

**Q. 1 – Q. 5 carry one mark each.**

Q.1 The volume of a sphere of diameter 1 unit is \_\_\_\_\_ than the volume of a cube of side 1 unit.  
(A) least (B) less (C) lesser (D) low

Q.2 The unruly crowd demanded that the accused be \_\_\_\_\_ without trial.  
(A) hanged (B) hanging (C) hankering (D) hung

Q.3 Choose the statement(s) where the underlined word is used correctly:

- (i) A prone is a dried plum.
- (ii) He was lying prone on the floor.
- (iii) People who eat a lot of fat are prone to heart disease.

(A) (i) and (iii) only (B) (iii) only (C) (i) and (ii) only (D) (ii) and (iii) only

Q.4 **Fact:** If it rains, then the field is wet.

Read the following statements:

- (i) It rains
- (ii) The field is not wet
- (iii) The field is wet
- (iv) It did not rain

Which one of the options given below is **NOT** logically possible, based on the given fact?

- (A) If (iii), then (iv).
- (B) If (i), then (iii).
- (C) If (i), then (ii).
- (D) If (ii), then (iv).

Q.5 A window is made up of a square portion and an equilateral triangle portion above it. The base of the triangular portion coincides with the upper side of the square. If the perimeter of the window is 6 m, the area of the window in  $\text{m}^2$  is \_\_\_\_\_.

(A) 1.43 (B) 2.06 (C) 2.68 (D) 2.88

**Q. 6 – Q. 10 carry two marks each.**

Q.6 Students taking an exam are divided into two groups, **P** and **Q** such that each group has the same number of students. The performance of each of the students in a test was evaluated out of 200 marks. It was observed that the mean of group **P** was 105, while that of group **Q** was 85. The standard deviation of group **P** was 25, while that of group **Q** was 5. Assuming that the marks were distributed on a normal distribution, which of the following statements will have the highest probability of being **TRUE**?

- (A) No student in group **Q** scored less marks than any student in group **P**.
- (B) No student in group **P** scored less marks than any student in group **Q**.
- (C) Most students of group **Q** scored marks in a narrower range than students in group **P**.
- (D) The median of the marks of group **P** is 100.

Q.7 A smart city integrates all modes of transport, uses clean energy and promotes sustainable use of resources. It also uses technology to ensure safety and security of the city, something which critics argue, will lead to a surveillance state.

Which of the following can be logically inferred from the above paragraph?

- (i) All smart cities encourage the formation of surveillance states.
- (ii) Surveillance is an integral part of a smart city.
- (iii) Sustainability and surveillance go hand in hand in a smart city.
- (iv) There is a perception that smart cities promote surveillance.

- (A) (i) and (iv) only
- (B) (ii) and (iii) only
- (C) (iv) only
- (D) (i) only

Q.8 Find the missing sequence in the letter series.

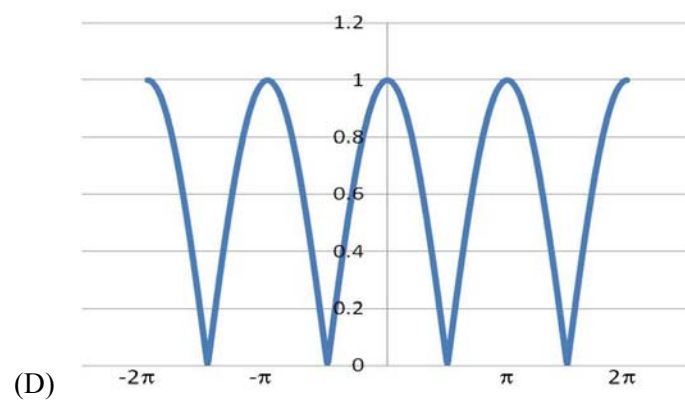
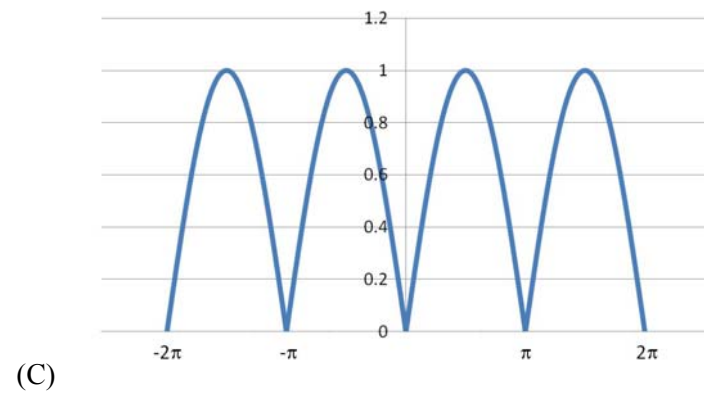
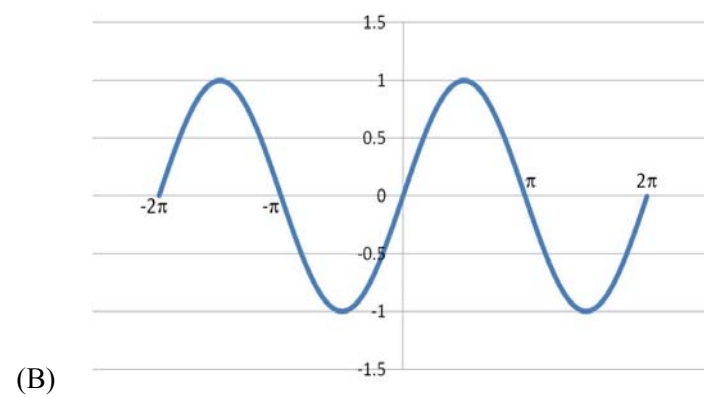
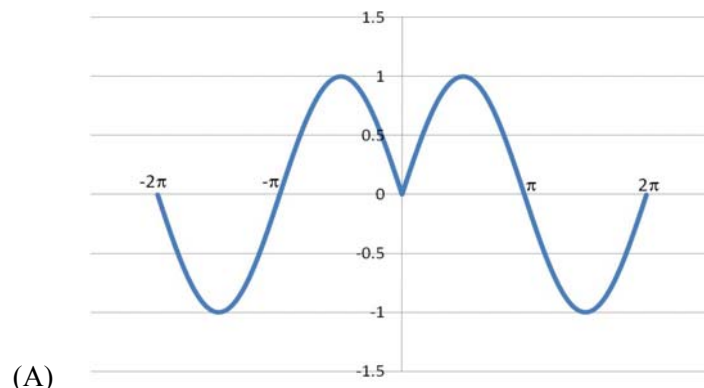
B, FH, LNP, \_\_\_\_.

