Q. 1 – Q. 5 carry one mark each.

Q.1 The fishermen, _____ the flood victims owed their lives, were rewarded by the government.

(A) whom (B) to which (C) to whom (D) that

Q.2 Some students were not involved in the strike.

If the above statement is true, which of the following conclusions is/are logically necessary?

1. Some who were involved in the strike were students.
2. No student was involved in the strike.
3. At least one student was involved in the strike.
4. Some who were not involved in the strike were students.

(A) 1 and 2 (B) 3 (C) 4 (D) 2 and 3

Q.3 The radius as well as the height of a circular cone increases by 10%. The percentage increase in its volume is _____.

(A) 17.1 (B) 21.0 (C) 33.1 (D) 72.8

Q.4 Five numbers 10, 7, 5, 4 and 2 are to be arranged in a sequence from left to right following the directions given below:
1. No two odd or even numbers are next to each other.
2. The second number from the left is exactly half of the left-most number.
3. The middle number is exactly twice the right-most number.

Which is the second number from the right?

(A) 2 (B) 4 (C) 7 (D) 10

Q.5 Until Iran came along, India had never been _____ in kabaddi.

(A) defeated (B) defeating (C) defeat (D) defeatist

Q. 6 – Q. 10 carry two marks each.

Q.6 Since the last one year, after a 125 basis point reduction in repo rate by the Reserve Bank of India, banking institutions have been making a demand to reduce interest rates on small saving schemes. Finally, the government announced yesterday a reduction in interest rates on small saving schemes to bring them on par with fixed deposit interest rates.

Which one of the following statements can be inferred from the given passage?

(A) Whenever the Reserve Bank of India reduces the repo rate, the interest rates on small saving schemes are also reduced

(B) Interest rates on small saving schemes are always maintained on par with fixed deposit interest rates

(C) The government sometimes takes into consideration the demands of banking institutions before reducing the interest rates on small saving schemes

(D) A reduction in interest rates on small saving schemes follow only after a reduction in repo rate by the Reserve Bank of India

Q.7 In a country of 1400 million population, 70% own mobile phones. Among the mobile phone owners, only 294 million access the Internet. Among these Internet users, only half buy goods from e-commerce portals. What is the percentage of these buyers in the country?

(A) 10.50 (B) 14.70 (C) 15.00 (D) 50.00

Q.8 The nomenclature of Hindustani music has changed over the centuries. Since the medieval period *dhrupad* styles were identified as *baanis*. Terms like *gayaki* and *baaj* were used to refer to vocal and instrumental styles, respectively. With the institutionalization of music education the term *gharana* became acceptable. *Gharana* originally referred to hereditary musicians from a particular lineage, including disciples and grand disciples.

Which one of the following pairings is NOT correct?

(A) *dhrupad*, *baani*
(B) *gayaki*, vocal
(C) *baaj*, institution
(D) *gharana*, lineage

Q.9 Two trains started at 7AM from the same point. The first train travelled north at a speed of 80km/h and the second train travelled south at a speed of 100 km/h. The time at which they were 540 km apart is _____ AM.

(A) 9 (B) 10 (C) 11 (D) 11.30

Q.10 "I read somewhere that in ancient times the prestige of a kingdom depended upon the number of taxes that it was able to levy on its people. It was very much like the prestige of a head-hunter in his own community."

Based on the paragraph above, the prestige of a head-hunter depended upon _____

(A) the prestige of the kingdom
(B) the prestige of the heads
(C) the number of taxes he could levy
(D) the number of heads he could gather

END OF THE QUESTION PAPER

PART A: COMPULSORY SECTION FOR ALL CANDIDATES

Q. 1 – Q. 25 carry one mark each.

Q.1 On the present-day global plate tectonic map, the Reunion hotspot is located in the_____.

(A) Indian Plate
(B) Australian Plate
(C) African Plate
(D) Antarctic Plate

Q.2 Which one of the following statements about the planetary motion of the Solar system is INCORRECT?

(A) The orbital-radius of planets sweep out equal areas in equal intervals of time.
(B) The orbital speed of planets is constant throughout their respective orbits.
(C) Planets revolve in anticlockwise direction relative to a point above the plane of planetary motion.
(D) At least one focus of the elliptical orbit of each planet lies at the same point.

Q.3 Choose the CORRECT combination for the following two statements

Statement-I: The correct order of magnetic chrons from the oldest to the youngest is Gilbert-Gauss-Matuyama-and Bruhnes.

Statement -II: Magnetic chrons Gilbert and Matuyama are reverse whereas Gauss and Bruhnes are normal.

(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.

Q.4 Body waves _____.

(A) can travel through vacuum
(B) have cylindrical wavefronts
(C) are mechanical waves
(D) are known as ground roll

Q.5 The acceleration due to gravity (g) begins to fall sharply towards the centre of the Earth from the _____ discontinuity.

