions, regardless of the temperature or fluid chemistry conditions
C	Mechanical unloading necessarily increases porosity permanently because cement cannot form during uplift
D	Uplift causes widespread carbonate cementation, which dominates fracture sealing in siliceous rocks

Correct answer:	A - Chemical compaction can continue and quartz cement can progressively seal fractures, partly offsetting mechanical opening from unloading

Rationale

The chapter states that chemical compaction in siliceous sediments can proceed as long as temperatures remain above the approximate threshold, even during uplift. Unloading tends to promote mechanical extension, but ongoing quartz cementation can gradually heal open fractures. Therefore, uplift does not automatically preserve fracture porosity if temperatures remain sufficiently high.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 13 - Compaction of Sedimentary Rocks Including Shales, Sandstones and Carbonates
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter’s statement that chemical compaction can persist during uplift at sufficiently high temperature and can seal fractures by quartz cement.

Question 367 of 505

ID	formationeval_v0.1_petroleumgeology_source_rock_deposition_001
Domains	Petroleum Geology, Sedimentology
Topics	Source Rock Formation, Redox Conditions
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A basin is producing thick organic-rich shale intervals. Which depositional condition most strongly supports preservation of organic matter so it can later become a petroleum source rock?

A	Persistent bottom-water ventilation that keeps seafloor sediments well oxidized
B	Limited renewal of bottom water that allows oxygen levels near the seafloor to stay low
C	Strong benthic activity that mixes organic matter into oxygenated sediment layers
D	Repeated exposure and drying of muds that promotes oxidation of organic material
Correct answer:	B - Limited renewal of bottom water that allows oxygen levels near the seafloor to stay low

Rationale

Organic matter is usually destroyed by oxidation in the water column or at the sediment surface. Conditions that restrict circulation and keep oxygen supply low increase the fraction that escapes oxidation and is buried. This is why many effective source rocks are black shales deposited under reducing conditions.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 14 - Source Rocks and Petroleum Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from discussion of why only a small fraction of marine organic matter is preserved and how organic-rich shales form.

Question 368 of 505

ID	formationeval_v0.1_petroleumgeology_kerogen_chemistry_002
Domains	Petroleum Geology
Topics	Kerogen Formation, Elemental Ratios
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

During early burial, organic precursors are altered into kerogen. Which change in elemental ratios is most consistent with this transformation process?

A	Both H/C and O/C increase because dehydration concentrates hydrogen and oxygen
B	H/C decreases while O/C increases because oxygen-bearing groups become more abundant
C	H/C increases while O/C decreases because oxygen-rich groups are removed from the material
D	Both H/C and O/C decrease because kerogen formation primarily removes carbon
Correct answer:	C - H/C increases while O/C decreases because oxygen-rich groups are removed from the material

Rationale

Kerogen formation involves loss of oxygen- and nitrogen-bearing functional groups, along with water and CO2, which lowers the oxygen relative to carbon. Compared with the original biomolecules, kerogen ends up relatively enriched in hydrogen and depleted in oxygen, raising H/C and lowering O/C. This trend is consistent with the chapter’s description of progressive chemical simplification during burial.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 14 - Source Rocks and Petroleum Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on how functional-group loss during kerogen formation shifts H/C and O/C ratios.

Question 369 of 505

ID	formationeval_v0.1_petroleumgeology_kerogen_types_003
Domains	Petroleum Geology
Topics	Kerogen Types, Van Krevelen Interpretation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A source rock from a lacustrine oil-shale setting contains kerogen with H/C ≈ 1.5 and O/C ≈ 0.05. Which kerogen type and hydrocarbon tendency best matches these properties?

A	Type I kerogen, expected to yield mainly oil with comparatively less gas
B	Type II kerogen, expected to yield mainly methane with minimal liquids
C	Type III kerogen, expected to yield mostly CO2 with little hydrocarbon generation
D	Type III kerogen, expected to yield mainly oil because it is hydrogen-rich

Correct answer: A - Type I kerogen, expected to yield mainly oil with comparatively less gas

Rationale

Hydrogen-rich and oxygen-poor kerogen is characteristic of Type I material, commonly associated with lipid-rich organic inputs and many oil-shale occurrences. Such kerogen is described as having high H/C and low O/C and typically generates predominantly oil. Type III is comparatively oxygen-rich and tends toward gas and CO2 production with maturation.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 14 - Source Rocks and Petroleum Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on kerogen classification by H/C and O/C and the typical products of Type I kerogen in freshwater oil-shale systems.

Question 370 of 505

ID	formationeval_v0.1_petroleumgeology_type_iii_generation_004
Domains	Petroleum Geology, Sedimentology
Topics	Type III Kerogen, Hydrocarbon Products
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A delta-plain shale contains abundant land-plant debris and has kerogen composition similar to coal. During maturation, what product mix is most consistent with this type of organic matter?

A	Predominantly liquid oil, because land plants are typically lipid-rich
B	Mostly waxy paraffins and very little gas, because coal-like material cracks poorly
C	Mainly condensate with negligible CO2 production, because oxygen is absent in plant matter
D	Large amounts of gas (notably methane) along with water and CO2, with limited oil in many cases
Correct answer:	D - Large amounts of gas (notably methane) along with water and CO2, with limited oil in many cases

Rationale

Kerogen derived from higher plants (Type III/humic) starts relatively oxygen-rich and hydrogen-poor compared with algal material. The chapter describes this type as generating abundant water, CO2, and methane as temperature increases, and notes that coal commonly behaves similarly and tends to be gas-prone. Some coals may generate some oil, but gas is typically dominant.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Reference	Chapter 14 - Source Rocks and Petroleum Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based question on Type III (humic) kerogen origin and typical maturation products, linked to coal-like organic matter.

Question 371 of 505

ID	formationeval_v0.1_petroleumgeology_oil_window_temperature_005
Domains	Petroleum Geology
Topics	Thermal Maturation, Oil Window
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Assuming a typical geothermal gradient and sufficient geologic time, which temperature interval best represents the main range where kerogen conversion to oil is most effective?

A	About 100–150°C
B	About 20–60°C
C	About 200–260°C
D	About 350–550°C

Correct answer: A - About 100–150°C

Rationale

The chapter indicates that hydrocarbon generation begins slowly near ~80–90°C, but that most of the oil-generating maturation occurs over roughly 100–150°C. Temperatures far below this are associated with very slow transformation, while substantially higher temperatures favor extensive cracking toward gas. The 350–550°C range is associated with laboratory pyrolysis conditions, not natural burial temperatures.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Type	textbook
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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 14 - Source Rocks and Petroleum Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter's description of temperature ranges for onset of generation and the main oil-generating maturation interval.

Question 372 of 505

ID	formationeval_v0.1_petroleumgeology_pressure_effects_maturation_006
Domains	Petroleum Geology, Reservoir Engineering
Topics	Maturation Kinetics, Pressure Effects, Overpressure
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In a closed source-rock system, why is the direct generation of gas generally expected to be more sensitive to high pressure than the formation of oil?

A	Because oil formation requires a much larger increase in volume than gas formation
B	Because pressure strongly increases activation energy for all kerogen reactions
C	Because gas generation involves a larger volume expansion, so higher pressure tends to slow the reaction direction that increases volume
D	Because pressure forces methane to polymerize back into kerogen under burial temperatures
Correct answer:	C - Because gas generation involves a larger volume expansion, so higher pressure tends to slow the reaction direction that increases volume

Rationale

The chapter notes that pressure is a secondary control compared with temperature, but it can reduce reaction rates when hydrocarbon generation causes a significant volume increase. Oil generation involves only a modest volume change because residual solid material remains, whereas converting kerogen (or oil) to gas produces a much larger expansion. By Le Chatelier's principle, higher pressure in a closed system tends to oppose the volume-increasing direction, making gas generation more pressure-sensitive.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 14 - Source Rocks and Petroleum Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Integrates the chapter's discussion of pressure, volume change, Le Chatelier's rule, and why gas generation can promote overpressure.

ID	formationeval_v0.1_petroleumgeology_vitrinite_reflectance_007
Domains	Petroleum Geology
Topics	Thermal Maturity Indicators, Vitrinite Reflectance
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A shale sample has a measured vitrinite reflectance of R0 = 0.95%. What maturity interpretation is most consistent with this value?

A	Immature for oil generation, with little hydrocarbon production expected
B	Near peak oil generation conditions in terms of thermal exposure
C	Beyond the upper oil limit where only dry gas should remain after thermal cracking has converted all liquids
D	Indicative of very shallow burial where bacterial methane dominates

Correct answer: B - Near peak oil generation conditions in terms of thermal exposure

Rationale

The chapter states that shales with R0 below about 0.5% are immature, while values around 0.9–1.0% correspond to maximum oil generation. Values around 1.3% mark the upper limit of oil generation. Therefore, an R0 near 0.95% aligns with peak oil generation maturity rather than immaturity or overmaturity.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 14 - Source Rocks and Petroleum Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Uses the maturity thresholds tied to vitrinite reflectance (R0) described in the chapter.

Question 374 of 505

ID	formationeval_v0.1_petroleumgeology_rock_eval_s2_008
Domains	Petroleum Geology
Topics	Rock-Eval Pyrolysis, Source Rock Screening
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In a Rock-Eval analysis, which measurement corresponds to hydrocarbons generated in the laboratory by heating and cracking kerogen (rather than hydrocarbons already present in the rock)?

A	S1
B	S3
C	Tmax
D	S2

Correct answer: D - S2

Rationale

S1 represents hydrocarbons that exist in the rock at the start of the program and are released at the lower-temperature step. S2 represents additional hydrocarbons created during programmed heating as kerogen breaks down in the instrument. Tmax is the temperature at which the S2 generation rate peaks, and S3 is tied to CO_2 released during heating.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 14 - Source Rocks and Petroleum Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on interpreting Rock-Eval peaks and what S2 physically represents during pyrolysis.

ID	formationeval_v0.1_petroleumgeology_production_index_009
Domains	Petroleum Geology
Topics	Rock-Eval Pyrolysis, Production Index
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two shale samples have the same S2 = 5 mg HC/g rock. Sample X has S1 = 1.0 mg HC/g rock, while sample Y has S1 = 0.2 mg HC/g rock. Using the Rock-Eval Production Index (PI = S1/(S1+S2)), which sample has the higher PI and why?

A	Sample X has the higher PI because a larger fraction of (S1 + S2) is already present as free hydrocarbons
B	Sample Y has the higher PI because lower S1 indicates a more efficient source rock
C	Both samples have the same PI because PI depends only on S2 and TOC, not on the volatile hydrocarbon fraction S1
D	Neither sample can have PI estimated because PI requires S3 and Tmax
Correct answer:	A - Sample X has the higher PI because a larger fraction of (S1 + S2) is already present as free hydrocarbons

Rationale

With S2 = 5 for both samples, Sample X has PI = 1.0/(1.0+5) = 0.167, while Sample Y has PI = 0.2/(0.2+5) = 0.038. Higher S1 at the same S2 increases PI. Conceptually, PI expresses how much petroleum is already present as free hydrocarbons (S1) relative to the total generative capacity (S1+S2). Note that S1 represents remaining petroleum after any migration losses.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 14 - Source Rocks and Petroleum Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Applies the Rock-Eval PI definition to compare two samples with identical S2 but different S1.

Question 376 of 505

ID	formationeval_v0.1_productionengineering_api_gravity_010
Domains	Production Engineering, Reservoir Engineering
Topics	API Gravity, Crude Oil Properties
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

A crude oil has density $\rho = 0.85$ g/cm^3 at 60°F (15°C). Using API gravity = $141.5/\rho - 131.5$, what is the API gravity (rounded to the nearest whole number)?

A	10° API
B	20° API
C	35° API
D	45° API

Correct answer: C - 35° API

Rationale

Substituting $\rho = 0.85$ g/cm^3 gives API = $141.5/0.85 - 131.5 \approx 166.5 - 131.5 \approx 35$. This reflects the inverse relationship: lower density corresponds to higher API. The value is therefore in the mid-30s rather than the heavy-oil range (~15–20 or lower).

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 14 - Source Rocks and Petroleum Geochemistry
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical application of the API gravity definition given in the chapter.

Question 377 of 505

ID	formationeval_v0.1_petroleumgeology_time_temperature_maturity_011
Domains	Petroleum Geology
Topics	Basin Modelling, Time-Temperature Integration, Maturity
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Two source rocks experienced different thermal histories after burial. Rock A stayed near 120°C for 60 million years, while Rock B reached 155°C for 5 million years. Given that kerogen transformation follows Arrhenius-type kinetics where reaction rates increase exponentially with temperature, which rock is more likely to have the higher maturity?

A	Rock A, because maturation depends only on total time regardless of temperature, as thermal cracking kinetics are independent of heat
B	Rock B, because reaction rates rise sharply with temperature and maturation above ~130–140°C becomes very rapid
C	Rock A, because maturation above ~130–140°C slows down so time becomes the controlling factor
D	Rock B, because pressure at 155°C intrinsically prevents kerogen transformation in closed systems by inhibiting the release of volatile products
Correct answer:	B - Rock B, because reaction rates rise sharply with temperature and maturation above ~130–140°C becomes very rapid

Rationale

The chapter emphasizes that maturation is an exponential function of temperature (Arrhenius-type behavior) and notes that when temperatures exceed roughly 130–140°C, maturity can increase quickly and the role of time becomes less decisive. A long duration at 120°C can mature a rock, but a shorter exposure at 155°C can drive much faster transformation. Therefore Rock B is expected to be more mature in many practical cases.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 14 - Source Rocks and Petroleum Geochemistry

Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Integrates the chapter’s discussion of Arrhenius kinetics, TTI-style integration, and reduced time sensitivity at high temperatures.

Question 378 of 505

ID	formationeval_v0.1_petroleumgeology_primary_migration_001
Domains	Petroleum Geology
Topics	Primary Migration, Source Rock Expulsion
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In the context of petroleum systems, what best describes primary migration?

A	Movement of newly generated hydrocarbons out of the source rock into adjacent rocks
B	Updip flow of oil and gas through carrier beds toward structural highs
C	Redistribution of hydrocarbons within a reservoir caused by production-related pressure drawdown
D	Diffusion of dissolved hydrocarbons through regional groundwater circulation over basin scale

Correct answer: A - Movement of newly generated hydrocarbons out of the source rock into adjacent rocks

Rationale

Primary migration refers to the initial expulsion step: hydrocarbons leaving the source rock after generation and entering nearby rocks. Updip movement through carrier beds is part of secondary migration, and production-driven changes are not how the chapter defines primary migration.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 15 - Petroleum Migration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item distinguishing the expulsion step from later carrier-bed flow.

Question 379 of 505

ID	formationeval_v0.1_petroleumgeology_gas_solubility_002
Domains	Petroleum Geology
Topics	Gas Solubility, Pressure Reduction
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A basin undergoes uplift, reducing pressure in fluids that previously contained dissolved gas. Which outcome is most likely for dissolved gases in this situation?

A	Oil becomes substantially more soluble in water, delaying hydrocarbon phase separation
B	Gas comes out of solution and can form free gas volumes in oil or water
C	Kerogen transforms back into solid coke, decreasing the fluid volume in the source rock
D	Capillary entry pressure drops to near zero, allowing universal vertical leakage through shales

Correct answer: B - Gas comes out of solution and can form free gas volumes in oil or water

Rationale

The chapter notes that reduced pressure (from uplift or production drawdown) can cause significant dissolved gas to exsolve and form a separate gas phase. It also emphasizes that oil has generally low solubility in water, so the key effect is gas bubbling out rather than oil dissolving.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 15 - Petroleum Migration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on how depressurization affects dissolved gas and phase behavior.

Question 380 of 505

ID	formationeval_v0.1_reservoirengineering_basin_hydrodynamics_003
Domains	Reservoir Engineering, Petroleum Geology
Topics	Basin Hydrodynamics, Two-Phase Flow
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

At the scale of an entire sedimentary basin, oil saturation is typically low and not laterally continuous. Under a regional fluid-pressure gradient, which phase is most likely to be transported effectively?

A	Oil, because its lower density makes it the dominant moving phase under any pressure gradient
B	Gas, because it invariably forms a connected phase even at very low saturation levels
C	Water, because it is the only phase expected to be continuous at basin scale
D	Oil and gas, because relative permeability does not depend on saturation at large scale
Correct answer:	C - Water, because it is the only phase expected to be continuous at basin scale

Rationale

The chapter argues that, on a regional scale, hydrocarbons are not usually present as a connected phase because average hydrocarbon saturation is low. As a result, large-scale pressure gradients mainly move water, while disconnected hydrocarbon droplets are held in place by capillary effects.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 15 - Petroleum Migration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on continuity of phases and what actually flows under basin-scale gradients.

Question 381 of 505

ID	formationeval_v0.1_petrophysics_void_ratio_004
Domains	Petrophysics
Topics	Void Ratio, Porosity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

A source rock interval has porosity $\phi = 0.20$. Void ratio expresses pore space as the ratio of void volume to solid volume. What is the void ratio V_r?

A	0.20
B	0.25
C	0.80
D	1.20
Correct answer:	B - 0.25

Rationale

The void ratio is defined as $V_r = \phi/(1-\phi)$. Substituting $\phi = 0.20$ gives $V_r = 0.20/0.80 = 0.25$. The other options correspond to either porosity itself or incorrect manipulations of the ratio.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 15 - Petroleum Migration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical application of the void-ratio relationship used to discuss fluidization during maturation.

Question 382 of 505

ID	formationeval_v0.1_petroleumgeology_hydrofracturing_005
Domains	Petroleum Geology, Drilling Engineering
Topics	Hydrofracturing, Stress State, Overpressure
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a fine-grained, clay-rich source rock with very low matrix permeability, what condition most directly allows petroleum to be expelled if capillary resistance prevents matrix flow?

A	The pore pressure rises until fracturing occurs, creating thin pathways for expulsion
B	The oil dissolves into the formation water and is transported as a single aqueous phase
C	Vertical compaction reduces the overburden stress until the rock becomes permeable
D	Regional groundwater flow shears the shale fabric and makes the matrix oil-wet

Correct answer: A - The pore pressure rises until fracturing occurs, creating thin pathways for expulsion

Rationale

The chapter explains that in tight shale matrices, oil cannot migrate through intergranular pores because permeability is too low and capillary entry pressure too high. Petroleum generation then contributes to overpressure until fracture pressure is reached, allowing expulsion through fractures.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 15 - Petroleum Migration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on why overpressure-driven fracturing enables expulsion from low-permeability source rocks.

Question 383 of 505

ID	formationeval_v0.1_petrophysics_relative_permeability_006
Domains	Petrophysics
Topics	Relative Permeability, Two-Phase Flow
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In a water-wet carrier rock containing both oil and water, what is the main reason that very low oil saturation leads to negligible oil migration?

A	Oil density increases at low saturation, eliminating buoyancy relative to water
B	Oil forms disconnected droplets and its relative permeability becomes very small
C	Water viscosity becomes extremely high in the presence of oil, preventing any flow
D	Cap rock fracture pressure decreases as oil saturation decreases in the carrier bed
Correct answer:	B - Oil forms disconnected droplets and its relative permeability becomes very small

Rationale

The chapter treats secondary migration as multi-phase flow where connectivity matters. When oil saturation is low, oil is not a continuous phase and capillary forces keep droplets from moving, so the relative permeability to oil is very small (the text notes very low mobility below roughly 20–30% oil saturation).

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 15 - Petroleum Migration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on saturation/connectivity control of relative permeability during secondary migration.

Question 384 of 505

ID	formationeval_v0.1_reservoirengineering_buoyancy_pressure_007
Domains	Reservoir Engineering, Petroleum Geology
Topics	Buoyancy Pressure, Migration Driving Force
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

Using the buoyancy pressure relation, estimate the oil–water pressure difference generated by a 150 m continuous oil column where ρw = 1.10 g/cm³ and ρo = 0.80 g/cm³ (using the approximation where 100 m of a 1.0 g/cm³ water column corresponds to ~1 MPa).

