Q. 1 – Q. 5 carry one mark each.

Q.1 "When she fell down the _____, she received many _____ but little help."

The words that best fill the blanks in the above sentence are

(A) stairs, stares
(B) stairs, stairs
(C) stares, stairs
(D) stares, stares

Q.2 "In spite of being warned repeatedly, he failed to correct his _____ behaviour."

The word that best fills the blank in the above sentence is

(A) rational (B) reasonable (C) errant (D) good

Q.3 For $0 \leq x \leq 2\pi$, $\sin x$ and $\cos x$ are both decreasing functions in the interval _____.

(A) $\left(0, \frac{\pi}{2}\right)$ (B) $\left(\frac{\pi}{2}, \pi\right)$ (C) $\left(\pi, \frac{3\pi}{2}\right)$ (D) $\left(\frac{3\pi}{2}, 2\pi\right)$

Q.4 The area of an equilateral triangle is $\sqrt{3}$. What is the perimeter of the triangle?

(A) 2 (B) 4 (C) 6 (D) 8

Q.5 Arrange the following three-dimensional objects in the descending order of their volumes:

(i) A cuboid with dimensions 10 cm, 8 cm and 6 cm
(ii) A cube of side 8 cm
(iii) A cylinder with base radius 7 cm and height 7 cm
(iv) A sphere of radius 7 cm

(A) (i), (ii), (iii), (iv)
(B) (ii), (i), (iv), (iii)
(C) (iii), (ii), (i), (iv)
(D) (iv), (iii), (ii), (i)

Q. 6 – Q. 10 carry two marks each.

Q.6 An automobile travels from city A to city B and returns to city A by the same route. The speed of the vehicle during the onward and return journeys were constant at 60 km/h and 90 km/h, respectively. What is the average speed in km/h for the entire journey?

(A) 72 (B) 73 (C) 74 (D) 75

Q.7 A set of 4 parallel lines intersect with another set of 5 parallel lines. How many parallelograms are formed?

(A) 20 (B) 48 (C) 60 (D) 72

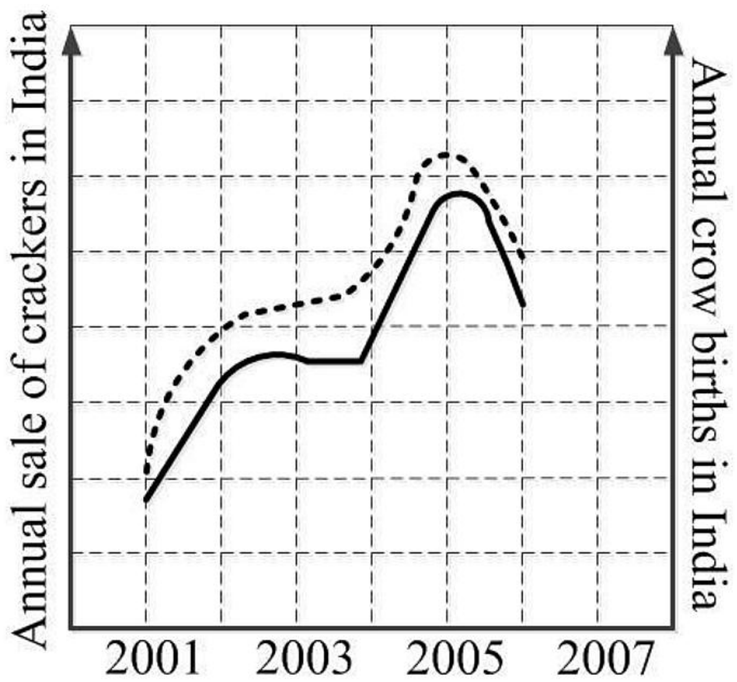
Q.8 To pass a test, a candidate needs to answer at least 2 out of 3 questions correctly. A total of 6,30,000 candidates appeared for the test. Question A was correctly answered by 3,30,000 candidates. Question B was answered correctly by 2,50,000 candidates. Question C was answered correctly by 2,60,000 candidates. Both questions A and B were answered correctly by 1,00,000 candidates. Both questions B and C were answered correctly by 90,000 candidates. Both questions A and C were answered correctly by 80,000 candidates. If the number of students answering all questions correctly is the same as the number answering none, how many candidates failed to clear the test?

(A) 30,000 (B) 2,70,000 (C) 3,90,000 (D) 4,20,000

Q.9 If $x^2 + x - 1 = 0$ what is the value of $x^4 + \frac{1}{x^4}$?

(A) 1 (B) 5 (C) 7 (D) 9

Q.10 In a detailed study of annual crow births in India, it was found that there was relatively no growth during the period 2002 to 2004 and a sudden spike from 2004 to 2005. In another unrelated study, it was found that the revenue from cracker sales in India which remained fairly flat from 2002 to 2004, saw a sudden spike in 2005 before declining again in 2006. The solid line in the graph below refers to annual sale of crackers and the dashed line refers to the annual crow births in India. Choose the most appropriate inference from the above data.



(A) There is a strong correlation between crow birth and cracker sales.
(B) Cracker usage increases crow birth rate.
(C) If cracker sale declines, crow birth will decline.
(D) Increased birth rate of crows will cause an increase in the sale of crackers.

END OF THE QUESTION PAPER

PART A: COMPULSORY SECTION FOR ALL CANDIDATES

Q. 1 – Q. 25 carry one mark each.

Q.1 Which one of the following periods has the longest time duration?

(A) Ordovician (B) Cretaceous (C) Jurassic (D) Silurian

Q.2 A siliciclastic sedimentary rock consisting predominantly of the same type of gravel-sized clasts is called

(A) Polymict conglomerate.
(B) Arkose.
(C) Oligomict conglomerate.
(D) Petromict conglomerate.

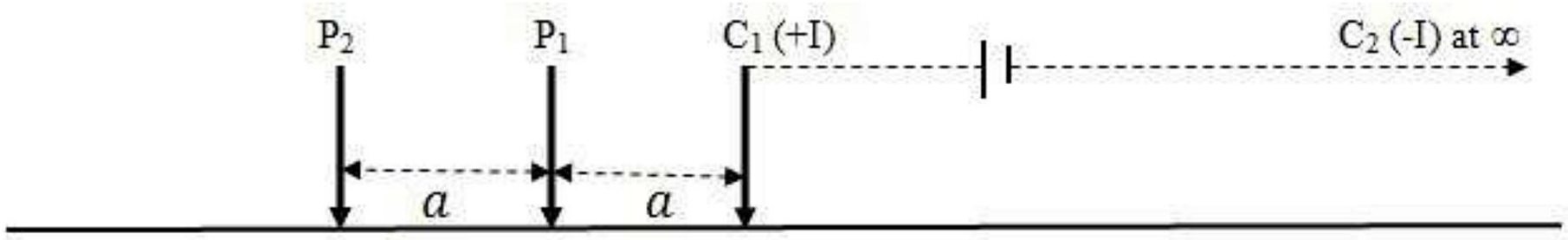
Q.3 Brown coal that has high moisture content and commonly retains many of the original wood fragments is called

(A) Anthracite.
(B) Bituminous coal.
(C) Lignite.
(D) Peat.

Q.4 The speed of revolution of the Earth around the Sun is

(A) maximum at Perihelion.
(B) minimum at Perihelion.
(C) maximum at Aphelion.
(D) equal at Aphelion and Perihelion.

Q.5 The geometrical factor for the following electrode configuration is



(A) πa (B) $2\pi a$ (C) $3\pi a$ (D) $4\pi a$

Q.6 Which one of the following geophysical methods uses the physical property 'Dielectric Constant'?

(A) Gravity
(B) Ground Penetrating Radar
(C) Seismic
(D) Self-Potential

Q.7 Pascal second is a unit of

(A) seepage force.
(B) dynamic viscosity.
(C) kinematic viscosity.
(D) permeability.

Q.8 Which one of the following statements is CORRECT?

(A) Strength of a rock decreases with increase in confining pressure.
(B) Strength of a rock increases with increase in temperature.
(C) Strength of a rock increases with increase in strain rate.
(D) Strength of a rock increases with increase in pore water pressure.

Q.9 The geomorphic feature 'horns' are formed by

(A) wind erosion. (B) river erosion.
(C) wind deposition. (D) glacial erosion.