(A) Conrad
(B) Mohorovicic
(C) Gutenberg
(D) Lehmann

Q.6 Which one of the following lists ONLY kinematic parameters?

(A) Force, translation, rotation.
(B) Translation, rotation, distortion.
(C) Stress, distortion, translation.
(D) Force, stress, strain.

Q.7 The plunge of the normal to the axial planes of vertical and upright folds is_____.

(A) 0° (B) 45° (C) 60° (D) 90°

Q.8 Which one of the following rocks is associated with metamorphic thermal aureoles?

(A) Chlorite schist (B) Amphibolite (C) Hornfels (D) Glaucophane schist

Q.9 Which one of the following clay minerals contain potassium (K)?

(A) Illite
(B) Kaolinite
(C) Montmorillonite
(D) Vermiculite

Q.10 Which one of the following sequences of minerals CORRECTLY list an increasing rate of dissolution during chemical weathering?

(A) Olivine-Quartz-Pyroxene-Orthoclase
(B) Quartz-Orthoclase-Pyroxene-Olivine
(C) Olivine-Pyroxene-Orthoclase-Quartz
(D) Quartz-Olivine-Orthoclase-Pyroxene

Q.11 Which one of the following combination of reservoir and cap rock respectively, is suitable for oil accumulation?

(A) Limestone-Sandstone
(B) Dolomite-Evaporite
(C) Sandstone-Conglomerate
(D) Shale-Limestone

Q.12 Bituminous coal is found in _____.

(A) Neyveli (B) Panandhro (C) Singareni (D) Vastan

Q.13 Extinction of Trilobites is associated with which one of the following geological time boundaries?

(A) Ordovician-Silurian
(B) Permian-Triassic
(C) Triassic-Jurassic
(D) Cretaceous-Palaeogene

Q.14 Transmissivity of an aquifer is the product of _____.

(A) saturated thickness and storitivity
(B) hydraulic conductivity and storitivity
(C) saturated thickness and hydraulic conductivity
(D) saturated thickness and hydraulic head

Q.15 Which one of the following is only a correction and not a reduction in the computation of gravity anomalies with respect to a datum?

(A) Free air (B) Bouguer (C) Terrain (D) Isostatic

Q.16 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

Q.17 A high frequency acoustic wave propagating in a gas saturated sandstone formation exhibits an increase in _____.

(A) frequency (B) velocity (C) wavelength (D) wave number

Q.18 Which one of the following logging methods uses a radioactive source in the sonde?

(A) Natural Gamma ray
(B) Gamma-Gamma
(C) Natural Gamma ray spectroscopy
(D) Nuclear Magnetic Resonance (NMR)

Q.19 Isodynamic contours of the geomagnetic field represent lines of equal _____.

(A) inclination
(B) declination
(C) total field intensity
(D) magnetic potential

Q.20 A Very Low Frequency (VLF) electromagnetic survey is conducted for the delineation of 2-D conducting mineralization located at 50 m depth from the surface with different geological formations as the overburden layer. For which of the following geological overburden layers given below, will the VLF method fail to yield response?

(A) Granite
(B) Snow
(C) Dry sand
(D) Saline water saturated sand

Q.21 Assuming Airy isostatic compensation, the depth to the Moho from a point located 2 km above the mean sea level is _____ km. (round off to 1 decimal place).
(The depth of compensation T for the crust at mean sea level is 30 km, the density of crust and upper mantle are 2.67 gm/cc and 3.30 gm/cc, respectively).

Q.22 On Survey of India Toposheet number 45 $\frac{D}{16}$, the distance between two points is 18 cm. The actual ground distance between these two points is _____km.

Q.23 For a dam site investigation, drilling was carried out up to a depth of 20 m. The total length of recovered core pieces, each over 100 mm, add up to 16 m. The Rock Quality Designation (RQD) of the foundation rock mass is _____%.

Q.24 Given that $\left(\frac{^{18}O}{^{16}O}\right)_{V-SMOW} = 2005.2 \times 10^{-6}$, the $\left(\frac{^{18}O}{^{16}O}\right)$ of a sample whose $\left(\delta^{18}O\right)_{V-SMOW} = +25‰$ is _____× 10^{-6} (round off to 1 decimal place).

Q.25 The shear wave velocity in an igneous rock with a density of 2.7 gm/cc and rigidity modulus of 24.3 GPa is _____ km/s. (round off to 1 decimal place).

