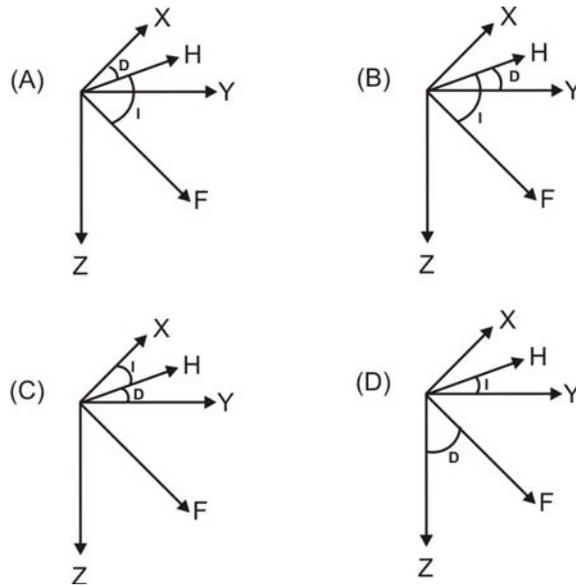


Q. 1 – Q. 25 carry one mark each.

- Q.1 The shape of the earth is best described as
(A) spheroid (B) prolate ellipsoid
(C) ellipsoid (D) oblate spheroid
- Q.2 Which one amongst the following is the CORRECT attitude of a bed?
(A) $221^\circ, 95^\circ$ (B) $N45^\circ W, 40^\circ SE$ (C) $090^\circ / 20^\circ W$ (D) $089^\circ, 75^\circ S$
- Q.3 Hawaiian Island chain is the result of
(A) collision of two oceanic plates
(B) intraplate hot spot activity
(C) divergence of two oceanic plates
(D) interplate hot spot activity
- Q.4 In which one of the following configurations the electrodes are uniformly spaced?
(A) Schlumberger array
(B) Pole-dipole array
(C) Wenner array
(D) Pole-pole array
- Q.5 In Triclinic crystal system, the three crystallographic axes **a, b, c** are of
(A) equal lengths with angle between **b** and **c** as 90°
(B) equal lengths with angle between **a** and **c** $\neq 90^\circ$
(C) unequal lengths with angle between **a** and **c** $\neq 90^\circ$
(D) unequal lengths with angle between **b** and **c** as 90°
- Q.6 A landform that results from free fall of rocks is called
(A) talus slope (B) eskers (C) alluvial fan (D) debris flow

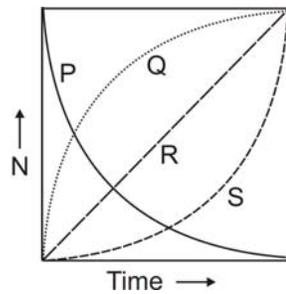
- Q.7 Which one of the following figures correctly depicts the geomagnetic declination (D) and inclination (I) angles ? (X: Geographic North; Y: Geographic East; Z: Vertical direction; H: Geomagnetic North; F: Total Field direction)



- Q.8 Which one of the following logging methods is NOT used to determine porosity?
 (A) Sonic (B) SP (C) Neutron (D) Gamma-gamma
- Q.9 PcP and ScS phases are reflected from
 (A) crust - mantle boundary
 (B) core - mantle boundary
 (C) inner core - outer core boundary
 (D) lithosphere - asthenosphere boundary
- Q.10 Identify the CORRECT sequence of the electromagnetic waves in their increasing frequency
 (A) radio wave, micro-wave, infrared, visible, ultra violet, X-ray
 (B) radio wave, infrared, micro-wave, visible, ultra violet, X-ray
 (C) micro-wave, radio wave, infrared, visible, X-ray, ultra violet
 (D) infrared, visible, micro-wave, radio wave, X-ray, ultra violet
- Q.11 Considering the Airy isostatic compensation for a mountain having elevation of 2.0 km above the mean sea level at a point P , the thickness of its root below P would be _____ km. (consider densities of crustal rocks and upper mantle as 2.7 gcm^{-3} and 3.3 gcm^{-3} respectively).
- Q.12 The reflection coefficient at the interface separating sandstone ($V_p = 2000 \text{ ms}^{-1}$; $\rho = 1.5 \text{ gcm}^{-3}$) underlain by shale ($V_p = 2500 \text{ ms}^{-1}$; $\rho = 2.0 \text{ gcm}^{-3}$) is _____.