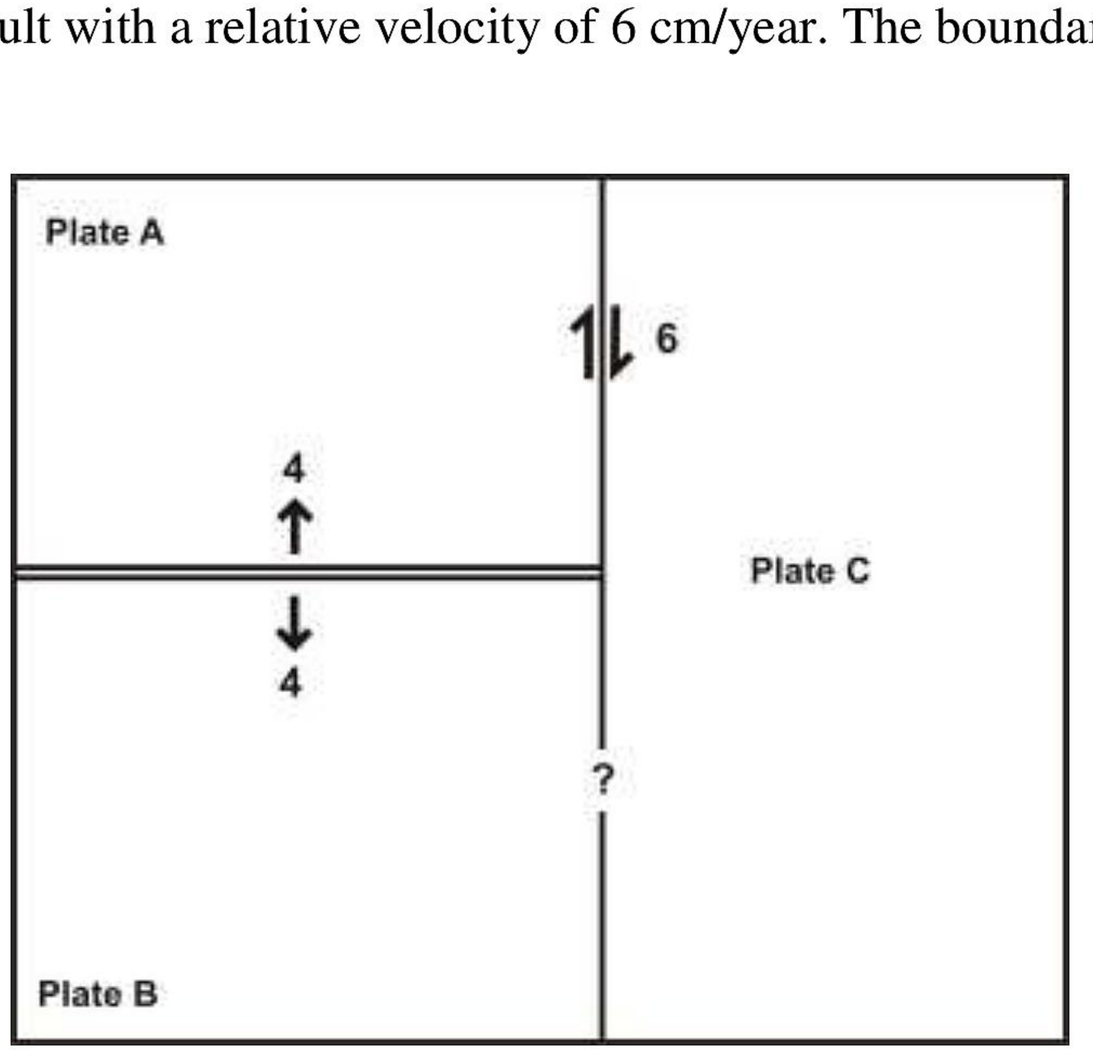
Q.10 A melanocratic porphyritic rock containing phenocrysts of biotite, with feldspar restricted to the groundmass, is called

(A) trachyte. (B) dacite. (C) andesite. (D) lamprophyre.

Q.11 The supercontinent that existed in the late Mesoproterozoic to early Neoproterozoic time was

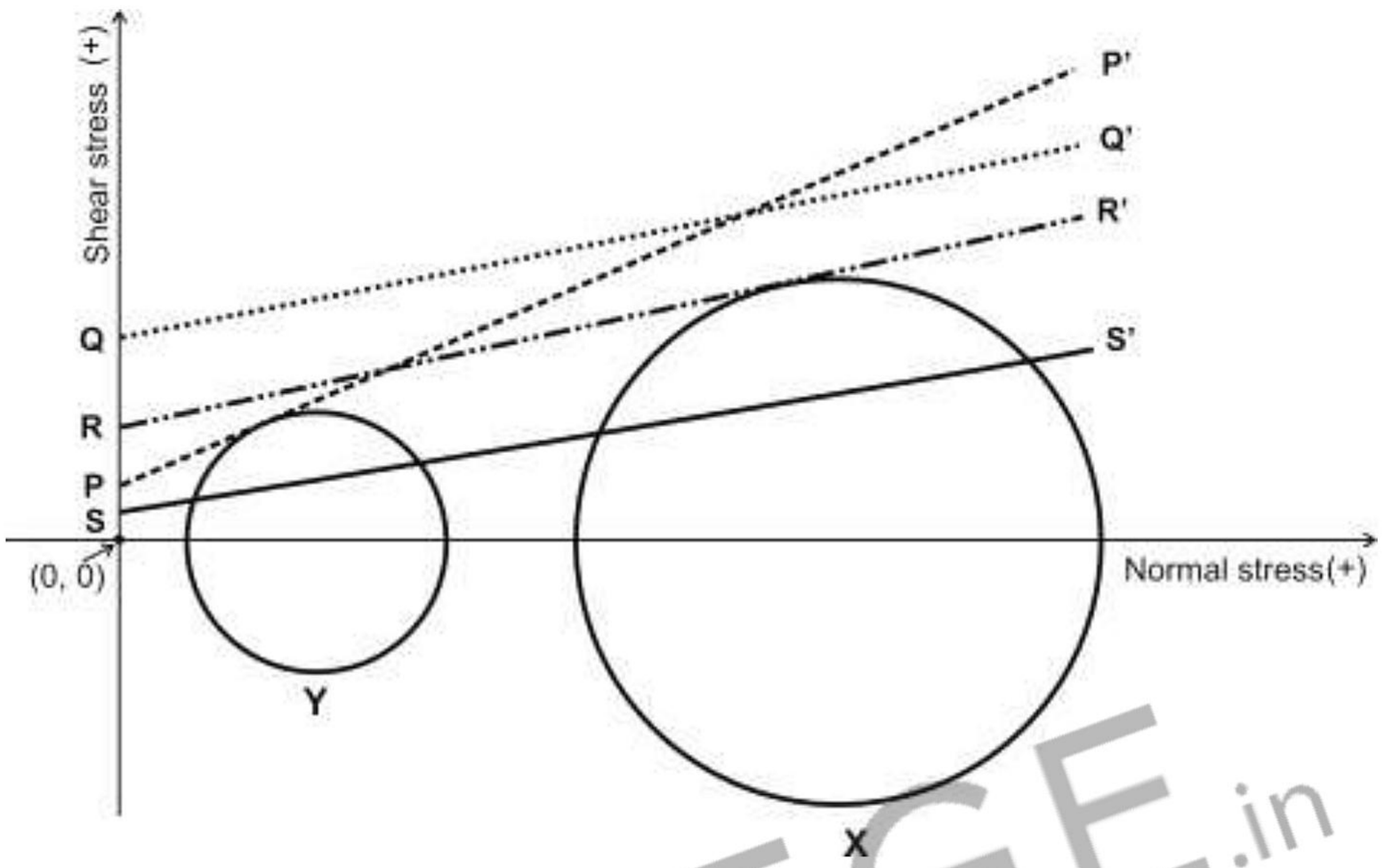
(A) Kenorland. (B) Columbia. (C) Rodinia. (D) Pangaea.

Q.12 The figure below shows the triple junction between three plates A, B and C. The boundary between the plates A and B is a ridge with a half-spreading rate of 4 cm/year. The A-C and B-C boundaries are collinear and orthogonal to the A-B ridge. The A-C boundary is a dextral transform fault with a relative velocity of 6 cm/year. The boundary between plates B and C is a



(A) dextral transform fault with a relative velocity of 10 cm/year.
(B) dextral transform fault with a relative velocity of 2 cm/year.
(C) sinistral transform fault with a relative velocity of 2 cm/year.
(D) sinistral transform fault with a relative velocity of 6 cm/year.

Q.13 A rock follows Mohr-Coulomb failure criterion. Which one of the Mohr-Coulomb failure envelopes shown below allows failure of the rock under stress state Y, but not under stress state X?



(A) PP' (B) QQ' (C) RR' (D) SS'

Q.14 The maximum and the minimum principal stresses are denoted by σ_1 and σ_3, respectively. The differential stress can have an absolute value greater than σ_1 when

(A) σ_1 and σ_3 are both compressive.
(B) σ_1 is compressive and σ_3 is tensile.
(C) σ_1 and σ_3 are equal.
(D) σ_1 and σ_3 are both tensile.

Q.15 The geoid can be best defined as

(A) an oblate spheroid that best approximates the shape of the earth.
(B) a surface over which the value of gravity is constant.
(C) the physical surface of the earth.
(D) an equipotential surface of gravity of the earth.

Q.16 For a layered isotropic medium with a flat horizontal free surface, match the wave types listed in Group-I with their corresponding polarizations listed in Group II.

Group-I	**Group-II**
P. P-waves	1. Particle motion is transverse to the direction of wave propagation.
Q. S-waves	2. Particle motion is transverse to the direction of wave propagation and confined to the horizontal plane.
R. Rayleigh waves	3. Particle motion is parallel to the direction of wave propagation.
S. Love waves	4. Particle motion is elliptical.

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

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

Q.17 A 'gentle' fold with an interlimb angle equal to 160° appears tight (apparent interlimb angle equal to 20°) in horizontal section. According to the plunge of the fold axis, it can also be classified as

(A) horizontal fold. (B) gently plunging fold.
(C) steeply plunging fold. (D) vertical fold.

