

**General Aptitude (GA)**

**Q.1 – Q.5 Carry ONE mark Each**

Q.1 If '→' denotes increasing order of intensity, then the meaning of the words [simmer → seethe → smolder] is analogous to [break → raze → \_\_\_\_\_]. Which one of the given options is appropriate to fill the blank?

- (A) obfuscate
- (B) obliterate
- (C) fracture
- (D) fissure

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Q.2 In a locality, the houses are numbered in the following way:

The house-numbers on one side of a road are consecutive odd integers starting from 301, while the house-numbers on the other side of the road are consecutive even numbers starting from 302. The total number of houses is the same on both sides of the road.

If the difference of the sum of the house-numbers between the two sides of the road is 27, then the number of houses on each side of the road is

- (A) 27
- (B) 52
- (C) 54
- (D) 26

Q.3 For positive integers  $p$  and  $q$ , with  $\frac{p}{q} \neq 1$ ,  $\left(\frac{p}{q}\right)^{\frac{p}{q}} = p^{\left(\frac{p}{q}-1\right)}$ . Then,

- (A)  $q^p = p^q$
- (B)  $q^p = p^{2q}$
- (C)  $\sqrt{q} = \sqrt{p}$
- (D)  ${}^p\sqrt{q} = {}^q\sqrt{p}$

Q.4 Which one of the given options is a possible value of  $x$  in the following sequence?

3, 7, 15,  $x$ , 63, 127, 255

- (A) 35
- (B) 40
- (C) 45
- (D) 31

Q.5 On a given day, how many times will the second-hand and the minute-hand of a clock cross each other during the clock time 12:05:00 hours to 12:55:00 hours?

- (A) 51
- (B) 49
- (C) 50
- (D) 55

**Q.6 – Q.10 Carry TWO marks Each**

Q.6 In the given text, the blanks are numbered (i)–(iv). Select the best match for all the blanks.

From the ancient Athenian arena to the modern Olympic stadiums, athletics <sup>(i)</sup> the potential for a spectacle. The crowd <sup>(ii)</sup> with bated breath as the Olympian artist twists his body, stretching the javelin behind him. Twelve strides in, he begins to cross-step. Six cross-steps <sup>(iii)</sup> in an abrupt stop on his left foot. As his body <sup>(iv)</sup> like a door turning on a hinge, the javelin is launched skyward at a precise angle.

- (A) (i) hold (ii) waits (iii) culminates (iv) pivot
- (B) (i) holds (ii) wait (iii) culminates (iv) pivot
- (C) (i) hold (ii) wait (iii) culminate (iv) pivots
- (D) (i) holds (ii) waits (iii) culminate (iv) pivots

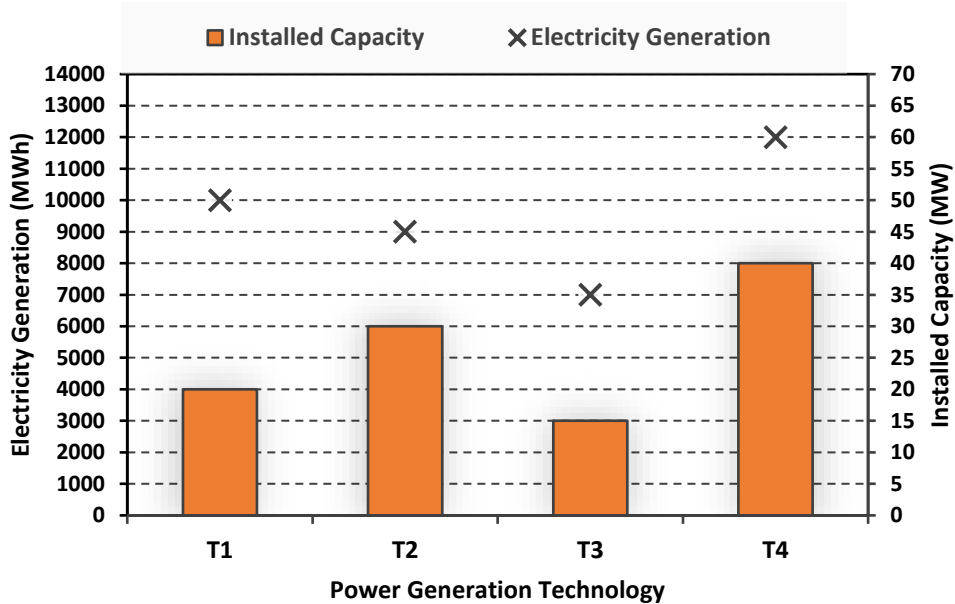
Q.7 Three distinct sets of indistinguishable twins are to be seated at a circular table that has 8 identical chairs. Unique seating arrangements are defined by the relative positions of the people.