- Q.13 Gardner's formula relates the seismic P-wave velocity (V_p) to
(A) density (B) porosity
(C) permeability (D) lithology
- Q.14 Which one of the following sedimentary basins is related to extension?
(A) foredeep (B) half-graben
(C) piggyback (D) fore-arc
- Q.15 In a seismic section, paraconformity is marked by
(A) onlap (B) downlap
(C) erosional truncation (D) concordance
- Q.16 Match the names listed in Group I with its attributes listed in Group II.
- | Group I | Group II |
|----------------------------|-----------------|
| P. Carlsberg Ridge | 1. Aseismic |
| Q. Ninetyeast Ridge | 2. Subduction |
| R. Pranhita-Godavari basin | 3. Spreading |
| S. Makran Coast | 4. Transform |
| | 5. Rift |
- (A) P-5; Q-3; R-1; S-4 (B) P-3; Q-1; R-5; S-2
(C) P-3; Q-4; R-1; S-2 (D) P-1; Q-3; R-5; S-4
- Q.17 In India, bituminous coal occurs at
(A) Panandhro (B) Palana (C) Neyveli (D) Jharia
- Q.18 On the Earth, all conditions being same, the time period of a simple pendulum will be maximum at the
(A) Poles (B) Tropic of Cancer
(C) Tropic of Capricorn (D) Equator
- Q.19 The two most abundant elements in the Earth are
(A) oxygen and iron (B) iron and magnesium
(C) oxygen and silicon (D) iron and silicon

- Q.20 The pair of curves that depicts the radioactive decay and growth of a parent-daughter pair in the following figure is (N – Number of nuclides, Time in multiples of half-life).



- (A) P, Q
(B) P, R
(C) P, S
(D) S, Q
- Q.21 A drainage basin with an area of $2.0 \times 10^6 \text{ m}^2$ receives continuous rainfall for 48 hours at a uniform rate of 3 mmh^{-1} . The volume of precipitation is _____ m^3 of water.
- Q.22 The main source of error in computing the orientation of planar features from drill cores is
(A) rotation of the core during extraction
(B) cylindrical shape of the core
(C) non-vertical orientation of the drill axis
(D) staining during drilling operations
- Q.23 Which combination of sorting and roundness of sand grains results in highest permeability?
(A) well sorted, poorly rounded
(B) well sorted, well rounded
(C) poorly sorted, poorly rounded
(D) poorly sorted, well rounded
- Q.24 Amongst the different gases in the atmosphere, which one of the following pairs DOES NOT contribute to heating of the atmosphere?
(A) CO_2 , H_2O (B) N_2 , O_2 (C) H_2O , CH_4 (D) H_2O , O_3
- Q.25 The data of which one of the following active electromagnetic techniques can be used to correct static shift effect in magnetotelluric apparent resistivity data?
(A) Slingram (B) Turam (C) VLF (D) TEM

PART B (SECTION 1): FOR GEOLOGY CANDIDATES ONLY**Q. 26 – Q. 55 carry two marks each.**

