Sample Paper

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GG: Geology and Geophysics

Q.No. 1 The groundwater flow equation $\frac{a^2h}{ax^2} + \frac{a^2h}{\partial y^2} + \frac{\partial^2 h}{\partial z^2} = 0$. where h refers to the hydraulic head and x, y, z are coordinates. is valid when the flow condition is

(A) steady state in isotropic media.

(B) unsteady state in isotropic media.

(C) steady state in anisotropic media.

(D) unsteady State in anisotropic media.

Answer: (A)

Q.No. 2 Match the Formation names in Group I with their dominant lithology in Group II

Group I	Group II
P. Hanseran Formation	1. Sandstone
Q. Nagthat Formation	2. Limestone
R. Bijli Formation	3. Evaporite
S. Shahbad Formation	4. Volcanics

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

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

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

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

Answer: (C)

Q.No. 3 Which one of the following sets of vectors {v1, v2, v3} is linearly dependent?

(A) v1 = (0, -1, 3), v2 = (2, 0, 1) , v3 = (-2, -1, 3)

(B) v1 = (2, -2, 0), v2 = (0, 1, -1) , v3 = (0, 4, 2)

(C) v1 = (2, 6, 2), v2 = (2, 0, -2) , v3 = (0, 4, 2)

(D) v1 = (1, 4, 7), v2 = (2, 5, 8) , v3 = (3, 6, 9)

Answer: (D)

Q.No. 4 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

Answer: (D)

Q.No. 5 Choose the CORRECT set of statements. Statement I: The hydrocarbon source rock in Cambay basin is of Jurassic age. Statement II: Borholla field is in Assam basin. Statement III: Toulene is an aromatic hydrocarbon. Statement IV: Porosity of a reservoir rock increases with increase in sorting.

(A) I, II and III

(B) III and IV

(C) I and II

(D) I and IV only

Answer: (A)

Q.No. 6 Which one of the following radioisotopes has the longest half-life?

(A) 87_{Rb}

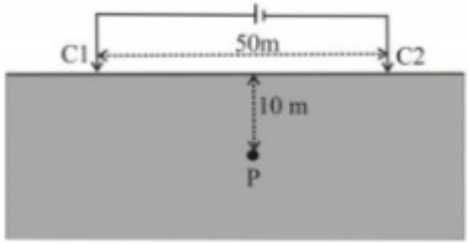
(B) 147_{Sm}

(C) 232_{Th}

(D) 238_{U}

Answer: (B)

Q.No. 7 A pair of current electrodes CI (+I) and C2 (-I) is placed 50m apart (shown in the figure below) over a homogeneous structure of resistivity 100 Ωm and 1 Ampere current flows through the subsurface. Which one of the following is CORRECT for the potential (Vp) and horizontal component of electric field (E_x) at a point P located exactly below the midpoint between C1 and C2 at a depth of 10 m?



(A) $V_p = 0$ and $E_x = 0$

(B) $V_p = 0$ and $E_x \neq 0$

(C) $V_p \neq 0$ and $E_x = 0$

(D) $V_p \neq 0$ and $E_x \neq 0$

Answer: (B)

Q.No. 8 In a 3 D seismic survey, there are 512 groups of receivers in one line of a patch. Eight groups are moved per line from one patch to the next along the swath. What is the inline fold?

(A) 32

(B) 16

(C) 8

(D) 4

Answer: (A)

Q.No. 9 Brightness temperature iV a function of surface temperature and

(A) transmittance.

(B) reflectance.

(C) refractive index.

(D) emissivity

Answer: (D)

Q.No. 10 Assuming the inner core of the Earth to be one-third of its present size, which one of the following statements is CORRECT? (Radius of the Earth and outer core remain unchanged)

(A) Shadow zone of P-wave increases but that of S-wave decreases

(B) Shadow zone of P-wave increases and that of S-wave remains unchanged

(C) Shadow zone of P-wave increases and that of S-wave increases

(D) Shadow zone of P-wave decreases but that of S-wave remains unchanged

Answer: (B)

Q.No. 11 Which one of the following options shows the internal structural units of the Earth arranged in the CORRECT sequence of increasing volume?