Q.18 The unit of shear modulus (rigidity modulus) is

(A) $kg\ m^{-1}s^{-2}$ (B) $m^2\ s^{-2}$ (C) $kg\ m^{-2}\ s^{-2}$ (D) m^{-1}

Q.19 With increasing activity of silica, the CORRECT order of appearance of minerals in a weathering environment with constant ratio of activities of K^+ and H^+ is

(A) gibbsite → kaolinite → pyrophyllite
(B) gibbsite → pyrophyllite → kaolinite
(C) kaolinite → gibbsite → pyrophyllite
(D) pyrophyllite → gibbsite → kaolinite

Q.20 Match the items listed in Group-I with those listed in Group-II.

Group-I	**Group-II**
P. Mica	1. Beldih
Q. Uranium	2. Koderma
R. Phosphate	3. Agucha
S. Zinc	4. Gogi

(A) P-2,Q-3, R-4, S-1

(B) P-2, Q-4, R-1, S-3

(C) P-4, Q-2, R-3, S-1

(D) P-3, Q-1, R-4, S-2

Q.21 Which one of the following corrections is always added during reduction of the observed gravity data?

(A) Latitude (B) Free-air (C) Bouguer (D) Terrain

Q.22 The magnitudes of the total geomagnetic field at the equator and pole are denoted by B_E and B_P, respectively. Which one of the following is TRUE?

(A) $B_P \approx 4\ B_E$ (B) $B_P \approx 2\ B_E$ (C) $B_P \approx B_E$ (D) $B_P \approx 1/2\ B_E$

Q.23 Assume a flat earth with crustal thickness of 35 km and average crustal and upper mantle P-wave velocities of 6.4 $km.s^{-1}$ and 8.1 $km.s^{-1}$, respectively. The minimum distance from the epicenter of a near surface earthquake at which P_n-waves are observed is _____ km.

Q.24 Given that the velocity of P-waves in a sandstone matrix is 5600 m/s and that in oil is 1200 m/s, the velocity of P-wave propagation in oil saturated sandstone with 30% porosity is _____ m/s. (Use Wyllie time average equation.)

Q.25 If the total porosity of a soil is 20%, its void ratio (%) is _____.

PART B (SECTION 1): FOR GEOLOGY CANDIDATES ONLY

Q. 26 – Q. 55 carry two marks each.

Q.26 Which one of the following Himalayan lithounits predates India-Eurasia collision?

(A) Kasauli sandstone (B) Rangit Pebble Slate

(C) Annapurna granite (D) Lower Karewa sandstone

Q.27 Which one of the following ore minerals shows internal reflection?

(A) Orpiment (B) Magnetite (C) Pyrite (D) Molybdenite

Q.28 Which one is CORRECT for the following equilibrium reaction between quartz and magnetite:

$$Si^{16}O^{16}O + Fe_3{}^{16}O_3{}^{18}O = Si^{16}O^{18}O + Fe_3{}^{16}O_4 \ ?$$

(A) $1000 \ln \alpha = \Delta_{qtz\text{-}mag}$ where $\alpha = K^{1/n}$ (K is the equilibrium constant at the specified temperature and n is a constant quantity)

(B) $1000 \ln \alpha = \Delta_{qtz\text{-}mag}$ where $\alpha = K^{n}$ (K is the equilibrium constant at the specified temperature and n is the number of exchangeable atomic sites)

(C) $(\ln \alpha /1000) = \Delta_{qtz\text{-}mag}$ where $\alpha = K^{1/n}$ (K is the equilibrium constant at the specified temperature and n is a constant quantity)

(D) $1000 \ln \alpha = \Delta_{qtz\text{-}mag}$ where $\alpha = K^{1/n}$ (K is the equilibrium constant at the specified temperature and n is the number of exchangeable atomic sites)

Q.29 Match the modes of life (listed in Group I) with the corresponding bivalve genera (listed in Group II).

Group I	**Group II**
P. Burrowing	1. *Mytilus*
Q. Recumbent unattached	2. *Pecten*
R. Byssally attached	3. *Mya*
S. Swimming	4. *Gryphaea*

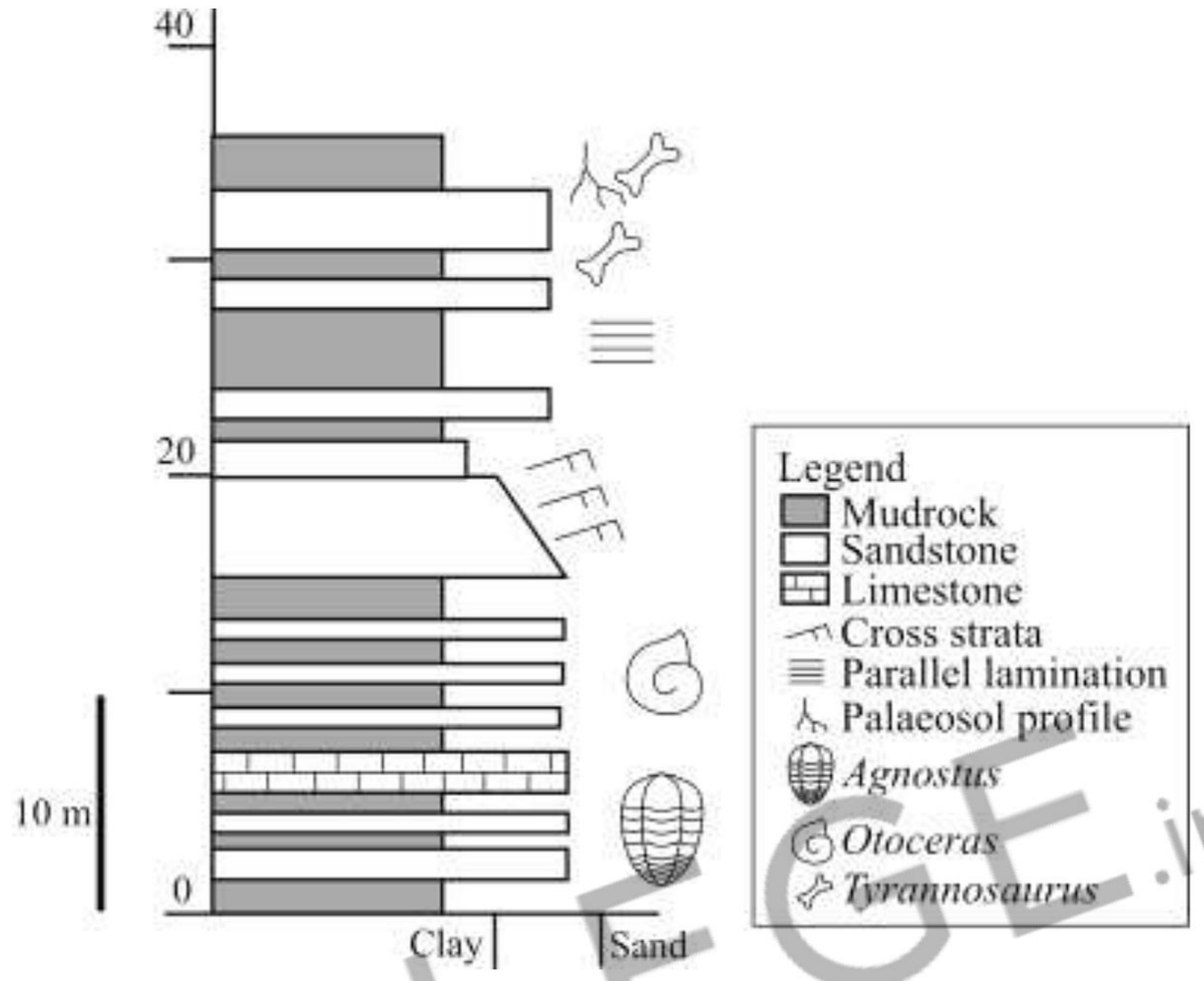
(A) P-4, Q-3, R-2, S-1

(B) P-3, Q-4, R-1, S-2

(C) P-2, Q-3, R-1, S-4

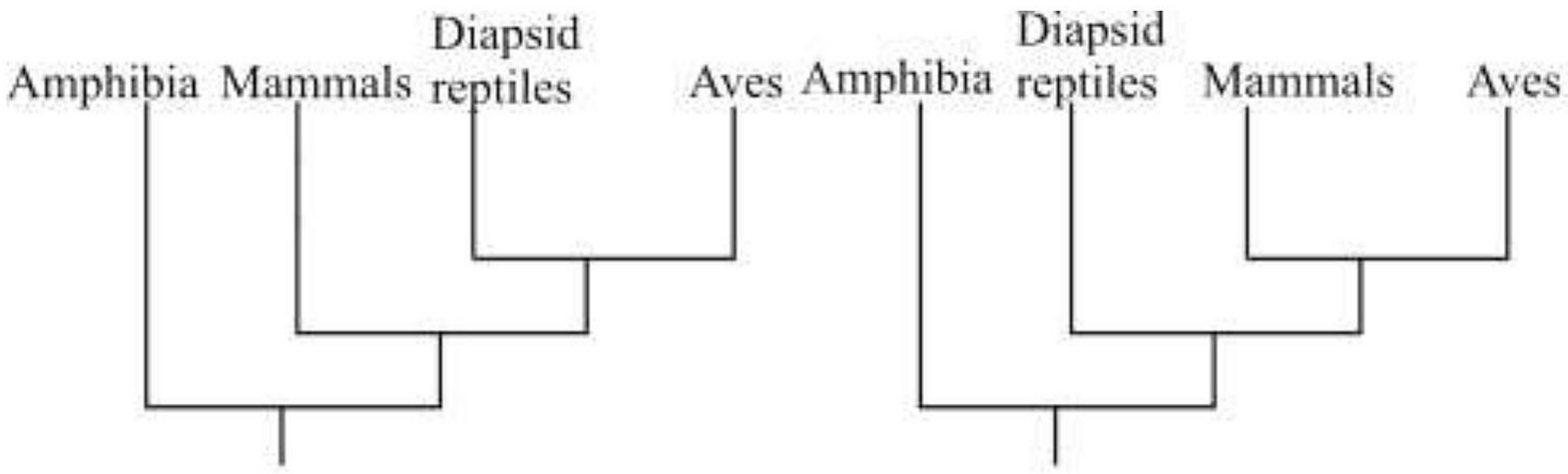
(D) P-3, Q-1, R-4, S-2

Q.30 Based on the hypothetical litholog given below that shows a continuous succession of sedimentary rocks, which one of the following statements is CORRECT?