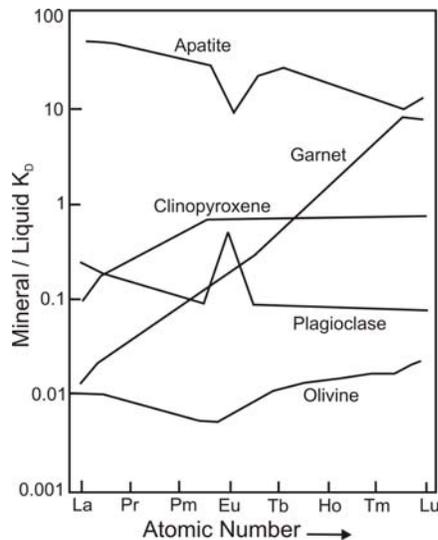
Q.26 Which one of the following statements describing aspects of partial melting behavior of a binary eutectic system is NOT TRUE?

- (A) Melting is complete at temperature just above the liquidus temperature.
- (B) Two solid phases and one liquid phase co-exist at eutectic temperature.
- (C) The lowest temperature at which partial melting occurs is independent of the chemical composition.
- (D) The composition of the first liquid to form depends on the composition of the sample.

Q.27 Find the CORRECT statement amongst the following.

- (A) Delthyrium is a triangular cavity in cephalopod
- (B) Madreporite is a skeletal part of Brachiopoda
- (C) Pleuron is a part of thorax in Trilobite
- (D) Endocone is the jaw of an Ammonoid

Q.28 Based on the figure below that shows typical distribution / partition coefficients ($K_D = \text{mineral/liquid}$) for REEs between various minerals and basaltic melt, which one of the following statements is NOT true?

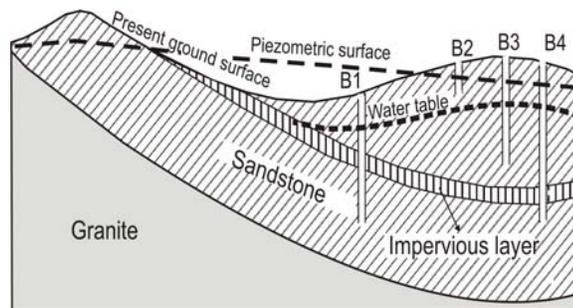


- (A) REEs are compatible only in apatite.
- (B) Heavy REEs are compatible whereas Light REEs are incompatible in garnet.
- (C) REEs are incompatible only in apatite.
- (D) REEs are incompatible in olivine.

Q.29 Which one of the following is NOT a set of polymorphous minerals?

- (A) calcite, aragonite, vaterite
- (B) quartz, coesite, tridymite
- (C) graphite, anthracite, diamond
- (D) kyanite, sillimanite, andalusite

- Q.30 Chemical analysis reveals that basalts contain much more aluminum ($\text{Al}_2\text{O}_3 \sim 15\%$) in comparison to peridotites ($\text{Al}_2\text{O}_3 \sim 4\%$). This is because they contain
- (A) very little olivine
 (B) higher proportion of pyroxene
 (C) feldspars as dominant mineral
 (D) no quartz
- Q.31 A sandstone bed whose attitude is $090^\circ, 30^\circ$ is exposed on a flat surface. The true thickness of the bed is 100 m. The width of the outcrop of the sandstone bed along a N-S traverse on the ground is _____ m.
- Q.32 **Assertion (a):** The $^{18}\text{O}/^{16}\text{O}$ ratio in natural systems can be used as a thermometer.
Reason (r): The fractionation of $^{18}\text{O}/^{16}\text{O}$ depends on temperature.
- (A) Both (a) and (r) are True and (r) is the correct reason for (a).
 (B) Both (a) and (r) are not True.
 (C) (a) is True but (r) is not True
 (D) Both (a) and (r) are True but (r) is not the correct reason for (a).
- Q.33 Based on the schematic figure below, match the boreholes B1, B2, B3 and B4 listed in Group I with their features listed in Group II.