- (A) SUWY
- (B) TUVW
- (C) TVXZ
- (D) TWXZ

Q.9 The binary operation  $\square$  is defined as  $a \square b = ab + (a+b)$ , where  $a$  and  $b$  are any two real numbers. The value of the identity element of this operation, defined as the number  $x$  such that  $a \square x = a$ , for any  $a$ , is \_\_\_\_.

- (A) 0
- (B) 1
- (C) 2
- (D) 10

- Q.10 Which of the following curves represents the function  $y = \ln(|e^{[\sin(|x|)]}|)$  for  $|x| < 2\pi$ ? Here,  $x$  represents the abscissa and  $y$  represents the ordinate.



**END OF THE QUESTION PAPER**

**Geology: Common Section**

**Q. 1 – Q. 25 carry one mark each.**

- Q.1 The first continental red beds appeared in the \_\_\_\_\_ Eon.  
(A) Proterozoic (B) Archaean (C) Hadean (D) Phanerozoic
- Q.2 Which one of the following is a chronostratigraphic unit?  
(A) Eon (B) Period (C) Era (D) System
- Q.3 \_\_\_\_\_ is a well-sorted sandstone containing up to 75% quartz, with rock fragments in excess of feldspar.  
(A) Arkose (B) Lithic arenite (C) Quartz arenite (D) Feldspathic arenite
- Q.4 International Geomagnetic Reference Field (IGRF) is used in processing regional magnetic data  
(A) to remove the secular variation of the geomagnetic field.  
(B) to remove the diurnal variation of the geomagnetic field.  
(C) to remove the latitudinal variation of the geomagnetic field.  
(D) to remove the terrain effect.
- Q.5 Which one of the following layers of the Earth has the largest volume?  
(A) Upper Mantle (B) Lower Mantle  
(C) Outer core (D) Inner Core
- Q.6 The S-wave shadow zone of the Earth ranges from \_\_\_\_\_.  
(A) 103° to 180° (B) 103° to 160° (C) 103° to 153° (D) 103° to 143°
- Q.7 According to Airy's model, gravity anomalies for fully isostatically compensated topography are characterized by  
(A) negative Bouguer anomaly and positive free-air anomaly.  
(B) positive Bouguer anomaly and negative free-air anomaly.  
(C) zero Bouguer anomaly and negative free-air anomaly.  
(D) positive Bouguer anomaly and zero free-air anomaly.

Q.8 Match the metals (listed in Group I) with the localities of their deposits (listed in Group II).

**Group I**

P. Iron  
Q. Zinc  
R. Gold  
S. Chromium

**Group II**

1. Boula  
2. Gadag  
3. Bellary  
4. Agucha

- (A) P-1; Q-2; R-3; S-4  
(B) P-4; Q-3; R-1; S-2  
(C) P-3; Q-1; R-2; S-4  
(D) P-3; Q-4; R-2; S-1

Q.9 In a region, given the palaeomagnetic inclination ( $I_R$ ), the palaeolatitude ( $\lambda_R$ ) can be calculated using the formula \_\_\_\_\_.

- (A)  $\cos I_R = \sin \lambda_R$   
(B)  $\tan I_R = \tan \lambda_R$   
(C)  $\tan I_R = 2 \tan \lambda_R$   
(D)  $\sin I_R = 2 \cos \lambda_R$

Q.10 Which one of the following parent-daughter systems has the longest half life?

- (A)  $^{147}\text{Sm} \rightarrow ^{143}\text{Nd}$   
(B)  $^{40}\text{K} \rightarrow ^{40}\text{Ar}$   
(C)  $^{87}\text{Rb} \rightarrow ^{87}\text{Sr}$   
(D)  $^{187}\text{Os} \rightarrow ^{187}\text{Re}$

Q.11 For a soil, Liquidity Index = (Natural Water Content – X) / Plasticity Index.  
Here, X is \_\_\_\_\_.

- (A) Shrinkage Limit    (B) Plastic Limit    (C) Liquid Limit    (D) Activity

Q.12 Match the following features (listed in Group I) with the different agents of erosion (listed in Group II).

**Group I**

P. Earth pillar  
Q. Fjord  
R. Pot hole  
S. Yardang

**Group II**

1. River  
2. Wind  
3. Glacier  
4. Rain

- (A) P-2; Q-4; R-1; S-3  
(B) P-2; Q-3; R-4; S-1  
(C) P-4; Q-3; R-1; S-2  
(D) P-3; Q-1; R-4; S-2

Q.13 Match the parameters listed in Group I with the units listed in Group II.

**Group I**

P. Hydraulic conductivity  
Q. Permeability  
R. Viscosity  
S. Hydraulic head

**Group II**

1. Newton sec./m<sup>2</sup>  
2. m/sec.  
3. m  
4. m<sup>2</sup>

- (A) P-2; Q-4; R-1; S-3  
(B) P-1; Q-2; R-4; S-3  
(C) P-2; Q-4; R-3; S-1  
(D) P-4; Q-2; R-1; S-3

Q.14 In digital remote sensing, land-water contrast is best identified in the \_\_\_\_\_ wavelength band.

- (A) ultraviolet                      (B) near IR                      (C) middle IR                      (D) thermal IR

Q.15 Which one of the following rocks has the highest magnetic susceptibility value?