How many unique seating arrangements are possible such that each person is sitting next to their twin?

- (A) 12
- (B) 14
- (C) 10
- (D) 28

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Q.8 The chart given below compares the Installed Capacity (MW) of four power generation technologies, T1, T2, T3, and T4, and their Electricity Generation (MWh) in a time of 1000 hours (h).



The Capacity Factor of a power generation technology is:

$$\text{Capacity Factor} = \frac{\text{Electricity Generation (MWh)}}{\text{Installed Capacity (MW)} \times 1000 \text{ (h)}}$$

Which one of the given technologies has the highest Capacity Factor?

- (A) T1
- (B) T2
- (C) T3
- (D) T4

Q.9 In the  $4 \times 4$  array shown below, each cell of the first three columns has either a cross (X) or a number, as per the given rule.

|   |   |   |  |
|---|---|---|--|
| 1 | 1 | 2 |  |
| 2 | X | 3 |  |
| 2 | X | 4 |  |
| 1 | 2 | X |  |

**Rule:** The number in a cell represents the count of crosses around its immediate neighboring cells (left, right, top, bottom, diagonals).

As per this rule, the **maximum** number of crosses possible in the empty column is

- (A) 0
- (B) 1
- (C) 2
- (D) 3

Q.10 During a half-moon phase, the Earth-Moon-Sun form a right triangle. If the Moon-Earth-Sun angle at this half-moon phase is measured to be  $89.85^\circ$ , the ratio of the Earth-Sun and Earth-Moon distances is closest to

- (A) 328
- (B) 382
- (C) 238
- (D) 283

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**PART A: COMPULSORY SECTION FOR ALL CANDIDATES**

**Q.11– Q .17 Carry ONE mark Each**

Q.11 The Earth's magnetic field originates from convection in which one of the following layers?

- (A) Inner core
- (B) Outer core
- (C) Lithosphere
- (D) Asthenosphere

Q.12 Which one of the following logging tools is used to measure the diameter of a borehole?

- (A) Sonic
- (B) Density
- (C) Neutron
- (D) Caliper

- Q.13 The given figure depicts an array used in DC resistivity surveys, where the current electrodes are denoted by C1 and C2, and potential electrodes by P1 and P2. If all the electrodes are equally spaced, then the given array corresponds to which one of the following configurations?



- (A) Wenner
- (B) Schlumberger
- (C) Dipole–Dipole
- (D) Pole–Pole

- Q.14 Which one of the following is an ultramafic rock?

- (A) Granite
- (B) Gabbro
- (C) Dunite
- (D) Basalt

Q.15 Gold is being produced from which one of the following mines in India?

- (A) Baula
- (B) Hutti
- (C) Dariba
- (D) Jaduguda

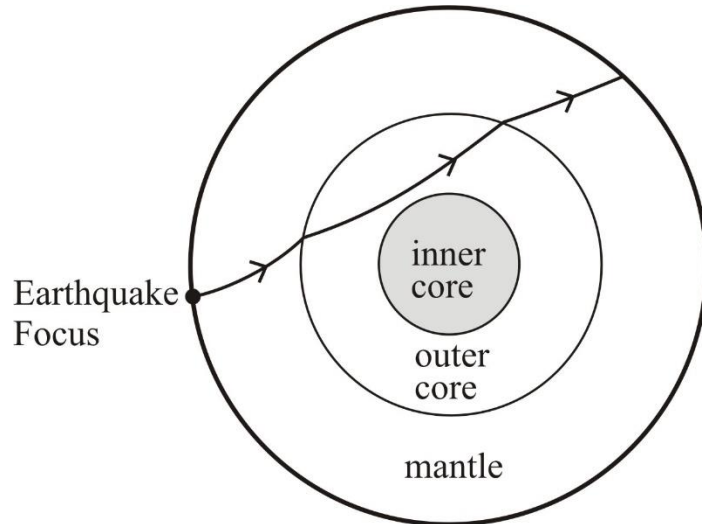
Q.16 Which of the following hydrocarbon fields is/are located in the western offshore of India?