A	0.15 MPa
B	0.30 MPa
C	0.45 MPa
D	0.90 MPa

Correct answer: C - 0.45 MPa

Rationale

The density difference is $\Delta\rho = 1.10-0.80 = 0.30$ g/cm³. In the chapter's scaling, a 100 m column gives a pressure difference of $\Delta\rho$ MPa, so 150 m gives $1.5\times0.30 = 0.45$ MPa. This is the excess pressure available to help overcome capillary resistance along a connected pathway.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 15 - Petroleum Migration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical application of the buoyancy pressure difference used to explain overcoming capillary entry pressure.

Question 385 of 505

ID	formationeval_v0.1_petrophysics_shale_sealing_008
Domains	Petrophysics, Petroleum Geology
Topics	Shale Sealing, Pore Throat Size, Oil Migration
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Why is oil unlikely to migrate through the shale matrix when the largest connected pore-throat sizes become very small (tens of angstroms)?

A	Because oil becomes denser than water in nanopores, reversing buoyancy-driven flow
B	Because pore throats can approach the size of large oil molecules, creating a molecular sieving effect
C	Because shale permeability increases sharply at depth, causing oil to bypass fractures entirely
D	Because oil–water interfacial tension approaches zero in shales, preventing capillary entry into fractures

Correct answer: B - Because pore throats can approach the size of large oil molecules, creating a molecular sieving effect

Rationale

The chapter links shale matrix permeability to the size of the largest connected pores, and notes that when connecting throats drop below roughly the scale of asphaltene-sized components, selective exclusion (sieving) should occur. Under such conditions, oil migration is inferred to require fractures rather than intergranular flow through the shale matrix.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 15 - Petroleum Migration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on pore-throat scale limits to matrix-controlled oil migration in shales.

Question 386 of 505

ID	formationeval_v0.1_petroleumgeology_cap_rock_integrity_009
Domains	Petroleum Geology
Topics	Cap Rock Integrity, Capillary Pressure, Hydrofracturing
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A geoscientist suggests that adding a taller oil column beneath a shale seal should directly raise the seal's water pressure and therefore trigger hydrofracturing earlier. Considering how capillary entry pressure governs oil-water pressure relationships at water-wet seal interfaces, what is the most defensible correction to this reasoning?

A	The extra oil-column pressure is countered by capillary forces, so the water pressure controlling fracture onset is not increased by buoyancy alone
B	The oil-column pressure is rapidly transferred into all shale pores, so fracture onset is guaranteed at the same depth as the oil–water contact
C	Hydrofracturing is controlled primarily by overburden stress, so horizontal stress is irrelevant for seal failure
D	Water-wet seals cannot fracture because imbibition inherently removes oil before pressures can build, as the capillary suction force dominates over buoyancy at all depths

Correct answer: A - The extra oil-column pressure is countered by capillary forces, so the water pressure controlling fracture onset is not increased by buoyancy alone

Rationale

The chapter emphasizes that the petroleum phase can have higher pressure than the water phase, but the difference is sustained by capillary forces. Because fracturing onset depends on the stress state and the pressure in the water-saturated pore system of the seal, buoyancy does not automatically raise the critical water pressure to fracture. Once a fracture forms and hydrocarbons become the continuous phase within it, hydrocarbon pressure can then govern whether fractures stay open.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 15 - Petroleum Migration

Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Nuanced item on why buoyancy-related petroleum overpressure does not automatically set the hydrofracture onset pressure in the seal.

Question 387 of 505

ID	formationeval_v0.1_petroleumgeology_pressure_compartments_010
Domains	Petroleum Geology
Topics	Pressure Compartments, Trap Leakage, Regional Migration
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Two structural closures sit within the same pressure compartment and are connected by a continuous permeable sandstone. One closure is shallower and structurally higher than the other. What is the most likely implication for fracture-driven leakage risk?

A	The deeper closure is more likely to leak first because its overburden stress is higher
B	The higher closure is more likely to reach fracture pressure and leak, reducing the chance that the lower closure fractures
C	Both closures must leak at the same time because pressure is identical everywhere within a compartment
D	Neither closure can leak because sandstones prevent pressure buildup by keeping the system hydrostatic

Correct answer:	B - The higher closure is more likely to reach fracture pressure and leak, reducing the chance that the lower closure fractures

Rationale

The chapter argues that leakage by fracturing tends to initiate at the top of the highest structure within a pressure compartment, where the intersection with fracture conditions is most easily met. If the structures communicate through a permeable carrier, the higher structure can act as a pressure relief path, making it less likely that the deeper structure reaches conditions needed to fracture and leak.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 15 - Petroleum Migration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Integration item using pressure communication, structural height, and fracture-controlled leakage within a compartment.

Question 388 of 505

ID	formationeval_v0.1_petrophysics_well_logging_basics_001
Domains	Petrophysics
Topics	Well Logging Basics, In-situ Measurements
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Compared with relying only on cuttings and a few core intervals, what is a key advantage of wireline well logs for describing the drilled section?

A	They provide only spot measurements but with higher chemical precision than core tests, since the tool must pause at each depth
B	They give a continuous in-well record and capture properties that may change when samples are brought to surface conditions
C	They eliminate the need for drilling mud, so measurements are unaffected by borehole fluids
D	They directly measure depositional grain-size distributions without needing any interpretation

Correct answer: B - They give a continuous in-well record and capture properties that may change when samples are brought to surface conditions

Rationale

Logs are recorded continuously along the borehole, so they show both gradual and abrupt property changes bed-by-bed. They also measure formation properties in place, which can differ from laboratory measurements on core or cuttings due to handling and non-reservoir conditions at surface. Cuttings and limited cores typically cannot represent the entire drilled interval with the same continuity.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 16 - Well Logs: A Brief Introduction
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Derived from the chapter’s discussion of why logs complement cores and cuttings through continuous, in-situ measurements.

Question 389 of 505

ID	formationeval_v0.1_petrophysics_logging_operations_002
Domains	Petrophysics, Drilling Engineering
Topics	Logging Operations, Cased-Hole Logging
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A well section has already been cased with steel pipe. Which type of log is still generally feasible to run through the casing?

A	A standard electrode-based resistivity log that requires electrical contact at the borehole wall
B	A micro log intended to assess mudcake thickness at the borehole wall
C	A self-potential (SP) log that relies on electrochemical potentials between mud and formation water
D	A gamma-ray log that detects natural radiation coming from the formation
Correct answer:	D - A gamma-ray log that detects natural radiation coming from the formation

Rationale

Radioactivity measurements do not require the same direct electrical contact with the formation as most electrical logs. Gamma radiation can penetrate steel casing sufficiently for logging to be performed after casing is set. In contrast, many electrical measurements depend strongly on borehole wall conditions and direct interaction with the formation.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 16 - Well Logs: A Brief Introduction
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter’s operational notes about which logs require borehole-wall contact versus radiation penetration through casing.

Question 390 of 505

ID	formationeval_v0.1_petrophysics_resistivity_principles_003
Domains	Petrophysics
Topics	Resistivity Logging, Formation Water Salinity
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Two clean, water-saturated sandstones have similar porosity and pore geometry, but one contains much more saline formation water. How should their measured resistivities typically compare?

A	The sandstone with more saline water should show lower resistivity
B	The sandstone with more saline water should show higher resistivity
C	Both should have the same resistivity because minerals control conduction
D	Both should have the same resistivity because porosity dominates and salinity is secondary

Correct answer:	A - The sandstone with more saline water should show lower resistivity

Rationale

In most sedimentary rocks, electrical conduction occurs mainly through the pore fluid rather than through the mineral grains. Higher dissolved salt content increases the pore fluid's ability to conduct current, which decreases resistivity. With similar pore structure, the main difference becomes the pore water salinity.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 16 - Well Logs: A Brief Introduction
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept item from the resistivity section explaining that conductivity is dominated by pore fluid and its salt content.

Question 391 of 505

ID	formationeval_v0.1_petrophysics_caliper_logs_004
Domains	Petrophysics, Drilling Engineering
Topics	Caliper Logs, Borehole Effects
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why is a caliper log commonly checked when interpreting other wireline logs from the same interval?

A	Because it directly provides shale volume from radioactive element concentrations
B	Because it measures formation water resistivity needed for Archie calculations
C	Because borehole enlargement or narrowing can distort many log measurements, and caliper data helps flag such intervals
D	Because it determines the dip of beds by comparing electrical responses around the borehole

Correct answer:	C - Because borehole enlargement or narrowing can distort many log measurements, and caliper data helps flag such intervals

Rationale

Many tools are sensitive to borehole geometry and tool contact with the wall, so washouts and irregular holes can create misleading responses. The caliper log indicates where the hole size differs from the bit size and where mudcake or caving may be present. This helps distinguish true formation changes from borehole-related artifacts.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 16 - Well Logs: A Brief Introduction
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Built from the caliper-log discussion emphasizing borehole diameter variations and their impact on other logs.

Question 392 of 505

ID	formationeval_v0.1_petrophysics_mud_invasion_005
Domains	Petrophysics
Topics	Mud Invasion, Flushed Zone
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the near-wellbore region affected by overbalanced drilling, which zone best matches the situation where the original pore fluids are almost completely replaced by mud-derived fluid?

A	The mudcake, where solids are deposited directly against the borehole wall
B	The flushed zone, where mud filtrate has displaced most of the native fluids
C	The uninvaded zone, where the formation is unaffected by drilling operations
D	A cemented zone, where quartz cement blocks flow and prevents any fluid entry
Correct answer:	B - The flushed zone, where mud filtrate has displaced most of the native fluids

Rationale

Overbalanced mud pressure drives filtrate into the formation, producing a sequence from mudcake at the wall to zones deeper in the rock. The flushed zone is described as the region where the primary pore fluids have been largely replaced by drilling-fluid filtrate. Farther out, replacement is only partial in the invaded zone.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 16 - Well Logs: A Brief Introduction
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the description of mudcake, flushed zone, and invaded zone and how they form during drilling.

Question 393 of 505

ID	formationeval_v0.1_petrophysics_formation_factor_006
Domains	Petrophysics
Topics	Formation Factor, Porosity-Resistivity Relationships
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two rocks are fully water-saturated with the same formation water resistivity (Rw), but Rock X has a much larger formation factor (F) than Rock Y. What does this most strongly imply about Rock X?

A	It likely has lower porosity and/or a more tortuous, better-cemented pore network that makes current paths less direct
B	It must contain more conductive minerals throughout the rock matrix, regardless of pore fluids
C	It must have higher permeability because permeability consistently increases formation factor as larger pore throats enhance ionic conductivity
D	It must contain more hydrocarbons because formation factor is defined for oil-saturated conditions
Correct answer:	A - It likely has lower porosity and/or a more tortuous, better-cemented pore network that makes current paths less direct

Rationale

Formation factor is defined using the rock resistivity at 100% water saturation relative to the water resistivity, so it is meant to reflect rock framework effects rather than the water's salinity itself. The chapter links F to porosity and to how well the pore system is cemented (via the cementation exponent and tortuosity). A larger F indicates electrical pathways are more restricted, commonly associated with lower porosity and/or more cemented, tortuous pore space.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 16 - Well Logs: A Brief Introduction
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based item from the formation factor definition and its dependency on porosity/cementation ($F = a/\phi^m$).

ID	formationeval_v0.1_petrophysics_archie_water_saturation_007
Domains	Petrophysics
Topics	Archie Equation, Water Saturation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

A clean reservoir interval has formation factor F = 12 (dimensionless), formation water resistivity Rw = 0.15 Ω·m, and true formation resistivity Rt = 2.7 Ω·m. Using Archie's equation with saturation exponent n = 2, what is the estimated water saturation Sw (fraction)?

A	Sw ≈ 0.58
B	Sw ≈ 0.67
C	Sw ≈ 0.74
D	Sw ≈ 0.82
Correct answer:	D - Sw ≈ 0.82

Rationale

From the chapter, Sw = (F·Rw/Rt)^(1/n). Here F·Rw/Rt = (12×0.15)/2.7 = 0.6667, and with n = 2, Sw = √0.6667 ≈ 0.82. The other options correspond to using an incorrect exponent or an incorrect ratio.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 16 - Well Logs: A Brief Introduction
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical application derived from the chapter’s Archie water saturation relationship using F, Rw, Rt, and n.

Question 395 of 505

ID	formationeval_v0.1_petrophysics_sp_logging_008
Domains	Petrophysics
Topics	SP Logging, Mud Type Effects
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A logging run shows that the SP curve is essentially absent (no meaningful deflection), while other logs record normally. Which explanation is most consistent with SP log theory?

A	The formation contains no clay minerals, so SP cannot form in any lithology
B	The formation water is too saline, so electrochemical potentials cannot exist
C	An oil-based mud was used, preventing the SP measurement from being obtained
D	The beds are too thick, and SP only responds to very thin layers where diffusion potentials can develop

Correct answer: C - An oil-based mud was used, preventing the SP measurement from being obtained

Rationale

The SP response relies on naturally generated electrical potentials associated with differences in electrolyte concentrations between borehole and formation fluids. The chapter notes that SP readings cannot be obtained when oil-based mud is used. The other explanations do not align with the described measurement principle.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
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Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 16 - Well Logs: A Brief Introduction
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	From the SP section describing the electrochemical basis of SP and the inability to record SP in oil-based mud.

Question 396 of 505

ID	formationeval_v0.1_petrophysics_spectral_gamma_ray_009
Domains	Petrophysics, Sedimentology
Topics	Gamma-Ray Logging, Spectral Gamma-Ray, Shale Volume
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In an interval where potassium-based gamma-ray response may be elevated by K-feldspar or mica in sandstones, which spectral gamma-ray component can give a more stable estimate of shale content?

A	Uranium (U), because it is least affected by organic matter
B	Thorium (Th), because its concentration in shales is described as less variable than K or U
C	Potassium (K), because it uniquely identifies clay minerals and is absent from sandstones
D	Total gamma ray, because splitting into components reduces accuracy
Correct answer:	B - Thorium (Th), because its concentration in shales is described as less variable than K or U

Rationale

The chapter explains that spectral gamma tools can separate K, U, and Th contributions. It notes that thorium in shales tends to vary less than uranium and potassium, so a Th-based interpretation can improve shale estimates when K is influenced by non-shale minerals. This is particularly relevant where sands contain mica or K-feldspar.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 16 - Well Logs: A Brief Introduction
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based question from the spectral gamma-ray discussion highlighting why Th can be preferred for shale estimation.

Question 397 of 505

ID	formationeval_v0.1_sedimentology_facies_from_logs_010
Domains	Sedimentology, Petrophysics
Topics	Facies Interpretation, Gamma-Ray Trends, SP Trends
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A gamma-ray curve across a sandstone body shows a sharp low-gamma base followed by progressively higher gamma readings toward the top, producing a bell-shaped motif. Which depositional interpretation is most consistent with standard log-motif analysis?

A	A fining-upward fluvial channel fill, where the upward increase in gamma is commonly linked to increasing clay-rich material
B	A coarsening-upward shallow-marine unit, where gamma typically increases upward as sands become cleaner
C	A massive evaporite package, where gamma increases upward due to halite becoming more radioactive
D	A coal seam, where gamma typically spikes because organic matter strongly emits potassium radiation
Correct answer:	A - A fining-upward fluvial channel fill, where the upward increase in gamma is commonly linked to increasing clay-rich material

Rationale

The chapter associates fining-upward successions with fluvial channels and notes that gamma/SP logs commonly capture such upward trends. A bell-shaped gamma motif corresponds to a cleaner base and increasing shale influence upward. The other choices conflict with the chapter's described log behavior for coarsening-upward units, evaporites, and coal.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 16 - Well Logs: A Brief Introduction
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Derived from the depositional-environment interpretation section describing fining-upward (channels) and coarsening-upward (shallow marine) motifs on gamma/SP logs.

Question 398 of 505

ID	formationeval_v0.1_drillingengineering_deviated_wells_011
Domains	Drilling Engineering, Petrophysics
Topics	Deviated Wells, Bed Boundary Resolution, Log Response Geometry
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A well is drilled at a high deviation so that it intersects bedding at a very low angle. Even if a sand–shale boundary is sharp in the formation, what log-response effect is most likely due to borehole geometry?

A	The boundary will appear sharper than in a vertical well because the tool samples only one lithology at a time due to reduced path length
B	The boundary will disappear because gamma rays cannot detect thin beds in deviated wells
C	The boundary will shift to a deeper measured depth because electrical logs necessarily read below the tool's current position in highly deviated wells
D	The boundary will look more gradual because the measurement samples properties from multiple layers away from the borehole
Correct answer:	D - The boundary will look more gradual because the measurement samples properties from multiple layers away from the borehole

Rationale

The chapter explains that when the well path is nearly parallel to layering, the log investigation volume can include contributions from different beds rather than cutting cleanly across them. This causes transitions between lithologies to be recorded as smeared or gradual even if the geological contact is abrupt. The effect is geometric and is distinct from tool-specific physics like gamma penetration.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 16 - Well Logs: A Brief Introduction
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	From the section on horizontal/deviated wells describing how low-angle intersection with bedding can smear otherwise sharp contacts.

Question 399 of 505

ID	formationeval_v0.1_petroleumgeology_temperature_logs_012
Domains	Petroleum Geology, Geophysics
Topics	Temperature Logs, Geothermal Gradient, Bottom-Hole Temperature
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A temperature measured during logging (BHT) is suspected to be biased by recent drilling. What approach is used to estimate the true formation temperature from such data?

A	Assume the first recorded temperature equals formation temperature because the tool equilibrates instantly
B	Replace the temperature log with an SP log because electrochemical potentials are temperature-independent
C	Stop mud circulation and use the temperature rise with time to extrapolate toward formation equilibrium
D	Increase the mud weight and re-log immediately so the mudcake is thicker and thermally insulating

Correct answer:	C - Stop mud circulation and use the temperature rise with time to extrapolate toward formation equilibrium

Rationale

The chapter notes that circulating mud is not in thermal equilibrium with the formation, so temperatures recorded during logging may not represent true formation temperature. After circulation stops, the mud temperature trends toward the formation temperature, and plotting the time-dependent change allows an estimate by extrapolation. It also emphasizes that equilibrium can take days to weeks, creating uncertainty if not properly corrected.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 16 - Well Logs: A Brief Introduction
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Based on the temperature-log discussion of BHT bias from mud circulation and extrapolation toward equilibrium formation temperature.

Question 400 of 505

ID	formationeval_v0.1_geophysics_reflection_seismology_001
Domains	Geophysics
Topics	Reflection Seismology, Hydrocarbon Exploration
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A team needs an imaging method that can map subsurface structure and stratigraphy in 2D or 3D for hydrocarbon prospecting. Which seismic approach is most commonly used for this purpose?

A	Refraction seismic, because it directly measures layer thickness from critically refracted arrivals
B	Reflection seismic, because it builds images from energy returned at impedance contrasts
C	Surface-wave surveying, because it tracks Rayleigh and Love waves through the deep subsurface
D	Passive earthquake seismology, because it relies on naturally occurring sources to illuminate targets
Correct answer:	B - Reflection seismic, because it builds images from energy returned at impedance contrasts

Rationale

In hydrocarbon exploration, reflection seismic is the standard method because reflections from boundaries in layered rocks can be processed into 2D or 3D subsurface images. Refraction and surface-wave methods have other applications, but they are not the primary tools for detailed imaging of traps and reservoir-scale features described in the chapter.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 17 - Seismic Exploration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Derived from the chapter’s overview of reflection vs refraction methods and the dominance of reflection seismic in petroleum exploration.

Question 401 of 505

ID	formationeval_v0.1_geophysics_wave_types_002
Domains	Geophysics
Topics	Seismic Waves, Elastic Properties
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

During a survey that involves a water layer above the seafloor, which wave type cannot propagate within the water column and therefore cannot exist there as a traveling body wave?