PART B (SECTION 1): FOR GEOLOGY CANDIDATES ONLY

Q. 26 – Q. 55 carry two marks each.

Q.26 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

Q.27 Match the landforms given in Group I to the causative process in Group II

Group I	**Group II**
P. Seif	1. Coastal
Q. Spit	2. Aeolian
R. Levee	3. Glacial
S. Drumlin	4. Fluvial

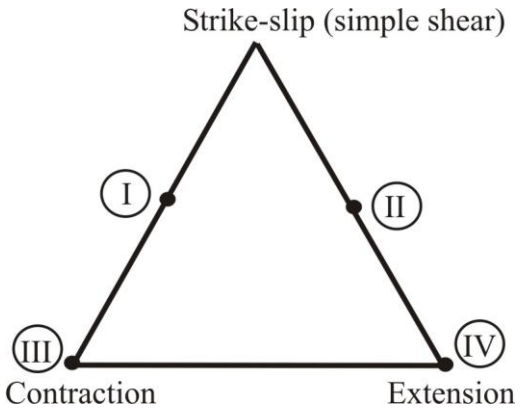
(A) P-2; Q-3; R-1; S-4
(B) P-1; Q-2; R-4; S-3
(C) P-4; Q-3; R-1; S-2
(D) P-2; Q-1; R-4; S-3

Q.28 In a thrust fault exhibiting ramp and flat geometry which one of the following pairs defines a **Flat**?

	Fault dip	**Bedding dip**
(I)	0°	20°N
(II)	30°N	30°S
(III)	40°S	40°N
(IV)	60°N	60°N

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

Q.29 In the given diagram, which one of the combinations CORRECTLY lists structures typically developed at I, II, III, IV?



(A) I-pressure ridge, II-thrust, III-horst, IV-pull-apart basin
(B) I- pull-apart basin, II-thrust, III-horst, IV-pressure ridge
(C) I-pressure ridge, II-pull-apart basin, III-thrust, IV-horst
(D) I- pull-apart basin, II- pressure ridge, III-horst, IV-thrust

Q.30 The best developed lineation and foliation traces in a L-S tectonite will be observed on a plane _____.

(A) parallel to the lineation and foliation
(B) perpendicular to the lineation and foliation
(C) perpendicular to the foliation but parallel to the lineation
(D) perpendicular to the lineation but parallel to the foliation

Q.31 Match the type of twinning (Group I) with the mineral (Group II) that best exhibits it

Group I	**Group II**
P. Carlsbad	1. Rutile
Q. Pericline	2. Quartz
R. Brazil	3. Orthoclase
S. Geniculated (elbow)	4. Plagioclase

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

Q.32 On inserting a first order red interference filter in SE-NW direction, the interference figure of quartz shows

(A) blue in NE, SW quadrants and yellow in NW, SE quadrants.
(B) yellow in NE, SW quadrants and blue in NW, SE quadrants.
(C) blue in NE, NW quadrants and yellow in SW, SE quadrants.
(D) yellow in NE, NW quadrants and blue in SW, SE quadrants.

Q.33 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.

Q.34 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.

Q.35 The value of salinity, in terms of wt.% NaCl equivalent, of an aqueous saline bi-phase liquid-vapour fluid inclusions is determined by measurement of _____ during microthermometry.

(A) last ice-melting temperature
(B) dissolution temperature of halite
(C) eutectic temperature
(D) homogenization temperature

Q.36 Which of the following case (s) represent (s) textural inversion in sandstone?

Case I: Rounded grains in clayey matrix.

Case II: Rounded, but poorly sorted grains.

(A) Only case I.
(B) Only case II.
(C) Both cases I and II.
(D) Neither case I nor case II.

Q.37 Which one of the following set of statements regarding the overall nature of marine shelf succession is CORRECT?
Statement I: Transgressive systems tract deposit is deepening upward
Statement II: Highstand systems tract deposit is deepening upward
Statement III: Falling stage systems tract deposit is deepening upward
Statement IV: Lowstand systems tract deposit is overall shallowing upward

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

Q.38 Which of the following set of statements is CORRECT?
Statement I: A well sorted sandstone bed showing current ripple, planar laminae, convolute laminae and prod marks.
Statement II: A poorly sorted sandstone bed showing wave ripples, dish structure, pillar structure and groove casts.
Statement III: A well sorted sandstone bed showing desiccation cracks, current crescent planar laminae and convolute laminae.
Statement IV: A poorly sorted sandstone bed showing current ripple, planar laminae, skip marks and load casts.

(A) I,II and III
(B) II,III and IV
(C) I, III and IV
(D) I, II and IV

Q.39 In metamafites, which one of the following mineral assemblages is stable under green schist facies conditions?

(A) Albite + Chlorite + Actinolite + Epidote
(B) Andesine + Biotite + Hornblende
(C) Oligoclase + Biotite + Hornblende
(D) Oligoclase + Epidote + Biotite + Hornblende

Q.40 Match the type of metamorphism listed in Group I with their products in Group II.

Group I	**Group II**
P. Contact metamorphism	1. Impactite
Q. Shear zone metamorphism	2. Spillite
R. Ocean floor metamorphism	3. Mylonite
S. Shock metamorphism	4. Skarn

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

Q.41 Glaucophane schist forms in _____.

(A) subduction zones
(B) pull-apart basins
(C) continental rifts
(D) mid-oceanic ridges

Q.42 Which one of the following statements is CORRECT about bivalve habitat?