- (A) Tapti
- (B) Lakwa
- (C) Ravva
- (D) Panna

Q.17 A cylindrical sample of granite (diameter = 54.7 mm; length = 137 mm) shows a linear relationship between axial stress and axial strain under uniaxial compression up to the peak stress level at which the specimen fails. If the uniaxial compressive strength of this sample is 200 MPa and the axial strain corresponding to this peak stress is 0.005, the Young's modulus of the sample in GPa is \_\_\_\_\_ (*in integer*).

**Q.18 – Q.26 Carry TWO marks Each**

Q.18 The given figure shows the ray path of a P-wave propagating through the Earth. Choose the CORRECT P-phase corresponding to the ray path.



- (A) PcP
- (B) PKP
- (C) PPP
- (D) PmP

Q.19 Match the geophysical methods in Group–I with their associated physical properties in Group–II.

Group–I

P. Magnetic

Q. Gravity

R. Magnetotelluric

S. Induced Polarization

Group–II

1. Chargeability

2. Electrical conductivity

3. Susceptibility

4. Density

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

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

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

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

Q.20 The number of planes of symmetry in a tetrahedron is

(A) 9

(B) 6

(C) 4

(D) 3

Q.21 Which of the following Epochs belong(s) to the Quaternary Period?

- (A) Holocene
- (B) Pleistocene
- (C) Pliocene
- (D) Miocene

Q.22 Which one or more of the following minerals shows O:Si ratio of 4:1 in its silicate structure?

- (A) Olivine
- (B) Quartz
- (C) Diopside
- (D) Albite

Q.23 Which of the following rock structures is/are fold(s)?

- (A) Antiform
- (B) Horst
- (C) Syncline
- (D) Synform

- Q.24 Assume heat producing elements are uniformly distributed within a 16 km thick layer in the crust in a heat flow province. Given that the surface heat flow and reduced heat flow are  $54 \text{ mW/m}^2$  and  $22 \text{ mW/m}^2$ , respectively, the radiogenic heat production in the given crustal layer in  $\mu\text{W/m}^3$  is \_\_\_\_\_ (*in integer*).
- Q.25 A confined aquifer with a uniform saturated thickness of 10 m has hydraulic conductivity of  $10^{-2} \text{ cm/s}$ . Considering a steady flow, the transmissivity of the aquifer in  $\text{m}^2/\text{day}$  is \_\_\_\_\_ (*rounded off to one decimal place*).
- Q.26 A current of 2 A passes through a cylindrical rod with uniform cross-sectional area of  $4 \text{ m}^2$  and resistivity of  $100 \Omega\text{-m}$ . The magnitude of the electric field ( $\mathbf{E}$ ) measured along the length of the rod in  $\text{V/m}$  is \_\_\_\_\_ (*in integer*).

**PART B2: FOR Geophysics CANDIDATES ONLY**

**Q.27 – Q.44 Carry ONE mark Each**

Q.27 With increasing depth in the Earth, the P-wave velocity shows a significant **decrease** across which one of the following boundaries?

- (A) crust – mantle
- (B) mantle – outer core
- (C) outer core – inner core
- (D) upper mantle – lower mantle

Q.28 The fold of a 2D seismic survey is defined as the maximum number of traces in which one of the following gathers?

- (A) Common midpoint gather
- (B) Common offset gather
- (C) Common shot gather
- (D) Common receiver gather



Q.29 The Z-transform of the sequence {1, 0, 1, 0, 1} is

(A)  $1 + Z^2 + Z^4$

(B)  $1 + Z + Z^2$

(C)  $Z + Z^3 + Z^5$

(D)  $Z + Z^2 + Z^3$

Q.30 Which one among the following events recorded in a land seismic reflection survey using vertical component geophones has the highest apparent slowness?