(A) Outer core < Inner core < Upper mantle < Lower mantle

(B) Outer core < Inner core < Lower mantle < Upper mantle

(C) Inner core < Outer core < Upper mantle < Lower mantle

(D) Inner core < Outer core < Lower mantle < Upper mantle

Answer: (C)

Q.No. 12 The plunge of the normal to the axial planes of vertical and upright folds is_____.

(A) 0°

(B) 45°

(C) 60°

(D) 90°

Answer: (A)

Q.No. 13 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

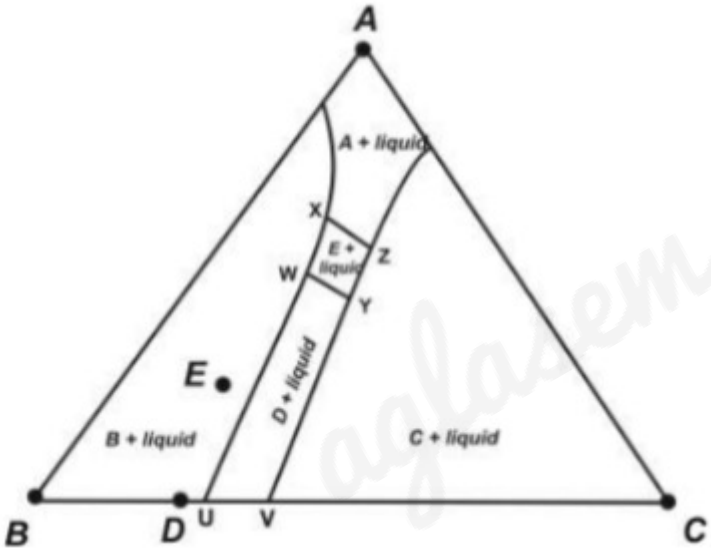
(B) P-1, Q-4, R-2, S-3

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

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

Answer: (D)

Q.No. 14 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

Answer: (D)

Q.No. 15 A reversed refraction survey was done over a two layered medium with the interface between them dipping at an angle of 15°. The velocities in the upper and lower medium are $V_1$and V_2 respectively, with $V_2 > V_1$. If the critical angle is 45°, then, which one of the following is CORRECT? (Vu and Vd are updip and downdip velocities).

(A) $V_1 = V_d = V_u$

(B) $V_u > V_d > V_1$

(C) $V_1 > V_d < V_u$

(D) $V_u < V_d > V_1$

Answer: (B)

Q.No. 16 Which one of the following statements is TRUE for a near surface earthquake occurring in a Homogeneous isotropic Earth?

(A) Rayleigh waves are generated.

(B) Love waves are generated.

(C) Shear waves are split.

(D) P waves undergo refraction.

Answer: (A)

Q.No. 17 Which of the following is NOT a point group?

(A) 222

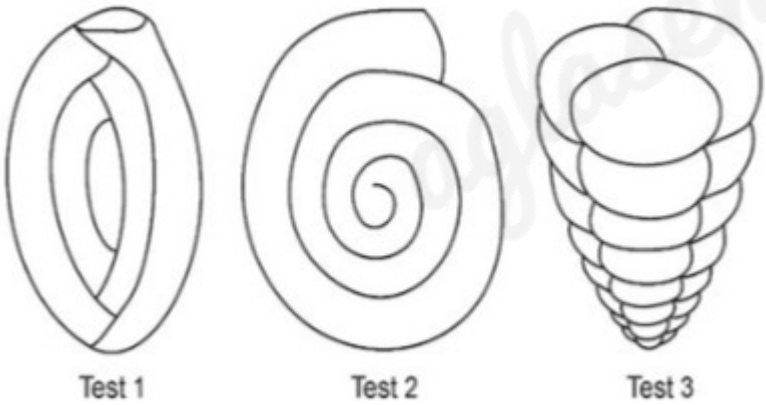
(B) 422

(C) 432

(D) 632

Answer: (D)

Q.No. 18 Choose the CORRECT combination of foraminiferal tests and types of coiling.