(A) *Gryphaea* is a burrowing variety.
(B) *Pholas* is a free lying form.
(C) *Lucina* is a boring variety.
(D) *Mytilus* is a bysally attached form.

Q.43 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

Q.44 Which one of the following stratigraphic units represents the CORRECT order of younging?

(A) Trichinopally Group - Uttatur Group - Ariyalur Group - Niniyur Group
(B) Kopili Formation - Sylhet Formation - Barail Formation - Boka Bil Formation
(C) Chinji Formation - Nagri Formation - Dhok Pathan Formation - Tatrot Formation
(D) Barakar Formation - Talchir Formation - Barren Measures - Raniganj Formation

Q.45 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

Q.46 Match the economic deposits in Group I with their occurrence in stratigraphic units in Group II

Group I	**Group II**
P. Phosphate	1. Sargur Group
Q. Manganese	2. Nallamalai Group
R. Chromite	3. Udaipur Formation
S. Barite	4. Mansar Formation

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

Q.47 Match the basin type in Group I with Indian example provided in Group II

Group I	**Group II**
P. Foreland basin	1. Kerala-Konkan
Q. Passive margin	2. Cambay
R. Fore-arc	3. Ganga
S. Failed rift	4. Andaman

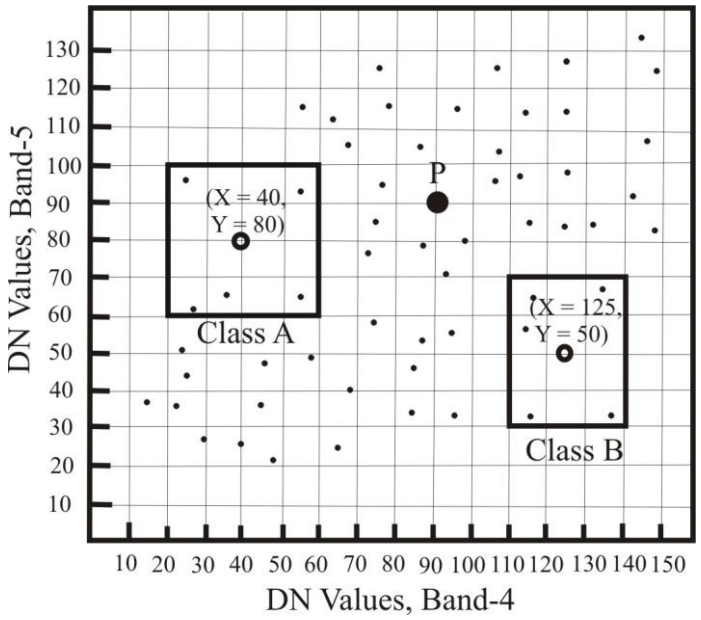
(A) P-3, Q-2, R-4, S-1
(B) P-3, Q-1, R-4, S-2
(C) P-4, Q-1, R-3, S-2
(D) P-1, Q-2, R-4, S-3

Q.48 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.

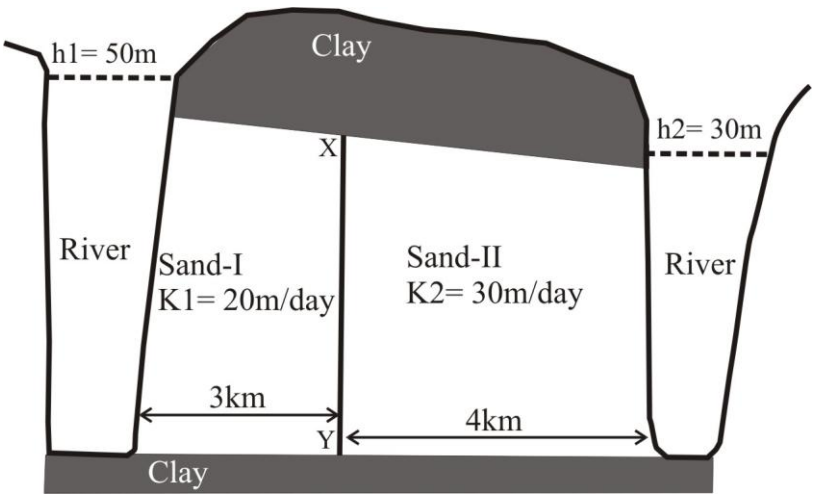
(A) I, II and III
(B) II, III and IV
(C) I and IV
(D) I and III only

Q.49 The figure given below represents a scatter plot of Digital Numbers (DN) of Band 4 and Band 5 of a satellite imagery. The fields of Class A and Class B are indicated by the rectangular boxes along with their class means (open circles). Class assignment for the point P by Minimum Distance to Mean (MDM) and Nearest Neighbour (NN) algorithms are _____.