- (A) Quartzite    (B) Limestone  
(C) Gabbro    (D) Shale

Q.16 In which one of the following electromagnetic methods is the rate of change of secondary field recorded?

- (A) Very Low Frequency method  
(B) Time-domain EM method  
(C) Magnetotelluric method  
(D) TURAM method

Q.17 A Wenner array with 60 m spacing between current electrodes is placed over an inhomogeneous ground. If the measured potential difference and current flow in subsurface are 10 mV and 5 mA, respectively, the apparent resistivity will be \_\_\_\_\_  $\Omega\text{m}$ . (Use  $\pi = 3.14$ )

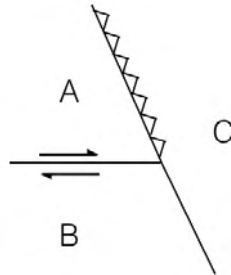
Q.18 Which one of the following geophysical methods is most suitable for the exploration of a horizontally stratified graphite deposit at a depth of 50 m?

- (A) Gravity                      (B) Magnetic                      (C) Radiometric                      (D) Electromagnetic

Q.19 Which one of the following logging techniques is most suitable to detect a shale layer sandwiched between two sandstone layers?

- (A) Neutron-Gamma    (B) Gamma-Gamma    (C) Natural Gamma    (D) Sonic

- Q.20 The following schematic diagram is a plan view of three oceanic plates forming a stable triple junction on a flat earth. Plate A subducts below Plate C normal to the plate boundary, while the contact between Plates A and B is a transform fault, as indicated. The boundary between Plates B and C is a \_\_\_\_\_.



- (A) mid-oceanic ridge  
(B) subduction zone  
(C) sinistral transform fault  
(D) dextral transform fault
- Q.21 In Gondwanaland reconstructions, much of the present west coast of India is placed adjacent to \_\_\_\_\_.
- (A) South America  
(B) Madagascar  
(C) Antarctica  
(D) Australia
- Q.22 Two vertically dipping limbs of a fold have perpendicular strikes. The fold can be classified as \_\_\_\_\_.
- (A) an antiformal fold  
(B) a synformal fold  
(C) a vertical fold  
(D) a recumbent fold
- Q.23 Match the crystal forms (listed in Group I) with their corresponding number of faces (listed in Group II).

**Group I**

P. Cube  
Q. Tetrahedron  
R. Pinacoid  
S. Dodecahedron

**Group II**

1. Two  
2. Four  
3. Six  
4. Twelve

- (A) P-4; Q-2; R-3; S-1  
(B) P-3; Q-2; R-1; S-4  
(C) P-3; Q-4; R-1; S-2  
(D) P-1; Q-3; R-4; S-2

Q.24 Match the rocks in Group I with their essential mineral assemblages in Group II.

**Group I**

P. Granodiorite  
Q. Harzburgite  
R. Gabbro  
S. Diorite

**Group II**

1. Hornblende-plagioclase  
2. Plagioclase-quartz  
3. Olivine-orthopyroxene  
4. Clinopyroxene-plagioclase

- (A) P-2; Q-3; R-4; S-1  
(B) P-3; Q-4; R-1; S-2  
(C) P-4; Q-1; R-3; S-2  
(D) P-1; Q-3; R-2; S-4

Q.25 Which one of the following mineral assemblages is stable under eclogite facies conditions?

- (A) Garnet-orthopyroxene-clinopyroxene-plagioclase  
(B) Garnet-clinopyroxene-plagioclase-kyanite  
(C) Garnet-orthopyroxene-hornblende-plagioclase  
(D) Garnet-clinopyroxene-kyanite-quartz



## Geology (Section-1): Optional Section

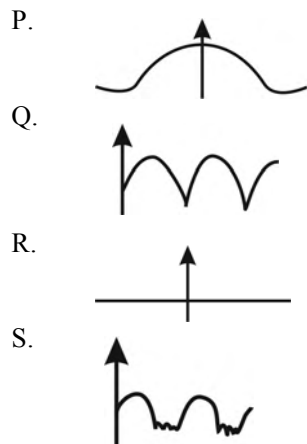
**Q. 26 – Q. 55 carry two marks each.**

Q.26 Select the CORRECT statement from the following options.

- (A) Hogback is an isolated tableland with sides that are usually steep.
- (B) Crevasses are deposits of glacial origin.
- (C) Loess comprises pebbles of rocks or minerals with some plane faces formed by wind abrasion.
- (D) Loamy soil is a mixture of sand and clay.

Q.27 Match the following patterns (listed in Group I) with their appropriate Cephalopod sutures (listed in Group II). Arrow gives the direction of aperture.

### Group I



### Group II

- 1. Ceratitic
- 2. Nautilitic
- 3. Goniatitic
- 4. Orthoceratitic

- (A) P-2; Q-3; R-4; S-1
- (B) P-2; Q-1; R-4; S-3
- (C) P-4; Q-3; R-1; S-2
- (D) P-3; Q-1; R-4; S-2

Q.28 Match the following test composition (listed in Group I) with the microfossil taxa (listed in Group II)

### Group I

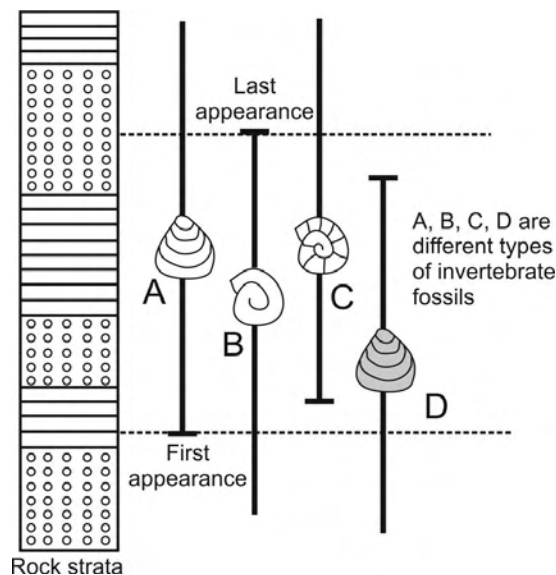
- P. Organic-walled
- Q. Siliceous
- R. Phosphatic
- S. Calcareous