(A) The rocks range from Cambrian to Cretaceous and show change in depositional environment from marine to continental.
(B) The rocks range from Cambrian to Triassic and show change in depositional environment from marine to continental.
(C) The rocks range from Cambrian to Cretaceous and show change in depositional environment from continental to marine.
(D) The rocks are Palaeozoic in age and show change in depositional environment from marine to continental.

Q.31 Which one of the following cladograms shows the CORRECT interrelationships among the major groups of vertebrates?



(A) Cladogram I (B) Cladogram II (C) Cladogram III (D) Cladogram IV

Q.32 Which one of the following stratigraphic successions is in the CORRECT chronological order (from older to younger)?

(A) Rajmahal, Dubrajpur, Barakar
(B) Fenestella Shale, Muth Quartzite, Syringothyris Limestone
(C) Bagh Bed, Lameta Formation, Deccan Traps
(D) Singhbhum Granite, Kolhan Group, Older Metamorphic Gneiss

Q.33 Match the items listed in Group I with their appropriate description listed in Group II.

Group I	**Group II**
P. Peloids	1. Grains containing nucleus surrounded by irregular, non-concentric laminae.
Q. Ooids	2. Small micritic grains without internal structure
R. Oncoids	3. Rounded grains with a thin coating of micrite.
S. Cortoids	4. Spherical grains consisting of regular laminae in concentric rings

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

Q.34 Which one of the following is an image rectification technique?

(A) Histogram equalization
(B) Density slicing
(C) Histogram normalization
(D) Rubbersheeting

Q.35 Match the items listed in Group I with those in Group II.

Group I	**Group II**
P. Determination of coefficient of compressibility of soils	1. Brazilian test
Q. A method of slope stabilization	2. Overcoring
R. A method of *in situ* stress determination	3. Oedometer test
S. Determination of indirect tensile strength of rocks	4. Shotcreting

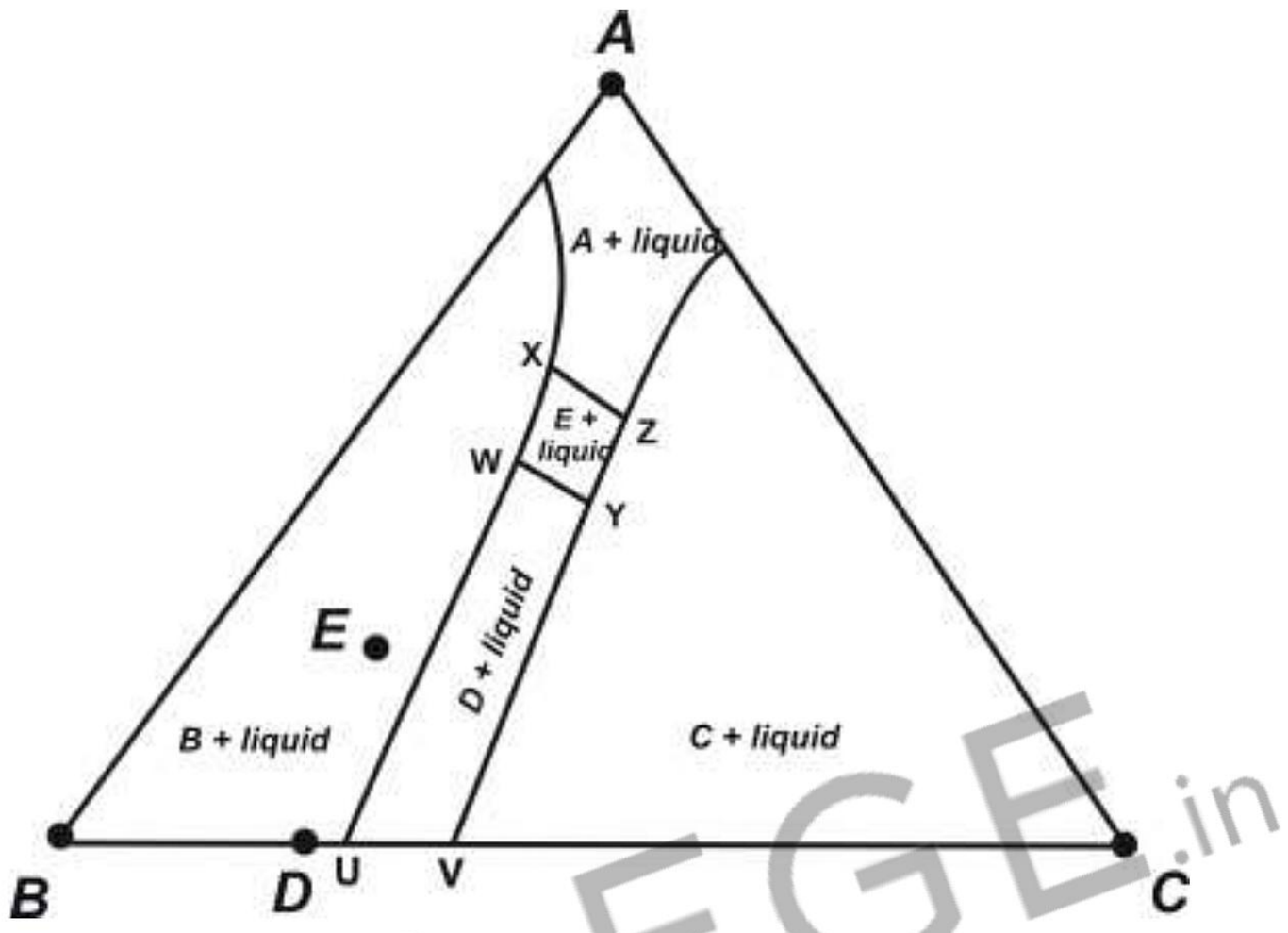
(A) P-4, Q-2, R-3, S-1
(B) P-1, Q-4, R-2, S-3
(C) P-3, Q-2, R-1, S-4
(D) P-3, Q-4, R-2, S-1

Q.36 Match the items listed in Group I with those listed in Group II.

Group I	**Group II**
P. Crevasse	1. River
Q. Yardang	2. Groundwater
R. Mesa	3. Wind
S. Stalactite	4. Glacier

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

Q.37 In the hypothetical isobaric ternary liquidus projection diagram given below, solid phases A, B, C, D and E exist in equilibrium with liquid. The reaction taking place at the isobaric invariant point **W** is



(A) Liquid (at W) = B + D + E
(B) Liquid (at W) = A + B + D
(C) Liquid (at W) + E = B + D
(D) Liquid (at W) + B + D = E

Q.38 Match the optical properties listed in Group I with the corresponding mineral in Group II.