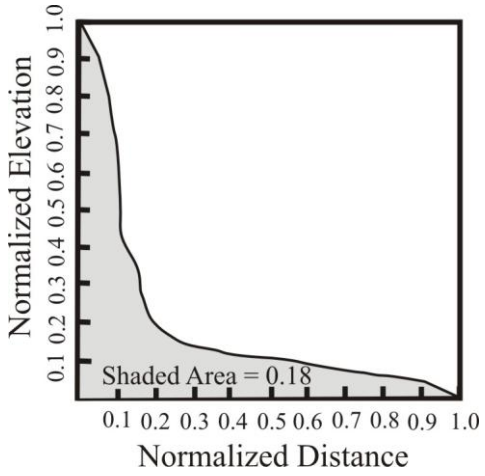


(A) Class A by MDM and class B by NN
(B) Class A by NN and class B by MDM
(C) Class A by both MDM and NN
(D) Class B by both MDM and NN

Q.50 Hydrogeological setup of a hypothetical alluvial area (where contact X-Y between two sands is vertical) is given in the schematic section. Hydraulic heads are indicated as h1, h2 and hydraulic conductivities as K1 and K2. The hydraulic head at the contact (X-Y) is _____ m. (round off to 2 decimal places).



Q.51 The normalized longitudinal profile of a river is given below. The Concavity Index of the river is_____ %.



Q.52 For producing 1 kg of gold from an ore having an assay of 2 ppm Au, _____ × 10^3 kg of ore needs to be processed.

Q.53 A cylindrical core of granite with a radius of 25 mm was subjected to point load test. The load was applied parallel to the diameter of the core and the failure load was 20 kN. The uncorrected point load strength index is _____ MPa.

Q.54 A hypothetical garnet peridotite composed of 60% olivine, 25% orthopyroxene, 10% clinopyroxene and 5% garnet undergoes 10% batch melting described by $\frac{C_L}{C_O} = \frac{1}{F+D-F*D}$ where F is degree of melting and D is bulk partition coefficient. The ratio of Ce in the melt to the original rock will be _____. (round off to 2 decimal places).
(The K_D values of Ce for olivine, orthopyroxene, clinopyroxene and garnet are 0.001, 0.003, 0.10 and 0.02, respectively)

Q.55 ^{87}Rb decays to ^{87}Sr with a decay constant $\lambda = 1.42 \times 10^{-11}$ per year. If at the time of formation, a system contains 8×10^4 atoms of ^{87}Rb and 10^3 atoms of ^{87}Sr, the number of ^{87}Sr atoms in this system at the end of 4 half-lives will be _____×10^3. Assume close system evolution for parent-daughter pair.

PART B (SECTION 2): FOR GEOPHYSICS CANDIDATES ONLY

Q. 56 – Q. 85 carry two marks each.

Q.56 The Young's modulus 'E' is related to the Lame's parameter 'λ' for a Poisson solid as _____.

(A) $E = 2.5\lambda$ (B) $E = 1.5\lambda$ (C) $E = \lambda$ (D) $E = 0.5\lambda$

Q.57 Which one of the following seismic phases is the earliest arrival in the P shadow zone?

(A) PKiKP (B) PPP (C) P_{diff} (D) PKIKP

Q.58 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? (V_u and V_d 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) $V_u < V_d > V_1$

Q.59 In a migrated seismic time section _____.

(A) both synclines and anticlines appear tighter
(B) both synclines and anticlines appear broader
(C) synclines appear tighter and anticlines appear broader
(D) synclines appear broader and anticlines appear tighter

Q.60 Which one of the following is CORRECT for the density porosity (ϕ_D) and neutron porosity (ϕ_N) estimated for a finely interbedded organic-rich, shaly sandstone formation relative to those for a shale-free sandstone formation at shallow depths?

(A) ϕ_N decreases and ϕ_D increases.
(B) ϕ_N increases and ϕ_D decreases.
(C) Both ϕ_N and ϕ_D decrease.
(D) Both ϕ_N and ϕ_D increase.

Q.61 Which one of the following statements is INCORRECT with regard to Nuclear Magnetic Resonance (NMR) logging? (ϕ_{NMR} - NMR derived total porosity, ϕ_D - Density porosity)

(A)The relaxation time (T2) decreases with decrease in pore size.
(B)The ϕ_{NMR} is greater than ϕ_D in a water saturated sandstone formation.
(C)The NMR logs provide lithology independent measurement of total porosity.
(D)The ϕ_{NMR} is less than ϕ_D in a gas saturated shaly sandstone formation.

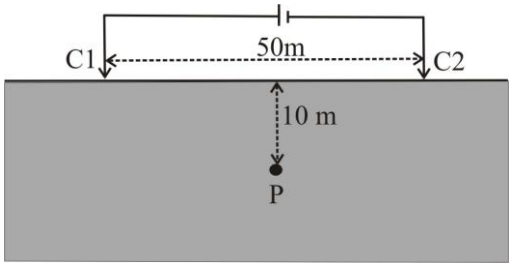
Q.62 A 3-D seismic tomography experiment was carried out with an inter-station spacing of 'X' km. The subsurface velocity perturbations in three dimensional blocks were estimated with block size of '2X'km and '0.5X'km in case 1 and case 2, respectively. Which one of the following statements is CORRECT?