### Group II

- 1. Radiolaria
- 2. Conodont
- 3. Foraminifera
- 4. Acritarch

- (A) P-4; Q-3; R-1; S-2
- (B) P-2; Q-1; R-4; S-3
- (C) P-4; Q-1; R-2; S-3
- (D) P-3; Q-4; R-1; S-2

- Q.29 Which one of the following statements is CORRECT?
- (A) Movement of the shoreline seaward is transgression.  
 (B) No movement of the shoreline is transgression.  
 (C) Movement of the shoreline seaward as a result of sea-level fall is forced regression.  
 (D) Movement of the shoreline landward is regression.
- Q.30 Mud-supported limestone containing greater than 10% allochems is called \_\_\_\_\_.
- (A) Packstone  
 (B) Wackestone  
 (C) Grainstone  
 (D) Mudstone
- Q.31 At a depth of 500 m, the determined in-situ stresses in a rock mass are as follows: maximum horizontal stress = 20 MPa, minimum horizontal stress = 8 MPa, vertical stress = 13.5 MPa. Assume principal stress directions are vertical and horizontal. If this compressive stress field leads to faulting, the plausible fault would be a
- (A) normal fault      (B) reverse fault      (C) strike-slip fault      (D) detachment fault
- Q.32 The following figure is a litholog showing various fossils found in the rock-strata. Identify the biozone (Note: The lines denote partial ranges of the fossils given in the figure).



- (A) Assemblage Zone      (B) Taxon Range Zone  
 (C) Consecutive Range Zone      (D) Acme Zone
- Q.33 Which one of the following stratigraphic successions is in the correct chronological order (from older to younger)?
- (A) Iron Ore Group, Older Metamorphic Group, Kolhan Group  
 (B) Chitradurga Group, Sargur Group, Bababudan Group  
 (C) Jharol Group, Alwar Group, Ajabgarh Group  
 (D) Chitravati Group, Papaghni Group, Kurnool Group

- Q.34 Water content and total porosity of a soil are given as 10% and 25%, respectively. Specific gravity of soil particles is 2.5. The volume of water that should be added to  $100 \text{ m}^3$  of this soil for full saturation is \_\_\_\_\_  $\text{m}^3$ .
- Q.35 In a zone of superposed folding, poles to bedding show a great circle distribution. For such a case, the fold axes related to the first generation of folding will
- (A) also be distributed along the same great circle girdle.  
(B) be distributed on a great circle girdle orthogonal to the bedding plane girdle.  
(C) show a cluster around the pole to the bedding plane girdle.  
(D) show a small circle distribution around the pole to the bedding plane girdle.
- Q.36 For horizontal flow in a saturated aquifer, the product of hydraulic conductivity and thickness is equal to \_\_\_\_\_
- (A) specific yield. (B) transmissivity.  
(C) coefficient of storage. (D) seepage force.
- Q.37 If a rectangle is deformed into a parallelogram of equal area by simple shear deformation (with shear strain  $\gamma$ ) parallel to the abscissa, the displacement matrix is \_\_\_\_\_.
- (A)  $\begin{pmatrix} \gamma & 0 \\ 1 & 0 \end{pmatrix}$  (B)  $\begin{pmatrix} 0 & 1 \\ \gamma & 0 \end{pmatrix}$   
(C)  $\begin{pmatrix} 0 & \gamma \\ 1 & 0 \end{pmatrix}$  (D)  $\begin{pmatrix} 1 & \gamma \\ 0 & 1 \end{pmatrix}$
- Q.38 If tangent Young's modulus (at 50% of the uniaxial compressive strength) and modulus ratio of a rock are given as 60 GPa and 500, respectively, the uniaxial compressive strength of the rock is \_\_\_\_\_ MPa.
- Q.39 In a rock sample, the values of  $(^{87}\text{Sr}/^{86}\text{Sr})_{\text{present}}$  and  $(^{87}\text{Rb}/^{86}\text{Sr})_{\text{present}}$  are 0.7125 and 0.2, respectively. The decay constant ( $\lambda$ ) of  $^{87}\text{Rb}$  is  $1.42 \times 10^{-11} \text{ year}^{-1}$ , and time before present (t) is 1000 million years. The value of the initial ratio  $(^{87}\text{Sr}/^{86}\text{Sr})_0$  is \_\_\_\_\_.
- Q.40 The  $\Delta G^0$  of a reaction  $2 \text{ Fe}_3\text{O}_4 + 0.5 \text{ O}_2 = 3 \text{ Fe}_2\text{O}_3$  at  $300^\circ\text{C}$  and 500 bars is  $-40.657$  kilo calories. The value of the logarithm of oxygen ( $\log f_{\text{O}_2}$ ) at that temperature and pressure is \_\_\_\_\_.

- Q.41 Match the types of mineralization in Group-I with their appropriate tectonic settings in Group-II. (VMS stands for volcanogenic massive sulfide)

**Group I**

P. Cyprus-type VMS  
Q. Kuroko-type VMS  
R. Porphyry copper  
S. Diamond in Kimberlite

**Group II**

1. Island Arc  
2. Continental Arc  
3. Intraplate  
4. Mid Oceanic Ridge

- (A) P-1; Q-2; R-3; S-4  
(B) P-4; Q-1; R-2; S-3  
(C) P-4; Q-2; R-3; S-1  
(D) P-2; Q-1; R-4; S-3

- Q.42 Clay minerals and Fe-oxide minerals, products of hydrothermal alteration and supergene oxidation, are good indicators of mineralization. Choose the CORRECT Thematic Mapper (TM) band ratio images for detection of these minerals.