Group I	**Group II**
P. Brown colour, very high refractive index, very high birefringence, biaxial positive	1. Apatite
Q. Colourless, very high refractive index, low birefringence, uniaxial negative	2. Rutile
R. Deep reddish-brown colour, very high refractive index, very high birefringence, uniaxial positive	3. Zircon
S. Colourless, very high refractive index, very high birefringence, uniaxial positive	4. Titanite

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

Q.39 The reaction

$$muscovite + quartz = K\text{-}feldspar + sillimanite + water$$

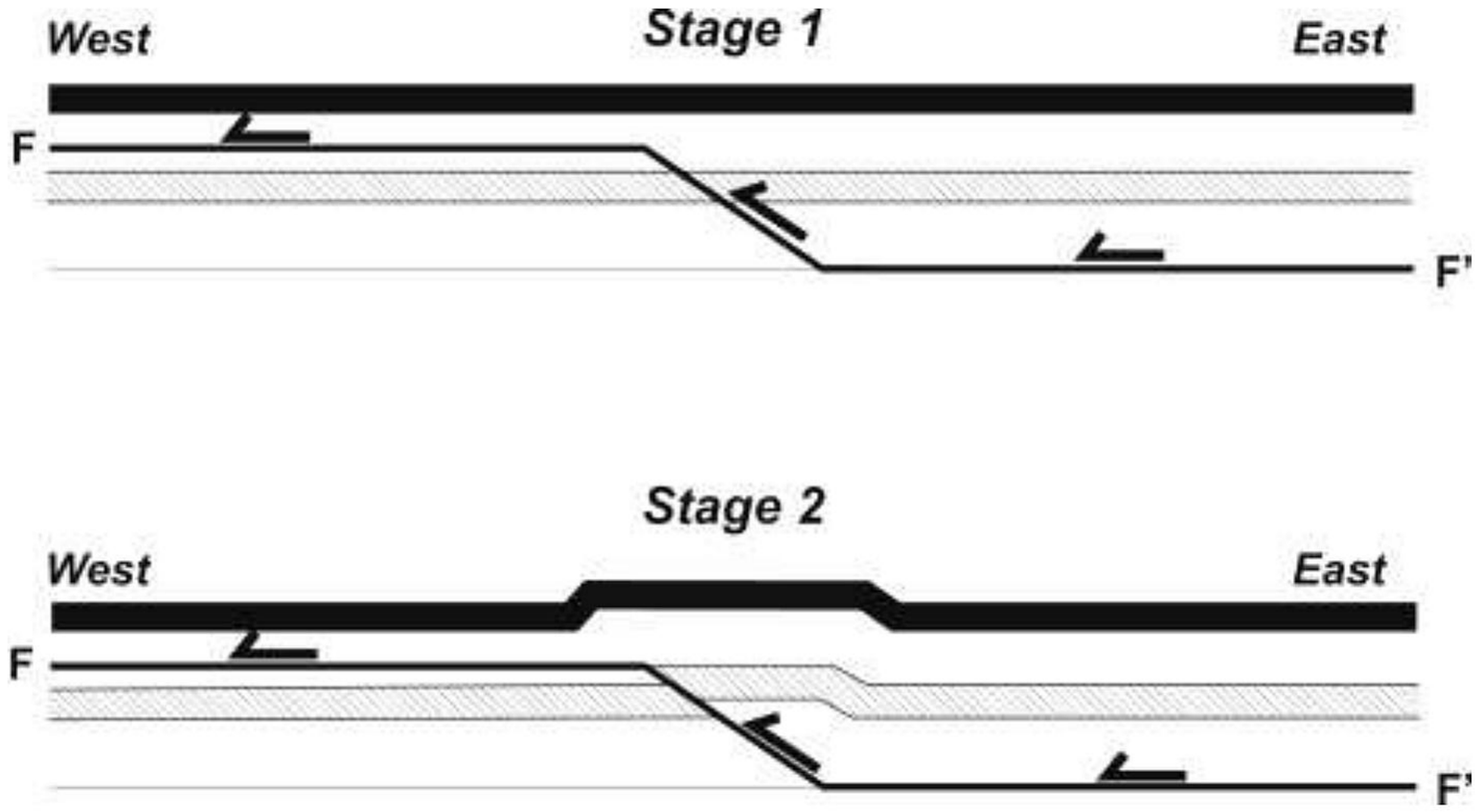
(A) takes place within the greenschist facies.
(B) takes place within the amphibolite facies.
(C) takes place within the eclogite facies.
(D) takes place within the granulite facies.

Q.40 Match the items listed in Group I with those in Group II.

Group I	**Group II**
P. Diopside-tremolite-forsterite	1. Pelite (low P, high T)
Q. Talc-phengite-kyanite	2. Metabasite (low P, high T)
R. Hornblende-cummingtonite-plagioclase	3. Calc-silicate (moderate P, T)
S. Andalusite-cordierite-biotite	4. Pelite (high P, low T)

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

Q.41 The figure below is a schematic section showing the initial stages of development of a thrust fault (FF') having a typical ramp and flat geometry, with the thrust sheet being transported from east to west. With respect to the synform and antiform created in Stage 2, which one of the options below is CORRECT for the next increment of movement on the fault plane?



(A) The synform and the antiform will both move westward.
(B) The synform will remain in position, while the antiform will grow in amplitude.
(C) Both synform and antiform will grow in amplitude.
(D) The geometry will remain unchanged.

Q.42 Which one of the following is the CORRECT chronological sequence for Iron formations?

(A) Algoma type > Superior type > Rapitan type > Minette type
(B) Superior type > Algoma type > Rapitan type > Minette type
(C) Rapitan type > Minette type > Algoma type > Superior type
(D) Algoma type > Minette type > Superior type > Rapitan type

Q.43 Assertion (a): High-temperature, low-pressure metamorphism occurs on the over-riding plate near convergent plate margins.
Reason (r): Partial melting in the mantle wedge generates magmas that rise to form the arc.

(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.44 Two coeval primary aqueous biphase fluid inclusions, X (liquid-rich) and Y (vapour-rich), occur in the same grain of the host mineral. Which one of the following situations most likely indicates boiling of the fluid?

(A) X homogenizes to liquid and Y homogenizes to vapour at different temperatures.
(B) Both homogenize to liquid at the same temperature.
(C) Both homogenize to vapour at the same temperature.
(D) X homogenizes to liquid and Y homogenizes to vapour at the same temperature.

Q.45 During bench blasting in a quarry, 50 kg of an explosive with a yield of 5 MegaJoule/kg is required to break 100 m^3 of marble. In this case, the energy expended in breaking a unit volume of marble in MegaNewton/m^2 would be _____.

Q.46 The stretching lineation on the axial plane (S_2) of a reclined fold on the S_1 foliation makes an angle of 30° with the S_1/S_2 intersection lineation. The rake of the stretching lineation on the axial plane in degrees is _____.

Q.47 A basaltic magma has an initial nickel concentration of 300 ppm. Olivine crystallizes from this magma by equilibrium crystallization (Case I) or fractional crystallization (Case II). Then, the absolute value of the difference between the nickel concentrations of the liquids remaining after 25% crystallization in these two cases is _____.
(Use $K_{D,Ni}$ olivine/melt = 10).

Q.48 The difference in the number of faces in forms {hkl} and {111} in the holosymmetric class of the isometric system is _____.

Q.49 An inclined cylindrical confined aquifer has coefficient of permeability of 40 m/day. The horizontal distance between two vertical wells penetrating the aquifer is 800 m. The water surface elevations in the wells are 50 m and 45 m above a common horizontal datum. The absolute value of Darcy flux through the aquifer is _____ m/day.

Q.50 The mass and volume of a natural soil sample are 2.1 kg and 1×10^{-3} m^3, respectively. When fully dried, the mass of the soil sample becomes 2 kg without any change in volume. Assuming the specific gravity of soil particles to be 2.5, and water density of 1000 kg/m^3, the degree of saturation of the natural soil sample is _____%.

Q.51 For a granitic rock mass, joint set number (Jn) = 9, joint water reduction factor (Jw) = 1, joint alteration number (Ja) = 1, stress reduction factor (SRF) = 1, rock quality designation (%) = 84 and joint roughness number (Jr) = 3. The Q-value as per Barton's Q-system of rock mass classification (year 1974) is _____.

Q.52 A sun synchronous satellite is at an altitude of 300 km and the spectrometer makes an angular coverage angle of 12°. The Swath (GFOV) of the satellite is _____ km.

Q.53 The stability field boundary between two minerals A and B is linear with a positive slope in P-T space. The molar entropy of A and B are 85.5 and 92.5 Joules K^{-1}, respectively and their respective molar volumes are 35.5 and 38.2 cc. The slope of the phase boundary in P-T space is _____ bar K^{-1}.

Q.54 Five moles of gas A (volume V1) and 3 moles of gas B (volume V2) were kept in separate containers. These two gases are completely transferred to a new container of volume V. Assuming isothermal condition, and that the work done is only mechanical, the entropy change of the system is _____ Joules K^{-1}. ($R = 8.3$ J K^{-1} $mole^{-1}$)

Q.55 The value of Eh corresponding to the upper limit of natural surface aqueous environment at pH of 8.0 is _____ V.

PART B (SECTION 2): FOR GEOPHYSICS CANDIDATES ONLY

Q. 56 – Q. 85 carry two marks each.

Q.56 The maximum number of linearly independent rows of an $m \times n$ matrix **G** where $m > n$ is

(A) m.
(B) n.
(C) $m - n$.
(D) 0.

Q.57 The impulse response of the Kirchhoff pre-stack time migration operator for non-zero offsets in a homogeneous and isotropic medium is _____.

(A) a circle.
(B) a parabola.
(C) a hyperbola.
(D) an ellipse.

Q.58 A solution to the eikonal equation $|\nabla\tau| = 1/v_0$ for a homogeneous and isotropic medium in cartesian coordinates is

(A) $\tau = \frac{\sqrt{x^2+y^2+z^2}}{v_0}$ (B) $\tau = \frac{1}{v_0}$ (C) $\tau = \frac{x+y+z}{v_0}$ (D) $\tau = \frac{xyz}{v_0}$

Q.59 The formula for the 'forward' Fourier transform is $F(\omega) = \int_{-\infty}^{\infty} f(t)\, e^{-i\omega t} dt$ and that for the 'inverse' Fourier transform is $f(t) = \int_{-\infty}^{\infty} F(\omega)\, e^{i\omega t} d\omega$. Then, the forward Fourier transform of the function $F(\omega) = e^{-2i\omega}$ is

(A) $2\delta(t)$.
(B) $\delta(2t)$.
(C) $\delta(t+2)$.
(D) $\delta(t-2)$.