(A) The spatial resolution is poor and variance is small for case 1.
(B) The spatial resolution is good and variance is small for case 2.
(C) The spatial resolution is good and variance is large for case 1.
(D) The spatial resolution is poor and variance is large for case 2.

Q.63 A shallow focus, Great earthquake with seismic moment of 2.5×10^{40} dyne-cm is recorded at an epicentral distance of 50°. The body wave magnitude (mb), surface wave magnitude (Ms) and moment magnitude (Mw) were estimated. Which one of the following is CORRECT?

(A) mb > Ms > Mw
(B) mb = Ms = Mw
(C) mb < Ms < Mw
(D) mb < Ms > Mw

Q.64 A pair of current electrodes C1 (+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 (V_p) 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 $E_x \neq 0$

Q.65 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.

Q.66 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°

Q.67 In an electromagnetic scale modeling experiment in the lab, the relation between the field and lab geometrical scaling factor (n) with the field and lab resistivity (ρ_f & ρ_m) as well as frequencies (f_f & f_m) will be _____.
(subscripts *f* and *m* refer to field and lab systems and n >> 1)

(A) $n^2 = \left(\frac{\rho_f}{\rho_m}\right)\left(\frac{f_m}{f_f}\right)$ (B) $n^2 = \left(\frac{\rho_f}{\rho_m}\right)\left(\frac{f_f}{f_m}\right)$

(C) $n^2 = \left(\frac{\rho_m}{\rho_f}\right)\left(\frac{f_m}{f_f}\right)$ (D) $n^2 = \left(\frac{\rho_m}{\rho_f}\right)\left(\frac{f_f}{f_m}\right)$

Q.68 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) $2e^{j\omega}G(\omega)$ (D) $2e^{-j\omega}G(\omega)$

Q.69 The primary objective of 'Regularization' in geophysical inversion is to _____.

(A) improve the resolution
(B) reduce the non-uniqueness
(C) enhance the condition number
(D) stabilize the inversion process

Q.70 P is a point on the Earth's surface defined by radius (r), colatitude (θ), and longitude (ϕ) in spherical coordinate system. The three components of the magnetic induction 'B' at P in Cartesian coordinate system are B_x, B_y and B_z (x-North, y-East and z-downward). For the relation B = -∇V (V is the magnetic potential), the B_x, B_y, and B_z can be expressed in spherical coordinate system as _____.

(A) $B_x = \frac{\partial V}{\partial \theta}, \quad B_y = -\frac{1}{r sin\theta}\frac{\partial V}{\partial \phi}, \quad B_z = \frac{1}{r}\frac{\partial V}{\partial r}$

(B) $B_x = \frac{1}{r}\frac{\partial V}{\partial r}, \quad B_y = -\frac{1}{sin\theta}\frac{\partial V}{\partial \phi}, \quad B_z = \frac{\partial V}{\partial \theta}$

(C) $B_x = \frac{1}{r}\frac{\partial V}{\partial \theta}, \quad B_y = -\frac{1}{r sin\theta}\frac{\partial V}{\partial \phi}, \quad B_z = \frac{\partial V}{\partial r}$

(D) $B_x = \frac{\partial V}{\partial \theta}, \quad B_y = \frac{1}{r sin\theta}\frac{\partial V}{\partial \phi}, \quad B_z = \frac{1}{r}\frac{\partial V}{\partial r}$

Q.71 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

Q.72 For defining the axial geocentric magnetic dipole of the Earth's magnetic field using the spherical harmonic expression for magnetic potential, the three non-zero Gauss coefficients for n = 1 are _____.

(A) $g_0^0,\ g_1^0,\ h_1^0$ (B) $g_1^0,\ g_1^1,\ h_1^1$ (C) $g_1^0,\ g_1^1,\ h_1^0$ (D) $g_1^0,\ g_1^1,\ h_0^0$

Q.73 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

Q.74 If ΔJ and Δσ are the uniform magnetization and density contrasts respectively, of a point source, the relation between the vertical components of the gravity (g_z) and magnetic (T_z) anomalies can be expressed (neglecting long-wavelength component) as _____. (G is Gravitational constant)

(A) $T_z = G\frac{\Delta J}{\Delta\sigma}\frac{\partial g_z}{\partial z}$ (B) $T_z = \frac{G}{2\pi}\frac{\Delta J}{\Delta\sigma}\frac{\partial g_z}{\partial z}$

(C) $T_z = \frac{1}{G}\frac{\Delta J}{\Delta\sigma}\frac{\partial g_z}{\partial z}$ (D) $T_z = \frac{1}{G}\frac{\Delta\sigma}{\Delta J}\frac{\partial g_z}{\partial z}$

Q.75 Which one of the following statements about the gravity anomalies on land is CORRECT?

