

ROUND 4

TOSS-UP

18) ENERGY Multiple Choice Which of the following conditions is NOT required to form coal?

W) A stagnant and stable water level

X) Heat and pressure over a long period of time

Y) An equal supply of both vegetation and sediment

Z) A plant accumulation rate equaling land subsidence rate

ANSWER: Y) AN EQUAL SUPPLY OF BOTH VEGETATION AND SEDIMENT

BONUS

18) ENERGY Short Answer Why, aside from making it possible to push more energy through a line in a given unit of time, is power transmitted at higher voltages over longer distances?

ANSWER: TO REDUCE TRANSMISSION LOSS (ACCEPT: TO REDUCE DISSIPATION, TO REDUCE ENERGY LOSS)

TOSS-UP

14) ENERGY Multiple Choice Which of the following sectors in the U.S. uses the most petroleum?

W) Industry

X) Residential

Y) Transportation

Z) Construction

ANSWER: Y) TRANSPORTATION

BONUS

14) ENERGY Multiple Choice Which of the following statements is true about the relationship between a BTU and a kilocalorie?

W) A BTU has about one tenth the energy of a kilocalorie

X) A BTU has about one fourth the energy of a kilocalorie

Y) A BTU has about the same amount of energy as a kilocalorie

Z) A BTU has about 251 times the energy of a kilocalorie

ANSWER: X) A BTU HAS ABOUT ONE FOURTH THE ENERGY OF A KILOCALORIE

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TOSS-UP

18) ENERGY Multiple Choice Rectifiers are used in computers and other appliances to do which of the following?

W) Convert direct current to alternating current

X) Convert alternating current to direct current

Y) Provide a steady amount of power at all times

Z) Reduce the energy consumption of an appliance

ANSWER: X) CONVERT ALTERNATING CURRENT TO DIRECT CURRENT

BONUS

18) ENERGY Short Answer When inductors are present in circuits with alternating currents, what type of power do they consume?

ANSWER: REACTIVE

TOSS-UP

23) PHYSICS Short Answer Three masses are arranged at the vertices of an equilateral triangle and are connected by springs along the edges of the equilateral triangle. How many normal modes for vibration does this mass-spring system have?

ANSWER: THREE

BONUS

23) PHYSICS Short Answer When a charged particle moves in a dielectric medium at a speed greater than the speed of light in that medium, what kind of radiation do the atoms in the medium emit?

ANSWER: CHERENKOV

TOSS-UP

5) BIOLOGY Multiple Choice Which of the following terms is used to describe a structure that is similar in different species of organisms, because the species share a common ancestor that was the source of the structure?

W) Homologous [huh-MOL-uh-guhs]

X) Convergent

Y) Analogous [uh-NAL-uh-guhs]

Z) Divergent

ANSWER: W) HOMOLOGOUS

BONUS

5) BIOLOGY Multiple Choice Which of the following is an example of an ectoparasite [ek-toh-PAR-uh-syt]?

W) Tapeworm

X) Hookworm

Y) Nematode

Z) Louse

ANSWER: Z) LOUSE

TOSS-UP

5) CHEMISTRY Multiple Choice Which of the following is false regarding the reaction $A(g) + B(s) \rightarrow C(s)$? (READ IS: A gaseous plus B solid yields C solid)

W) As pressure decreases, reaction rate decreases

X) As temperature increases, reaction rate increases

Y) As surface area increases, reaction rate decreases

Z) When a catalyst is added, reaction rate increases

ANSWER: Y) AS SURFACE AREA INCREASES, REACTION RATE DECREASES

[NOTE: \rightarrow = YIELDS; (G) = GASEOUS; (S) = SOLID]

BONUS

5) CHEMISTRY Short Answer Calculate the change in energy from a hydrogen atom's ground state to its first excited state in Rydbergs.

ANSWER: +3/4

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TOSS-UP

11) MATH Short Answer What is the surface area of a cube with volume 8?

ANSWER: 24

BONUS

11) MATH Short Answer In terms of x and in standard polynomial form, what is the volume of a right rectangular prism with dimensions $(x + 4)$, $(x + 1)$, and $(x + 6)$?

ANSWER: $x^3 + 11x^2 + 34x + 24$

TOSS-UP

3) CHEMISTRY Short Answer What is the specific chemical term for the minimum pressure required to produce liquefaction of a substance at the critical temperature?

ANSWER: CRITICAL PRESSURE

BONUS

3) CHEMISTRY Short Answer Name the molecule with the formula $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_3$.

ANSWER: PROPYL ETHANOATE (ACCEPT: PROPYL ACETATE)

TOSS-UP

6) EARTH AND SPACE Short Answer What do scientists call the process by which trade winds in the Pacific weaken, allowing warmer water to move toward the west coast of South America?