Q.60 Which one of the following rock types has the highest bulk magnetic susceptibility value?

(A) Gabbro
(B) Marble
(C) Orthoquartzite
(D) Limestone

Q.61 Figure 1 is a schematic diagram of four seismic events in t-x (time-offset) domain and Figure 2 is the result of transformation from t-x domain to f-kx (frequency-horizontal wavenumber) domain. Match the events in t-x domain in Figure 1 with their counterparts in f-kx domain in Figure 2.

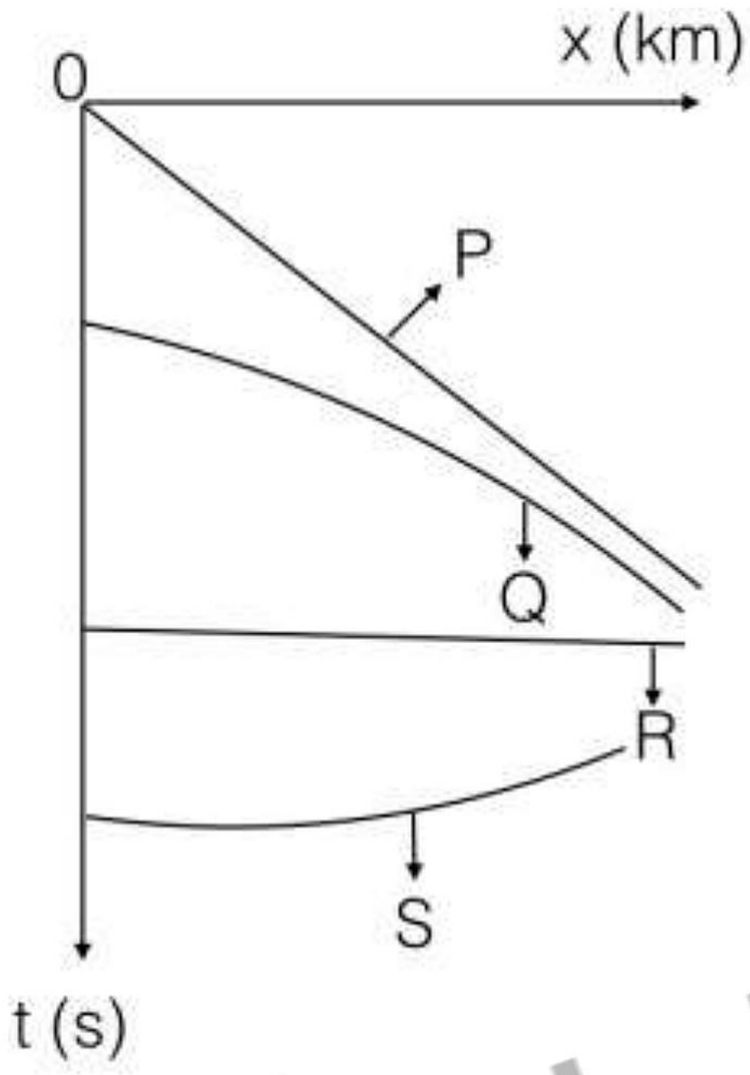


Figure 1

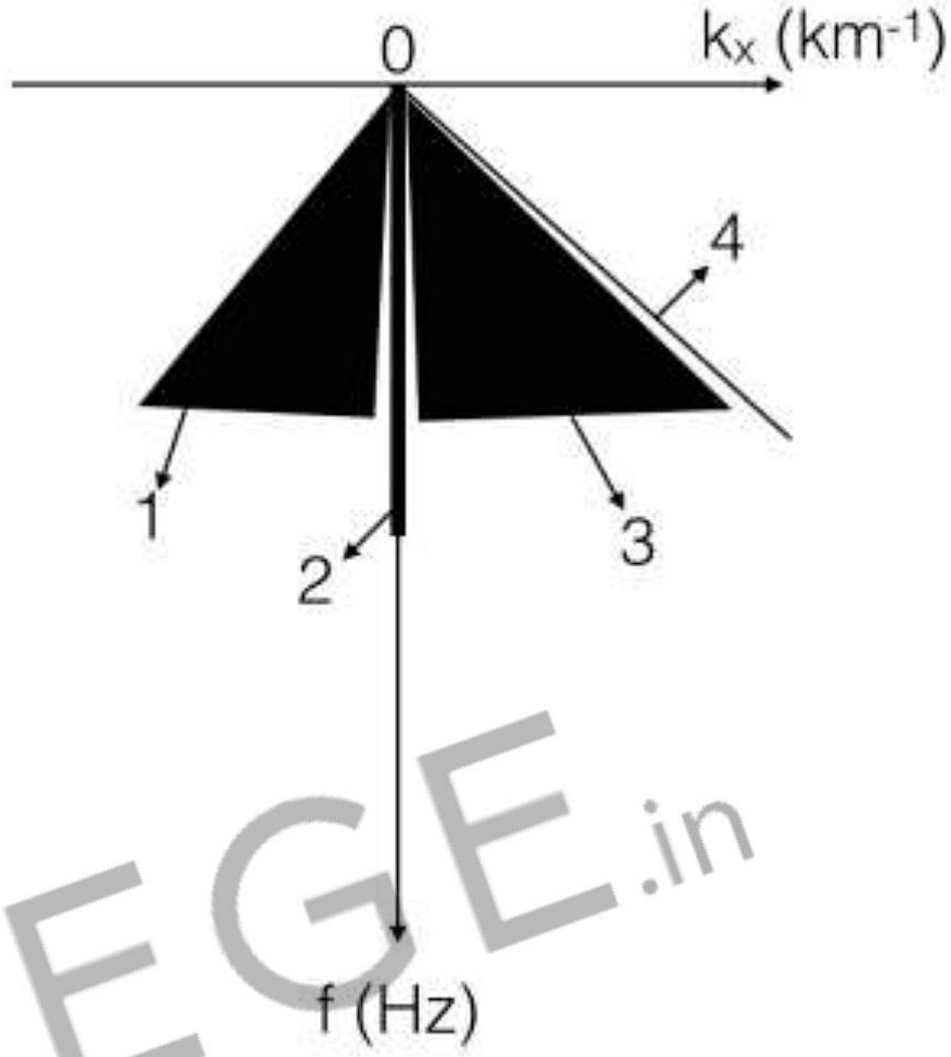


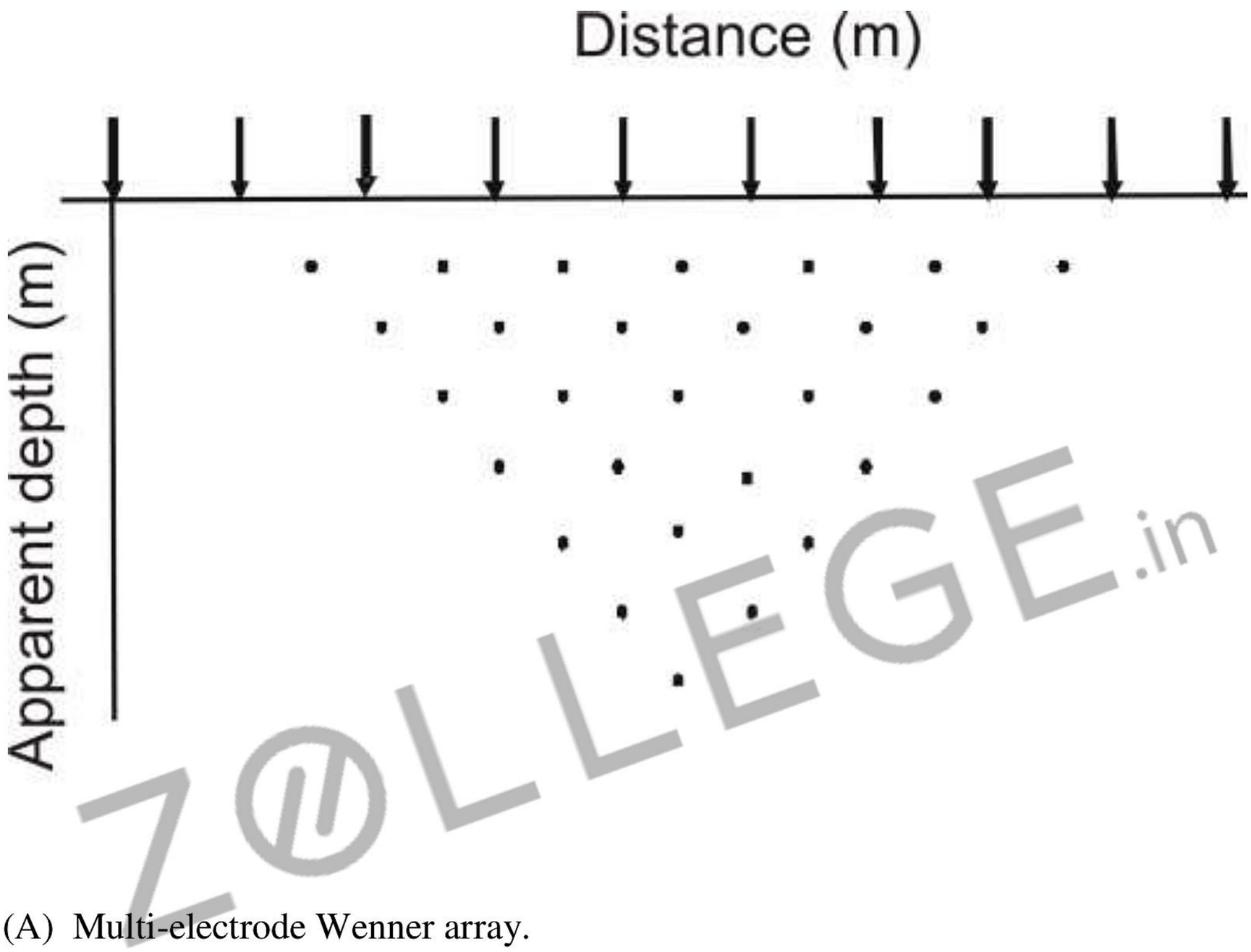
Figure 2

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

Q.62 There is a change in the values of the bulk modulus and density across the Gutenberg discontinuity (from mantle to outer core). Which one of the following statements is CORRECT?