**Group I**

- P. Borehole B1
 Q. Borehole B2
 R. Borehole B3
 S. Borehole B4

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

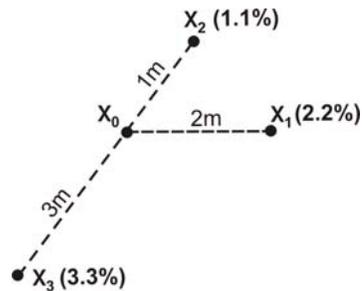
Group II

1. well in unconfined aquifer
2. artesian well with water not flowing to surface
3. artesian well with water flowing to surface
4. dry well

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

- Q.34 If the total volume of water in the Earth's atmosphere, estimated to be about $1.29 \times 10^4 \text{ km}^3$, were to completely precipitate and uniformly cover the Earth's surface, estimated to be $5.1 \times 10^8 \text{ km}^2$, the height of the resulting water column would be _____ cm.

- Q.35 Samples of copper ores are drawn from locations X_1 , X_2 and X_3 as shown in figure below. The values of (% Cu) at sampling locations are given in brackets. The estimated grade at point X_0 using inverse distances weighting is _____%.



- Q.36 Match the point group (HM symbol) in Group I with its corresponding general form in Group II

Group I

- P. $\bar{6}2m$
 Q. $3/m$
 R. 422
 S. $\bar{4}2m$

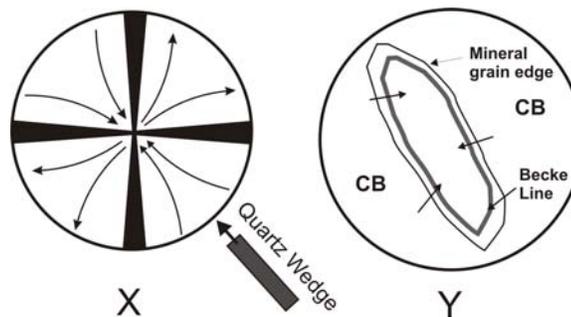
Group II

1. Ditrigonal Dipyramid
 2. Tetragonal Scalenohedron
 3. Trigonal Dipyramid
 4. Tetragonal Trapezohedron
 5. Hexagonal Dipyramid

- (A) P-5; Q-1; R-2; S-4
 (C) P-1; Q-3; R-2; S-5

- (B) P-1; Q-3; R-4; S-2
 (D) P-3; Q-5; R-2; S-4

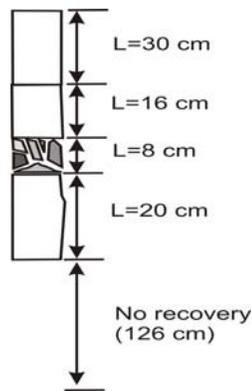
- Q.37 Identify the CORRECT pair of minerals both of which show optical properties as shown in figures X (optic axis figure) and Y (with increasing free working distance between objective and stage).
 CB – Canada Balsam



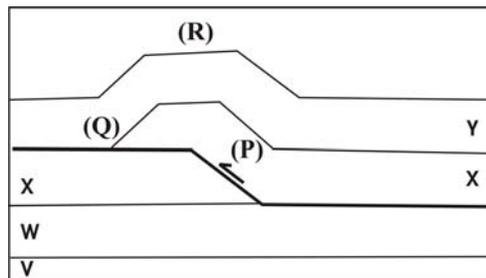
- (A) Quartz, Stishovite
 (C) Apatite, Tourmaline

- (B) Cordierite, Chlorite
 (D) Nosean, Halite

- Q.38 From the figure given below depicting a recovered core of a total length of 200 cm, the RQD (Rock Quality Designation) is _____ %.



- Q.39 Interlimb angle and shape of a fold is best studied in a
- section parallel to the plunge of the fold axis
 - section parallel to the axial plane of the fold
 - section parallel to dip of bedding in the fold
 - section whose pole is the fold axis
- Q.40 The cross-section below shows a thrust fault with an associated fault-related fold. For the hanging wall, which one of the combinations of (P), (Q) and (R) is correct?