- (A) band ratio 5/7 for clay and 3/1 for Fe-oxide minerals  
(B) band ratio 3/1 for clay and 5/7 for Fe-oxide minerals  
(C) band ratio 3/7 for clay and 5/1 for Fe-oxide minerals  
(D) band ratio 5/1 for clay and 3/7 for Fe-oxide minerals

- Q.43 The age range of reservoir rock in Cambay oil field is \_\_\_\_\_.

- (A) 34 – 15 million years  
(B) 56 – 34 million years  
(C) 65 – 56 million years  
(D) 100 – 65 million years

- Q.44 Which one of the following statements is CORRECT in all respects for the amphibole glaucophane,  $\text{Na}_2\text{Mg}_3\text{Al}_2\text{Si}_8\text{O}_{22}(\text{OH})_2$ ?

- (A) Na is in the M4-site, Al is in octahedral coordination and Si is in tetrahedral coordination.  
(B) Na is in the A-site, both Al and Si are in tetrahedral coordination.  
(C) Na is in the M4-site, Al is partly in octahedral and partly in tetrahedral coordination, Si is in tetrahedral coordination.  
(D) Na is in the A-site, both Al and Si are in octahedral coordination.

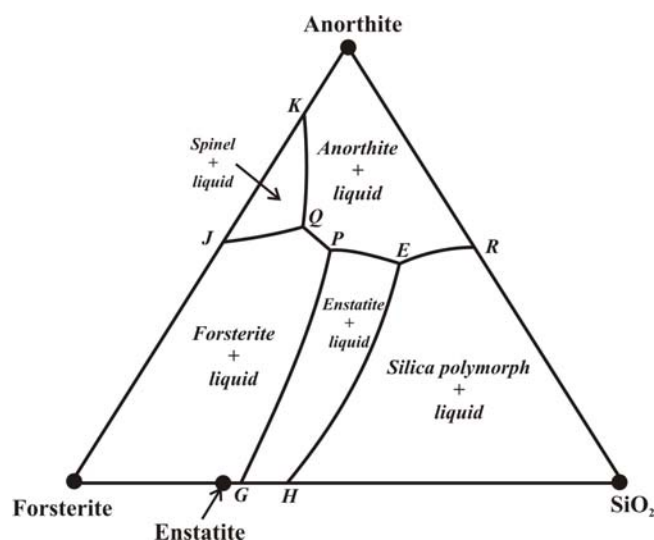
- Q.45 Choose the CORRECT modern analog of Besshi type VMS (volcanogenic massive sulfide) deposits (all these are ocean floor rift zones).

- (A) 21°N East Pacific Rise (EPR)  
(B) Guaymas Basin  
(C) Lau Basin  
(D) Trans Atlantic Geotraverse (TAG)

- Q.46 Which one of the following options is arranged in the CORRECT increasing order of Vicker's micro-hardness?

- (A) galena < chalcopyrite < sphalerite < magnetite  
(B) sphalerite < galena < magnetite < chalcopyrite  
(C) galena < magnetite < chalcopyrite < sphalerite  
(D) sphalerite < magnetite < chalcopyrite < galena

- Q.47 The ( $^{18}\text{O} / ^{16}\text{O}$ ) of a quartz sample yields a value of 0.0019. The value of  $\delta^{18}\text{O}$  of the quartz sample is \_\_\_\_\_. (Use the value of the ratio in VSMOW as 0.002005.)
- Q.48 The ionic strength of a solution having 0.5 molal NaCl and 0.25 molal  $\text{CaCl}_2$  is \_\_\_\_\_ molal.
- Q.49 During which stage of coalification is most of the methane gas generated?  
 (A) Lignite (B) Peat (C) Bituminous (D) Anthracite
- Q.50 The figure shows the liquidus phase relations in the forsterite-anorthite-silica system at 1 bar pressure. From the options below, identify the CORRECT reaction that takes place at the isobaric invariant point P.



- (A) Liquid (at P) = Forsterite + Anorthite + Enstatite  
 (B) Liquid (at P) + Forsterite = Anorthite + Enstatite  
 (C) Liquid (at P) + Forsterite + Anorthite = Enstatite  
 (D) Liquid (at P) = Forsterite + Anorthite + Silica polymorph
- Q.51 A garnet peridotite contains 2400 ppm of nickel. After 20% partial melting, a basaltic melt is generated, leaving a residue comprising 60% olivine, 30% orthopyroxene and 10% clinopyroxene. Given the  $K_D^{\text{Ni}}$  (olivine) = 10,  $K_D^{\text{Ni}}$  (orthopyroxene) = 4 and  $K_D^{\text{Ni}}$  (clinopyroxene) = 2, the nickel concentration in the melt, assuming equilibrium batch melting, is \_\_\_\_\_ ppm.
- Q.52 Which one of the following mineral assemblages is stable in a pelitic rock in the greenschist facies?  
 (A) Albite-epidote-actinolite-chlorite-quartz  
 (B) Muscovite-biotite-garnet-quartz  
 (C) Tremolite-talc-calcite-quartz  
 (D) Muscovite-biotite-garnet-sillimanite-quartz

- Q.53 Match the co-existing mineral pairs in Group I with the diagnostic metamorphic conditions they are associated with in Group II.

**Group I**

P. Talc-phengite  
Q. Cordierite-andalusite  
R. Spinel-quartz  
S. Laumontite-wairakite

**Group II**

1. Ultrahigh temperature  
2. Very low temperature  
3. Ultrahigh pressure  
4. Low pressure, high temperature

- (A) P-2; Q-3; R-1; S-4  
(B) P-3; Q-4; R-1; S-2  
(C) P-4; Q-1; R-2; S-3  
(D) P-3; Q-2; R-4; S-1

- Q.54 Out of the following symmetry elements, which one is present in all classes of the cubic system?

- (A) Four axes of 3-fold symmetry  
(B) Three axes of 4-fold symmetry  
(C) Six axes of 2-fold symmetry  
(D) Three mirror planes

- Q.55 Match the minerals in Group-I with their optical properties in Group-II.