ANSWER: EL NINO (ACCEPT: EL NINO SOUTHERN OSCILLATION OR ENSO)

BONUS

6) EARTH AND SPACE Multiple Choice Which of the following surfaces has the highest albedo?

W) Fresh snow cover

X) Metallic roof on a skyscraper

Y) Grass

Z) Asphalt

ANSWER: W) FRESH SNOW COVER

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2) PHYSICS Multiple Choice Which of the following best describes why arches and domes are more stable than flat roofed structures?

W) They transmit compressive forces along their length to the ground, uniformly bearing the load of gravity upon the structure

X) Each section is under great tension, using the stronger dimension of the components

Y) Torsional resistance to sideways swaying ensures that such structures are stable, even in high winds

Z) The surface tension of the arched shape allows the building components to be hollowed out, saving weight

ANSWER: W) THEY TRANSMIT COMPRESSIVE FORCES ALONG THEIR LENGTH TO THE

BONUS

2) PHYSICS Short Answer Given a piece of glass with an index refraction of 2, what is the optimal index of refraction, to one decimal place, for an antireflection coating?

ANSWER: 1.4

TOSS-UP

12) ENERGY Multiple Choice Which of the following was NOT an effect of removing sulfur from diesel fuel?

W) It lowered the nitrous oxides and soot emissions

X) It slightly increased gas mileage in diesel engines

Y) It allowed the use of advanced emissions control systems

Z) It reduced the lubricity of the fuel

ANSWER: X) IT SLIGHTLY INCREASED GAS MILEAGE IN DIESEL ENGINES

BONUS

12) ENERGY Multiple Choice Which of the following most accurately describes an advantage of a nuclear fusion reactor over a nuclear fission reactor?

W) A failure of control systems shuts down the fusion reactor

X) Fusion based nuclear plants are much less expensive than fission plants

Y) Fusion reactors operate at a lower temperature than fission reactors

Z) The fuel rods in the fusion reactor can be reused

ANSWER: W) A FAILURE OF CONTROL SYSTEMS SHUTS DOWN THE FUSION REACTOR

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ANSWER: CRITICAL PRESSURE

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16) MATH Multiple Choice Which of the following numbers is NOT prime?

W) 107

X) 109

Y) 111

Z) 113

ANSWER: Y) 111

BONUS

16) MATH Short Answer Todd the Tortoise is 268 years old, while Sammy the Snail is 32 years old. How many years will it take for Todd's age to be exactly 5 times Sammy's age?

ANSWER: 27

TOSS-UP

12) EARTH AND SPACE Multiple Choice Which of the following processes leads directly to the formation of topsoil and subsoil in the A and B horizons?

W) Erosion and deposition

X) Erosion and leaching

Y) Weathering and leaching

Z) Weathering and deposition

ANSWER: Y) WEATHERING AND LEACHING

BONUS

12) EARTH AND SPACE Short Answer Taking the value of the Hubble constant to be 75 kilometers per second per megaparsec, if a galaxy is observed with a recessional velocity of 50 kilometers per second, what is its distance, in kiloparsecs, to two significant figures?

ANSWER: 670

TOSS-UP

21) CHEMISTRY Multiple Choice When hydrogen reacts with 2-butanone, which of the following is the primary product?

W) A primary aldehyde [AL-duh-hyd]

X) A secondary aldehyde

Y) A primary alcohol

Z) A secondary alcohol

ANSWER: Z) A SECONDARY ALCOHOL

BONUS

21) CHEMISTRY Short Answer Arrange the following three choices in order of increasing number of oxygen atoms: 1) one mole of carbon monoxide; 2) one mole of carbon dioxide; 3) one-half mole of calcium carbonate.

ANSWER: 1, 3, 2 (ACCEPT: ONE MOLE OF CARBON MONOXIDE; ONE-HALF MOLE OF CALCIUM CARBONATE; ONE MOLE OF CARBON DIOXIDE)

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TOSS-UP

13) EARTH AND SPACE Multiple Choice Which of the following classes of stars does NOT have radiative zones?

W) A

X) G

Y) M

Z) O

ANSWER: Y) M

BONUS

13) EARTH AND SPACE Multiple Choice Under which of the following circumstances does ocean depth affect ocean wave motion?

W) When ocean depth falls below half the wavelength of a wave

X) When the ocean wave has a period exceeding 20 seconds

Y) When the ocean waves are impacted by tides

Z) When the ocean floor has high relief, regardless of the depth

ANSWER: W) WHEN OCEAN DEPTH FALLS BELOW HALF THE WAVELENGTH OF A WAVE

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