(A) Test 1 — Trochospiral, Test 2 — Planispiral, Test 3 — Milioline

(B) Test 1 — Milioline, Test 2 — Planispiral, Test 3 — Trochospiral

(C) Test 1 — Milioline, Test 2 — Trochospiral, Test 3 — Planispiral

(D) Test 1 — Trochospiral, Test 2 — Milioline, Test 3 — Planispiral

Answer: (B)

Q.No. 19 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

Answer: (A)

Q.No. 20 The phase difference between the input and output signals for a ‘Compensator device’ used in electromagnetic prospecting to nullify the effect of primary field at the receiver coil is _____.

(A) 0°

(B) 45°

(C) 90°

(D) 180°

Answer: (D)

Q.No. 21 Which one of the following geophysical methods uses the physical property ‘Dielectric Constant’?

(A) Gravity

(B) Ground Penetrating Radar

(C) Seismic

(D) Self-Potential

Answer: (B)

Q.No. 22 Normal moveout (NMO) correction was applied to seismic data in the common midpoint (CMP) domain. The frequency distortion due to "NMO stretch" is highest for

(A) larger offsets of deeper reflections.

(B) smaller offsets of shallower reflections.

(C) larger offsets of shallower reflections.

(D) smaller offsets of deeper reflections.

Answer: (C)

Q.No. 23 How do the P-wave velocity (Vp), S-wave velocity (Vs), and Poisson's ratio (σ) change from a water saturated sandstone to a gas saturated sandstone?

(A) Vp increases, Vs decreases and σ increases.

(B) Vp decreases, Vs remains the same and σ decreases.

(C) Vp decreases, Vs increases and σ decreases.

(D) Vp,Vs, and σ all remain constant.

Answer: (B)

Q.No. 24 International gravity formula is based on which one of the following models?

(A) Non-rotating homogeneous spherical Earth model

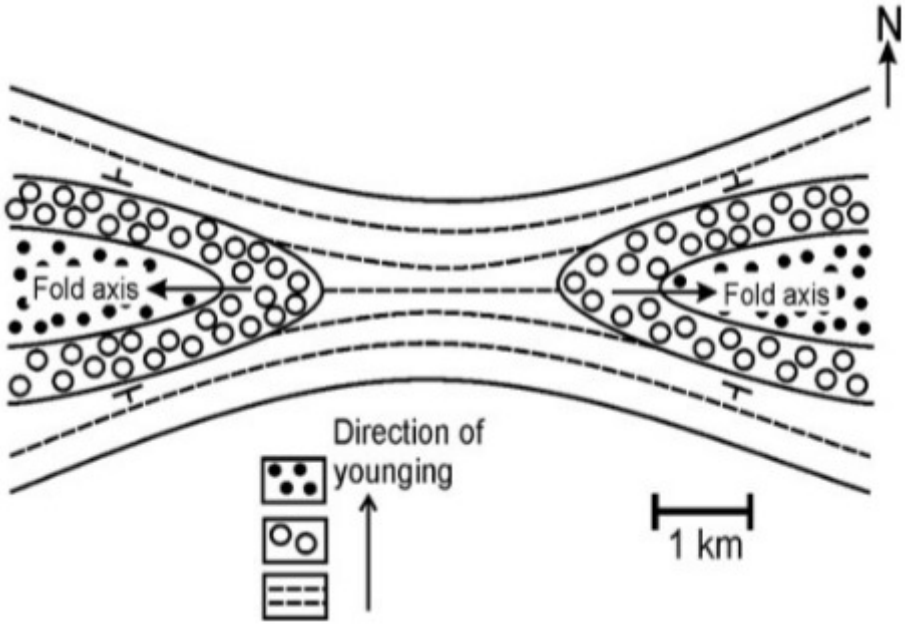
(B) Non-rotating homogeneous oblate spheroidal Earth model

(C) Rotating homogeneous oblate spheroidal Earth model

(D) Rotating inhomogeneous spherical Earth model

Answer: (C)

Q.No. 25 The given geological map represents



(A) culmination of an antiformal anticline

(B) culmination of an antiformal syncline

(C) depression of a synformal anticline

(D) culmination of a synformal syncline

Answer: (B)

Q.No. 26 Which one amongst the following logs has the maximum depth of investigation?