A	P-waves, because water cannot transmit compressional motion
B	Rayleigh waves, because they require a solid surface to travel along
C	Love waves, because they require layered sediments beneath the water
D	S-waves, because water cannot support shear deformation
Correct answer:	D - S-waves, because water cannot support shear deformation

Rationale

Shear waves require the medium to resist shear strain, but fluids have essentially no shear strength. The chapter states that S-waves do not travel through fluids, which is why S-wave propagation is absent in the fluid part at a fluid–solid interface like the seafloor.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 17 - Seismic Exploration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept check on wave propagation constraints at fluid–solid interfaces.

Question 402 of 505

ID	formationeval_v0.1_geophysics_seismic_sources_003
Domains	Geophysics
Topics	Seismic Sources, Acquisition
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Which pairing correctly matches a common seismic source with the environment where it is typically used?

A	Air-gun in marine surveys; vibrator or dynamite in land surveys
B	Air-gun in land surveys; vibrator in marine surveys
C	Vibrator in marine surveys; dynamite in deep-water surveys
D	Dynamite in marine surveys; air-gun in desert surveys

Correct answer: A - Air-gun in marine surveys; vibrator or dynamite in land surveys

Rationale

The chapter distinguishes typical source choices by setting: air-guns are standard for marine acquisition, while vibrators and explosives are common land sources. This reflects practical coupling of energy into water versus into the ground.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 17 - Seismic Exploration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Item based on the chapter’s discussion of typical seismic sources for land vs marine acquisition.

Question 403 of 505

ID	formationeval_v0.1_geophysics_acoustic_impedance_004
Domains	Geophysics
Topics	Acoustic Impedance, Reflection Coefficient
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A normally incident P-wave encounters a boundary between two layers. Which situation is most likely to produce a strong reflected event on the seismic record?

A	A boundary where velocity changes slightly but density stays nearly constant
B	A boundary where density changes slightly but velocity stays nearly constant
C	A boundary where both density and P-wave velocity change substantially across the contact
D	A boundary where both layers have similar density and similar P-wave velocity
Correct answer:	C - A boundary where both density and P-wave velocity change substantially across the contact

Rationale

For normal incidence, the reflection coefficient depends on the contrast in P-impedance, which is the product of density and P-wave velocity. Large changes in both parameters create a large impedance contrast and therefore a larger fraction of energy is reflected back to the surface.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 17 - Seismic Exploration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the impedance-contrast control of reflection strength and the normal-incidence reflection coefficient relation.

Question 404 of 505

ID	formationeval_v0.1_geophysics_sampling_nyquist_005
Domains	Geophysics
Topics	Seismic Sampling, Aliasing
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

A seismic line is recorded with a time sampling interval of Δt = 2 ms. Using the standard definition, what is the Nyquist frequency?

A	125 Hz
B	250 Hz
C	500 Hz
D	50 Hz
Correct answer:	B - 250 Hz

Rationale

The Nyquist frequency is defined as $1/(2\Delta t)$. With $\Delta t = 0.002$ s, the Nyquist frequency is $1/(2\times0.002) = 250$ Hz. Frequencies above this would be folded back into lower frequencies if present in the signal.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 17 - Seismic Exploration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical application of the Nyquist frequency definition discussed in the processing section.

Question 405 of 505

ID	formationeval_v0.1_geophysics_wavelet_estimation_006
Domains	Geophysics
Topics	Seismic Trace Model, Seismic Inversion
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A petrophysicist is performing seismic inversion using the model that a trace equals a wavelet convolved with reflectivity plus noise. If the wavelet shape is estimated incorrectly, what is the most likely impact on the inversion outcome?

A	Only the random noise level changes; the recovered reflectivity is otherwise unaffected
B	The travel times of reflections change, but impedance-related estimates remain reliable
C	Multiples are automatically removed, so inversion becomes more stable
D	The recovered reflectivity/impedance is biased because the data are being matched with the wrong source signature

Correct answer:	D - The recovered reflectivity/impedance is biased because the data are being matched with the wrong source signature

Rationale

In the convolutional view, the wavelet controls how reflectivity is mapped into the recorded trace. If the wavelet is wrong, the inversion can fit the seismic but assign incorrect reflectivity (and therefore incorrect impedance contrasts), leading to misleading reservoir-quality interpretations.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 17 - Seismic Exploration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Uses the chapter’s convolutional trace model and its emphasis on wavelet estimation for inversion reliability.

Question 406 of 505

ID	formationeval_v0.1_geophysics_fold_calculation_007
Domains	Geophysics
Topics	Marine Acquisition, Fold
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

For a standard marine acquisition, the nominal fold is given by $F = (N\Delta g)/(2\Delta s)$. If $N = 240$ channels, $\Delta g = 12.5$ m, and $\Delta s = 25$ m, what is the nominal fold?

A	60
B	30
C	120
D	15
Correct answer:	A - 60

Rationale

Substituting into the formula gives $F = (240\times12.5)/(2\times25) = 3000/50 = 60$. Fold represents the number of traces contributing to a stacked trace at a midpoint/cell, and higher fold generally supports better noise suppression during stacking.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 17 - Seismic Exploration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Applies the chapter’s marine fold equation to a realistic channel/spacing scenario.

Question 407 of 505

ID	formationeval_v0.1_geophysics_3d_acquisition_008
Domains	Geophysics
Topics	3D Seismic Acquisition, Wavefield Sampling
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A 2D marine line crosses an area with complex structures that extend away from the line. Why can a 2D section be misleading in such settings compared with a 3D survey?

A	2D surveys cannot measure two-way travel time, so depth conversion becomes impossible
B	2D surveys record only S-waves due to receiver coupling limitations, while 3D surveys record both P- and S-waves simultaneously
C	2D surveys may include events generated by structures located off the profile because the wavefront spreads in 3D
D	2D surveys universally have lower frequencies than 3D surveys, so vertical resolution is inherently worse in 2D acquisitions
Correct answer:	C - 2D surveys may include events generated by structures located off the profile because the wavefront spreads in 3D

Rationale

Because seismic energy propagates as expanding wavefronts, reflections and diffractions can originate from features that are not directly beneath a 2D receiver line. The chapter notes that 3D acquisition samples the wavefield more completely (multiple streamers, azimuths, and offsets), which reduces out-of-plane ambiguity and improves interpretability.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 17 - Seismic Exploration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Targets the chapter's rationale for 3D surveys: full wavefield sampling and reduction of out-of-plane artefacts common in 2D.

Question 408 of 505

ID	formationeval_v0.1_geophysics_nmo_stretch_009
Domains	Geophysics
Topics	NMO Correction, Stacking
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

After NMO correction, early arrivals at far offsets show strong stretch. If an interpreter applies front-end (stretch) muting to remove the most stretched samples, what processing drawback should they expect at early times?

A	Lower effective fold at early times, which reduces the noise suppression normally gained from stacking
B	More accurate travel times at far offsets, which increases the bandwidth of early events
C	An increase in multiples because muting forces multiple energy to align with primaries
D	Improved velocity picking because the muted traces contain stronger low-frequency energy

Correct answer: A - Lower effective fold at early times, which reduces the noise suppression normally gained from stacking

Rationale

Stretch muting removes the severely stretched early-time samples, which can also remove substantial parts of the far-offset data. The chapter explains that this can leave little fold at early times, weakening the stacking benefit and potentially degrading interpretability despite reducing stretch-related distortion.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 17 - Seismic Exploration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter's discussion of NMO stretch, stretch muting, and the impact on fold and stacking performance.

Question 409 of 505

ID	formationeval_v0.1_geophysics_obs_geometry_010
Domains	Geophysics
Topics	Ocean Bottom Seismic (OBS), Survey Design
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In 4C ocean bottom seismic (OBS) acquisition, how do patch and swath geometries typically differ?

A Patch designs minimize azimuth coverage, while swath designs maximize azimuth coverage

B Patch designs provide a wider azimuth range, while swath designs tend to give more uniform offset sampling with better near-offset coverage

C Patch designs are used only for 2D surveys in shallow water settings, while swath designs are used only for 3D surveys in deep water environments

D Patch designs eliminate the need for a hydrophone, while swath designs require a hydrophone plus 3C geophones

Correct answer: B - Patch designs provide a wider azimuth range, while swath designs tend to give more uniform offset sampling with better near-offset coverage

Rationale

The chapter contrasts the two designs: patch layouts (source lines perpendicular to receiver lines) are described as producing a relatively wide range of azimuths. Swath layouts (parallel source and receiver lines) are described as having narrower azimuth range but providing more uniform offset sampling and better near-offset coverage.

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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 17 - Seismic Exploration
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URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Question derived from the OBS 4C acquisition discussion of patch vs swath geometry trade-offs (azimuth and offset sampling).

Question 410 of 505

ID	formationeval_v0.1_geophysics_fresnel_zone_011
Domains	Geophysics
Topics	Seismic Resolution, Fresnel Zone
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

Using the standard approximation for Fresnel-zone radius, Rf = sqrt(VZ/(2fc)), estimate Rf for V = 3000 m/s, Z = 2000 m, and fc = 30 Hz.

A	About 100 m
B	About 30 m
C	About 316 m
D	About 1000 m
Correct answer:	C - About 316 m

Rationale

Compute Rf = sqrt((3000×2000)/(2×30)) = sqrt(6,000,000/60) = sqrt(100,000) ≈ 316 m. The Fresnel zone represents the lateral area that contributes most strongly to a reflection event, so its size sets a practical limit on horizontal detectability.

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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 17 - Seismic Exploration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical application of the Fresnel-zone relation presented in the seismic resolution section.

ID	formationeval_v0.1_geophysics_4d_seismic_012
Domains	Geophysics, Reservoir Engineering
Topics	4D Seismic, Reservoir Monitoring
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A field team plans to use time-lapse (4D) seismic to guide infill drilling during production. What is a key requirement for interpreting differences between repeated 3D surveys (4D seismic) as reservoir changes rather than artefacts?

A	Ensure that only surface waves are used, because they are most sensitive to saturation changes in the shallow subsurface and avoid deeper noise
B	Rely exclusively on raw (unprocessed) data, because processing can remove true time-lapse signals
C	Acquire surveys with intentionally different orientations to maximize attribute variability over time
D	Minimize and correct differences in acquisition/processing so that observed attribute changes can be linked to fluid and pressure evolution

Correct answer: D - Minimize and correct differences in acquisition/processing so that observed attribute changes can be linked to fluid and pressure evolution

Rationale

The chapter emphasizes that 4D interpretation depends on relating seismic-attribute differences to changes in pore fluid and pore pressure during production. It also notes that differences in acquisition geometry, orientation, processing, and data quality can introduce significant noise, so these must be corrected as much as possible.

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Reference	Chapter 17 - Seismic Exploration
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Built from the chapter's description of 4D seismic as repeated 3D surveys and the need to control non-reservoir sources of time-lapse differences.

Question 412 of 505

ID	formationeval_v0.1_geophysics_rock_physics_link_001
Domains	Geophysics
Topics	Rock Physics, Quantitative Seismic Interpretation
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In quantitative seismic interpretation, what is the main purpose of using rock physics models alongside seismic amplitudes?

A	To replace seismic interpretation with a purely geological facies model built from cores
B	To connect geological characteristics of the rock to elastic properties that control reflection amplitudes
C	To remove all dependence on well data by using universal velocity–porosity equations
D	To ensure amplitude anomalies are interpreted only as fluid changes rather than rock changes, which may not affect seismic response

Correct answer:	B - To connect geological characteristics of the rock to elastic properties that control reflection amplitudes

Rationale

Seismic amplitudes arise from contrasts in elastic properties, not directly from facies descriptions. Rock physics provides the bridge from geological parameters (e.g., porosity, clay, cementation) to elastic properties used in seismic interpretation, reducing interpretational ambiguity.

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License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 18 - Explorational Rock Physics
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the chapter’s framing of rock physics as the connection between geological parameters and seismic observables.

Question 413 of 505

ID	formationeval_v0.1_geophysics_lithology_substitution_002
Domains	Geophysics, Petrophysics
Topics	Lithology Substitution, Seismic Interpretation Uncertainty
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

When predicting seismic response away from existing wells, why can lithology substitution be as important as fluid substitution?

A	Because pore fluid properties are nearly constant across a basin at comparable depths, while lithology consistently changes abruptly and controls the seismic response
B	Because seismic amplitudes are controlled only by density contrasts, which are unaffected by pore fluids or changes in velocity structure
C	Because fluid substitution is only valid for carbonates, while lithology substitution is valid for clastics, due to pore geometry differences
D	Because changes in rock texture and mineral/clay/cement content can alter elastic properties as much as changing the pore fluid

Correct answer: D - Because changes in rock texture and mineral/clay/cement content can alter elastic properties as much as changing the pore fluid

Rationale

The chapter emphasizes that reflection amplitudes respond to elastic contrasts, which can be strongly influenced by lithology and microstructure (e.g., cement, clay volume, sorting). Assuming the rock frame stays fixed while only the fluid changes can miss real geologic variability between brine and hydrocarbon zones or laterally between depositional settings.

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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 18 - Explorational Rock Physics
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on why varying depositional/diagenetic rock properties can compete with fluid effects in seismic prediction.

Question 414 of 505

ID	formationeval_v0.1_petrophysics_microstructure_diagnostics_003
Domains	Petrophysics
Topics	Rock Physics Diagnostics, Microstructure Interpretation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A rock physics workflow aims to estimate sandstone texture parameters (e.g., cement amount and sorting) from logs. Which crossplot choice is most appropriate if you want to minimize direct pore-fluid influence on the elastic attribute?

A	Shear-wave velocity versus porosity
B	P-wave velocity versus porosity
C	Bulk density versus porosity
D	Acoustic impedance versus water saturation

Correct answer: A - Shear-wave velocity versus porosity

Rationale

The chapter highlights using a shear-velocity–porosity domain to reduce fluid effects compared with compressional attributes. This makes it easier to diagnose microstructural changes such as cementation and sorting from elastic measurements.

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License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 18 - Explorational Rock Physics
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter’s discussion of estimating cement volume and sorting using Vs–porosity diagnostics to avoid strong fluid effects.

Question 415 of 505

ID	formationeval_v0.1_petrophysics_sorting_diagnostics_004
Domains	Petrophysics, Sedimentology
Topics	Sorting Estimation, Cement Diagnostics
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In a diagnostic workflow where sorting is defined along constant-cement trends, what does it imply when a data point falls far from the contact-cement end member and trends toward the low-porosity end member (for the same cement volume trend)?

A	Sorting is interpreted as higher, because pore-filling material increases elastic stiffness
B	Sorting is unchanged, because cement volume alone controls the position on the trend
C	Sorting is interpreted as lower, because increasing non-cementing pore-fill is associated with reduced porosity
D	Sorting is interpreted as lower, because higher temperature directly forces sorting to decrease with depth

Correct answer:	C - Sorting is interpreted as lower, because increasing non-cementing pore-fill is associated with reduced porosity

Rationale

In the chapter’s diagnostic definition, sorting is highest when points lie on the contact-cement model and decreases as points move away toward the zero-porosity end member. That movement is interpreted as increasing pore-filling (non-cementing) material that reduces porosity, not as a direct temperature-controlled depth trend.

Sources

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Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 18 - Explorational Rock Physics
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Targets the chapter’s specific diagnostic interpretation of sorting (0–1 scale) along constant-cement trends.

Question 416 of 505

ID	formationeval_v0.1_sedimentology_clay_content_trends_005
Domains	Sedimentology, Geophysics
Topics	Sand/Shale Mixtures, Depositional Trends
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a model where clay initially occupies the pore space of a load-bearing sand framework (before the system becomes clay-supported), what combined trend is expected as clay content increases toward the transition point?

A	Porosity decreases while P-wave velocity increases
B	Porosity increases while P-wave velocity increases
C	Porosity increases while P-wave velocity decreases
D	Porosity decreases while P-wave velocity decreases

Correct answer: A - Porosity decreases while P-wave velocity increases

Rationale

When clay is pore-filling within a grain-supported sand framework, it tends to reduce porosity and increase the stiffness of the pore-filling material, increasing velocity. The chapter describes a turning point (critical clay content) beyond which the framework changes and the trend reverses.

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Reference	Chapter 18 - Explorational Rock Physics
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the described behavior of sand/shale mixtures as clay increases up to the critical clay content.

ID	formationeval_v0.1_geophysics_vpvs_discrimination_006
Domains	Geophysics
Topics	Seismic Lithofacies, Vp/Vs Interpretation
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

When trying to separate clean sands from shales using crossplots that include gamma ray (as a clay indicator), why can a Vp/Vs versus gamma ray plot be less ambiguous than an acoustic impedance versus gamma ray plot?

A	Because Vp/Vs is independent of mineralogy, while acoustic impedance depends only on mineralogy and not on fluid content
B	Because gamma ray directly measures pore pressure, which makes Vp/Vs unnecessary
C	Because Vp/Vs tends to increase with clay-rich facies, giving a more monotonic trend than acoustic impedance
D	Because acoustic impedance is unaffected by porosity changes, while Vp/Vs is controlled only by porosity

Correct answer:	C - Because Vp/Vs tends to increase with clay-rich facies, giving a more monotonic trend than acoustic impedance

Rationale

The chapter describes an overturned V-shape behavior for acoustic impedance across sand-to-shale transitions, which can cause sand/shale overlap. By contrast, Vp/Vs shows a more consistently increasing trend with increasing clay content, reducing that particular ambiguity.

Sources

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Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 18 - Explorational Rock Physics
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Drawn from the chapter’s discussion of facies separation using AI–GR versus Vp/Vs–GR crossplots.

ID	formationeval_v0.1_petroleumgeology_compaction_diagenesis_007
Domains	Petroleum Geology, Geophysics
Topics	Compactional Trends, Shale Diagenesis
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A siliciclastic sequence is buried to conditions near 70–80°C, which marks the transition from mechanical to chemical compaction dominance. Which change is most relevant to expect for seismic properties at this burial stage?

A	Shales become more permeable due to smectite formation, reducing overpressure risk
B	Sands lose all cement because smectite converts to illite and dissolves quartz
C	Both sands and shales show decreasing velocity because chemical compaction weakens the framework
D	Shales may stiffen and lose porosity due to smectite-to-illite transformation, while quartz cementation may begin in nearby sands

Correct answer: D - Shales may stiffen and lose porosity due to smectite-to-illite transformation, while quartz cementation may begin in nearby sands

Rationale

The chapter links the onset of a key shale mineral reaction (smectite to illite) to porosity reduction and stiffer shale behavior, and also notes concurrent quartz generation that can contribute to sandstone cementation if connected pathways exist. These processes can cause seismic signature changes that are unrelated to pore-fluid changes.

Sources

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License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 18 - Explorational Rock Physics
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based question on the chapter's mechanical-to-chemical compaction transition and its seismic implications in sands and shales.

Question 419 of 505

ID	formationeval_v0.1_geophysics_rpt_cement_ntg_008
Domains	Geophysics, Petrophysics
Topics	Rock Physics Templates, Cementation Effects, Net-to-Gross Effects
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In an AI versus Vp/Vs rock-physics template for siliciclastic reservoirs, which statement best captures how initial cementation and reduced net-to-gross can complicate fluid identification?