- Ramp (P), Flat (Q), Fault Bend Fold (R)
 - Ramp (P), Flat (Q), Fault Propagation Fold (R)
 - Flat (P), Ramp (Q), Fault Bend Fold (R)
 - Flat (P), Ramp (Q), Fault Propagation Fold (R)
- Q.41 Euler Poles defined for plate motions on a spherical earth are
- parallel to associated transform faults
 - perpendicular to associated transform faults
 - not related to associated transform faults
 - oblique to associated transform faults
- Q.42 Which one of the following sedimentary structures CANNOT be identified in vertical sections?
- Convolute lamination
 - Gutter cast
 - Dish structures
 - Skip marks

Q.43 A predominantly siliciclastic Mesozoic stratigraphic unit in mainland Kutch containing *Trigonia* and abundant plant fossils including *Ptillophyllum* is

- (A) Baisakhi Formation (B) Chari Formation
(C) Pachcham Formation (D) Umia Formation

Q.44 Match the texture in Group I with its corresponding description in Group II.

Group I

- P. Cumulus texture
Q. Exsolution texture
R. Caries texture
S. Cockade texture

Group II

1. triple point junction
2. banding and crustification in open spaces
3. protuberances of replacing mineral with replaced host
4. spindles or lamellae of one mineral in another
5. aggregates of minerals with non-penetrative mineral boundaries

- (A) P-5; Q-4; R-3; S-2
(C) P-5; Q-4; R-2; S-3

- (B) P-4; Q-5; R-3; S-1
(D) P-4; Q-3; R-2; S-5

Q.45 Choose the CORRECT statement regarding coal.

- (A) Sapropelic coal is a potential source rock of oil
(B) Vitrinite reflectance value (R_o %) should be >1 for a lignite sample
(C) H/C content of the vitrinite maceral groups is more than that of liptinite maceral groups
(D) In Ranigunj field coal seams alternate with limestone beds

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

Group I

- P. Bailadila Group
Q. Nallamalai Group
R. Udaipur Group
S. Sausar Group

Group II

1. Mn
2. Phosphorite
3. BIF
4. Pb-Zn
5. Pyrite

- (A) P-3; Q-4; R-2; S-1
(C) P-2; Q-3; R-4; S-5

- (B) P-4; Q-2; R-3; S-5
(D) P-3; Q-4; R-1; S-2

Q.47 Match the igneous bodies in Group I with the cratons where they occur in Group II.

Group I

- P. Untala Granite
Q. Dalma Volcanics
R. Chamundi Granite
S. Bijli Rhyolite

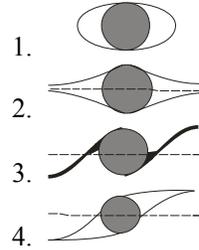
Group II

1. Singbhum craton
2. Aravalli craton
3. Bastar craton
4. Dharwar craton
5. Bundelkhand craton

- (A) P-2; Q-1; R-5; S-3
(C) P-3; Q-4; R-1; S-5

- (B) P-2; Q-1; R-4; S-3
(D) P-1; Q-3; R-1; S-5

- Q.48 The reflectance spectrum of solar energy by the hydrous molecules in plant leaves is best represented in an optical spectrometer in the wavelength range of
- (A) Near Infrared (0.7 - 1.3 μm)
 (B) Short Infrared (1.3 - 3.0 μm)
 (C) Mid Infrared (3 - 8 μm)
 (D) Long Infrared (8 - 15 μm)
- Q.49 Match the type of mantled porphyroclasts in Group I with the corresponding figure in Group II.