(A) Neutron log

(B) Natural Gamma-ray log

(C) Lateral log

(D) Density log

Answer: (C)

Q.No. 27 What are the Miller indices Of a plane that intercepts each of the crystallographic axes X, Y and Z, at 20 Å? (Assume a primitive unit-cell with the dimensions a = 5Å, b = 2 Å and c = 4 Å.)

(A) (111)

(B) (524)

(C) (425)

(D) (542)

Answer: (B)

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Q.No. 28 Based on the three statements given below, choose the CORRECT option. Statement I: Barchans are crescent-shaped dunes that close in the downwind direction. Statement II: Parabolic dunes are U-shaped dunes that close in the downwind direction. Statement Ill: Barchanoid dunes are sinuous transverse ridges, the crestline sinuousity of successive bedforms are either in-phase or out-phase.

(A) All the statements are correct

(B) Statement I is correct, but statements II and Ill are incorrect

(C) Statements I and II are correct, but statement Ill is incorrect

(D) Statements II and Ill are correct, but statement I is incorrect

Answer: (D)

Q.No. 29 If G(ω) is the Fourier transform of g(t), then the Fourier transform of g(t + ln 2) will be _____.

(A) $e^{-2j\omega G(\omega)}$

(B) $e^{2j\omega G(\omega)}$

(C) $2^{ej\omega G(\omega)}$

(D) $2^{e-j\omega G(\omega)}$

Answer: (A)

Q.No. 30 The magnetic potential of a uniform vertically magnetized buried spherical body with uniform density is given as $W = \frac{\mu_0}{4\pi G}\frac{I}{\rho} g_Z$. Then, the vertical magnetic field B_z is proportional to [I = intensity of magnetization, ρ = density, g_z = vertical component of gravity field, G = Universal gravitational constant, $\boldsymbol{\mu}_o$ = magnetic permeability of free space, coordinate of the center of the body is (0, z) and that of the observation point is (x, 0)]

(A) $\frac{2z^2-x^2}{\left(z^2+x^2\right)^{\frac{5}{2}}}$

(B) $\frac{2z^2-x^2}{\left(z^2+x^2\right)^{\frac{3}{2}}}$

(C) $\frac{z^2-x^2}{\left(z^2+x^2\right)^{\frac{5}{2}}}$

(D) $\frac{z^2-x^2}{\left(z^2+x^2\right)^{\frac{3}{2}}}$

Answer: (A)

Q.No. 31 Miich one of the following microfossils is commonly used in biostratigraphic correlation of Palaeozoic marine strata?

(A) Angiosperm pollen

(B) Diatom

(C) Dinoflagellates

(D) Chitinozoans

Answer: (D)

Q.No. 32 A siliciclastic sedimentary rock with <5% matrix and QFL composition Of 60% quartz, 30% rock fragments and 10% feldspar, is called

(A) quartz wacke

(B) lithic arenite

(C) quartz arenite

(D) feldspathic wacke

Answer: (B)

Q.No. 33 Arrange the following stratigraphic formations sequentially from Older to younger. (P) Jodhpur Sandstone (Q) Cambay Shale (R) Kajrahat Limestone (S) Tipam Sandstone