(A) Free-air and Bouguer anomalies are always positively correlated with elevation
(B) Isostatic anomalies are not useful to understand the crustal heterogeneities
(C) Vertical derivatives are used to enhance the gravity effects of deep-seated bodies
(D) X-horizontal gradient ($\frac{\partial g}{\partial x}$) map enhances / sharpens anomalies of bodies trending N-S (X-East, Y-North, Z-downward).

Q.76 An aeromagnetic survey is conducted over an area with outcropping magnetic sources. The aircraft is flying at a height of 250 m with a speed of 200 km/hour. In order to fully define the magnetic anomalies along the flight path, the largest sampling rate of measurement by a Proton Precession Magnetometer will be _____ seconds. (round off to the nearest integer).

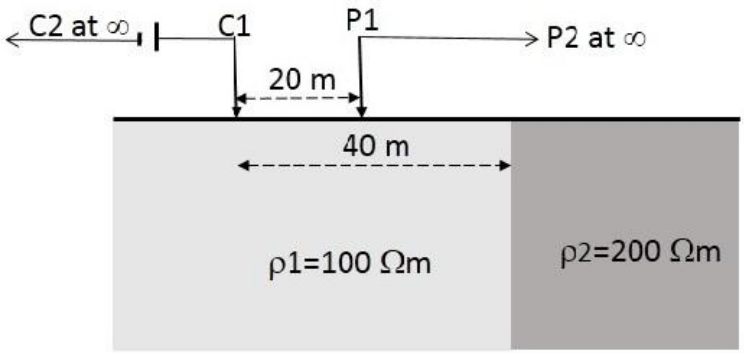
Q.77 In an abandoned mine-site, three hollow spherical cavities are located below the surface centered at depths of 50, 100 and 150 metres. Assuming that residual gravity is low due to each one of these cavities are small (~ 0.05 mGal), do not interfere and can be detected by the gravimeter, the most ideal (largest) grid spacing for carrying out the gravity surveys in order to correctly delineate these cavities is _____metres. (round off to the nearest integer).

Q.78 A split-spread reflection survey is carried out along a profile in the direction of the dipping interface. The difference in arrival times of the reflected waves from the interface at two geophones with an offset distance of 1000 m from the shot-point on both sides is 20 msec. If the velocity of the layer above the dipping interface is 3000 m/s, then the dip of the bed is _____degrees. (round off to 1 decimal place).
(Assumption 2d >> X, where 'd' is depth below the shot-point normal to the interface and X is the source-geophone spacing)

Q.79 The bulk resistivity of a carbonate formation having 10% porosity which is 75% saturated with hydrocarbons is 500 Ωm. The bulk resistivity of the formation when the porosity is doubled and 100% saturated with water is_____ ohm-metres. (round off to 1 decimal place).
(Assume the tortuosity, cementation factor and saturation exponent to be 1, 2 and 2, respectively).

Q.80 In a seismogram of a shallow focus (h = 5 km) earthquake, the difference between the arrival times of the S and P phases is 1.34 s. Assuming the average P wave velocity of the crust to be 6.0 km/s and the Poisson's ratio to be 0.27, the epicentral distance is _____kilometres. (round off to 1 decimal place)

Q.81 A Two-electrode array is placed over a vertical contact (2-D) as shown in the given figure (strike of contact is perpendicular to the plane of paper). If 1 Amp current flows through the subsurface, then the potential at the potential electrode P1 will be _____ milliVolts. (round off to the nearest integer).
(Consider structures with resistivity ρ1 and ρ2 to be laterally extending to infinity on both sides of the contact and also in the downward direction, C2 and P2 are grounded at infinity)
(Use $\pi = 3.14$)



Q.82 In an electrical resistivity imaging survey, Axial Dipole-dipole array is placed over an inhomogeneous structure. The centers of current and potential dipoles are separated by a distance of 100 m. The length of each dipole is 10 m. If 5 Amp current flows through the subsurface and 50 mV potential difference is measured across the potential dipole then apparent resistivity will be _____ohm-metres. (round off to the nearest integer) (Use π = 3.14)

Q.83 In an electromagnetic land survey, the resultant field (primary and secondary) at any point P makes an angle of 60° from the vertical. A 30 mV signal is observed in the receiver coil placed in a horizontal position at point P. The magnitude of the signal in the receiver coil when the plane of the receiver coil is perpendicular to the resultant field is _____ milliVolts.

Q.84 A vibroseis source sweeps acoustic signal in the frequency range 10 Hz – 100 Hz. The maximum sampling interval to correctly recover the recorded signal will be _____milliseconds.