(A) Both bulk modulus and density increase.
(B) Both bulk modulus and density decrease.
(C) Bulk modulus decreases and density increases.
(D) Bulk modulus increases and density decreases.

Q.63 Multi-electrode resistivity survey is carried out by placing 10 equispaced electrodes (denoted by arrows in the figure below) on the surface of the earth. The points of observations in the distance-apparent depth plane are marked as solid dots in the figure shown below. Considering the mid-point of the 4-electrode array as the point of observation in the lateral direction, identify the CORRECT electrode configuration used for the survey.



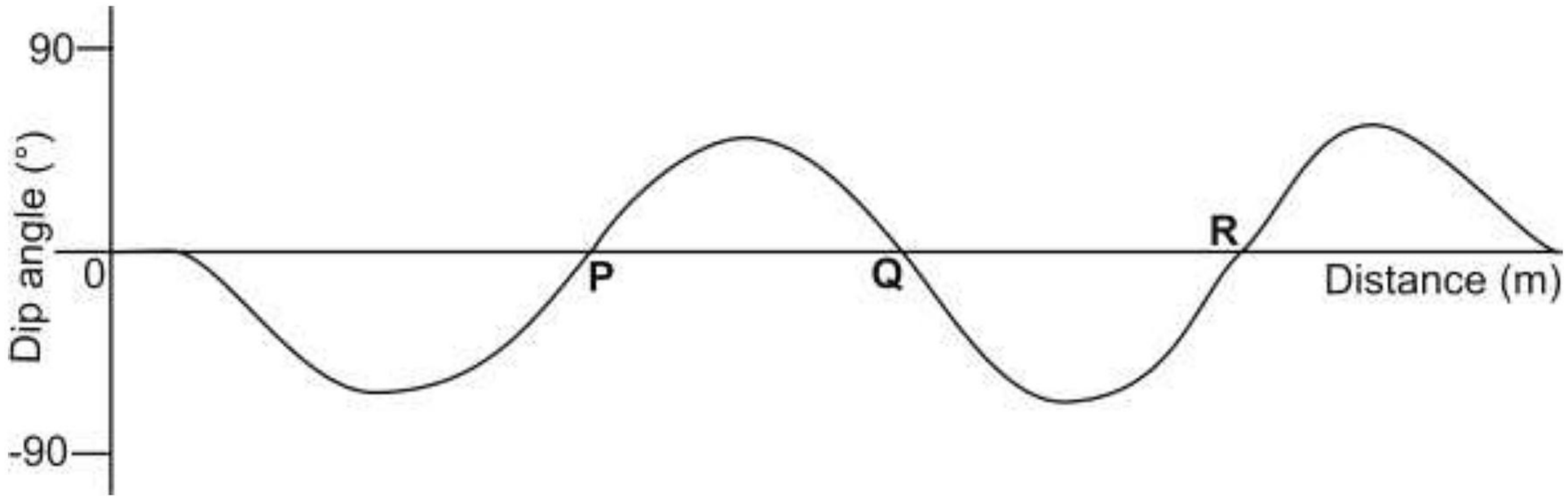
(A) Multi-electrode Wenner array.
(B) Multi-electrode Axial Dipole-dipole array.
(C) Multi-electrode Wenner-Schlumberger array.
(D) Multi-electrode Axial Pole-dipole array.

Q.64 Match the Electromagnetic methods in Group I with the corresponding quantity measured by them given in Group II.

Group I	**Group II**
P. AFMAG method	1. Decay of secondary field
Q. Time domain EM method	2. Real and imaginary components
R. TURAM method	3. Dip angle
S. Slingram method	4. Amplitude ratio and phase difference
	5. Ellipticity of polarization ellipse

(A) P-3, Q-2, R-4, S-5
(B) P-2, Q-1, R-4, S-3
(C) P-3, Q-1, R-4, S-2
(D) P-1, Q-2, R-5, S-3

Q.65 Dip angle electromagnetic response measured along a profile over multiple conductors is shown in the figure below. Which of the crossover points P, Q and R represent the CORRECT locations of conductors beneath them?



(A) P, Q and R
(B) Q and R
(C) P and R
(D) P and Q

Q.66 The effect of small scale near surface inhomogeneities can be removed from magnetic data by

(A) upward continuation.
(B) downward continuation.
(C) second vertical derivative.
(D) reduction to pole.

Q.67 The frequencies of the primary magnetic field generated by worldwide thunderstorm activity vary in the range

(A) 10^{-6} Hz -10^{-3} Hz
(B) 10^{-3} Hz -1 Hz
(C) 1 Hz -10^{3} Hz
(D) 10^{3} Hz -10^{6} Hz

Q.68 Assertion (a): The Static Self-Potential for a thick, clean freshwater bearing sandstone formation is positive.
Reason(r): Resistivity of the formation water is less than the resistivity of salt water mud-filtrate.

(A) Both (a) and (r) are true and (r) is the correct reason for (a).
(B) Both (a) and (r) are true and (r) is not the correct reason for (a)
(C) Both (a) and (r) are false.
(D) (a) is true but (r) is false.

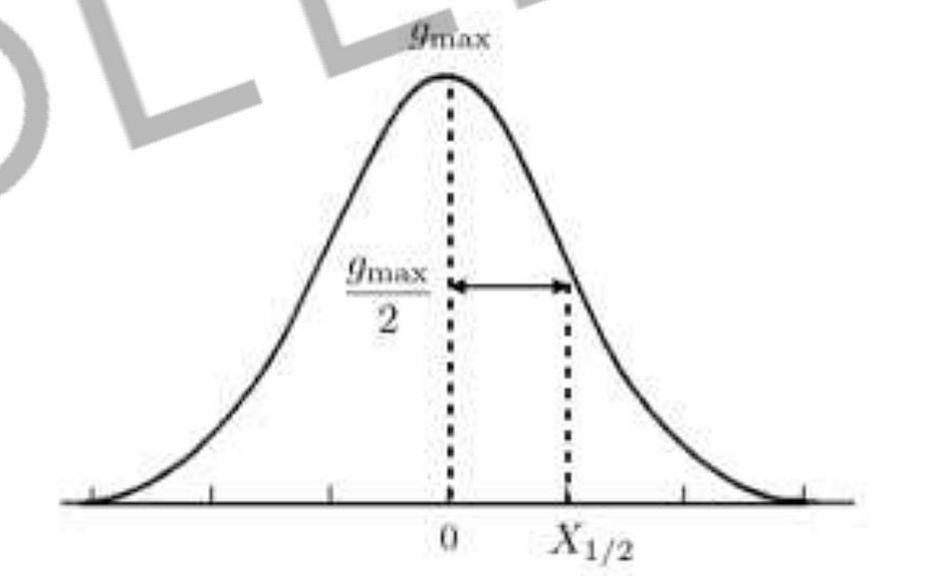
Q.69 Which one of the following well log responses characterizes an overpressured zone in the subsurface?

(A) High velocity and high resistivity.
(B) Low velocity and low density.
(C) High velocity and low resistivity.
(D) Low velocity and high density.

Q.70 The angle of inclination of the remanent magnetization measured on a basalt flow at a location P (28°N 85°E) is 40°. The palaeomagnetic latitude of the basalt flow is _____ °N.

Q.71 Using the Gutenberg-Richter recurrence relationship, the mean annual rate of exceedance of earthquake occurrence in a seismic belt is 0.3 per year for an earthquake of magnitude 6.0. The return period for an earthquake of magnitude 6.0 in this belt is _____ years.

Q.72 In the figure below, Z denotes the depth to the center of a buried sphere from the surface and $X_{1/2}$ denotes the half-width of the profile at half the maximum value of gravity. Then, the ratio $Z/X_{1/2}$ is _____.



Q.73 Two survey vessels with shipborne gravimeters are cruising towards each other at a speed of 6 knots each along an east-west course. The difference in gravity readings of the two gravimeters is 63.5 mGal at the point at which the survey vessels cross each other. The latitude along which the survey vessels are cruising is _____ °N.

Q.74 A gravity reading is taken in a stationary helicopter hovering 1 km above mean-sea level at a particular location. The difference in the value of g measured in the helicopter and at mean sea level vertically beneath the helicopter is _____ mGals.