(A) Primary P-wave reflection

(B) Direct wave

(C) Head wave

(D) Ground roll

Q.31 A GPR pulse is propagated into a non-magnetic medium comprising of a single layer underlain by a half space. If the dielectric constants for the top layer and the half-space are  $\epsilon_1$  and  $\epsilon_2$ , respectively, the reflection coefficient at normal incidence is

(A)  $\frac{\sqrt{\epsilon_1} - \sqrt{\epsilon_2}}{\sqrt{\epsilon_1} + \sqrt{\epsilon_2}}$

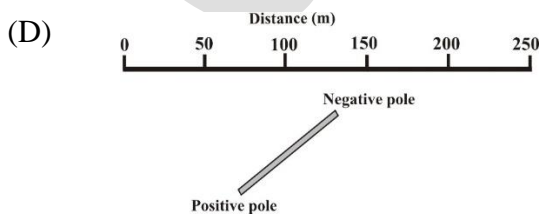
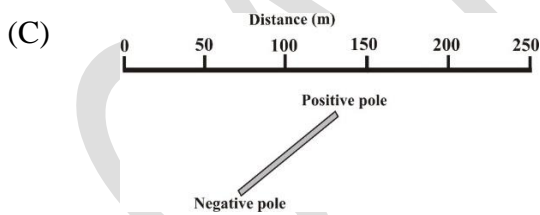
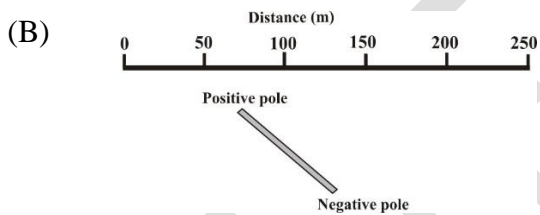
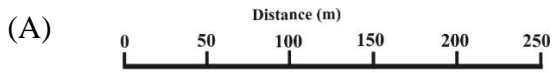
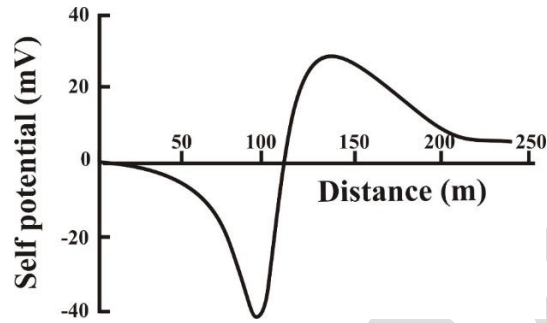
(B)  $\frac{\sqrt{\epsilon_1} + \sqrt{\epsilon_2}}{\sqrt{\epsilon_1} - \sqrt{\epsilon_2}}$

(C)  $\frac{\sqrt{\epsilon_1}}{\sqrt{\epsilon_1} + \sqrt{\epsilon_2}}$

(D)  $\frac{\sqrt{\epsilon_2}}{\sqrt{\epsilon_1} + \sqrt{\epsilon_2}}$

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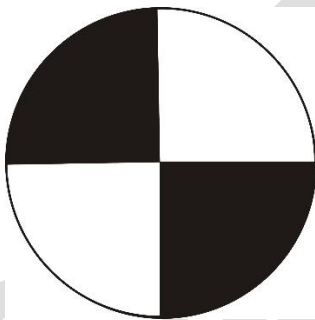
Q.32 The given figure shows the self-potential anomaly observed over a two dimensional thin sheet-type ore body whose strike is perpendicular to the plane of the paper. Which one of the following directions of polarization of the ore body leads to the given anomaly?



Q.33 Which one of the following geophysical methods is suitable for the identification of seepage of water from dams?

- (A) Self-Potential
- (B) Gravity
- (C) Magnetic
- (D) Radiometric

Q.34 The given beach-ball figure denotes the focal mechanism corresponding to which one of the following faults?



- (A) oblique slip normal
- (B) thrust
- (C) strike-slip
- (D) normal

Q.35 At present, which one of the following planets does NOT have a magnetic field of internal origin produced by an active dynamo?

- (A) Mercury
- (B) Venus
- (C) Earth
- (D) Uranus

Q.36 The dimension of permeability is

- (A) L
- (B)  $L^2$
- (C)  $L^3$
- (D)  $L^2T^{-2}$

Q.37 In radiometric surveys, potassium in subsurface rocks will show a  $\gamma$ -ray peak in which one of the following MeV energy channels?