Q.85 The abundance of ^{234}U in secular equilibrium with its parent ^{238}U will be _____$\times 10^{-3}$ %. (Given Half-life ($T_{1/2}$) of ^{238}U and ^{234}U are 4.467×10^{9} y and 2.44×10^{5} y, respectively, and abundance of ^{238}U is 99.28%)(round off to 2 decimal places)

END OF THE QUESTION PAPER

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

Q.No.	Type	Section	Key	Marks
15	MCQ	Part-A Common Section	C	1
16	MCQ	Part-A Common Section	A	1
17	MCQ	Part-A Common Section	C	1
18	MCQ	Part-A Common Section	B	1
19	MCQ	Part-A Common Section	C	1
20	MCQ	Part-A Common Section	D	1
21	NAT	Part-A Common Section	40.3 to 40.6	1
22	NAT	Part-A Common Section	9 to 9	1
23	NAT	Part-A Common Section	80 to 80	1
24	NAT	Part-A Common Section	2055.1 to 2055.5	1
25	NAT	Part-A Common Section	2.9 to 3.1	1
26	MCQ	Part-B Geology (Section 1)	C	2
27	MCQ	Part-B Geology (Section 1)	D	2
28	MCQ	Part-B Geology (Section 1)	D	2
29	MCQ	Part-B Geology (Section 1)	C	2
30	MCQ	Part-B Geology (Section 1)	C	2
31	MCQ	Part-B Geology (Section 1)	A	2
32	MCQ	Part-B Geology (Section 1)	A OR B	2
33	MCQ	Part-B Geology (Section 1)	A	2
34	MCQ	Part-B Geology (Section 1)	A	2
35	MCQ	Part-B Geology (Section 1)	A	2
36	MCQ	Part-B Geology (Section 1)	C	2
37	MCQ	Part-B Geology (Section 1)	D	2
38	MCQ	Part-B Geology (Section 1)	D	2

Q.No.	Type	Section	Key	Marks
39	MCQ	Part-B Geology (Section 1)	A	2
40	MCQ	Part-B Geology (Section 1)	A	2
41	MCQ	Part-B Geology (Section 1)	A	2
42	MCQ	Part-B Geology (Section 1)	D	2
43	MCQ	Part-B Geology (Section 1)	D	2
44	MCQ	Part-B Geology (Section 1)	C	2
45	MCQ	Part-B Geology (Section 1)	C	2
46	MCQ	Part-B Geology (Section 1)	D	2
47	MCQ	Part-B Geology (Section 1)	B	2
48	MCQ	Part-B Geology (Section 1)	Marks to All	2
49	MCQ	Part-B Geology (Section 1)	A	2
50	NAT	Part-B Geology (Section 1)	39.00 to 39.80	2
51	NAT	Part-B Geology (Section 1)	64 to 64	2
52	NAT	Part-B Geology (Section 1)	500 to 500	2
53	NAT	Part-B Geology (Section 1)	8 to 8	2
54	NAT	Part-B Geology (Section 1)	8.90 to 9.10	2
55	NAT	Part-B Geology (Section 1)	75.97 to 76.03	2
56	MCQ	Part-B Geophysics (Section 2)	A	2
57	MCQ	Part-B Geophysics (Section 2)	C	2
58	MCQ	Part-B Geophysics (Section 2)	B	2
59	MCQ	Part-B Geophysics (Section 2)	D	2
60	MCQ	Part-B Geophysics (Section 2)	D	2
61	MCQ	Part-B Geophysics (Section 2)	B	2
62	MCQ	Part-B Geophysics (Section 2)	A	2

Q.No.	Type	Section	Key	Marks
63	MCQ	Part-B Geophysics (Section 2)	C	2
64	MCQ	Part-B Geophysics (Section 2)	B	2
65	MCQ	Part-B Geophysics (Section 2)	A	2
66	MCQ	Part-B Geophysics (Section 2)	D	2
67	MCQ	Part-B Geophysics (Section 2)	A	2
68	MCQ	Part-B Geophysics (Section 2)	Marks to All	2
69	MCQ	Part-B Geophysics (Section 2)	D	2
70	MCQ	Part-B Geophysics (Section 2)	C	2
71	MCQ	Part-B Geophysics (Section 2)	C	2
72	MCQ	Part-B Geophysics (Section 2)	B	2
73	MCQ	Part-B Geophysics (Section 2)	A	2
74	MCQ	Part-B Geophysics (Section 2)	C	2
75	MCQ	Part-B Geophysics (Section 2)	D	2
76	NAT	Part-B Geophysics (Section 2)	2 to 2	2
77	NAT	Part-B Geophysics (Section 2)	38 to 39	2
78	NAT	Part-B Geophysics (Section 2)	1.6 to 1.8	2
79	NAT	Part-B Geophysics (Section 2)	7.7 to 7.9	2
80	NAT	Part-B Geophysics (Section 2)	8.8 to 9.2	2
81	NAT	Part-B Geophysics (Section 2)	880 to 890	2
82	NAT	Part-B Geophysics (Section 2)	305 to 315	2
83	NAT	Part-B Geophysics (Section 2)	60 to 60	2
84	NAT	Part-B Geophysics (Section 2)	5 to 5	2
85	NAT	Part-B Geophysics (Section 2)	5.40 to 5.44	2