(A) P,R,Q,S

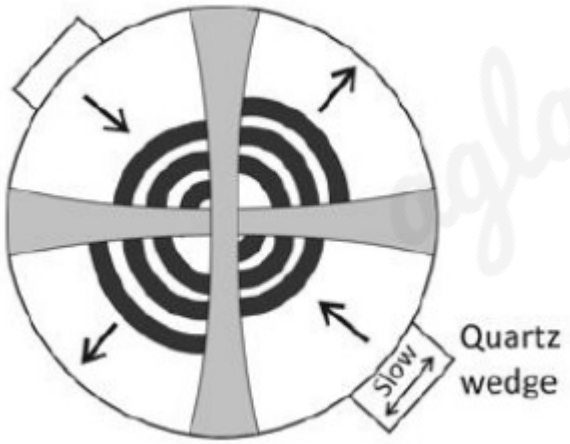
(B) R,Q,P,S

(C) P,S,R,Q

(D) R,P,Q,S

Answer: (D)

Q.No. 34 The diagram below shows the interference figure of a mineral. The mineral is



(A) uniaxial positive.

(B) biaxial negative.

(C) triaxial negative.

(D) biaxial positive.

Answer: (C)

Q.No. 35 In gravity anomalies, the 'Indirect effect' mainly arises from _____.

(A) the sources outside the area of investigation

(B) improper instrument drift

(C) effect of mass lying between the geoid and ellipsoid

(D) short-wavelength uncompensated masses in the subsurface

Answer: (C)

Q.No. 36 The supercontinent that existed in the late Mesoproterozoic to early Neoproterozoic time was

(A) Kenorland

(B) Columbia

(C) Rodinia

(D) Pangaea.

Answer: (C)

Q.No. 37 Which one of the following minerals has poor cleavage in all directions?

(A) Fluorite

(B) Orthoclase

(C) Quartz

(D) Muscovite

Answer: (C)

Q.No. 38 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}

Answer: (A)

Q.No. 39 The effect of small scale near surface inhomogeneities can be removed from magnetic data by

(A) upward continuation.

(B) downward continuation.

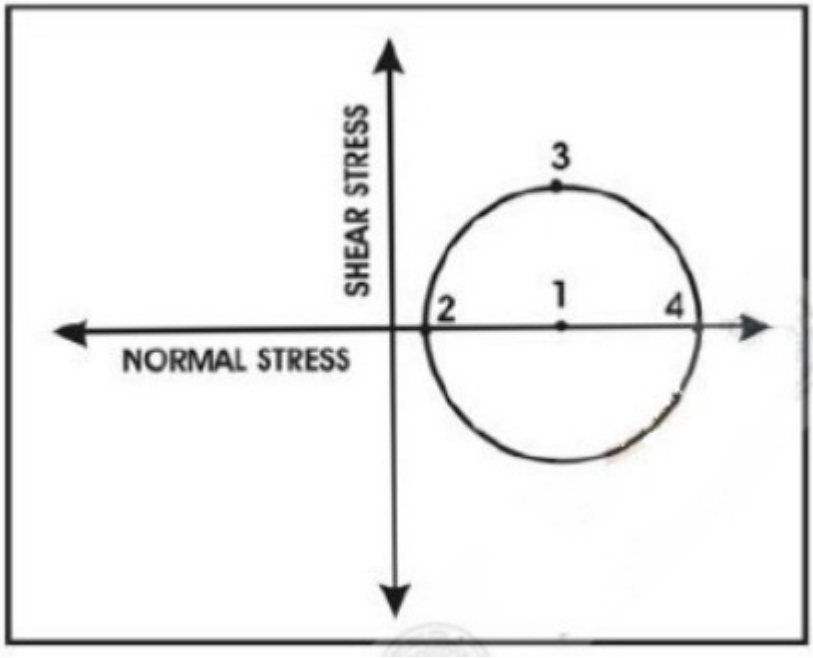
(C) second vertical derivative.

(D) reduction to pole.

Answer: (A)

Q.No. 40 The diagram given below shows a Mohi circle for two-dimensional stress with points as shown. The mean stress and the maximum shear stress are given by Which one of the following number pairs?