A	Both initial cement and reduced net-to-gross push data toward lower Vp/Vs and lower AI, mimicking strong gas effects
B	Initial cement can move brine sands toward the low Vp/Vs region expected for hydrocarbons, while reduced net-to-gross tends to shift responses toward shale-like behavior, opposing the cement trend
C	Initial cement mainly changes density but not stiffness, while net-to-gross mainly changes stiffness but not density, so fluid effects remain unambiguous
D	Both effects mainly alter gamma ray response, so they do not affect AI–Vp/Vs interpretation once GR is known

Correct answer:	B - Initial cement can move brine sands toward the low Vp/Vs region expected for hydrocarbons, while reduced net-to-gross tends to shift responses toward shale-like behavior, opposing the cement trend

Rationale

The chapter explains that early cementation is a microstructural stiffening that can shift brine sands into regions often associated with hydrocarbon-bearing sands in AI–Vp/Vs space. It also describes net-to-gross/interbedding effects as moving the response toward shale clusters and acting in the opposite direction to cement effects, creating interpretation overlap.

Sources

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Reference	Chapter 18 - Explorational Rock Physics
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Integrates the chapter’s discussion of RPT interpretation pitfalls: cementation versus net-to-gross trends in AI–Vp/Vs space.

Question 420 of 505

ID	formationeval_v0.1_geophysics_avo_intercept_009
Domains	Geophysics
Topics	AVO Analysis, Zero-Offset Reflectivity
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

At a shale–sand interface, acoustic impedance in the shale is 8.0 MRayl and in the sand is 10.0 MRayl. Using the zero-offset reflectivity expression R(0) = (AI2 − AI1)/(AI1 + AI2), what is R(0) for this interface?

A	0.11
B	0.20
C	-0.11
D	-0.20
Correct answer:	A - 0.11

Rationale

Applying the provided formula gives R(0) = (10 − 8)/(10 + 8) = 2/18 ≈ 0.11. A positive value indicates the acoustic impedance increases from the upper to the lower layer.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Year	2010
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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 18 - Explorational Rock Physics
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical application of the chapter’s definition of AVO intercept (zero-offset reflectivity) from acoustic impedance contrast.

Question 421 of 505

ID	formationeval_v0.1_petrophysics_gassmann_moduli_010
Domains	Petrophysics
Topics	Gassmann Theory, Fluid Substitution
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

According to Gassmann fluid substitution for isotropic rocks at seismic frequencies, what elastic-modulus behavior is expected when the pore fluid changes but the rock frame stays the same?

A	Both bulk modulus and shear modulus change because fluids affect all elastic constants
B	Shear modulus changes, but bulk modulus stays constant because fluids do not affect compressibility
C	Neither bulk nor shear modulus changes because only density changes during fluid substitution
D	Bulk modulus changes, while shear modulus remains the same
Correct answer:	D - Bulk modulus changes, while shear modulus remains the same

Rationale

The chapter states that Gassmann's relations predict a fluid-dependent change in bulk modulus (compressibility) but not in shear modulus for isotropic rocks under the stated assumptions. Velocities can still change because both density and bulk modulus can change with fluid.

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Reference	Chapter 18 - Explorational Rock Physics
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept check on the chapter's statement of Gassmann outcomes for bulk versus shear modulus during fluid changes.

Question 422 of 505

ID	formationeval_v0.1_petrophysics_saturation_distribution_011
Domains	Petrophysics, Geophysics
Topics	Uniform vs Patchy Saturation, Effective Fluid Modulus
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two rocks have the same porosity and the same overall gas–brine saturation, but one has fine-scale uniform mixing while the other has large-scale patchiness. Considering how fluid distribution scale affects the effective bulk modulus sensed by seismic waves, which outcome is most consistent?

A	Uniform mixing typically produces higher velocities than patchy saturation because fluids cannot equilibrate
B	Patchy saturation typically produces higher velocities/impedances than uniform mixing because the effective response is stiffer
C	Both cases give identical velocities if the average saturation is the same, so only density changes matter for seismic response
D	Patchy saturation intrinsically produces lower velocities because gas is intrinsically the least stiff phase and dominates the bulk elastic response

Correct answer:	B - Patchy saturation typically produces higher velocities/impedances than uniform mixing because the effective response is stiffer

Rationale

The chapter explains that the commonly used uniform-mixing effective fluid (Reuss/isostress) assumes pressure equilibration during a seismic period. When phases are patchy at scales larger than the equilibration length, pressure gradients cannot relax and the effective rock response is stiffer, leading to higher velocities and impedances than in the uniform case.

Sources

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Reference	Chapter 18 - Explorational Rock Physics
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the chapter’s contrast between uniform saturation (Reuss average) and patchy saturation (stiffer effective response).

Question 423 of 505

ID	formationeval_v0.1_geophysics_avo_background_trend_012
Domains	Geophysics
Topics	AVO Crossplots, Background Trend Interpretation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In qualitative AVO work, interpreters often identify a brine-sand/shale “background trend” and then search for outliers. What is the most defensible reason for using both intercept R(0) and gradient G rather than relying on near-stack amplitude alone?

A	Near-stack amplitude contains all necessary information because it uniquely determines Vp/Vs contrasts
B	R(0) and G are used mainly to eliminate random noise, not to add new rock-physics sensitivity
C	R(0) is mainly controlled by acoustic impedance contrast while G is strongly influenced by Vp/Vs contrast, so combining them helps separate fluid effects from lithology effects
D	Intercept and gradient are used only because Zoeppritz equations cannot be applied to pre-stack data due to computational limitations and numerical instability in seismic processing workflows
Correct answer:	C - R(0) is mainly controlled by acoustic impedance contrast while G is strongly influenced by Vp/Vs contrast, so combining them helps separate fluid effects from lithology effects

Rationale

The chapter links R(0) to acoustic impedance contrast and emphasizes that G is strongly affected by contrasts related to Vp/Vs across the interface. Using both attributes provides two independent constraints, helping reduce fluid/lithology ambiguities that can persist if only near-stack amplitude (a proxy for R(0)) is used.

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URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on why AVO crossplots use both intercept and gradient: different sensitivity to impedance versus Vp/Vs contrasts.

Question 424 of 505

ID	formationeval_v0.1_geophysics_time_lapse_seismic_001
Domains	Geophysics
Topics	Time-Lapse Seismic, 4D Seismic Fundamentals
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In reservoir monitoring, what makes a seismic program “4D” rather than “3D”?

A	It records four independent wave types (P, SV, SH, and tube waves) in a single survey
B	It repeats seismic acquisition over the same area at different calendar dates to reveal changes over time
C	It uses four different source signatures so that bandwidth is increased relative to a conventional survey
D	It requires that all surveys are marine 3D streamer surveys acquired with identical vessel hardware

Correct answer: B - It repeats seismic acquisition over the same area at different calendar dates to reveal changes over time

Rationale

The “fourth dimension” refers to time between surveys, so 4D is fundamentally repeated (time-lapse) seismic acquisition and comparison. The method can be applied even if the repeated surveys are 2D lines, as long as the intent is to monitor change through time. Wave-type count, bandwidth strategy, or marine-only requirements are not what defines 4D.

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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 19 - 4D Seismic
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the chapter introduction distinguishing 4D from repeated seismic surveys.

Question 425 of 505

ID	formationeval_v0.1_geophysics_4d_applications_002
Domains	Geophysics
Topics	4D Seismic Applications, CO_2 Storage Monitoring
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Which situation is a major non-hydrocarbon application area for 4D seismic?

A	Choosing regional source-rock maturity trends from a single reconnaissance survey
B	Estimating porosity directly from seismic amplitudes without any rock-physics information
C	Mapping unexplored structural traps using only one survey per prospect, which provides no time-lapse information
D	Tracking subsurface changes associated with CO_2 injected into a saline aquifer
Correct answer:	D - Tracking subsurface changes associated with CO_2 injected into a saline aquifer

Rationale

The chapter highlights repeated seismic as a tool not only for producing fields, but also for monitoring injected CO_2 during underground storage in saline aquifers. The other options describe exploration or interpretation tasks that do not require repeated surveys through time in the way 4D does.

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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 19 - 4D Seismic
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the overview of current 4D seismic use cases, including CO_2 storage.

Question 426 of 505

ID	formationeval_v0.1_petrophysics_reservoir_parameter_changes_003
Domains	Petrophysics, Geophysics
Topics	Reservoir Changes, Rock Physics Link
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A team is scoping a 4D seismic feasibility study for a producing field. Which group of reservoir changes is most directly relevant to time-lapse seismic response?

A	Fluid saturation, pore pressure, temperature, and thickness/compaction changes
B	Permeability, clay content, grain size, and cement type changes
C	Wellbore skin, tubing head pressure, separator efficiency, and choke settings
D	Structural dip, depositional environment, burial depth, and source-rock richness
Correct answer:	A - Fluid saturation, pore pressure, temperature, and thickness/compaction changes

Rationale

The chapter emphasizes that production can alter saturation, pore pressure, temperature, and layer thickness (through compaction or stretching), and these are the key drivers considered in 4D seismic interpretation. The other options list properties that may matter for reservoir behavior or geology, but they are not presented as the primary production-driven variables in the 4D context here.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 19 - 4D Seismic
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Targets the reservoir-parameter list in the rock physics section describing what changes during production.

Question 427 of 505

ID	formationeval_v0.1_geophysics_reflectivity_change_004
Domains	Geophysics
Topics	Reflectivity Change, Acoustic Impedance
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

For a top-reservoir reflector, assume the pre-production acoustic impedance contrast between cap rock and reservoir is about 18% (relative). If production changes the reservoir acoustic impedance by about 8% (relative), what is the approximate relative change in reflectivity (ΔR/R) using the approximation that ΔR/R equals the production-induced impedance change divided by the original contrast?

A	About 26%
B	About 18%
C	About 44%
D	About 8%

Correct answer: C - About 44%

Rationale

The chapter relates relative reflectivity change to the ratio of the production-induced impedance change to the original impedance contrast across the interface. Using the given numbers, ΔR/R ≈ 8% / 18% ≈ 0.44, i.e., about 44%. The other options confuse the ratio with one of the input percentages or with an unrelated subtraction.

Sources

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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 19 - 4D Seismic
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical item based on the Gullfaks reflectivity-change relationship using acoustic impedance contrasts.

Question 428 of 505

ID	formationeval_v0.1_geophysics_amplitude_vs_timeshift_005
Domains	Geophysics
Topics	4D Analysis, Amplitude Monitoring, Travel-Time Shifts
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

When comparing baseline and monitor seismic datasets, which 4D analysis approach is generally the more robust option in practical experience?

A	Computing microseismic event locations from passive recordings
B	Interpreting differences in reflection amplitudes between surveys
C	Inferring changes using only time-to-depth conversion updates, which cannot resolve fluid movements
D	Estimating reservoir changes only from gravity anomalies, which have insufficient resolution for production monitoring

Correct answer: B - Interpreting differences in reflection amplitudes between surveys

Rationale

The chapter separates 4D interpretation into amplitude-based and travel-time-shift-based approaches, and notes that amplitude differencing has historically been the most robust in practice. The other options are different monitoring or processing activities not presented as the primary robust 4D comparison method here.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 19 - 4D Seismic
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the section contrasting amplitude-change detection with travel-time-change detection.

Question 429 of 505

ID	formationeval_v0.1_geophysics_timeshift_interpretation_006
Domains	Geophysics
Topics	Travel-Time Shifts, Quantitative 4D Interpretation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why can highly accurate 4D travel-time shift measurements be especially valuable for reservoir monitoring compared with using only amplitude differences?

A	They directly provide detailed density changes without needing any modelling
B	They are only sensitive to the cap rock and overburden changes, and therefore avoid reservoir uncertainty in the target interval entirely
C	They eliminate the need for repeatable acquisition because timing is unaffected by positioning errors
D	They can be related to average changes through an interval and are proportional to pay-thickness change in the chapter’s discussion

Correct answer: D - They can be related to average changes through an interval and are proportional to pay-thickness change in the chapter’s discussion

Rationale

The chapter notes that precise time shifts can be picked to sub-millisecond accuracy and that this observable is proportional to changes in pay thickness, making it a direct quantitative measure. It also contrasts timeshift as an averaged interval effect, whereas amplitude differences are more local to interfaces. Timeshifts do not automatically remove repeatability requirements, nor do they directly give density without additional constraints.

Sources

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Reference	Chapter 19 - 4D Seismic
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URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Targets the chapter’s stated advantage of accurate timeshift measurements for quantitative pay-thickness assessment.

Question 430 of 505

ID	formationeval_v0.1_geophysics_nrms_repeatability_007
Domains	Geophysics
Topics	Repeatability (NRMS), Time-Lapse Acquisition
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

NRMS is used as a repeatability metric for 4D seismic. Why is it recommended to compute NRMS in a time window where production effects are not expected?

A	To isolate non-repeatable acquisition/processing differences rather than true reservoir change
B	To ensure the window contains the strongest reservoir reflections for higher RMS values
C	To remove all multiples so that the NRMS formula becomes independent of bandwidth
D	To guarantee the result is comparable between fields regardless of geology
Correct answer:	A - To isolate non-repeatable acquisition/processing differences rather than true reservoir change

Rationale

The intent of NRMS is to quantify how well the seismic measurements repeat; using a window with no expected 4D signal reduces contamination from real production-induced changes. The chapter also cautions that geology can affect NRMS, so it is not automatically comparable between fields, and NRMS is frequency-band dependent.

Sources

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URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Built from the repeatability discussion defining NRMS and where it should be measured.

Question 431 of 505

ID	formationeval_v0.1_petrophysics_effective_pressure_velocity_008
Domains	Petrophysics, Geophysics
Topics	Effective Pressure, Velocity-Stress Sensitivity, Hertz-Mindlin Model
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

Using the Hertz–Mindlin-based relation for dry rock where the relative P-wave velocity varies as (P/P0)^(1/6). If effective pressure drops from 6 MPa (P0) to 1.5 MPa (P), approximately how much does VP decrease relative to baseline?

A	About a 6% decrease
B	About a 37% decrease
C	About a 21% decrease
D	About a 13% decrease

Correct answer: C - About a 21% decrease

Rationale

Here P/P0 = 1.5/6 = 0.25, so VP/VP0 ≈ 0.25^(1/6) ≈ 0.79. That corresponds to a decrease of roughly 21%. The chapter also notes that real rocks often show weaker sensitivity than this idealised curve, but the calculation follows the provided exponent model.

Sources

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Type	textbook
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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 19 - 4D Seismic
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Quantitative question based on the pressure–velocity power-law relationship presented from the Hertz–Mindlin framework.

Question 432 of 505

ID	formationeval_v0.1_geophysics_pressure_saturation_discrimination_009
Domains	Geophysics
Topics	Pressure vs Saturation, 4D AVO, Oil-Water Contact
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In the Gullfaks Cook Formation 4D seismic case study, which observation most strongly suggests that the 4D amplitude anomaly is not caused only by saturation change?

A	The anomaly is strongest exactly at the crest of the structure where oil is thickest
B	The anomaly appears only in far offsets and disappears in near offsets due to geometric spreading effects
C	The anomaly is limited to a single trace and does not form a coherent pattern
D	The amplitude change is seen both above and below the original oil–water contact level
Correct answer:	D - The amplitude change is seen both above and below the original oil–water contact level

Rationale

A saturation-driven effect tied to oil being replaced by water is expected to be closely associated with the oil–water contact region. The chapter notes that when amplitude change extends beyond the oil–water contact into areas not explained by saturation movement alone, a pore-pressure effect is a plausible explanation. This motivates the use of near/far amplitude information (AVO) plus rock physics to separate the two contributions.

Sources

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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 19 - 4D Seismic
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept item derived from the pressure-versus-saturation discrimination discussion around the Cook Formation example.

Question 433 of 505

ID	formationeval_v0.1_geophysics_time_lapse_em_010
Domains	Geophysics
Topics	CSEM Monitoring, Multi-Method 4D Integration
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why can repeated electromagnetic (CSEM/EM) surveys complement 4D seismic for reservoir monitoring?

A	EM data provide higher vertical resolution than seismic at the same cost and frequency range
B	EM measurements are much less sensitive to pore pressure than seismic and can help constrain saturation changes
C	EM surveys directly measure acoustic impedance and therefore replace the need for time-lapse seismic processing
D	EM repeatability is limited by seawater temperature so it is mainly useful only onshore where conductive fluids are not present
Correct answer:	B - EM measurements are much less sensitive to pore pressure than seismic and can help constrain saturation changes

Rationale

The chapter points out that seismic responds to changes in acoustic impedance and can be influenced by both pressure and saturation, whereas EM methods are not very pressure sensitive. That difference in sensitivity makes EM a useful companion for separating and constraining saturation changes that are difficult to quantify from seismic alone. The chapter also notes that EM spatial resolution can be limited at the low frequencies often used.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 19 - 4D Seismic
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Derived from the section on alternative monitoring methods discussing why time-lapse EM helps separate saturation from pressure effects.

Question 434 of 505

ID	formationeval_v0.1_reservoirengineering_well_to_well_tracers_001
Domains	Reservoir Engineering, Production Engineering
Topics	Well-to-Well Tracers, Reservoir Connectivity
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A dissolved tracer is injected with water in an injection well and is detected in a nearby producer much sooner than expected. What is the most defensible interpretation of this early arrival?

A	A high-conductivity flow path connects the wells, such as a fracture, open fault, or very permeable sand layer
B	The reservoir rock has very high capillary entry pressure, which pulls the tracer rapidly toward the producer
C	The tracer has reacted with reservoir minerals, creating a faster-moving gaseous phase that reaches the producer first
D	The producer is likely completed above the gas/oil contact, causing rapid tracer appearance independent of rock flow paths
Correct answer:	A - A high-conductivity flow path connects the wells, such as a fracture, open fault, or very permeable sand layer

Rationale

Tracer breakthrough timing reflects how efficiently the injected water phase can move between wells. A very early detection implies an unusually effective connection, commonly an open structural feature (fault/fracture) or a high-permeability layer providing preferential flow. Capillary entry pressure and fluid contacts do not, by themselves, create a fast well-to-well pathway for a water-dissolved tracer.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
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Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 20 - Production Geology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Derived from the chapter discussion of tracer breakthrough and what it implies about high-permeability connections.

Question 435 of 505

ID	formationeval_v0.1_drillingengineering_horizontal_wells_002
Domains	Drilling Engineering, Reservoir Engineering
Topics	Horizontal Wells, Reservoir Compartmentalization
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Why can a long horizontal well path improve production performance compared with a single vertical well in a compartmentalized reservoir?

A	It increases oil density in the wellbore, which lowers the pressure needed to lift fluids to surface
B	It eliminates capillary forces by creating larger pore throats near the well
C	It can intersect and drain multiple isolated reservoir compartments along its trajectory
D	It guarantees that the oil/water contact is level across the field by balancing buoyancy forces
Correct answer:	C - It can intersect and drain multiple isolated reservoir compartments along its trajectory

Rationale

Horizontal wells can traverse long distances within the reservoir interval and contact multiple separated flow units, increasing the drained volume relative to a vertical well that samples only a narrow column. This is especially valuable where internal barriers or small compartments limit pressure communication. The improvement is due to well geometry and reservoir contact, not changes to pore-scale physics.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
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License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 20 - Production Geology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item from the chapter's discussion of long horizontal drilling paths and drainage of multiple compartments.

Question 436 of 505

ID	formationeval_v0.1_geophysics_4d_seismic_monitoring_013
Domains	Geophysics, Reservoir Engineering
Topics	4D Seismic, Fluid Contacts
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A field team plans to repeat 3D seismic surveys during production to locate bypassed zones. What reservoir change is the time-lapse (4D) seismic most directly attempting to detect to infer movement of fluid contacts?

A	A shift in grain size caused by fines migration near the wellbore
B	A reduction in capillary entry pressure caused by polymer flooding
C	An increase in clay mineral specific surface caused by diagenesis during production
D	A change in acoustic properties driven by saturation-dependent density and velocity contrasts

Correct answer:	D - A change in acoustic properties driven by saturation-dependent density and velocity contrasts

Rationale

The chapter describes repeated seismic acquisition as a way to follow shifts in OWC/GOC because elastic properties change with saturation. Density and velocity contrasts between hydrocarbon-filled and water-filled rock alter seismic response, enabling time-lapse interpretation. The other options describe processes not presented as primary drivers of a 4D seismic signature for contact tracking.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 20 - Production Geology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter's description of repeating 3D seismic to create 4D monitoring of contact movement using saturation-linked contrasts.