**Group I**

P. Calcite  
Q. Nepheline  
R. Apatite  
S. Quartz

**Group II**

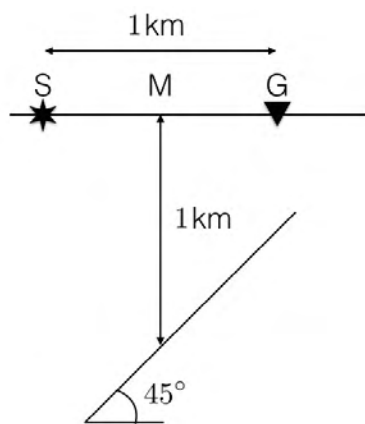
1. Uniaxial negative, low birefringence, high relief  
2. Uniaxial negative, high birefringence, moderately high relief  
3. Uniaxial positive, low birefringence, low relief  
4. Uniaxial negative, low birefringence, low relief

- (A) P-4; Q-2; R-1; S-3  
(B) P-3; Q-2; R-4; S-1  
(C) P-2; Q-4; R-1; S-3  
(D) P-1; Q-3; R-2; S-4

## Section-2 (Geophysics): Optional Section

**Q. 26 – Q. 55 carry two marks each.**

- Q.26 Depth migration is applied to a stacked seismic section. Compared to the stacked section, dipping events in the migrated section
- (A) have a steeper slope and move updip.  
 (B) remain unchanged.  
 (C) have a gentler slope and move downdip.  
 (D) have a steeper slope and move downdip.
- Q.27 A monochromatic elastic wave of frequency 20 Hz propagates in a medium with average velocity 3 km/s. For zero offset reflection from horizontal reflectors, the thickness of the vertical first Fresnel zone is \_\_\_\_\_ m.
- Q.28 The following figure shows a seismic reflection experiment above a reflector that dips  $45^\circ$ . The P-wave velocity in the medium is constant and equal to 2 km/s. The source is kept at location 'S' and the receiver is kept at location 'G'. The midpoint between S and G is denoted by 'M' and the depth to the reflector from 'M' is 1 km. The traveltime of the primary reflected arrival recorded at the receiver is equal to \_\_\_\_\_ seconds.



- Q.29 Given a seismic wavelet  $w = \{ 6, -4, -2 \}$  and reflectivity series  $r = \{ 0, 1, 0 \}$ , the corresponding seismic trace is \_\_\_\_\_.
- (A)  $\{ 0, -4, 0, 0, 0 \}$     (B)  $\{ 0, -2, -4, 6, 0 \}$     (C)  $\{ 0, 6, 0, 0, 0 \}$     (D)  $\{ 0, 6, -4, -2, 0 \}$

- Q.30 The time period of the signal  $s(t) = \sin\left(\frac{\pi}{3}t\right) + \cos\left(\frac{\pi}{2}t\right)$  is \_\_\_\_\_ seconds.
- Q.31 **Assertion (a):** The inverse of a minimum phase wavelet is causal and stable.  
**Reason (r):** The Z-transform of a minimum phase wavelet has all its zeros outside the unit circle.  
 (A) (a) is true but (r) is false  
 (B) (a) is false but (r) is true  
 (C) Both (a) and (r) are true and (r) is the correct reason for (a)  
 (D) Both (a) and (r) are true and (r) is not the correct reason for (a)
- Q.32 The value of free-air correction (assuming sea level as datum plane) at an elevation of 150 m is \_\_\_\_\_ mGal.
- Q.33 A spherical cavity of radius 8 m has its centre 15 m below the surface. If the cavity is full of sediments of density  $1.5 \times 10^3 \text{ kg/m}^3$  and is in a rock body of density  $2.4 \times 10^3 \text{ kg/m}^3$ , the maximum value of its gravity anomaly is \_\_\_\_\_ mGal.

- Q.34 Match the items (listed in Group I) with the corresponding corrections applied for reduction of marine gravity data (listed in Group II).

**Group I**

- P. Effect of rotating homogeneous ellipsoidal Earth  
 Q. Effect of deficit mass from mean sea level to average depth to ocean floor  
 R. Effect of relative motion of ship with respect to revolving Earth  
 S. Effect of elastic creep of gravimeter spring system and Earth tides

**Group II**

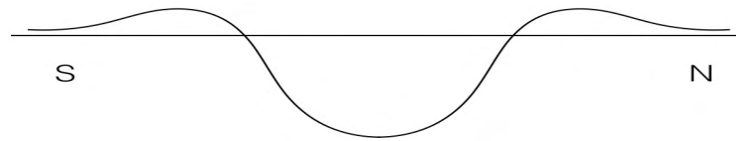
1. Drift correction  
 2. Latitude correction  
 3. Bouguer correction  
 4. Eotvos correction

- (A) P-4; Q-3; R-1; S-2  
 (B) P-2; Q-3; R-4; S-1  
 (C) P-4; Q-1; R-2; S-3  
 (D) P-3; Q-1; R-4; S-2

- Q.35 Which one of the following Natural Remanent Magnetization (NRM) gives a primary, stable magnetization for igneous rocks?  
 (A) Depositional Remanent Magnetization (DRM)  
 (B) Thermo Remanent Magnetization (TRM)  
 (C) Chemical Remanent Magnetization (CRM)  
 (D) Isothermal Remanent Magnetization (IRM)



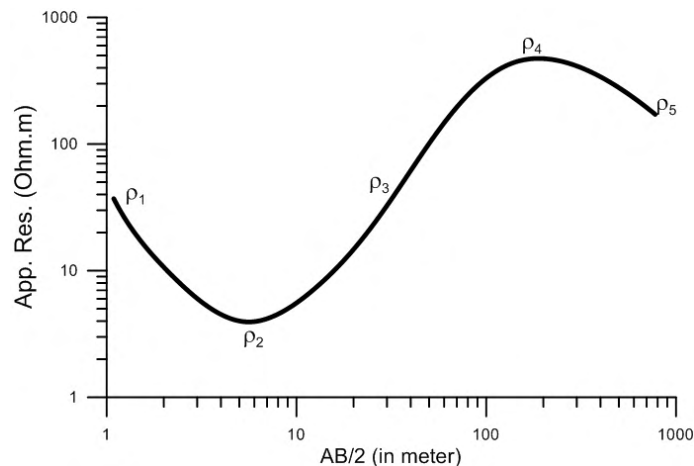
- Q.36 The following figure shows the total magnetic field intensity anomaly above a spherical body polarized by the present day geomagnetic field. From among the options below, identify the region in which such an anomaly could be observed.