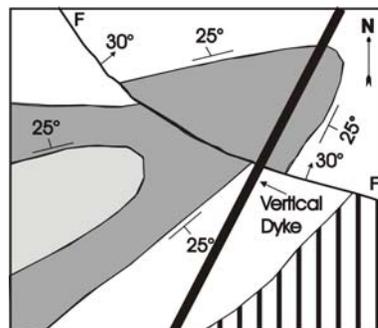
Group IP. δ typeQ. σ typeR. θ typeS. ϕ type**Group II**

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

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

- Q.50 Choose the CORRECT symmetry operations that can create all possible two dimensional planar point groups.
- (A) translation, rotation, screw, glide
 (B) translation, reflection, rotation, glide
 (C) screw, reflection, rotation, glide
 (D) translation, reflection, screw, glide

- Q.51 In the folded and faulted sequence of beds given in the map below, the fault F-F (dipping 30°NE) is which type of fault?



- (A) sinistral strike-slip
 (C) normal
 (B) reverse
 (D) dextral strike-slip

- Q.52 Which one of the following sets of isotopic ratios contains ONLY those that change with time?
- (A) $^{87}\text{Sr}/^{86}\text{Sr}$, $^{143}\text{Nd}/^{144}\text{Nd}$, $^{207}\text{Pb}/^{206}\text{Pb}$, $^{147}\text{Sm}/^{144}\text{Nd}$
(B) $^{88}\text{Sr}/^{86}\text{Sr}$, $^{145}\text{Nd}/^{144}\text{Nd}$, $^{238}\text{U}/^{204}\text{Pb}$, $^{207}\text{Pb}/^{204}\text{Pb}$
(C) $^{84}\text{Sr}/^{86}\text{Sr}$, $^{143}\text{Nd}/^{144}\text{Nd}$, $^{208}\text{Pb}/^{204}\text{Pb}$, $^{85}\text{Rb}/^{87}\text{Sr}$
(D) $^{145}\text{Nd}/^{144}\text{Nd}$, $^{86}\text{Sr}/^{84}\text{Sr}$, $^{147}\text{Sm}/^{144}\text{Nd}$, $^{208}\text{Pb}/^{86}\text{Sr}$
- Q.53 Sediments derived exclusively from the Deccan basalt are deposited on a high-energy beach and are lithified under shallow burial conditions. The sedimentary rock formed would be a/an
- (A) arkose (B) greywacke
(C) lithic arenite (D) quartz arenite
- Q.54 Choose the CORRECT mineral assemblages in mafic rocks that indicate eclogite facies metamorphism.
- (A) orthopyroxene + plagioclase + garnet
(B) glaucophane + omphacite + lawsonite ± garnet
(C) ugrandite garnet + omphacite + plagioclase
(D) pyralspite garnet + omphacite ± kyanite
- Q.55 The maximum velocity of the Indian Plate is observed in
- (A) Maldives (B) Bangalore (C) Delhi (D) Srinagar

PART B (SECTION 2): FOR GEOPHYSICS CANDIDATES ONLY**Q. 26 – Q. 55 carry two marks each.**

- Q.26 Which type of VES curve is obtained for a three-layered earth model consisting of wet shale (top layer), poorly water saturated sandstone (middle layer) and impermeable granite (bottom layer)?
 (A) K (B) Q (C) H (D) A
- Q.27 In the estimation of magnetotelluric transfer function, the time-independent conservation of current at conductivity discontinuities will result in
 (A) phase rotation (B) static-shift
 (C) null tipper (D) equal bi-modal apparent resistivity values
- Q.28 In any given signal, removal of all periods shorter than Nyquist period is achieved by
 (A) high-pass filtering (B) band-pass filtering
 (C) low-pass filtering (D) band-reject filtering
- Q.29 The magnetic flux density, \vec{B} and the magnetic vector potential, \vec{A} are related by
 (A) $\vec{B} = \nabla \cdot \vec{A}$ (B) $\vec{B} = \nabla \times \vec{A}$
 (C) $\vec{A} = \nabla \vec{B}$ (D) $\vec{A} = \nabla \times \vec{B}$
- Q.30 The frequency range (in Hz) that defines *dead-band* in magnetotelluric source signal is
 (A) 0.1 – 10 (B) 10 – 100
 (C) 100 – 1000 (D) 1000 – 10000
- Q.31 The maximum foldage obtained from a 48-channel common-depth-point (CDP) reflection survey with the geophone and shot point spacing of 50 m and 100 m respectively, is _____.
- Q.32 The deviation in the geographical locations of the magnetic poles from the geomagnetic poles of the Earth's magnetic field is due to the
 (A) orientation of dipole axis
 (B) external magnetic field
 (C) non-dipole component
 (D) ionospheric currents
- Q.33 The analytic signal for the function $f(t) = \sin \omega t$ is
 (A) $-\cos \omega t$ (B) $-\sin \omega t$ (C) $e^{i\omega t}$ (D) $-ie^{i\omega t}$
- Q.34 The minimum frequency at which a signal comprising of 30 Hz, 50 Hz and 70 Hz frequencies should be sampled to avoid aliasing is _____ Hz.