Question 437 of 505

ID	formationeval_v0.1_reservoirengineering_gas_cap_management_004
Domains	Reservoir Engineering, Production Engineering
Topics	Gas Cap Management, Reservoir Pressure
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In an oil reservoir with an overlying free-gas zone, why is producing the oil phase before extensive gas production often emphasized for maximizing ultimate oil recovery?

A	Because early gas production increases oil viscosity, preventing later oil flow
B	Because removing gas too early can sharply lower pressure and disturb the gas/oil contact, making remaining oil harder to recover
C	Because producing oil first prevents the cap rock from becoming oil-wet and losing seal integrity
D	Because early gas production forces the oil/water contact downward by capillary rise, trapping oil below it

Correct answer: B - Because removing gas too early can sharply lower pressure and disturb the gas/oil contact, making remaining oil harder to recover

Rationale

The text highlights that free gas provides pressure support and that premature gas production can cause a strong pressure drop. That pressure reduction and contact distortion complicate recovery of oil left behind. The key is reservoir energy management rather than wettability changes or capillary rise mechanisms.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 20 - Production Geology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Drawn from the chapter's discussion of pressure support from free gas and the consequences of producing gas before oil.

Question 438 of 505

ID	formationeval_v0.1_petrophysics_wettability_and_capillary_rise_005
Domains	Petrophysics
Topics	Wettability, Capillary Rise
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Consider a capillary tube or pore throat containing oil and water. If conditions shift so that the wetting angle becomes greater than 90°, what qualitative effect should you expect on the local position of the oil/water interface relative to the bulk oil/water contact?

A	The interface in the tube tends to sit below the bulk contact because the tube surface preferentially wets with oil
B	The interface rises above the bulk contact because water inherently climbs in small tubes regardless of surface wettability
C	The interface becomes independent of gravity because capillary forces cancel when the wetting angle exceeds 90°
D	The interface remains at the same level as the bulk contact because density contrast controls the contact position uniquely
Correct answer:	A - The interface in the tube tends to sit below the bulk contact because the tube surface preferentially wets with oil

Rationale

The chapter links a wetting angle above 90° to an oil-wet condition, where the solid surface is preferentially wetted by oil. In that situation the capillary effect shifts the local interface downward relative to the general OWC. If the system is water-wet (angle below 90°), the capillary effect instead elevates the water level in small conduits.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Reference	Chapter 20 - Production Geology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based question from the section on capillary forces and how wetting angle alters interface position.

Question 439 of 505

ID	formationeval_v0.1_petrophysics_capillary_transition_zone_006
Domains	Petrophysics, Sedimentology
Topics	Capillary Transition Zone, Grain Size Effects
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two reservoir intervals are at similar structural height but differ strongly in pore-throat size: one is fine-grained and the other is coarse-grained. Why can the oil/water contact inferred from resistivity logs appear offset between these intervals by metres?

A	Because resistivity tools measure only porosity, and porosity changes shift the interpreted contact even at constant saturation due to geometric effects
B	Because coarse grains generate higher interfacial tension, which increases water resistivity and lowers apparent water saturation
C	Because smaller pore throats create a stronger capillary-controlled saturation transition, so the water/oil distribution changes gradually with height
D	Because fine-grained rocks cannot contain any connate water due to their extremely small pore throats, so the logged contact must necessarily be deeper than the true contact

Correct answer:	C - Because smaller pore throats create a stronger capillary-controlled saturation transition, so the water/oil distribution changes gradually with height

Rationale

The chapter explains that capillary forces are stronger in small pore throats, drawing water upward and creating a thicker saturation transition rather than an abrupt contact. Resistivity responds to water saturation, so the log-derived contact can differ from the structural OWC by a few metres. This is a petrophysical effect tied to pore-throat size, not to porosity-only measurement or the absence of connate water.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 20 - Production Geology

Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from discussion of capillary rise/imbibition in fine pores and why log-indicated contacts can differ between lithologies.

Question 440 of 505

ID	formationeval_v0.1_reservoirengineering_net_to_gross_007
Domains	Reservoir Engineering
Topics	Net-to-Gross, Pay Zone
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In volumetric reserve estimation, what does the net-to-gross ratio (N/G) represent?

A	The fraction of produced water that is reinjected to maintain pressure
B	The ratio of gas compressibility to oil compressibility under reservoir conditions
C	The ratio of average permeability to average porosity in the reservoir interval
D	The fraction of the mapped reservoir rock volume that has sufficient quality to be considered productive

Correct answer: D - The fraction of the mapped reservoir rock volume that has sufficient quality to be considered productive

Rationale

The chapter defines net-to-gross as the proportion of the total reservoir volume that qualifies as pay (productive rock) relative to the total mapped reservoir volume. This accounts for tight or low-quality intervals that may be above the OWC but still contribute little to flow. It is not a fluid property ratio or a reinjection metric.

Sources

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Reference	Chapter 20 - Production Geology
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter's explanation of pay vs non-pay and the N/G term used in volumetric calculations.

Question 441 of 505

ID	formationeval_v0.1_reservoirengineering_volumetric_oil_in_place_008
Domains	Reservoir Engineering
Topics	Volumetric Reserves, Oil in Place
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

A reservoir has a rock volume above the mapped oil/water contact of Vr = 2.0×10^8 m^3. If N/G = 0.50, average porosity phi_a = 0.18, and average hydrocarbon saturation Sat = 0.70, what oil (hydrocarbon) volume in place Vp does the standard volumetric relation give?

A	1.8×10^7 m^3
B	1.26×10^7 m^3
C	6.3×10^7 m^3
D	1.26×10^8 m^3
Correct answer:	B - 1.26×10^7 m^3

Rationale

Using the given relation Vp = Vr·(N/G)·phi_a·Sat: 2.0×10^8 × 0.50 = 1.0×10^8 m^3 of net rock volume, then ×0.18 gives 1.8×10^7 m^3 of pore volume, and ×0.70 gives 1.26×10^7 m^3 of hydrocarbons. The other options result from omitting one of the multipliers or misplacing a decimal factor.

Sources

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Reference	Chapter 20 - Production Geology
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URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical application of the chapter’s volumetric expression for hydrocarbon volume in place using Vr, N/G, porosity, and saturation.

Question 442 of 505

ID	formationeval_v0.1_reservoirengineering_relative_permeability_009
Domains	Reservoir Engineering, Petrophysics
Topics	Relative Permeability, Multiphase Flow
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

What is the most accurate conceptual meaning of relative permeability for a given phase (e.g., water) in a rock that contains two fluid phases?

A	It is the permeability to that phase during multiphase flow divided by the permeability measured when only that phase occupies the pore space
B	It is the permeability of the rock multiplied by the viscosity of that phase to account for frictional losses
C	It is the fraction of pore volume occupied by that phase, expressed as a percentage
D	It is the permeability of the cap rock divided by the permeability of the reservoir rock
Correct answer:	A - It is the permeability to that phase during multiphase flow divided by the permeability measured when only that phase occupies the pore space

Rationale

The chapter defines relative permeability as a ratio comparing flow capacity under two-phase conditions to the single-phase case. This captures how the presence of another phase reduces the effective flow pathways available. Viscosity and saturation influence flow behavior but are not the definition of relative permeability itself.

Sources

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URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	From the chapter section explaining why multiphase flow reduces effective permeability and how relative permeability is defined as a ratio.

Question 443 of 505

ID	formationeval_v0.1_reservoirengineering_pressure_support_mechanisms_010
Domains	Reservoir Engineering
Topics	Pressure Depletion, Water Drive, Reservoir Connectivity
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two oil reservoirs have similar fluids and initial conditions and are produced at comparable rates. Reservoir X is an isolated sand body surrounded by low-permeability shales and laterally offset by sealing faults; Reservoir Y is in hydraulic communication with a thick, laterally extensive sandstone aquifer. Which outcome best matches the expected pressure evolution and geomechanical consequences?

A	Reservoir X will maintain pressure better because shales are the main source of rapid water influx during production
B	Reservoir Y will show a faster pressure decline because aquifer communication increases oil compressibility
C	Both reservoirs will have nearly identical pressure decline because compressibility dominates over boundary conditions
D	Reservoir X will tend to deplete faster, increasing effective stress and making compaction-related effects more likely than in Reservoir Y

Correct answer: D - Reservoir X will tend to deplete faster, increasing effective stress and making compaction-related effects more likely than in Reservoir Y

Rationale

The chapter emphasizes that pressure support depends strongly on how much permeable rock volume communicates with the reservoir and on external fluid supply. An isolated sand body bounded by shales and sealing faults receives little water drive, so pressure can fall quickly; this raises effective stress and can promote compaction-related changes. A reservoir connected to a large sandstone aquifer generally receives stronger pressure support and depletes more slowly.

Sources

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Reference	Chapter 20 - Production Geology

Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Integrates the chapter’s discussion of water drive, reservoir boundary conditions (shales/faults vs connected sands), and compaction under increased effective stress.

Question 444 of 505

ID	formationeval_v0.1_reservoirengineering_water_injection_sweep_011
Domains	Reservoir Engineering, Sedimentology
Topics	Water Injection, Sweep Efficiency, Vertical Permeability Trends
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two sandstone reservoirs are waterflooded under similar operating conditions. One has a fining-upward vertical trend and the other has a coarsening-upward trend. Which situation is most likely to experience early water breakthrough at a producer, and why?

A	The coarsening-upward case, because injected water preferentially moves up-dip into the least permeable layers
B	The fining-upward case, because injected water tends to follow the more permeable basal interval and can reach the producer before sweeping tighter beds
C	The fining-upward case, because capillary resistance is lowest in fine-grained layers and water therefore rises fastest through them
D	The coarsening-upward case, because oil invariably flows only at the base due to higher density than water, causing early breakthrough when injected water reaches that zone

Correct answer: B - The fining-upward case, because injected water tends to follow the more permeable basal interval and can reach the producer before sweeping tighter beds

Rationale

The chapter links vertical permeability structure to displacement patterns during water injection. In a fining-upward sequence, the basal part is typically the most permeable pathway, so injected water can move quickly along it and short-circuit to a producer, bypassing oil in less permeable beds. A coarsening-upward sequence more often favors hydrocarbon flow near the top and can yield a different sweep pattern.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 20 - Production Geology
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter’s comparison of waterflood behavior in fining-upward vs coarsening-upward successions and implications for sweep and breakthrough.

Question 445 of 505

ID	formationeval_v0.1_petrophysics_formation_damage_diagnosis_012
Domains	Petrophysics, Production Engineering
Topics	Formation Damage, Fines Migration, Pore Geometry
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A coreflood experiment shows a permeability drop during flow. When the flow direction is reversed, the measured permeability increases temporarily before declining again. Considering the reversibility characteristics of different formation damage mechanisms, what damage type is most consistent with this behavior?

A	Permanent pore-filling cement precipitation from iron hydroxides, which is reversed by changing flow direction
B	Capillary trapping of oil droplets, which is eliminated by reversing the pressure gradient
C	Mobilization and plugging by a migrating clay/silt fraction that can be partially dislodged when flow is reversed
D	Sudden compaction of the rock matrix caused by a reduction in pore pressure during the laboratory test

Correct answer:	C - Mobilization and plugging by a migrating clay/silt fraction that can be partially dislodged when flow is reversed

Rationale

The chapter describes a diagnostic sign of mechanical formation damage: if reversing flow briefly restores permeability, it indicates blockage by transported fine particles rather than an irreversible chemical cement. This aligns with the idea that loose clays and small grains can move with produced water and obstruct pore throats. Chemical precipitation and compaction would not typically show a quick, reversible permeability improvement upon flow reversal.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 20 - Production Geology
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the chapter’s discussion of mechanical formation damage, fines transport, and the diagnostic use of flow reversal in lab testing.

Question 446 of 505

ID	formationeval_v0.1_petroleumgeology_tar_sands_001
Domains	Petroleum Geology, Sedimentology
Topics	Tar Sands, Biodegradation
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A sandstone reservoir is charged with oil at shallow depth and later contains bitumen-like, extremely viscous hydrocarbons. Which condition most directly favors this transformation of the oil after emplacement?

A	Increasing burial pressure that compacts the pore space and concentrates the oil
B	Low temperatures at shallow depth that allow microbial alteration of the oil
C	High-temperature cracking of oil to methane that removes the liquid fraction
D	Strong quartz cementation that seals pores and prevents fluid movement

Correct answer: B - Low temperatures at shallow depth that allow microbial alteration of the oil

Rationale

In shallow, relatively cool reservoirs, bacteria can alter the oil, leading to biodegraded, asphaltic, high-viscosity material typical of tar sands. Deep, hot conditions instead tend to thermally alter hydrocarbons in different ways. Cementation and compaction affect reservoir quality but are not the primary driver of biodegradation.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 21 - Unconventional Hydrocarbons
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the discussion of why shallow reservoirs are prone to biodegraded tar-sand accumulations.

ID	formationeval_v0.1_petroleumgeology_thermal_history_002
Domains	Petroleum Geology
Topics	Thermal History, Biodegradation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A sandstone unit was once buried deeply enough to reach relatively high temperatures, then uplifted and later charged with oil at shallow depth. Compared with a similar sandstone that never experienced the high-temperature phase, what outcome is most likely regarding later oil biodegradation in the uplifted unit?

A	More biodegradation, because high temperature creates more nutrients for bacteria
B	No change, because biodegradation depends only on the oil API gravity and not on the reservoir's thermal exposure history
C	Less biodegradation, because prior heating can reduce the likelihood of bacterial alteration later
D	Less biodegradation, because uplift consistently increases quartz cementation and seals the rock pores completely
Correct answer:	C - Less biodegradation, because prior heating can reduce the likelihood of bacterial alteration later

Rationale

The chapter indicates that sandstones that experienced higher temperatures during deeper burial can become effectively “sterilised,” making subsequent biodegradation of later oil charges less likely. A sandstone that remained shallow and cool is more prone to microbial alteration. Quartz cementation trends are discussed separately and do not by themselves explain the “sterilisation” effect described.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 21 - Unconventional Hydrocarbons
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Conceptual question based on the chapter’s link between maximum temperature exposure and reduced biodegradation potential after uplift.

Question 448 of 505

ID	formationeval_v0.1_productionengineering_sagd_003
Domains	Production Engineering, Reservoir Engineering
Topics	Steam-Assisted Gravity Drainage, Thermal Recovery
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Which description best captures the well layout and production mechanism of steam-assisted gravity drainage (SAGD) in a tar-sand reservoir?

A	Two horizontal wells are drilled one above the other; steam is injected in the upper well and heated oil drains by gravity into the lower producing well
B	A single vertical well alternates between steam injection and oil production without moving fluids laterally in the reservoir
C	Steam is injected into a deep well so it rises and lifts oil up the same wellbore by gas-lift
D	Several horizontal wells inject cold water to dissolve bitumen, which is then pumped to surface

Correct answer: A - Two horizontal wells are drilled one above the other; steam is injected in the upper well and heated oil drains by gravity into the lower producing well

Rationale

SAGD relies on a paired horizontal-well system with injection above production so that heating lowers viscosity and gravity moves the mobilized oil downward. This geometry is central to the process and differs from single-well cyclic methods. Cold-water dissolution is not the mechanism described for SAGD in the chapter.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 21 - Unconventional Hydrocarbons
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter’s description of SAGD geometry and gravity-driven drainage after steam heating.

Question 449 of 505

ID	formationeval_v0.1_reservoirengineering_heterogeneity_004
Domains	Reservoir Engineering, Sedimentology
Topics	Reservoir Heterogeneity, Tar Sands
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

During thermal production from a tar-sand interval, thin shale layers interbedded with sand most directly influence performance by affecting which property?

A	They increase horizontal permeability, making steam spread laterally faster than oil
B	They increase reservoir temperature, because shales have higher thermal conductivity than sands
C	They increase oil density, because shale minerals dissolve into the bitumen during heating
D	They restrict vertical flow, making it harder for heat and mobilized fluids to move across layers
Correct answer:	D - They restrict vertical flow, making it harder for heat and mobilized fluids to move across layers

Rationale

The chapter emphasizes that shale interbeds can act as vertical barriers that hinder upward/downward movement, affecting steam and heated oil migration. This reduces vertical communication and can impede gravity drainage efficiency. Thermal conductivity and oil density changes are not presented as the controlling effects of shale stringers.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 21 - Unconventional Hydrocarbons
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the discussion of shale layers reducing vertical mobility during heating-based tar-sand recovery.

Question 450 of 505

ID	formationeval_v0.1_productionengineering_steam_energy_balance_005
Domains	Production Engineering
Topics	Thermal Recovery, Energy Requirements
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

A steam-based in situ tar-sand project follows a typical industry rule-of-thumb that one barrel of produced oil must be burned to generate steam for every three barrels of oil produced. If the operation produces 90,000 bbl/day at the surface, approximately how many bbl/day are burned to make steam?

A	15,000 bbl/day
B	30,000 bbl/day
C	45,000 bbl/day
D	60,000 bbl/day

Correct answer: B - 30,000 bbl/day

Rationale

The ratio given is 1 barrel burned per 3 barrels produced, so the burned volume is 90,000/3 = 30,000 bbl/day. This highlights the substantial on-site energy penalty of generating steam for thermal recovery. The other options correspond to incorrect ratios or arithmetic.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 21 - Unconventional Hydrocarbons
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Quantitative check on the chapter’s stated oil-to-steam energy requirement for steam-based tar-sand production.

Question 451 of 505

ID	formationeval_v0.1_petroleumgeology_oil_shales_006
Domains	Petroleum Geology
Topics	Oil Shales, Source Rock Maturity
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A mudstone has high TOC but has not reached sufficient burial temperature to generate and expel most of its petroleum naturally. According to the definition of oil shales, what is the primary step needed to obtain large amounts of oil from this rock?

A	Inject CO_2 to dissolve kerogen and produce it as a miscible fluid
B	Waterflood the rock to displace oil trapped in large pores
C	Cool the rock to preserve kerogen and prevent cracking during production
D	Mine the rock and heat it to several hundred degrees Celsius to convert kerogen into producible oil

Correct answer:	D - Mine the rock and heat it to several hundred degrees Celsius to convert kerogen into producible oil

Rationale

Oil shales are described as organic-rich source rocks that are insufficiently mature, so most hydrocarbons have not been generated. The chapter explains that recovery therefore relies on mining and high-temperature heating (pyrolysis) to generate petroleum from kerogen. Reservoir displacement methods like waterflooding are not the central mechanism for these immature rocks.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 21 - Unconventional Hydrocarbons
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on why immature organic-rich shales require ex situ heating to yield significant oil.

Question 452 of 505

ID	formationeval_v0.1_petroleumgeology_source_rock_maturity_007
Domains	Petroleum Geology
Topics	Source Rock Maturity, Oil Shales
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Consider the contrast between Upper Cambrian alum shales in the Oslo region with similar alum shales in Sweden. Which explanation best accounts for why the Swedish unit can yield more oil by pyrolysis than the Oslo-region unit?

A	The Oslo-region shale experienced higher maximum temperatures and expelled most hydrocarbons, leaving less remaining material to generate oil during pyrolysis
B	The Swedish shale is much younger, so its kerogen has had less time to convert to oil during burial
C	The Oslo-region shale contains no organic matter, while the Swedish shale is organic-rich
D	The Swedish shale is deeper today, so it is automatically more mature and produces more oil in ovens

Correct answer: A - The Oslo-region shale experienced higher maximum temperatures and expelled most hydrocarbons, leaving less remaining material to generate oil during pyrolysis

Rationale

The chapter attributes the difference mainly to contrasting thermal histories: the Oslo-area alum shale was heated to much higher temperatures during deep burial and lost most of its hydrocarbons during tectonic events. In Sweden, the unit was not buried as deeply and retains more material that can be converted to oil during pyrolysis. The explanation is therefore maturity and expulsion history, not simply present-day depth or age.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 21 - Unconventional Hydrocarbons
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Integrates maturity, burial depth/temperature, and expulsion concepts using the chapter’s alum-shale comparison.