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(A) 1,2

(B) 1,3

(C) 1,4

(D) 2,3

Answer: (B)

Q.No. 41 The difference in the mobility of ions in the electrolyte and electrons in metallic conductors in the sub-surface due to applied external electric field gives rise to _____.

(A) electrode polarization

(B) membrane polarization

(C) electro-kinetic potential

(D) electro-chemical potential

Answer: (A)

Q.No. 42 Match foraminifera in Group I with its wall structure in Group II

Group I	**Group II**
P. *Fusulina*	1. Hyaline
Q. *Cibicides*	2. Porcellaneous
R. *Textularia*	3. Microgranular
S. *Quinqueloculina*	4. Agglutinated

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

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

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

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

Answer: (D)

Q.No. 43 Match the geophysical terms in Group—I with their corresponding units of measurements in Group—II.

Group-I	Group-II
P. Transit time	1. mGal
Q.Conductivity	2. nano Tesla
R. Gravity anomaly	3. siemens
S. Magnetic field intensity	4. millivolt
	5. microsecond per feet

(A) P-5,Q-4,R-2,S-1

(B) P-5,Q-4,R-3,S-2

(C) P-5,Q-3,R-1,S-2

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

Answer: (C)

Q.No. 44 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.

Answer: (C)

Q.No. 45 Which one of the following is NOT an earthquake intensity scale?

(A) Richter scale

(B) JMA scale

(C) Modified Mercalli scale

(D) Rossi-Forel scale

Answer: (A)

Q.No. 46 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

Answer: (A)

Q.No. 47 The ratio of eccentricity to the polar flattening of an ellipsoidal Earth with equatorial radius 'e' and polar radius 'p' can be expressed as

(A) $\frac{\sqrt{e^2+p^2}}{\sqrt{e-p}}$

(B) $\frac{\sqrt{e^2-p^2}}{\sqrt{e+p}}$

(C) $\frac{\sqrt{e+p}}{\sqrt{e-p}}$

(D) $\frac{\sqrt{e^2+p^2}}{\sqrt{e+p}}$

Answer: (C)

Q.No. 48 Choose the CORRECT combination for the following two statements. Statement I: Four elements that make up about 90% of the bulk Earth are Fe, O, Si and Mg (in decreasing order of wt % abundance). Statement II: The four most abundant elements in the Earth's crust (in decreasing order of wt % abundance) are O, Si, Al and Fe.

(A) Both Statements I and II are correct.

(B) Both Statements I and II are incorrect.

(C) Statement I is correct and Statement II is incorrect.

(D) Statement I is incorrect and Statement II is correct.

Answer: (A)

Q.No. 49 Stream power is the product of specific weight of water with _____.

(A) hydraulic radius and Manning roughness coefficient

(B) wetted perimeter and slope

(C) slope and discharge

(D) discharge and Manning roughness coefficient

Answer: (C)

Q.No. 50 The flexural rigidity (D) of the oceanic lithosphere (assuming no secondary thermal perturbations) _____.

(A) increases with both age and plate cooling

(B) decreases with age and increases with plate cooling

(C) increases with age and decreases with plate thickness

(D) decreases with both age and plate thickness

Answer: (A)

Q.No. 51 A massive sulphide body in the subsurface is partially above the water table. According to the pH variation hypothesis for the origin of Self Potential, which one of the following statements is CORRECT for such a body?

(A) Acidic above and basic below the water table.