- Q.35 **Assertion (a):** The Gutenberg-Richter frequency-magnitude relation of earthquakes globally suggests that subduction zones in general are characterized by lower b-values (b-value is slope of frequency-magnitude relation) when compared to the mid-oceanic ridges.
Reason (r): Earthquakes in the subduction zones occur at deeper focal depths also, whereas, earthquakes along mid-oceanic ridges occur at shallow focal depths.

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

- Q.36 The masses and radioactive heat generation values respectively for different parts of the Earth are tabulated as given below.

Region	Mass x 10 ²¹ kg	Radioactive heat generation x 10 ⁸ (mWkg ⁻¹)
Upper continental crust	8	96.40
Lower continental crust	8	40.00
Oceanic crust	7	18.60
Mantle	4080	0.26
Core	1880	0

Deduce which one of the following statements is NOT correct from the given data

- (A) Core does not contain any radioactive isotope
 (B) Lower continental crust is depleted in heat producing elements related to upper continental crust
 (C) Mantle produces the highest radiogenic heat
 (D) Upper continental crust produces the highest radiogenic heat
- Q.37 Which ONE of the following statements is CORRECT with regard to the application of reduction-to-pole (RTP) technique on the total field magnetic anomaly map of any region?
- (A) RTP is an efficient tool in the areas close to the equator (below $\pm 20^{\circ}$ Lat.)
 (B) RTP assumes mainly induced magnetization for the source bodies
 (C) RTP cannot be applied at higher latitudes (above $\pm 60^{\circ}$ Lat.)
 (D) RTP completely eliminates the sources of remnant magnetization.

- Q.38 After migration, an anticline observed on an unmigrated seismic section becomes

- (A) broader (B) tighter (C) unaltered (D) flat

- Q.39 A clean, thick and hydrocarbon bearing sandstone bed can be identified through a combination of

- (A) low SP and high resistivity
 (B) large SP and high resistivity
 (C) low transit time and high resistivity
 (D) large SP and low resistivity

- Q.40 In a consolidated sandstone formation, the interval transit times of the formation, matrix and fluid are $70 \mu s$, $55 \mu s$ and $190 \mu s$ respectively. The porosity of the formation is _____.
- Q.41 Which one of the following statements is NOT CORRECT?
- (A) A well-conditioned matrix has a condition number close to 1.
 (B) An ill-conditioned matrix has a large condition number
 (C) The inverse of a well-conditioned matrix can be computed with good accuracy.
 (D) A matrix that is not invertible has a condition number close to 1.
- Q.42 Match the type of inverse problem in Group I with its solution in Group II.