- (A) Equator                      (B) Latitude  $27^\circ$                       (C) North pole                      (D) South pole
- Q.37 Which one of the following is the ray path for the P-wave that converts to S-wave while passing through the solid inner core?
- (A) PKiKP                      (B) PKIKP                      (C) pPcP                      (D) PKJKP
- Q.38 Which one of the following statements is CORRECT for the stress drop ( $\Delta\sigma$ ) of an earthquake?
- (A) Large slip on a small fault will cause more stress drop.  
 (B) Small slip on a large fault will cause more stress drop.  
 (C) Stress drop is inversely proportional to the slip of the fault.  
 (D) Stress is directly proportional to the rupture dimension.
- Q.39 The energy released by an earthquake of magnitude 7 is \_\_\_\_\_ times the energy released by an earthquake of magnitude 4 (use Kanamori's formula).
- Q.40 In resistivity logging using a 'Normal device', the distance between electrodes A and M is 0.40 m. If 20 mA current generates 10 mV potential, the apparent resistivity of the layer between the electrodes is \_\_\_\_\_  $\Omega\text{m}$ . (Use  $\pi = 3.14$ )
- Q.41 A cylindrical sandstone core sample of diameter 0.02 m and length 0.04 m is fully saturated with brine solution of resistivity 0.5  $\Omega\text{m}$ . The resistance of the saturated sample measured in the laboratory is 500  $\Omega$ . The formation factor of the sample is \_\_\_\_\_. (Use  $\pi = 3.14$ )
- Q.42 A Schlumberger array with current electrode separation 50 m and potential electrode separation 5 m is placed over an inhomogeneous medium. If the measured potential difference is 50 mV and the computed apparent resistivity is 100  $\Omega\text{m}$ , then the magnitude of current passing through the subsurface is \_\_\_\_\_ mA. (Use  $\pi = 3.14$ )

- Q.43 Two horizontal layers have resistivities and thicknesses of  $10 \Omega\text{m}$ ,  $5\text{m}$  and  $50 \Omega\text{m}$ ,  $10\text{m}$ , respectively. If the two layers are reduced to a single layer, then the coefficient of electrical anisotropy will be \_\_\_\_\_.

- Q.44 The five-layer Schlumberger resistivity sounding curve given below represents \_\_\_\_\_.



- (A) HAQ-type      (B) HKQ-type      (C) HKH-type      (D) HAK-type

- Q.45 How are the numerical values of the real and imaginary components of the impedance tensor ( $Z$ ) in Magnetotelluric (MT) method related over a homogeneous half-space?

- (A) Imaginary component is one third of the real component.  
 (B) Imaginary component is half of the real component.  
 (C) Imaginary component is equal to the real component.  
 (D) Imaginary component is twice that of the real component.

- Q.46 The strike of a 2-D geological structure is in Y-direction. From the following options, choose the field components required to compute the apparent resistivity in E-Polarization mode for plane wave electromagnetic signals.

- (A)  $E_x$  and  $H_x$       (B)  $E_x$  and  $H_y$       (C)  $E_y$  and  $H_y$       (D)  $E_y$  and  $H_x$

- Q.47 Dip angle electromagnetic methods are suitable to delineate

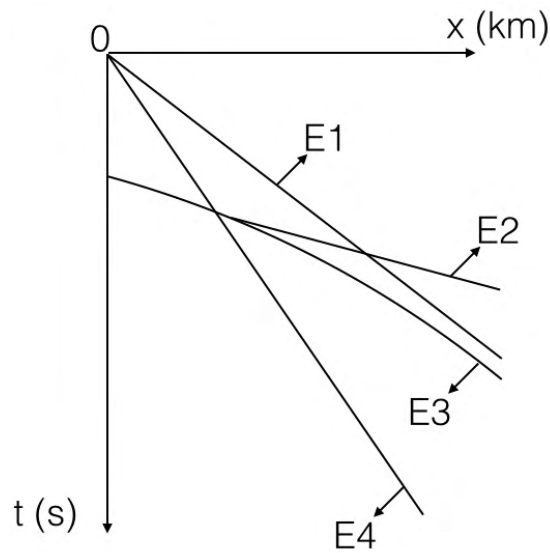
- (A) both vertical and horizontal conductors.  
 (B) horizontal conductors only.  
 (C) vertical and dipping conductors.  
 (D) horizontal and dipping conductors.

- Q.48 Which one of the following equations is CORRECT for a time invariant field?

- (A)  $\nabla \times H = 0$       (B)  $\nabla \times H = \frac{\partial D}{\partial t}$   
 (C)  $\nabla \times H = J + \frac{\partial D}{\partial t}$       (D)  $\nabla \times H = J$