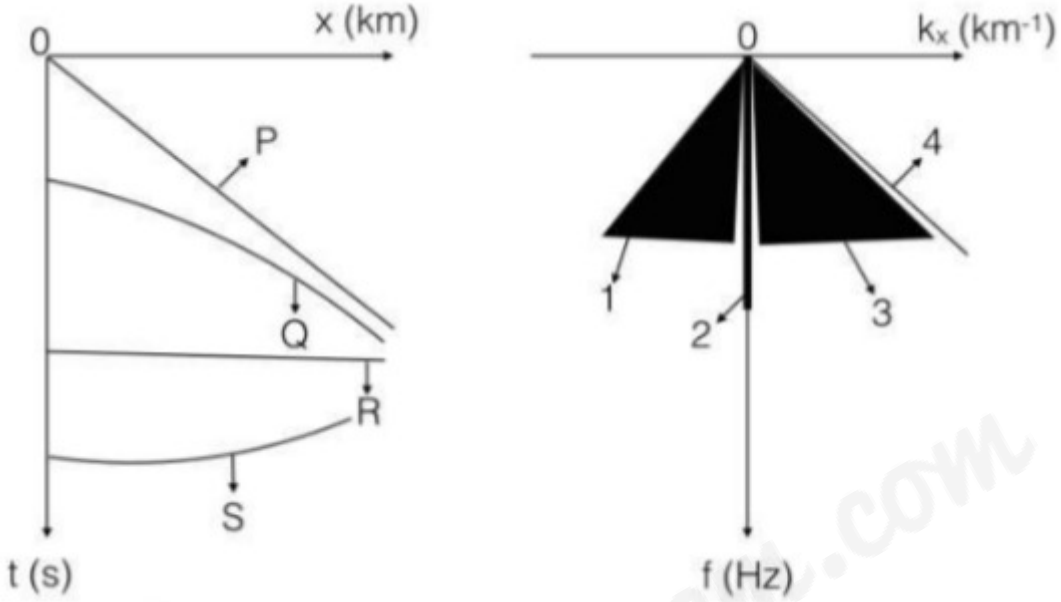
(B) Basic above and acidic below the water table.

(C) Acidic above and below the water table.

(D) Basic above and below the water table.

Answer: (A)

Q.No. 52 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.



(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

Answer: (C)

Q.No. 53 Match the sedimentary rocks and their features listed in Group I with depositional environments listed in Group II.

Group I	Group II
(P) Sandstone with belling-bone cross bedding	(l) Eolian
(Q) Chalk with coccolith	(2) Glacial
(R) Well sorted arenite with large cross bedding (5-10 m thick)	(3) Sabkha
(S) Poorly sorted sediments with faceted and striated pebbles	(4) Tidal
	(5) Pelagic

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

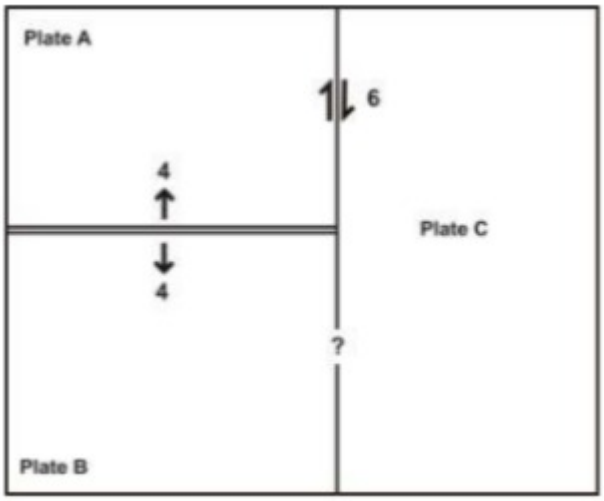
(B) P-3,Q-5,R-1,S-2

(C) P-5,Q-2,R-4,S-1

(D) P-3,Q-5,R-2,S-4

Answer: (B)

Q.No. 54 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.

Answer: (C)

Q.No. 55 Choose the CORRECT combination for the following four statements. Statement I: Anhydrous partial melting of peridotites produces basaltic magma. Statement II: Hydrous melting of peridotites produces andesitic magma. Statement III: Congruent melting of minerals produces liquids of compositions identical to the minerals. Statement IV: Incongruent melting of minerals produces liquids of different compositions and new solids.

(A) All the four statements I to IV are correct.

(B) Statements I, II and III are correct but statement IV is incorrect.

(C) Statements I and II are correct but statements III and IV are incorrect.

(D) All the four statements I to IV are incorrect.

Answer: (A)