Group I

P. Over determined

Q. Under determined

R. Mixed determined

S. Even determined

Group II

1. $m = [G^T G + K^2 I]^{-1} G^T d$

2. $m = [G^T G]^{-1} G^T d$

3. $m = G [G^T G]^{-1} G^T d$

4. $m = G^T [G G^T]^{-1} d$

5. $m = G^{-1} d$ (N = M, rank of G = N)

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

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

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

(D) P-3; Q-5; R-2; S-1

- Q.43 In frequency domain IP, which one of the following frequency ranges (in Hz) is used to measure apparent resistivity at DC and AC limits?
- (A) 0.01 – 0.1 (B) 0.1 – 1 (C) 0.1 – 10 (D) 10 – 100

- Q.44 The expression for electrical potential, V , at a distance r from a subsurface point source of current in a homogeneous medium is given by

(A) $V = \frac{2\pi r \rho}{I}$ (B) $V = \frac{\rho I}{4\pi r}$ (C) $V = \frac{2\pi r I}{\rho}$ (D) $V = \frac{r \rho}{4\pi I}$

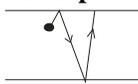
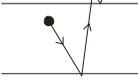
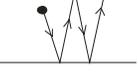
- Q.45 The Bouguer anomaly obtained after applying all necessary corrections is due to

- (A) topographic undulations above the datum
 (B) increase in densities of crustal rocks with depth
 (C) lateral density variations
 (D) vertical density contrast across Moho

- Q.46 In a 3-D seismic survey, the bin size for the maximum frequency (f_{\max}) of 80 Hz at the target having a reflector dip of 15° and interval velocity of 3600 ms^{-1} is _____.
- Q.47 A spherical body with its centre located at a depth of 1040 m gives a symmetric residual gravity anomaly high with $\Delta g_{\max} = 5.2 \text{ mGal}$. If the same anomaly were to be obtained over a 2-D horizontal cylinder, the depth to the centre of the horizontal cylinder (in m) is _____.

- Q.48 Analysis of data from a 3-component broadband seismological station yields seismic velocities, $V_p = 7.0$ km/s and $V_s = 3.87$ km/s for the lower crust. The resulting Poisson's ratio of the lower crustal rocks (rounded to two decimal places) is
- (A) 0.24 (B) 0.26 (C) 0.28 (D) 0.30

- Q.49 Match the geometry of multiple reflections shown in Group I with their corresponding names in Group II.

Group I	Group II
 <p>P.</p>	1. peg-leg multiple
 <p>Q.</p>	2. simple multiple
 <p>R.</p>	3. near-surface multiple
 <p>S.</p>	4. ghost multiple
<p>(A) P-1; Q-4; R-2; S-3 (C) P-2; Q-4; R-1; S-3</p>	<p>(B) P-4; Q-1; R-3; S-2 (D) P-3; Q-1; R-4; S-2</p>

- Q.50 The Königsberger ratio, Q_n , related to magnetization of rocks is very low ($Q_n \ll 1$) for
- (A) sandstone (B) continental shield rocks
(C) oceanic basalt (D) continental volcanic rocks

- Q.51 In free-space, the integral form of Faraday's law is expressed as

(A) $\oint \vec{H} \cdot d\vec{l} = \epsilon \int_S (\partial \vec{E} / \partial t) \cdot d\vec{s}$

(B) $\oint \vec{E} \cdot d\vec{l} = - \int_S (\partial \vec{B} / \partial t) \cdot d\vec{s}$

(C) $\oint \vec{E} \cdot d\vec{s} = 0$

(D) $\oint \vec{B} \cdot d\vec{s} = 0$

- Q.52 Four point charges, $Q_1 = 40$ nC, $Q_2 = 50$ nC, $Q_3 = 20$ nC, $Q_4 = -60$ nC, are enclosed by a Gaussian surface, S . The net flux crossing S is _____ nC.

- Q.53 The highest frequency range (in Hz) of an inducing electromagnetic wave that can penetrate up to a depth of 178 m in a medium having a resistivity of $10 \Omega\text{-m}$ is (Consider permeability of the medium, $\mu = 1$).

(A) 1-10 (B) 15-25 (C) 70-100 (D) 800-1000