- Q.49 The solution to the Laplace equation  $\nabla^2 V = 0$  in a spherical coordinate system with spherical symmetry is \_\_\_\_\_.  
A and B are constants and r is the distance of the observation point from the source.
- (A)  $V = -\frac{A}{r^2} + B$  (B)  $V = -\frac{A}{r} + B$   
(C)  $V = -A \ln(r) + B$  (D)  $V = -Ar + B$
- Q.50 If J is the Jacobian matrix in a geophysical inverse problem, then the addition of the regularization parameter,  $\lambda$ , as  $(J^T J + \lambda I)$ , in finding the inverse leads to
- (A) unstable solution with increased parameter resolution  
(B) stable solution with increased parameter resolution  
(C) unstable solution with decreased parameters resolution  
(D) stable solution with decreased parameter resolution
- Q.51 The Singular Value Decomposition of a square nonsingular matrix J is given by  $J = U\lambda V^T$ . The inverse of matrix J will be
- (A)  $J^{-1} = U\lambda^{-1}V^T$  (B)  $J^{-1} = V\lambda^{-1}U^T$  (C)  $J^{-1} = U^T\lambda^{-1}V^T$  (D)  $J^{-1} = U\lambda^{-1}V$
- Q.52 The fraction of a radioactive nuclide remaining after 10 half-lives is closest to
- (A) 0.1 (B) 0.01 (C) 0.001 (D) 0.0001
- Q.53 The correct relationship between the residual amount P of the parent radionuclide and amount D of the daughter product in a radioactive decay is
- (A)  $D = P(e^{\lambda t} - 1)$  (B)  $D = P(1 - e^{\lambda t})$   
(C)  $D = \frac{P}{(e^{\lambda t} - 1)}$  (D)  $D = \frac{P}{(1 - e^{\lambda t})}$
- Q.54 Which one of the following resistivity sounding curves exhibits both 'Equivalence' and 'Suppression' type ambiguities in interpretation of data?
- (A) HA-type (B) AH-type (C) HK-type (D) KH-type

- Q.55 For land seismic data acquisition, the following figure is a schematic plot of arrival times of seismic waves recorded at several detectors placed along the x-axis. The shot is placed at the origin ( $x=0$ ).



Match the events labeled in the figure (listed in Group I) with their corresponding types (listed in Group II)

**Group I**

- P. E1  
Q. E2  
R. E3  
S. E4

**Group II**

1. Ground roll  
2. Direct arrival  
3. Refracted energy  
4. Primary reflection

- (A) P-3; Q-1; R-2; S-4  
(B) P-2; Q-3; R-4; S-1  
(C) P-1; Q-4; R-3; S-2  
(D) P-4; Q-2; R-1; S-3

**END OF THE QUESTION PAPER**

Q. No	Type	Section	Key	Marks
1	MCQ	GA	B	1
2	MCQ	GA	A	1
3	MCQ	GA	D	1
4	MCQ	GA	C	1
5	MCQ	GA	B	1
6	MCQ	GA	C	2
7	MCQ	GA	C	2
8	MCQ	GA	C	2
9	MCQ	GA	A	2
10	MCQ	GA	C	2
1	MCQ	GG-C	A	1
2	MCQ	GG-C	D	1
3	MCQ	GG-C	B	1
4	MCQ	GG-C	C	1
5	MCQ	GG-C	B	1
6	MCQ	GG-C	A	1
7	MCQ	GG-C	A	1
8	MCQ	GG-C	D	1
9	MCQ	GG-C	C	1
10	MCQ	GG-C	A	1
11	MCQ	GG-C	B	1
12	MCQ	GG-C	C	1
13	MCQ	GG-C	A	1
14	MCQ	GG-C	B	1
15	MCQ	GG-C	C	1
16	MCQ	GG-C	B	1
17	NAT	GG-C	250 : 252	1
18	MCQ	GG-C	D	1
19	MCQ	GG-C	C	1
20	MCQ	GG-C	B ; D	1
21	MCQ	GG-C	B	1
22	MCQ	GG-C	C	1
23	MCQ	GG-C	B	1
24	MCQ	GG-C	A	1
25	MCQ	GG-C	D	1
26	MCQ	GG-1	D	2
27	MCQ	GG-1	A	2
28	MCQ	GG-1	C	2
29	MCQ	GG-1	C	2
30	MCQ	GG-1	B	2
31	MCQ	GG-1	C	2
32	MCQ	GG-1	A	2
33	MCQ	GG-1	C	2
34	NAT	GG-1	6.25 : 6.25	2
35	MCQ	GG-1	C	2
36	MCQ	GG-1	B	2
37	MCQ	GG-1	D	2
38	NAT	GG-1	120 : 120	2
39	NAT	GG-1	0.7096 : 0.7097	2

40	NAT	GG-1	-31.1 : -30.0	2
41	MCQ	GG-1	B	2
42	MCQ	GG-1	A	2
43	MCQ	GG-1	B	2
44	MCQ	GG-1	A	2
45	MCQ	GG-1	B	2
46	MCQ	GG-1	A	2
47	NAT	GG-1	-52.5 : -52.3	2
48	NAT	GG-1	1.25 : 1.25	2
49	MCQ	GG-1	C	2
50	MCQ	GG-1	B	2
51	NAT	GG-1	390 : 395	2
52	MCQ	GG-1	B	2
53	MCQ	GG-1	B	2
54	MCQ	GG-1	A	2
55	MCQ	GG-1	C	2
26	MCQ	GP-1	A	2
27	NAT	GP-1	37.0 : 38.0	2
28	NAT	GP-1	0.7 : 0.9	2
29	MCQ	GP-1	D	2
30	NAT	GP-1	12.0 : 12.0	2
31	MCQ	GP-1	A ; C	2
32	NAT	GP-1	46.2 : 46.3	2
33	NAT	GP-1	0.05 : 0.06 ; -0.06 : -0.05	2
34	MCQ	GP-1	B	2
35	MCQ	GP-1	B	2
36	MCQ	GP-1	A	2
37	MCQ	GP-1	D	2
38	MCQ	GP-1	A	2
39	NAT	GP-1	27000 : 32770	2
40	NAT	GP-1	2.5 : 2.6	2
41	NAT	GP-1	7.8 : 7.9	2
42	NAT	GP-1	190 : 200	2
43	NAT	GP-1	1.30 : 1.32	2
44	MCQ	GP-1	D	2
45	MCQ	GP-1	C	2
46	MCQ	GP-1	D	2
47	MCQ	GP-1	C	2
48	MCQ	GP-1	D	2
49	MCQ	GP-1	B	2
50	MCQ	GP-1	D	2
51	MCQ	GP-1	B	2
52	MCQ	GP-1	C	2
53	MCQ	GP-1	A	2
54	MCQ	GP-1	A	2
55	MCQ	GP-1	B	2