Q.75 The P-wave velocity and the Poisson's ratio for a homogeneous and isotropic sedimentary rock are 2500 m/s and 0.3, respectively. The S-wave velocity for the rock is _____m/s.

Q.76 A plane electromagnetic (EM) wave travelling vertically downwards with a frequency of 1000 Hz in a homogeneous medium has a skin depth of 100 m. The ratio of the amplitude of the EM wave at a depth of 75 m with respect to the amplitude at the Earth's surface is _____.

Q.77 A student interpreted a four layer Schlumberger resistivity sounding data and obtained the resistivities (ρ) and thicknesses (h) as follows: ρ_1=100 Ωm, ρ_2=20 Ωm, ρ_3=1500 Ωm and ρ_4=50 Ωm; h_1=50 m, h_2=10 m and h_3=20 m. The same data is interpreted by another student who obtains ρ_3=2000 Ωm. Then, according to the principle of equivalence, the value of h_3 interpreted by the second student is _____m. (All other model parameters estimated by both the students are the same.)

Q.78 The apparent resistivities obtained at 0.1 Hz and 10 Hz in the frequency domain I.P. measurement are 100 Ωm and 80 Ωm, respectively. The Percentage Frequency Effect is _____.

Q.79 A 15 Volt power supply is applied across a cylindrical container (diameter = 0.20 m and length = 0.50 m). Currents of 750 mA and 500 mA are measured when the container is filled with (i) brine only, and (ii) rock sample fully saturated with brine, respectively. The formation factor of the rock sample is _____.

Q.80 The ratio of the number of daughter nuclides to the number of parent nuclides after a decay period of 3 half-lives is _____.

Q.81 Consider a laterally homogeneous and isotropic earth model with a flat horizontal surface and three horizontal layers underlain by a half-space. A seismic reflection survey was simulated on this model with the sources and receivers placed on the surface. The table below lists the root mean square (rms) velocities, V_{rms}, and zero-offset two-way traveltimes t_0 for the three reflection events from the bottom of each of the three layers observed in a pre-stack CDP (CMP) gather. The interval velocity of the second layer is _____ m/s.

Reflection Event	V_{rms}	t_0
1	1500 m/s	0.2 s
2	1600 m/s	0.3 s
3	1700 m/s	0.4 s

Q.82 A spherically symmetric vector field $\overrightarrow{g(r)}$ is defined by the relationship $\nabla \cdot \overrightarrow{g(r)} = -r$. The flux of the vector field through a sphere of unit radius is _____.
(Use $\pi = 3.14$)

Q.83 A horizontally travelling surface wave with a wavelength of 20 m is attenuated by a linear and uniform receiver array consisting of 4 receivers if the minimum receiver spacing is _____ m.

Q.84 An end-on marine survey is carried out with equal and uniform shot and receiver spacing. If the total number of shots fired is 50 and a total of 10000 traces are recorded, the maximum fold for the survey is _____.

Q.85 The highest singular value of the matrix $\mathbf{G} = \begin{pmatrix} 1 & 2 & 1 \\ -1 & 2 & 0 \end{pmatrix}$ is _____.

END OF THE QUESTION PAPER

Q.No.	Type	Section	Key/Range	Marks
1	MCQ	GA	A	1
2	MCQ	GA	C	1
3	MCQ	GA	B	1
4	MCQ	GA	C	1
5	MCQ	GA	D	1
6	MCQ	GA	A	2
7	MCQ	GA	C	2
8	MCQ	GA	D	2
9	MCQ	GA	C	2
10	MCQ	GA	A	2
1	MCQ	Part-A Common Section	B	1
2	MCQ	Part-A Common Section	C	1
3	MCQ	Part-A Common Section	C	1
4	MCQ	Part-A Common Section	A	1
5	MCQ	Part-A Common Section	D	1
6	MCQ	Part-A Common Section	B	1
7	MCQ	Part-A Common Section	B	1
8	MCQ	Part-A Common Section	C	1
9	MCQ	Part-A Common Section	D	1
10	MCQ	Part-A Common Section	D	1
11	MCQ	Part-A Common Section	C	1
12	MCQ	Part-A Common Section	C	1
13	MCQ	Part-A Common Section	A	1
14	MCQ	Part-A Common Section	B	1
15	MCQ	Part-A Common Section	D	1

Q.No.	Type	Section	Key/Range	Marks
16	MCQ	Part-A Common Section	B	1
17	MCQ	Part-A Common Section	B	1
18	MCQ	Part-A Common Section	A	1
19	MCQ	Part-A Common Section	A	1
20	MCQ	Part-A Common Section	B	1
21	MCQ	Part-A Common Section	D	1
22	MCQ	Part-A Common Section	B	1
23	NAT	Part-A Common Section	85 to 95	1
24	NAT	Part-A Common Section	2660 to 2670	1
25	NAT	Part-A Common Section	25 to 25	1
26	MCQ	Part-B Geology (Section 1)	B	2
27	MCQ	Part-B Geology (Section 1)	A	2
28	MCQ	Part-B Geology (Section 1)	D	2
29	MCQ	Part-B Geology (Section 1)	B	2
30	MCQ	Part-B Geology (Section 1)	A	2
31	MCQ	Part-B Geology (Section 1)	A	2
32	MCQ	Part-B Geology (Section 1)	C	2
33	MCQ	Part-B Geology (Section 1)	B	2
34	MCQ	Part-B Geology (Section 1)	D	2
35	MCQ	Part-B Geology (Section 1)	D	2
36	MCQ	Part-B Geology (Section 1)	A	2
37	MCQ	Part-B Geology (Section 1)	D	2
38	MCQ	Part-B Geology (Section 1)	A	2
39	MCQ	Part-B Geology (Section 1)	B	2
40	MCQ	Part-B Geology (Section 1)	C	2

Q.No.	Type	Section	Key/Range	Marks
41	MCQ	Part-B Geology (Section 1)	B	2
42	MCQ	Part-B Geology (Section 1)	A	2
43	MCQ	Part-B Geology (Section 1)	C	2
44	MCQ	Part-B Geology (Section 1)	D	2
45	NAT	Part-B Geology (Section 1)	2.5 to 2.5	2
46	NAT	Part-B Geology (Section 1)	60 to 60	2
47	NAT	Part-B Geology (Section 1)	69 to 71	2
48	NAT	Part-B Geology (Section 1)	40 to 40	2
49	NAT	Part-B Geology (Section 1)	0.25 to 0.25	2
50	NAT	Part-B Geology (Section 1)	50 to50	2
51	NAT	Part-B Geology (Section 1)	28 to 28	2
52	NAT	Part-B Geology (Section 1)	62 to 64	2
53	NAT	Part-B Geology (Section 1)	24 to 26	2
54	NAT	Part-B Geology (Section 1)	42 to 45	2
55	NAT	Part-B Geology (Section 1)	0.7 to 0.8	2
56	MCQ	Part-B Geophysics (Section 2)	B	2
57	MCQ	Part-B Geophysics (Section 2)	D	2
58	MCQ	Part-B Geophysics (Section 2)	A	2
59	MCQ	Part-B Geophysics (Section 2)	C (or) D	2
60	MCQ	Part-B Geophysics (Section 2)	A	2
61	MCQ	Part-B Geophysics (Section 2)	C	2
62	MCQ	Part-B Geophysics (Section 2)	A	2
63	MCQ	Part-B Geophysics (Section 2)	B	2
64	MCQ	Part-B Geophysics (Section 2)	C	2
65	MCQ	Part-B Geophysics (Section 2)	C	2

Q.No.	Type	Section	Key/Range	Marks
66	MCQ	Part-B Geophysics (Section 2)	A	2
67	MCQ	Part-B Geophysics (Section 2)	C	2
68	MCQ	Part-B Geophysics (Section 2)	D	2
69	MCQ	Part-B Geophysics (Section 2)	B	2
70	NAT	Part-B Geophysics (Section 2)	22.5 to 23.0	2
71	NAT	Part-B Geophysics (Section 2)	3.0 to 3.5	2
72	NAT	Part-B Geophysics (Section 2)	1.2 to 1.4	2
73	NAT	Part-B Geophysics (Section 2)	44.5 to 46.0	2
74	NAT	Part-B Geophysics (Section 2)	300 to 320 (or) -320 to -300	2
75	NAT	Part-B Geophysics (Section 2)	1330 to 1340	2
76	NAT	Part-B Geophysics (Section 2)	0.46 to 0.49	2
77	NAT	Part-B Geophysics (Section 2)	15 to 15	2
78	NAT	Part-B Geophysics (Section 2)	25 to 25	2
79	NAT	Part-B Geophysics (Section 2)	1.50 to 1.50	2
80	NAT	Part-B Geophysics (Section 2)	6.9 to 7.1	2
81	NAT	Part-B Geophysics (Section 2)	1770 to 1790	2
82	NAT	Part-B Geophysics (Section 2)	-3.142 to -3.140	2
83	NAT	Part-B Geophysics (Section 2)	5.0 to 5.0	2
84	NAT	Part-B Geophysics (Section 2)	50 to 50 (or) 100 to 100	2
85	NAT	Part-B Geophysics (Section 2)	2.8 to 3.0	2