Question 453 of 505

ID	formationeval_v0.1_reservoirengineering_cbm_storage_008
Domains	Reservoir Engineering
Topics	Coal Bed Methane, Gas Storage Mechanisms
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Coal seams can contain large volumes of methane even though coal has very low permeability. What mechanism allows coal to hold substantial methane quantities?

A	Methane is stored mainly as free gas in large vugs and caverns within coal
B	Methane is trapped as a separate liquid phase that later boils during production
C	Methane is largely held by adsorption on extensive internal surfaces created by coal's microporosity
D	Methane is stored primarily as hydrate crystals throughout the coal matrix
Correct answer:	C - Methane is largely held by adsorption on extensive internal surfaces created by coal's microporosity

Rationale

The chapter explains that coal's microporous fabric creates a very large surface area, allowing significant methane to be adsorbed. This storage mode differs from conventional reservoirs where free gas in interconnected pores dominates. Hydrate storage is discussed for marine sediments, not coal seams.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 21 - Unconventional Hydrocarbons
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter's description of adsorption and surface-area control on CBM storage.

Question 454 of 505

ID	formationeval_v0.1_reservoirengineering_cbm_permeability_009
Domains	Reservoir Engineering, Production Engineering
Topics	Coal Bed Methane, Fractures and Cleats
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In coal bed methane (CBM) production, coal matrix permeability is typically very low. Which feature most strongly enables methane to flow to wells?

A	Primary porosity created by depositional sorting of coal grains
B	Natural fracture networks (cleats) that provide flow pathways, often associated with uplift
C	Solution-enlarged channels formed by groundwater dissolution of coal minerals
D	Thick salt layers that transmit gas by plastic deformation around the well

Correct answer: B - Natural fracture networks (cleats) that provide flow pathways, often associated with uplift

Rationale

The chapter notes that gas flow from coal relies on thin fractures (cleats), because the coal matrix itself has very low permeability. These fractures are linked to deformation/uplift and provide connected pathways to the well. Depositional sorting and dissolution channels are not presented as the key permeability mechanism for CBM.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 21 - Unconventional Hydrocarbons
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the chapter’s point that cleats control deliverability in low-permeability coal.

Question 455 of 505

ID	formationeval_v0.1_reservoirengineering_shale_gas_storage_010
Domains	Reservoir Engineering, Petrophysics
Topics	Shale Gas, Gas Storage Mechanisms
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Before stimulation, methane in organic-rich shale gas systems primarily resides in which set of locations?

A	Mostly as a free gas cap above an oil leg, like a conventional anticlinal trap
B	Only dissolved in connate water, with essentially no gas in pores or on surfaces
C	In very small pores, with an additional portion attached to organic residue and clay mineral surfaces
D	Exclusively trapped in large open fractures that formed during deposition of the shale

Correct answer:	C - In very small pores, with an additional portion attached to organic residue and clay mineral surfaces

Rationale

The chapter describes shale gas as being held in tiny pore spaces and also partly adsorbed on remaining organic material (coke) and clays. This differs from conventional traps dominated by free gas in relatively permeable pore networks. Large, depositional open fractures are not presented as the primary storage mechanism.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 21 - Unconventional Hydrocarbons
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based question on shale-gas storage modes (micro/nanopores and adsorption) described in the chapter.

Question 456 of 505

ID	formationeval_v0.1_petroleumgeology_gas_hydrate_stability_011
Domains	Petroleum Geology, Geophysics
Topics	Gas Hydrates, Temperature-Pressure Stability
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

Assume seafloor temperature is 2°C and the geothermal gradient is 30°C/km. Using the approximate stability limit that gas hydrates become unstable above about 20°C, what is the maximum depth below the seafloor where hydrates would be expected to remain stable under these conditions (ignoring pressure changes)?

A	About 0.2 km
B	About 0.4 km
C	About 0.8 km
D	About 0.6 km

Correct answer: D - About 0.6 km

Rationale

Temperature increases by 30°C per km, so reaching 20°C from a 2°C starting point requires an 18°C increase. That corresponds to 18/30 = 0.6 km below the seafloor. This aligns with the chapter's qualitative statement that hydrates are only stable within a few hundred meters beneath the seafloor in typical settings.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 21 - Unconventional Hydrocarbons
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Numerical stability check based on the chapter's hydrate temperature limits and typical geothermal gradient.

Question 457 of 505

ID	formationeval_v0.1_petroleumgeology_gas_hydrate_yield_012
Domains	Petroleum Geology
Topics	Gas Hydrates, Resource Potential
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

When gas hydrate dissociates, one volume of hydrate can release about 160 volumes of gas. Approximately how much gas volume would be released from 3 m^3 of hydrate (using the same volume ratio)?

A	480 m^3 of gas
B	160 m^3 of gas
C	320 m^3 of gas
D	640 m^3 of gas

Correct answer: A - 480 m^3 of gas

Rationale

Using the stated expansion ratio, gas volume is 3 × 160 = 480 m^3. The key point is that hydrate holds methane in a condensed form that expands greatly upon dissociation. The other options correspond to using the wrong multiplier or an incorrect ratio.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 21 - Unconventional Hydrocarbons
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Simple quantitative application of the chapter’s hydrate-to-gas expansion factor.

Question 458 of 505

ID	formationeval_v0.1_petroleumgeology_ncs_provinces_001
Domains	Petroleum Geology
Topics	NCS Provinces, Regional Setting
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

For regional petroleum geology on the Norwegian Continental Shelf, which three broad provinces are treated as the main framework for comparing basin evolution and petroleum systems?

A	North Sea, Baltic Sea, Greenland Sea
B	North Sea, Mid-Norwegian continental margin, Western Barents Sea
C	Skagerrak, Møre Basin, Oslo Graben
D	Central Graben, Viking Graben, Norwegian-Danish Basin

Correct answer: B - North Sea, Mid-Norwegian continental margin, Western Barents Sea

Rationale

The chapter organizes the shelf into three principal provinces to discuss similarities and contrasts in tectonic history, stratigraphy, and petroleum systems. Those provinces are the North Sea, the Mid-Norwegian margin, and the Western Barents Sea. The other options mix smaller structural elements or regions not used as the main three-part division.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the chapter's regional subdivision of the Norwegian Continental Shelf into major provinces.

Question 459 of 505

ID	formationeval_v0.1_petroleumgeology_intracratonic_basins_002
Domains	Petroleum Geology, Geophysics
Topics	Intracratonic Basins, Lithospheric Stretching
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

The North Sea is described as an intracratonic basin. What geodynamic change is emphasized as the key prerequisite for creating major accommodation space on continental crust in such basins?

A	A large, long-lived global sea-level rise that floods a stable craton
B	Rapid sediment piling that forces subsidence without tectonic thinning
C	Crustal thickening by compression that creates a deep flexural basin
D	Stretching and thinning of crust and mantle lithosphere that drives isostatic subsidence

Correct answer: D - Stretching and thinning of crust and mantle lithosphere that drives isostatic subsidence

Rationale

The chapter links large basin subsidence on continental crust to lithospheric stretching and thinning, which requires the crust-mantle system to sink to preserve isostatic balance. Sediment loading can enhance subsidence but is not presented as the prerequisite mechanism. Compression and simple eustatic flooding do not explain the rift-related subsidence history described.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept item based on the chapter's explanation of intracratonic basin formation and isostatic subsidence driven by lithospheric thinning.

Question 460 of 505

ID	formationeval_v0.1_petroleumgeology_rift_phases_003
Domains	Petroleum Geology
Topics	Rift Phases, North Sea Tectonics
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

The North Sea experienced multiple stretching/thinning episodes. Which set of time intervals matches the major rift phases highlighted for the North Sea?

A	Late Carboniferous, Permian–Early Triassic, Late Jurassic
B	Cambrian, Silurian, Late Cretaceous
C	Ordovician, Devonian, Miocene
D	Triassic, Late Cretaceous, Quaternary

Correct answer: A - Late Carboniferous, Permian–Early Triassic, Late Jurassic

Rationale

The North Sea is described as undergoing several rift phases separated by post-rift subsidence stages. The major rift-related stretching episodes identified are late Carboniferous, Permian–Early Triassic, and Late Jurassic. The other options include periods not presented as the main rifting stages for this basin.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter's summary of rift episodes affecting the North Sea and their timing.

Question 461 of 505

ID	formationeval_v0.1_petroleumgeology_post_rift_subsidence_004
Domains	Petroleum Geology, Geophysics
Topics	Post Rift Subsidence, Thermal Cooling
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In the North Sea, active Late Jurassic rifting stretched and thinned the crust and mantle lithosphere. What process then produced the broad, regional post-rift subsidence phase?

A	Long-term compaction of pre-existing sediments with no thermal component
B	Renewed compression that thickens the crust and loads the basin
C	Thermal cooling and contraction after stretching, producing widespread subsidence
D	Rapid eustatic sea-level rise that deepens the basin everywhere
Correct answer:	C - Thermal cooling and contraction after stretching, producing widespread subsidence

Rationale

Extensional basins follow a characteristic sequence: active rifting (stretching/thinning) followed by a thermal cooling stage. As the lithosphere cools after rifting, it contracts and subsides regionally. This thermal subsidence is distinct from local compaction-only effects or compressional loading.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based question on syn-rift vs post-rift basin evolution as described for the North Sea.

Question 462 of 505

ID	formationeval_v0.1_petroleumgeology_salt_tectonics_005
Domains	Petroleum Geology
Topics	Salt Tectonics, Central Graben
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the Norwegian Central North Sea, why can some major structural complications predate the main Jurassic rift event even though the Central Graben is largely Jurassic–Cretaceous in overall geometry?

A	Salt began moving early and could deform strata before and long after Jurassic rifting
B	Deep-water carbonate reefs built rigid mounds that forced later faulting
C	Cenozoic glacial erosion created the tilted half-graben pattern offshore
D	Precambrian basement metamorphism directly created the Jurassic rotated blocks
Correct answer:	A - Salt began moving early and could deform strata before and long after Jurassic rifting

Rationale

The chapter notes that salt movement affected the Central Graben area already in Triassic time and in places persisted into younger periods. Because salt can flow and reactivate structures independent of the timing of main rifting, it can create significant pre-Jurassic structuring and later overprinting. The other options do not match the described mechanism for early deformation in this area.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the discussion of Central Graben halokinesis and its role in structuring through time.

Question 463 of 505

ID	formationeval_v0.1_petroleumgeology_unconformities_006
Domains	Petroleum Geology, Geophysics
Topics	Unconformities, Cretaceous Evolution
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

The Base Cretaceous Unconformity is described as a strong seismic marker across much of the North Sea. Which geological scenario best explains why this boundary is regionally developed but may be less pronounced in the deepest rift basins?

A	Cretaceous carbonate platforms abruptly drowned everywhere, producing a uniform hardground
B	A global fall in sea level removed all Jurassic sediments from the entire basin at once
C	Many rift highs remained exposed or starved, while deep rift axes could continue accumulating sediment
D	Permian evaporites were deposited directly on Cretaceous mudstones, creating a sharp contrast

Correct answer:	C - Many rift highs remained exposed or starved, while deep rift axes could continue accumulating sediment

Rationale

The chapter describes Early Cretaceous conditions where uplifted rift structures stayed as islands for much of the Early Cretaceous, leading to erosion or non-deposition on highs. In contrast, the deepest parts of rifts could preserve more continuous sedimentation across the boundary. This creates a regionally strong unconformity that is locally reduced in deep depocentres.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
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Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Based on the chapter's explanation of Early Cretaceous exposure of rift highs and the regional Base Cretaceous unconformity.

Question 464 of 505

ID	formationeval_v0.1_petroleumgeology_source_rocks_007
Domains	Petroleum Geology, Sedimentology
Topics	Source Rocks, Anoxic Basins
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Upper Jurassic shales are described as the dominant source rocks for many North Sea fields. Which set of depositional conditions best supports development of such highly effective source rocks in rift basins?

A	Well-oxygenated bottom waters and slow sedimentation on a shallow shelf
B	High-energy shoreface reworking that concentrates organic matter into sand
C	Frequent subaerial exposure that creates thick coal seams across the basin
D	Restricted bottom-water renewal in overdeepened sub-basins plus burial that preserves organic matter

Correct answer:	D - Restricted bottom-water renewal in overdeepened sub-basins plus burial that preserves organic matter

Rationale

The chapter links the best Upper Jurassic source rocks to rift-related basin topography that produced poorly ventilated bottom waters, allowing much organic matter to avoid oxidation. Relatively high sedimentation also aided preservation by rapid burial. Well-oxygenated shelves and high-energy sandy settings generally reduce preservation of dispersed marine organic matter.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on why Upper Jurassic organic-rich shales became prime source rocks in North Sea rift basins.

ID	formationeval_v0.1_sedimentology_deltaic_facies_008
Domains	Sedimentology, Petrophysics
Topics	Deltaic Facies, Brent Group
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A Brent Group core interval contains coal beds, fluvial channel sands, crevasse-splay deposits, and lagoonal muds. Which Brent Group subdivision best fits this facies association?

A	Rannoch Formation
B	Ness Formation
C	Tarbert Formation
D	Etive Formation

Correct answer: B - Ness Formation

Rationale

The chapter describes the Ness Formation as the delta-top interval dominated by fluvial and lagoonal environments and including coal. Rannoch and Etive are associated with more marine-influenced, progradational delta-front/shoreface settings, while Tarbert reflects transgressive reworking into better-sorted marine sand. The facies listed most closely match a delta-top package.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Facies-recognition item derived from the Brent Group internal subdivision and depositional environments.

Question 466 of 505

ID	formationeval_v0.1_petrophysics_overpressure_effects_009
Domains	Petrophysics, Reservoir Engineering
Topics	Overpressure Effects, Chalk Reservoirs
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the well-documented Ekofisk chalk reservoir case, porosity around 30–35% is noted despite burial depths greater than 3 km. What mechanism is emphasized as a key reason for this unusually high porosity at depth?

A	Complete replacement of calcite by quartz, which increases pore volume
B	Strong meteoric-water flushing during burial that dissolves the matrix everywhere
C	Reduced effective stress due to overpressure beneath low-permeability clay seals, limiting compaction
D	Late Cenozoic glacial unloading that instantly reopened pores in the chalk
Correct answer:	C - Reduced effective stress due to overpressure beneath low-permeability clay seals, limiting compaction

Rationale

The chapter attributes the preserved chalk porosity largely to overpressure created by low-permeability clay-rich seals, which lowers effective stress and reduces both mechanical compaction and pressure solution. This allows relatively high porosity to persist even at several kilometres depth. Glacial unloading and wholesale quartz replacement are not presented as the controlling explanation for Ekofisk porosity.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the Ekofisk chalk discussion focusing on overpressure, effective stress, and compaction/porosity preservation.

ID	formationeval_v0.1_petroleumgeology_trapping_mechanisms_010
Domains	Petroleum Geology, Petrophysics
Topics	Trapping Mechanisms, Ekofisk Field
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A dome-shaped structure has a mapped structural closure smaller than the observed hydrocarbon column thickness, implying hydrocarbons extend below the spill point. Considering how diagenetic changes in chalk reservoirs can create additional trapping capacity beyond pure structural closure, what explanation best accounts for this situation?

A	A combined structural trap and a lateral flow barrier created by tight rock/capillary effects (a diagenetic component)
B	A constant capillary pressure of zero, so hydrocarbons ignore the spill point everywhere
C	A fully open fault network that allows continuous replenishment from deeper levels without trapping
D	A sea-level fall that permanently lowered the free-water level across the entire basin

Correct answer: A - A combined structural trap and a lateral flow barrier created by tight rock/capillary effects (a diagenetic component)

Rationale

The chapter explains that Ekofisk requires more than simple structural closure because the oil column exceeds the closure height. A diagenetic/capillary barrier associated with low permeability can inhibit lateral escape even below the mapped spill point. The other options either remove the concept of trapping or invoke basin-wide controls not used to explain this local observation.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
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Type	textbook
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Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Concept-based item on mixed structural–diagenetic trapping illustrated by Ekofisk's oil column relative to closure.

Question 468 of 505

ID	formationeval_v0.1_petroleumgeology_structural_traps_011
Domains	Petroleum Geology
Topics	Structural Traps, Rotated Fault Blocks
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

The northern North Sea experienced significant Late Jurassic extension along the Viking Graben. Which trap geometry, formed during this rifting episode, is the most commonly developed type along the basin margins?

A	Shallow anticlines created solely by glacial loading
B	Rotated fault blocks where fault sealing is often crucial
C	Carbonate reef buildups formed during Late Pliocene time
D	Stratigraphic traps formed only by Holocene shoreline migration

Correct answer: B - Rotated fault blocks where fault sealing is often crucial

Rationale

Rotated fault blocks generated during Late Jurassic rifting are the dominant trap type along both margins of the Viking Graben. Sealing faults are frequently important for these traps. The other trap types listed (glacial anticlines, Pliocene reefs, Holocene stratigraphic traps) do not match the structural style of this province.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the northern North Sea trap-type overview emphasizing rotated fault blocks and fault seals.

ID	formationeval_v0.1_petroleumgeology_kitchen_areas_012
Domains	Petroleum Geology
Topics	Kitchen Areas, Hydrocarbon Generation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In petroleum system analysis of the northern North Sea, what is the practical meaning of a “kitchen area” in a petroleum system?

A	A shallow platform where source rock remains immature but reservoirs are thick
B	An area where reservoirs are highly cemented and therefore do not produce
C	A region dominated by volcanic intrusions that inherently converts oil to gas through high-temperature thermal cracking processes
D	A deeply buried part of the basin where source rocks generate large hydrocarbon volumes that later migrate

Correct answer:	D - A deeply buried part of the basin where source rocks generate large hydrocarbon volumes that later migrate

Rationale

The chapter uses “kitchen area” for the deeper, more strongly buried parts of the basin where the Upper Jurassic source rock reaches sufficient maturity to generate substantial hydrocarbons. These generated fluids then migrate into shallower traps such as rotated fault blocks. Shallow immature areas and reservoir-cementation problems are distinct concepts and not the definition of a kitchen area.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item based on the chapter's use of 'kitchen areas' for mature, deeply buried source rock zones feeding migration.

ID	formationeval_v0.1_petroleumgeology_seal_failure_013
Domains	Petroleum Geology, Geophysics
Topics	Seal Failure, Secondary Migration
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In cases where hydrocarbons leak from some northern North Sea reservoirs, what outcome is expected as a consequence when pressure approaches or exceeds cap-rock fracture strength?

A	Hydrocarbons are permanently trapped deeper because fractures close instantly
B	Hydrocarbons are converted to coal due to sudden cooling during leakage
C	Upward escape into younger successions can charge Palaeocene–Eocene turbidite sands, creating new accumulations
D	The source rock becomes immature because leakage reduces burial depth
Correct answer:	C - Upward escape into younger successions can charge Palaeocene–Eocene turbidite sands, creating new accumulations

Rationale

The chapter links leakage to pressure build-up sufficient to fracture the seal, allowing fluids to migrate upward into younger stratigraphy. It specifically notes that leaked oil and gas can accumulate in Palaeocene–Eocene sand bodies deposited as turbidites. Fracture closure, coal formation, and instantaneous maturity reversal are not presented as the primary outcomes.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the discussion of seal breach/leakage and subsequent charging of Paleocene–Eocene turbidite reservoirs.

Question 471 of 505

ID	formationeval_v0.1_petrophysics_co2_storage_014
Domains	Petrophysics, Reservoir Engineering
Topics	CO2 Storage, Utsira Formation
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

CO2 injection in the Sleipner area. What property of the Utsira Formation is most directly relevant to its suitability for injection operations?

A	It is a relatively thick sandstone unit with good aquifer properties
B	It is a crystalline basement unit with negligible pore space
C	It is a tight evaporite interval that prevents any fluid movement
D	It is a thin Holocene silt drape that compacts instantly under load
Correct answer:	A - It is a relatively thick sandstone unit with good aquifer properties

Rationale

The chapter describes the Utsira Formation as a thick sandstone that functions as a good aquifer, which implies high injectivity and storage capacity. This type of reservoir quality is central to CO2 injection feasibility. Basement rocks, tight evaporites, or thin Holocene silts do not match the stated injection target characteristics.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item based on the Utsira Formation description and its use for CO2 injection at Sleipner.

Question 472 of 505

ID	formationeval_v0.1_petroleumgeology_mid_norwegian_margin_015
Domains	Petroleum Geology
Topics	Mid Norwegian Margin, Structural Segments
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Along strike, the mid-Norwegian margin is divided into three main segments. Which grouping matches those segments?

A	Viking Graben, Central Graben, Oslo Rift
B	Hammerfest Basin, Nordkapp Basin, Tromsø Basin
C	Svalbard Platform, Bjørnøya Basin, Senja Ridge
D	Møre, Vøring, and Lofoten–Vesterålen

Correct answer: D - Møre, Vøring, and Lofoten–Vesterålen

Rationale

The chapter identifies three main mid-Norwegian margin segments: the Møre, Vøring, and Lofoten–Vesterålen margins. The other options list North Sea structural elements or Barents Sea basins rather than the mid-Norwegian margin segmentation.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the mid-Norwegian margin structural framework and along-strike segmentation.

Question 473 of 505

ID	formationeval_v0.1_petroleumgeology_transfer_zones_016
Domains	Petroleum Geology, Geophysics
Topics	Transfer Zones, Margin Magmatism
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

The Bivrost Lineament/Transfer Zone serves as a key boundary on the mid-Norwegian margin. Which contrast across this boundary is emphasized?

A	North of the boundary, basement is entirely Precambrian; south of it, basement is entirely oceanic
B	South of the boundary, break-up magmatism is more voluminous; north of it, the margin is less magmatic and more prone to early post-opening subsidence
C	South of the boundary, rifting ceased in the Carboniferous due to regional compression; north of it, rifting began only in the Quaternary after ice sheet retreat
D	North of the boundary, salt tectonics dominates; south of it, no faults occur

Correct answer: B - South of the boundary, break-up magmatism is more voluminous; north of it, the margin is less magmatic and more prone to early post-opening subsidence

Rationale

The chapter describes the Bivrost zone as separating sectors with distinct physiography, stretching, and break-up magmatism. Magmatism related to break-up is stated to be more voluminous to the south, while the less magmatic margin to the north was more susceptible to initial post-opening subsidence. The other options introduce contrasts not described in the chapter.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
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Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3

Notes	Derived from the chapter's description of the Bivrost Transfer Zone as a boundary in physiography, stretching, and break-up magmatism.

Question 474 of 505

ID	formationeval_v0.1_geophysics_seismic_reflectors_017
Domains	Geophysics, Petroleum Geology
Topics	Seismic Reflectors, Volcanic Margins
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

On the outer Møre and Vøring margins, characteristic seismic packages are commonly used to recognize volcanic passive margins. What do these seaward-dipping reflector sequences most commonly represent in this context?

A	Stacks of basalt flows erupted around break-up, forming dipping lava wedges
B	Thick carbonate platforms that prograded oceanward during the Jurassic
C	Glacial tills deposited on a continental shelf and later rotated by compaction
D	Salt sheets that flowed seaward due to gravity spreading in the Cenozoic

Correct answer: A - Stacks of basalt flows erupted around break-up, forming dipping lava wedges

Rationale

The chapter states that drilling has shown the seaward-dipping reflector sequences to be basaltic lavas erupted subaerially and/or in shallow marine settings during the break-up phase. These lava stacks create a diagnostic dipping geometry on seismic data. Carbonate platforms, tills, and salt sheets are not presented as the origin of these particular reflector packages on the mid-Norwegian volcanic margin.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
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Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept question based on the interpretation of seaward-dipping reflector sequences as diagnostic volcanic margin features.

Question 475 of 505

ID	formationeval_v0.1_petroleumgeology_sill_intrusions_018
Domains	Petroleum Geology, Geophysics
Topics	Sill Intrusions, Hydrothermal Vents
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

During break-up on the Norwegian margin, widespread sill intrusion occurred into thick Cretaceous successions. What mechanism is proposed to explain the formation of numerous hydrothermal vent complexes during this igneous episode?

A	Glacial scouring created vent pipes that later filled with basalt
B	Normal faulting alone pumped seawater upward to build vent mounds
C	Heating of organic-rich sediments by intrusions generated large gas volumes that escaped explosively to the surface
D	Quartz cementation in sandstones increased pore pressure until vents formed
Correct answer:	C - Heating of organic-rich sediments by intrusions generated large gas volumes that escaped explosively to the surface

Rationale

The chapter links intrusion of magma into organic-rich sedimentary rocks to rapid generation of greenhouse gases. These gases were then vented in explosive events, forming many hydrothermal vent complexes along the margin. The other options do not match the described cause-and-effect connection between intrusion, gas generation, and vent formation.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
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Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the chapter's discussion of break-up magmatism, sill intrusion, and associated hydrothermal vent complexes.

Question 476 of 505

ID	formationeval_v0.1_reservoirengineering_pore_pressure_019
Domains	Reservoir Engineering, Petroleum Geology
Topics	Pore Pressure, Haltenbanken Traps
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In the Haltenbanken area, some reservoirs east of a major fault are close to hydrostatic pressure. Which explanation is given for why this pressure regime can reduce the chance of leakage from traps?

A	Hydrostatic pressure implies no buoyancy force, so hydrocarbons cannot migrate
B	Drainage through Jurassic sandstones toward the coast limits overpressure, reducing the likelihood of seal fracturing
C	Lower pressure consistently increases oil viscosity substantially, making it immobile in the pore space and preventing any migration
D	Hydrostatic pressure guarantees that the source rock remains immature
Correct answer:	B - Drainage through Jurassic sandstones toward the coast limits overpressure, reducing the likelihood of seal fracturing

Rationale

The chapter explains that pressure did not build far above hydrostatic on the eastern side because fluids could drain through Jurassic sandstones toward the coast. Lower pore pressure reduces the risk that pressure will reach fracture strength and breach the seal. The other options confuse pressure with buoyancy, viscosity, or maturity in ways not supported by the chapter's discussion.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the Haltenbanken discussion of drainage, pore pressure, and its implications for leakage risk.

Question 477 of 505

ID	formationeval_v0.1_petrophysics_quartz_cementation_020
Domains	Petrophysics
Topics	Quartz Cementation, Deep Reservoir Quality
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

For very deep Jurassic reservoirs on the mid-Norwegian shelf (depths >5 km and temperatures approaching 170–180°C), which factor is highlighted as critical for preserving producible porosity in some sandstones?

A	Abundant feldspar dissolution consistently increases porosity regardless of burial depth or temperature
B	Early dolomitization creates rigid frameworks that prevent quartz cement
C	A thick salt cover blocks any cementation reactions in underlying sands
D	Chlorite grain coatings can inhibit quartz cement growth and help retain higher porosity
Correct answer:	D - Chlorite grain coatings can inhibit quartz cement growth and help retain higher porosity

Rationale

The chapter emphasizes that at great burial depth, reservoir quality depends strongly on how much quartz cement forms. It notes that chlorite coatings on grains can hinder quartz precipitation, allowing porosity to remain relatively high (on the order of 20–25%) even at depth. Where such coatings are absent and quartz dominates, porosity can be much lower.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the chapter’s deep-burial reservoir quality discussion for Kristin/Lavrans-type settings (quartz cement vs chlorite coatings).

Question 478 of 505

ID	formationeval_v0.1_petroleumgeology_timing_of_petroleum_systems_021
Domains	Petroleum Geology
Topics	Timing of Petroleum Systems, Vøring-Møre Basins
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

In the deep Vøring and Møre basin province, some very large traps formed relatively late compared with hydrocarbon generation. What petroleum-system consequence follows if Upper Jurassic source rocks mature by mid-Cretaceous time but key reservoirs and inversion structures develop later?

A	Oil is guaranteed to be trapped because early generation consistently improves charge efficiency by ensuring hydrocarbons reach the structure before any seal degradation
B	Hydrocarbon generation cannot occur without inversion structures, so no charge is possible
C	Later-formed traps may capture mainly gas (including gas derived from earlier oil) rather than large oil accumulations
D	Reservoir sandstones cannot be deposited after source rock maturation, so prospects are impossible

Correct answer: C - Later-formed traps may capture mainly gas (including gas derived from earlier oil) rather than large oil accumulations

Rationale

The chapter describes a timing mismatch: source rocks became mature before important Upper Cretaceous–Lower Tertiary reservoirs were deposited and before the large traps visible today formed. In such cases, much of the earlier-generated oil may not be trapped, and later traps may preferentially retain gas or gas that formed from oil at depth. This is a classic charge–trap timing risk highlighted for the province.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

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Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Concept-based item on timing mismatch between source maturation and later development of reservoirs/traps in the Vøring–Møre basins.

ID	formationeval_v0.1_petroleumgeology_exploration_acreage_022
Domains	Petroleum Geology
Topics	Exploration Acreage, Norwegian Shelf Licensing
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

The Norwegian continental shelf covers about 2.2 million km², about half is considered prospective bedrock, and about half of that prospective area has been opened for exploration. Approximately what area has been opened?

A	0.55 million km^2
B	1.10 million km^2
C	0.22 million km^2
D	2.20 million km^2

Correct answer: A - 0.55 million km^2

Rationale

Opened area is computed by applying the two successive halves: 2.2 million $km^2 \times 0.5 \times 0.5 = 0.55$ million km^2. This calculation follows directly from the proportions provided in the chapter. The other options correspond to using only one reduction or none.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Simple quantitative item derived from the chapter's shelf-area and exploration-access proportions.

Question 480 of 505

ID	formationeval_v0.1_petroleumgeology_barents_sea_rift_phases_023
Domains	Petroleum Geology
Topics	Barents Sea Rift Phases, Tectonic Evolution
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

The post-Caledonian history of the western Barents Sea is dominated by three major rift phases. Which combination matches those phases?

A	Cambrian, Silurian, Devonian
B	Late Triassic, Late Cretaceous, Miocene
C	Permian only, with no later rifting
D	Late Devonian?–Carboniferous, Middle Jurassic–Early Cretaceous, Early Tertiary
Correct answer:	D - Late Devonian?–Carboniferous, Middle Jurassic–Early Cretaceous, Early Tertiary

Rationale

The chapter identifies three main rift phases for the western Barents Sea spanning Late Devonian?–Carboniferous, Middle Jurassic–Early Cretaceous, and Early Tertiary times, with multiple pulses within each. This framework is used to interpret the basin architecture and later margin development. The other options do not reflect the phase grouping stated.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22
URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Based on the chapter's synthesis of major rift phases controlling western Barents Sea basin evolution.

Question 481 of 505

ID	formationeval_v0.1_petroleumgeology_uplift_and_erosion_effects_024
Domains	Petroleum Geology, Reservoir Engineering
Topics	Uplift and Erosion Effects, Barents Sea Prospectivity
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

Late Cenozoic uplift and erosion is a key reason why many Barents Sea discoveries are gas-dominated even where oil was present earlier. Which mechanism best explains this shift in fluid type and trap filling?

A	Uplift increases pressure, compressing gas back into oil and improving oil retention
B	Pressure reduction during uplift causes gas to come out of solution and expand, which can expel oil and promote spilling/breaching while cooling also reduces further generation
C	Erosion adds overburden, increasing maturity and creating new oil that refills traps immediately
D	Glacial sediments invariably dissolve seals through their high content of corrosive meltwater and organic acids, making effective trapping impossible anywhere on the continental shelf
Correct answer:	B - Pressure reduction during uplift causes gas to come out of solution and expand, which can expel oil and promote spilling/breaching while cooling also reduces further generation

Rationale

The chapter explains that removal of large overburden thickness reduces pressure, promoting gas exsolution from oil and expansion of gas that can drive oil out of traps and contribute to seal breaching/spillage. It also notes that cooling of source rocks during uplift can largely stop continued hydrocarbon generation, limiting replenishment. This combination helps account for gas-dominated accumulations and residual oil columns.

Sources

Source 1: Petroleum Geoscience: From Sedimentary Environments to Rock Physics

Source ID	bjorlykke_petroleum_geoscience_2010
Year	2010
Type	textbook
License	Proprietary (Springer)
Attribution	Knut Bjørlykke (ed.)
Reference	Chapter 22 - Geology of the Norwegian Continental Shelf
Retrieved	2025-12-22

URL	https://doi.org/10.1007/978-3-642-02332-3
Notes	Derived from the chapter’s explanation of how uplift/erosion affects pressure, phase behavior, trap integrity, and ongoing generation in the Barents Sea.

Question 482 of 505

ID	formationeval_v0.1_petroleumgeology_reserves_production_ratio_002
Domains	Petroleum Geology, Reservoir Engineering
Topics	Reserves and Resources, R/P Ratio
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A region is reported to have an oil R/P value of 45 years. In the intended meaning of this metric, what does the “45 years” represent?

A	The typical time from discovery to first production in that region
B	The expected interval between major field discoveries in that region
C	The predicted time until global oil demand stops growing
D	The number of years the remaining reserves would last if production stayed at today’s rate

Correct answer:	D - The number of years the remaining reserves would last if production stayed at today’s rate

Rationale

R/P is the ratio of remaining reserves (R) to current annual production (P), reported as an equivalent number of years. Interpreting it as “years remaining” implicitly assumes production stays constant and reserves are not revised. The lecture emphasizes it is a simple message-carrying metric rather than a full forecast.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 1 - Introduction
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Concept-based interpretation of the reserves-to-production ratio discussed with world/area R/P figures.

Question 483 of 505

ID	formationeval_v0.1_petroleumgeology_rp_limitations_003
Domains	Petroleum Geology, Reservoir Engineering
Topics	R/P Ratio, Uncertainty and Forecasting
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Two countries show the same R/P ratio this year. One is actively adding reserves through new discoveries and improved recovery, while the other is not. Why can their future supply outlook still differ even if today's R/P values match?

A	Because both reserves estimates and production rates can change, so the ratio is not a stand-alone predictor
B	Because the ratio already includes future demand growth and therefore cancels differences between countries
C	Because the ratio is computed from oil prices and therefore reacts only to market cycles rather than to geological maturity
D	Because the ratio measures the quality (API gravity) of the remaining oil rather than remaining quantity

Correct answer:	A - Because both reserves estimates and production rates can change, so the ratio is not a stand-alone predictor

Rationale

The lecture characterizes R/P as a simple snapshot that carries a message but has limited forecasting power. Reserves are revised and expanded, and production rates change with development strategy, technology, and economics. Therefore, identical R/P values today do not guarantee similar trajectories tomorrow.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 1 - Introduction
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/

Notes	Concept-based question targeting the lecture's caution that R/P is a static snapshot with limited predictive value.

Question 484 of 505

ID	formationeval_v0.1_petroleumgeology_early_exploration_clues_004
Domains	Petroleum Geology
Topics	Exploration History, Surface Indications
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In the period before 1900, subsurface concepts were not commonly applied in exploration. Which observation would have been the most direct practical clue for finding oil in that era?

A	A strong reflection event on a processed seismic section
B	A time-lapse change between two repeated seismic surveys
C	Oil or gas visibly leaking at the surface
D	A detailed wireline resistivity log showing hydrocarbon saturation

Correct answer: C - Oil or gas visibly leaking at the surface

Rationale

The lecture notes that early discoveries were largely made from surface seepages rather than from systematic subsurface mapping. Seismic interpretation, time-lapse seismic, and electrical well logs are technologies that became important later. A seep provides a direct indication of hydrocarbons at or near the surface and was actionable without advanced tools.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 1 - Introduction
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Concept-based item derived from the ‘Prior to 1900’ history slide emphasizing seepage-led discoveries.

Question 485 of 505

ID	formationeval_v0.1_petroleumgeology_carbon_chemistry_001
Domains	Petroleum Geology
Topics	Carbon Chemistry, Organic vs Inorganic Carbon
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In near-surface Earth conditions, why do carbonate minerals tend to persist while freshly produced biological organic matter is often quickly destroyed?

A	Carbonates are reduced carbon, so they resist reaction with oxygen in air and water
B	Carbonates hold carbon in an oxidized form that is relatively stable, while organic matter is reduced and readily oxidized
C	Organic matter is more stable because it contains stronger C–H bonds than carbonates
D	Organic matter persists because it is protected from bacteria, while carbonates dissolve rapidly in seawater

Correct answer: B - Carbonates hold carbon in an oxidized form that is relatively stable, while organic matter is reduced and readily oxidized

Rationale

The slides distinguish reduced organic carbon (more reactive in an oxygenated biosphere) from oxidized inorganic carbon stored mainly in carbonates, which is comparatively stable. Exposure to oxygen promotes oxidation of organic matter to CO_2 and H_2O, whereas carbonates already represent an oxidized carbon sink. The other choices reverse these redox roles or add claims not supported by the lecture.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 2 - Carbon Cycle and Maturation
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Concept-based item on reduced vs oxidized carbon and relative stability in the biosphere.

Question 486 of 505

ID	formationeval_v0.1_petroleumgeology_organic_matter_preservation_003
Domains	Petroleum Geology
Topics	Organic Matter Preservation, Anoxic Conditions
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Which depositional setting best promotes long-term preservation of organic matter that could later contribute to hydrocarbon generation?

A	A stratified basin where deep water receives little oxygen because vertical mixing is suppressed
B	A well-mixed open ocean where oxygen is replenished throughout the water column
C	A high-energy beach where rapid wave action buries organic debris in coarse sand
D	A river channel where frequent reworking keeps sediments in constant motion
Correct answer:	A - A stratified basin where deep water receives little oxygen because vertical mixing is suppressed

Rationale

The lecture stresses that preservation of reduced biomolecules depends on oxygen-poor conditions, because oxygen would oxidize them to CO_2 and H_2O. Stratified basins (e.g., salinity- or temperature-stratified) limit oxygen delivery to depth and therefore favor preservation. Well-mixed or high-energy environments generally enhance oxygen exposure and degradation.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 2 - Carbon Cycle and Maturation
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Concept-based item on anoxia and stratification as controls on organic matter preservation.

Question 487 of 505

ID	formationeval_v0.1_petroleumgeology_source_rock_toc_004
Domains	Petroleum Geology, Sedimentology
Topics	Source Rocks, TOC Controls, Grain Size Effects
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Why do fine-grained sediments commonly contain more preserved organic matter (and often higher TOC) than coarse-grained sediments deposited in comparable environments?

A	Fine-grained rocks have higher permeability, which increases oxygen supply and slows organic decay
B	Coarse-grained rocks generate more organic matter because they contain more plankton skeletons
C	Fine-grained sediments restrict oxygen transport to the organic matter, reducing oxidation during early burial
D	Coarse-grained sediments are necessarily deposited in anoxic bottom waters, which ensures better organic matter preservation
Correct answer:	C - Fine-grained sediments restrict oxygen transport to the organic matter, reducing oxidation during early burial

Rationale

The lecture links higher organic contents in finer-grained sediments to limited diffusion and thus reduced oxygen access to organic matter. Less oxygen contact means less oxidation and better preservation, raising TOC. The other options contradict this diffusion/oxygen argument or make absolute depositional claims not supported by the slides.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 2 - Carbon Cycle and Maturation
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Concept-based item on sediment texture, oxygen diffusion, and implications for TOC.

Question 488 of 505

ID	formationeval_v0.1_petroleumgeology_hydrocarbon_classes_001
Domains	Petroleum Geology
Topics	Hydrocarbon Classification, Paraffins
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A saturated hydrocarbon that follows the general formula CnH2n+2 and does not contain rings is most appropriately classified as which hydrocarbon group?

A	Paraffin (alkane)
B	Naphthene (cycloparaffin)
C	Aromatic hydrocarbon
D	Olefin (alkene/alkyne)

Correct answer: A - Paraffin (alkane)

Rationale

Paraffins (alkanes) are saturated hydrocarbons with the general formula CnH2n+2 when they are acyclic. Naphthenes are saturated but ring-shaped and follow CnH2n, while aromatics contain benzene-ring structures. Olefins are undersaturated and therefore do not match the fully saturated alkane formula.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 3 - Composition of Oil and Gas
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Concept-based item derived from the lecture's hydrocarbon group definitions (paraffins vs naphthenes vs aromatics vs olefins).

Question 489 of 505

ID	formationeval_v0.1_petroleumgeology_naphthenes_ring_size_003
Domains	Petroleum Geology
Topics	Naphthenes, Molecular Structure
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

Naturally occurring cycloparaffins (naphthenes) in crude oil are most commonly built from rings containing which number of carbon atoms?

A	Two to three, because small rings are most stable
B	Seven to eight, because larger rings dominate crude oils
C	Five to six, because these ring sizes fit feasible carbon bond angles
D	Ten to twelve, because multi-ring structures require very large rings
Correct answer:	C - Five to six, because these ring sizes fit feasible carbon bond angles

Rationale

The lecture notes that, in nature, naphthene ring sizes are effectively restricted to 5- and 6-membered rings due to geometric constraints on carbon bonding. Options featuring very small or much larger rings are inconsistent with this natural limitation. This question targets the structural reason for observed ring-size prevalence.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 3 - Composition of Oil and Gas
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Concept-based item derived from the lecture's discussion of why natural naphthenes are dominated by 5- and 6-membered rings.

Question 490 of 505

ID	formationeval_v0.1_productionengineering_h2s_removal_chemistry_006
Domains	Production Engineering
Topics	Natural Gas Processing, H2S Removal Chemistry
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	medium

In the first reaction step shown for converting H2S at a refinery (2 H2S + 3 O2 → 2 SO2 + 2 H2O), how many moles of O2 are required per mole of H2S consumed?

A	1.0 mol O2 per mol H2S
B	1.5 mol O2 per mol H2S
C	2.0 mol O2 per mol H2S
D	3.0 mol O2 per mol H2S

Correct answer: B - 1.5 mol O2 per mol H2S

Rationale

The reaction uses 3 moles of O2 for every 2 moles of H2S. Dividing by 2 gives 1.5 moles of O2 per mole of H2S. The other options do not match the stoichiometric coefficients shown in the lecture.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 3 - Composition of Oil and Gas
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Concept-based item derived from the lecture’s refinery reactions for H2S conversion (de-mercaptanization section).

Question 491 of 505

ID	formationeval_v0.1_petroleumgeology_formation_waters_001
Domains	Petroleum Geology
Topics	Formation Waters, Reservoir Fluids
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A reservoir contains saline water that was trapped in the pore space during or shortly after deposition and has remained isolated during burial. What term best describes this water?

A	Meteoric water that infiltrated from the surface during uplift
B	Connate water that represents fossil pore water from deposition
C	Juvenile water introduced by deep magmatic activity
D	Condensed water formed by cooling of hydrocarbon vapors in the reservoir
Correct answer:	B - Connate water that represents fossil pore water from deposition

Rationale

Connate water is the original pore water associated with deposition (or shortly thereafter) and is therefore “fossil” water in the reservoir. Meteoric water originates at the surface and may enter the subsurface later, often changing chemistry during burial. The other options describe processes not presented as the typical origin of reservoir formation water in the lecture.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 4 - Migration
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Derived from the slide section distinguishing connate and meteoric water in reservoirs.

Question 492 of 505

ID	formationeval_v0.1_petroleumgeology_salinity_depth_002
Domains	Petroleum Geology
Topics	Formation Water Salinity, Diagenesis
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In many sedimentary basins, formation water salinity increases from about 35,000 ppm (seawater concentration) near surface to over 350,000 ppm at several kilometers depth. Which process best explains this trend?

A	Salt is created in situ by thermal cracking of kerogen, enriching deep waters in ions
B	Deep formation water is diluted by continuous influx of fresh meteoric water during burial
C	Water molecules can move upward through shale while dissolved ions are largely retained, concentrating brines at depth
D	Bacterial sulfate reduction produces large sulfate concentrations that drive salinity increases downward

Correct answer: C - Water molecules can move upward through shale while dissolved ions are largely retained, concentrating brines at depth

Rationale

The salinity increase with depth is attributed to a reverse-osmosis type process (membrane filtration) in which water molecules can pass through shales more readily than dissolved ions. This preferential upward movement of water leaves ions behind, concentrating the remaining formation water into brines at greater depth. The other options either contradict this process (dilution) or invoke chemistry that doesn't explain the systematic depth trend.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 4 - Migration
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/

Notes	Concept-based question on the proposed reverse-osmosis explanation for salinity increase with depth.

ID	formationeval_v0.1_petroleumgeology_compaction_overpressure_003
Domains	Petroleum Geology
Topics	Compaction, Overpressure, Primary Migration
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

During burial, why are shales especially prone to developing overpressure compared with more permeable sedimentary rocks?

A	Their low permeability slows fluid escape and pressure equilibration as overburden stress increases
B	Their high permeability allows rapid inflow of water that raises pore pressure above surrounding rocks
C	Their pore fluids cool faster than surrounding rocks, causing thermal contraction and pressure buildup
D	Their pore space increases with depth, creating excess fluid volume that must be pressurized

Correct answer:	A - Their low permeability slows fluid escape and pressure equilibration as overburden stress increases

Rationale

As sediments are buried, increasing stress compacts the rock and reduces pore space; pore fluids must either escape or carry more of the load. Shales transmit fluids slowly, so pressure can remain elevated relative to adjacent permeable layers, producing compaction disequilibrium overpressure. The other choices contradict the burial compaction trend or rely on mechanisms not presented in the lecture.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 4 - Migration
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/

Notes	Based on slides linking burial compaction, delayed pressure equilibration in shales, and overpressure development.

Question 494 of 505

ID	formationeval_v0.1_petroleumgeology_secondary_migration_008
Domains	Petroleum Geology
Topics	Secondary Migration, Buoyancy
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Once hydrocarbons are moving through a porous, permeable carrier bed toward a trap, what is identified as the dominant driver of this secondary migration?

A	Capillary imbibition of oil into shale driven by clay surface charge
B	Diffusion driven by concentration differences between source and reservoir
C	Long-term cooling of the basin causing density inversion of brines
D	Buoyancy arising from the density contrast between hydrocarbons and water

Correct answer: D - Buoyancy arising from the density contrast between hydrocarbons and water

Rationale

The lecture treats secondary migration as far less controversial than primary migration and describes it as controlled mainly by buoyancy forces. Those forces scale with the density difference between hydrocarbons and water and drive hydrocarbons toward structurally higher positions in connected permeable pathways. Diffusion and shale–clay effects are discussed in the context of primary migration challenges, not as the main control on secondary movement.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 4 - Migration
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Derived from the secondary migration slides emphasizing buoyancy control.

ID	formationeval_v0.1_petroleumgeology_differential_entrapment_010
Domains	Petroleum Geology
Topics	Differential Entrapment, Trap Filling
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	low

A series of structural traps are connected along an updip migration route. Under the conditions discussed for differential entrapment (including the ability for free gas to form), which geometric feature most strongly determines which trap captures which fluid phase?

A	The absolute height of the structural culmination above regional datum
B	The thickness of the reservoir layer at each structure
C	The elevation of spill points that control when a trap overflows to the next one
D	The age difference between the source rock and the reservoir rock

Correct answer: C - The elevation of spill points that control when a trap overflows to the next one

Rationale

The lecture emphasizes that selective trapping in a connected system is governed by spill behavior: once a trap reaches its spill point, fluids can bypass to the next structure. It also notes that this effect can lead to counterintuitive phase distributions and requires that free gas can form. Culmination height alone is not the controlling factor if spill-point elevations differ.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 4 - Migration
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Derived from the differential entrapment slides highlighting spill-point elevation as the key control and noting the need for free gas.

Question 496 of 505

ID	formationeval_v0.1_petrophysics_porosity_permeability_001
Domains	Petrophysics
Topics	Porosity, Permeability
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

Two rocks have the same bulk volume. Rock X contains many void spaces but those voids are poorly connected; Rock Y has fewer void spaces but they form continuous pathways. Which statement best describes the likely reservoir behavior of Rock X compared with Rock Y?

A	Rock X will transmit fluids more easily because more pore space inherently means higher permeability
B	Rock X can store more fluid, but may transmit it less efficiently than Rock Y
C	Rock X must have both higher porosity and higher permeability than Rock Y
D	Rock X will have lower porosity because poor connectivity eliminates pore volume
Correct answer:	B - Rock X can store more fluid, but may transmit it less efficiently than Rock Y

Rationale

Porosity describes how much void space exists for storing fluids, while permeability depends mainly on whether those pores are connected well enough to form flow pathways. A rock can have significant pore volume yet still have low permeability if connections between pores are restricted. Conversely, a smaller pore volume can still yield better flow if the pore network is well connected.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 5 - Reservoir Rock Properties
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Concept-based item contrasting storage (porosity) and transmissibility (permeability) as principal reservoir-rock properties.

Question 497 of 505

ID	formationeval_v0.1_petroleumgeology_hydrocarbon_trapping_001
Domains	Petroleum Geology
Topics	Hydrocarbon Trapping, Trap Efficiency
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

In petroleum systems analysis, what is meant by a hydrocarbon “trap” in the context of migration and accumulation?

A	A geologic configuration that prevents further movement of hydrocarbons so they can build up in a reservoir
B	A process that generates hydrocarbons from source rock by increasing temperature and pressure
C	A zone where hydrocarbons are chemically altered into heavier components during biodegradation
D	A pathway that increases hydrocarbon movement by connecting source rock to reservoir with high permeability
Correct answer:	A - A geologic configuration that prevents further movement of hydrocarbons so they can build up in a reservoir

Rationale

A trap is defined by its function: it stops migrating oil and/or gas so that fluids can accumulate. Generation and alteration processes relate to source maturation and in-reservoir changes, while migration pathways facilitate movement rather than stopping it.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 6 - Trapping
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Concept-based item on the functional meaning of trapping in petroleum geology.

Question 498 of 505

ID	formationeval_v0.1_petroleumgeology_hydrocarbon_trapping_002
Domains	Petroleum Geology
Topics	Trap Types, Structural vs Stratigraphic Traps
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

A reservoir interval is trapped because the rock layers thin and terminate laterally into a tight facies, without requiring tectonic deformation. How would this trap most appropriately be classified?

A	Structural trap because all closures require tectonic strain
B	Stratigraphic trap because depositional changes create the closure
C	Structural trap because the key control is a fold hinge
D	Dynamic trap because the contact must be tilted by groundwater flow

Correct answer: B - Stratigraphic trap because depositional changes create the closure

Rationale

Stratigraphic traps arise from lateral changes created during deposition (or related stratigraphic architecture), such as pinchout into less-permeable rock. Structural traps are tied to deformation like folding or faulting, while dynamic traps involve pressure-driven tilted contacts rather than static geometric closure.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

Source ID	tudelft_petroleum_geology_ocw
Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 6 - Trapping
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Derived from the lecture’s distinction between traps produced by deformation versus depositional contrasts.

Question 499 of 505

ID	formationeval_v0.1_petroleumgeology_hydrocarbon_trapping_003
Domains	Petroleum Geology
Topics	Anticlinal Traps, Structural Trap Formation
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

An exploration team finds a closed, convex-upward reservoir surface but regional evidence for compressional folding is weak. Which mechanism is still consistent with forming an anticlinal-style trap in this situation?

A	Bioturbation increasing permeability at the top of the sand body
B	Cementation lowering porosity until the reservoir becomes a seal
C	Differential compaction or draping over a pre-existing high (including salt-related uplift)
D	Updip facies change from sandstone into shale without any structural relief
Correct answer:	C - Differential compaction or draping over a pre-existing high (including salt-related uplift)

Rationale

The lecture emphasizes that arch-shaped closures can develop without classic tectonic folding, such as by differential compaction or sedimentary drape over a high, including salt-related uplift. Facies pinchout would be stratigraphic, and changes in bioturbation or cementation do not by themselves create the required structural geometry.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

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Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 6 - Trapping
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Focuses on non-folding processes that can still create arching needed for anticline traps.

Question 500 of 505

ID	formationeval_v0.1_petroleumgeology_syndepositional_vs_postdepositional_001
Domains	Petroleum Geology, Sedimentology
Topics	Basin Types, Depositional Systems
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A geologist compares two basins: Basin X shows facies belts that systematically align with the shape of the basin floor, while Basin Y shows no consistent link between facies patterns and the present basin-floor geometry. Which interpretation best matches these observations?

A	Basin X is post-depositional; Basin Y is syn-depositional
B	Both basins are syn-depositional because facies invariably follow topography
C	Basin X is syn-depositional; Basin Y is post-depositional
D	Both basins are post-depositional because facies are controlled only by sediment supply
Correct answer:	C - Basin X is syn-depositional; Basin Y is post-depositional

Rationale

In syn-depositional basins, depositional patterns (facies) tend to reflect the contemporaneous basin shape, so facies and basin contours correlate. In post-depositional basins, the basin-floor geometry formed after deposition, so the infill does not show a consistent relationship to the later basin contours.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

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Year	2008
Type	lecture_slides
License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 7 - Basin Types and Exploration
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Derived from the contrast between syn-depositional and post-depositional basin fill relationships to basin-floor contours.

Question 501 of 505

ID	formationeval_v0.1_petroleumgeology_basin_types_002
Domains	Petroleum Geology, Sedimentology
Topics	Basin Types, Sediment Transport
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In regional basin analysis, why are basement boundaries often associated with thicker sediment packages and more active depositional systems?

A	They typically coincide with steep relief that promotes downslope sediment transfer and accommodation changes
B	They necessarily generate carbonate platforms that outpace clastic input, even in tectonically active or high-sediment-supply settings
C	They prevent sediment transport by creating closed drainage systems
D	They eliminate topographic gradients, leading to uniformly thin deposits
Correct answer:	A - They typically coincide with steep relief that promotes downslope sediment transfer and accommodation changes

Rationale

Large contrasts in basement elevation commonly create strong slopes and relief, which encourages sediment routing and deposition along the gradient. Such settings can also localize accommodation, making them natural sites for substantial sediment accumulation. The other choices either reverse the role of gradients or assume a specific lithology that is not implied.

Sources

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Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 7 - Basin Types and Exploration
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Based on the lecture point linking topographic gradients (often near basement boundaries) to enhanced sediment transport and deposition.

ID	formationeval_v0.1_petroleumgeology_maturation_controls_004
Domains	Petroleum Geology
Topics	Thermal Maturation, Basin Analysis
Difficulty	medium
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

A basin cross-section shows that producing intervals become both deeper and younger toward the basinward (southern) direction. What interpretation best explains why this trend is meaningful for hydrocarbon generation?

A	Hydrocarbon generation depends mainly on present-day salinity, so deeper burial is inherently better for maturation
B	Generation is controlled only by depositional facies, so age and depth trends are irrelevant to the timing or extent of hydrocarbon maturation
C	Time and temperature jointly influence maturation, so younger units may need greater burial to reach maturity
D	Younger units mature faster because they invariably contain more reactive organic matter and kerogen than older units

Correct answer: C - Time and temperature jointly influence maturation, so younger units may need greater burial to reach maturity

Rationale

The lecture emphasizes that maturation depends on both the thermal regime and the time available for heating (e.g., via a time–temperature concept such as TTI). A basinward shift to younger yet deeper productive intervals is consistent with younger rocks requiring more burial (and thus higher temperature) to attain sufficient maturity.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

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Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 7 - Basin Types and Exploration
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/

Notes	Built from the Gulf of Mexico observation linking southward deepening/younging production to time–temperature maturation controls.

ID	formationeval_v0.1_petroleumgeology_depocenter_migration_thickness_007
Domains	Petroleum Geology, Sedimentology
Topics	Depocenter Migration, Stratigraphic Architecture
Difficulty	hard
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	medium

In a basin where the main depositional center shifts position through time, why can adding mapped thicknesses of successive stratigraphic packages give an incorrect estimate of the total sequence thickness?

A	Because thickness maps cannot be made in basins with any tectonic activity
B	Because facies changes necessarily force thickness to remain constant through time, as the grain size and depositional energy compensate for any subsidence variations
C	Because later compaction removes thickness from older units, making summation impossible in principle
D	Because individual packages may thicken in different places as the depocenter moves, so the local maximum thicknesses do not stack in one location

Correct answer: D - Because individual packages may thicken in different places as the depocenter moves, so the local maximum thicknesses do not stack in one location

Rationale

When the depocenter migrates, the thickest part of each time slice occurs in different locations. Summing those separate maxima implies a single point received all thickness increments, which is not true; the total thickness must be evaluated in a consistent spatial framework. This is the specific limitation highlighted in the lecture for pre- or syn-depositional settings.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

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Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 7 - Basin Types and Exploration
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/

Notes	Derived from the lecture note that depocenter migration prevents straightforward summation of individual stratigraphic thicknesses.

Question 504 of 505

ID	formationeval_v0.1_petroleumgeology_prospect_risking_008
Domains	Petroleum Geology
Topics	Prospect Evaluation, Risk Assessment
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	yes
Contamination risk	high

A prospect is evaluated by assigning independent probabilities to key petroleum system elements and multiplying them. If the probabilities are 0.7 (charge), 0.6 (reservoir), and 0.5 (trap/seal), what is the combined probability of success using this approach?

A	0.18
B	0.21
C	0.35
D	0.90

Correct answer: B - 0.21

Rationale

Under the stated approach, the combined probability is the product of the individual probabilities: 0.7 × 0.6 × 0.5 = 0.21. Adding probabilities or selecting the largest probability would not match the multiplication-based risking method described in the lecture.

Sources

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Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 7 - Basin Types and Exploration
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Numerical application of the lecture’s prospect evaluation concept: multiplying probabilities of key conditions.

Question 505 of 505

ID	formationeval_v0.1_petroleumgeology_resources_vs_reserves_009
Domains	Petroleum Geology, Reservoir Engineering
Topics	Reserves and Resources, Uncertainty and Economics
Difficulty	easy
Language	en
Derivation	concept_based
Calc required	no
Contamination risk	high

When classifying discovered hydrocarbon volumes along a spectrum from resources to reserves, which pair of factors is emphasized as controlling where a project falls on that spectrum?

A	Rock color and seismic frequency content
B	Geological confidence and economic feasibility
C	Distance to coastline and water depth
D	API gravity and gas-oil ratio

Correct answer: B - Geological confidence and economic feasibility

Rationale

The lecture frames the distinction between resources and reserves as driven by how well the subsurface is understood and whether development is economically viable. Properties like fluid composition or geography can influence economics indirectly, but they are not the defining classification criteria described here.

Sources

Source 1: Petroleum Geology (AES3820) - TU Delft Open CourseWare

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License	CC BY-NC-SA 4.0
Attribution	Prof. Dr. Stefan M. Luthi, TU Delft
Reference	Lecture 7 - Basin Types and Exploration
Retrieved	2025-12-22
URL	https://ocw.tudelft.nl/courses/petroleum-geology/
Notes	Based on the lecture’s reserves/resources classification concept driven by subsurface knowledge and economic viability.