(A) 0.92

(B) 1.46

(C) 1.76

(D) 2.62

Q.38 Assume the acceleration due to gravity is  $10 \text{ m/s}^2$ . The geoid height anomaly in metres due to the gravitational potential anomaly of  $-59 \text{ m}^2/\text{s}^2$  measured over the spheroid is

(A)  $-5.9$

(B) 5.9

(C) 59

(D)  $-59$

Q.39 Which one among the following factors contributes the least amount of heat to the Earth's annual heat budget?

- (A) Geothermal flux from Earth's interior
- (B) Reflection and re-radiation of Solar energy
- (C) Energy released from Earthquakes
- (D) Rotational deceleration by Tidal friction

Q.40 Identify the CORRECT assumption(s) supporting the convolutional model of zero-offset seismic data from the following statements.

- (A) Seismic data consist of a single temporal frequency
- (B) There are no sharp changes in the material properties in the subsurface
- (C) Density is constant in the subsurface
- (D) The source waveform is stationary, that is, the source waveform does not change as it travels in the subsurface

- Q.41 A spherical ore body produces a maximum gravity anomaly of 18 mGal when its centre is at a depth of 2 km from the surface. Assuming that the density contrast and the radius of the body remain unchanged, the ore body will produce a maximum gravity anomaly of 2 mGal if the depth to its centre in km is \_\_\_\_\_ (*in integer*).
- Q.42 The ratio of the largest to the smallest amplitude of waveforms that can be accurately recorded by a digital seismometer is reported as  $10^7$ . Then, the dynamic range of the seismometer in dB is \_\_\_\_\_ (*in integer*).
- Q.43 A petroleum company estimates that a reservoir holds oil with a prior probability of 60 %. It then acquires petrophysical data that suggests the presence of oil. If the petrophysical analysis is accurate with a probability of 70 %, the posterior probability of the presence of oil in % is \_\_\_\_\_ (*rounded off to two decimal places*).
- Q.44 The magnitude of horizontal and vertical components of the total magnetic field at a particular location are 40500 nT and 36450 nT, respectively. The magnetic inclination at the same location in degrees is \_\_\_\_\_ (*rounded off to one decimal place*).



**Q.45 – Q .65 Carry TWO marks Each**

Q.45 A stress tensor  $\sigma$ , with elements in MPa, is as given. The maximum value of the principal stress in MPa is

$$\sigma = \begin{bmatrix} 1 & 0 & \sqrt{2} \\ 0 & 1 & 0 \\ \sqrt{2} & 0 & 0 \end{bmatrix}$$

- (A) 2.0
- (B)  $\sqrt{2}$
- (C) 1.0
- (D) 0.0

Q.46 An overdetermined linear inverse problem is expressed as  $\mathbf{Gm} = \mathbf{d}$ , where  $\mathbf{G}$  is the data kernel,  $\mathbf{m}$  is the vector of model parameters and  $\mathbf{d}$  is the vector of observed data. If damping is applied to the inverse problem and the resultant generalized inverse is represented by  $\mathbf{G}^{-g}$ , the **model resolution** matrix can be expressed as

- (A)  $\mathbf{G}^T \mathbf{G}^{-g}$
- (B)  $\mathbf{G}^{-g} \mathbf{G}^T$
- (C)  $\mathbf{G}^{-g} \mathbf{G}$
- (D)  $\mathbf{G} \mathbf{G}^{-g}$

Q.47 A Wenner resistivity survey was performed with a spacing of 15 m between the current electrodes. Potential difference values of  $-25$  mV and 225 mV were measured before and after injecting 100 mA current into the ground. The apparent resistivity in  $\Omega$ -m after correcting for the self-potential effect is

- (A) 78.5
- (B) 62.8
- (C) 188.5
- (D) 235.6

Q.48 Nine equally spaced electrodes are placed along a profile to perform Dipole-Dipole multi-electrode resistivity imaging. The maximum number of data points that can be obtained at measurement level  $n = 2$  is

- (A) 5
- (B) 6
- (C) 4
- (D) 2

Q.49 Match the electromagnetic methods in Group-I with their corresponding frequency range in Group-II.

| Group-I                           | Group-II           |
|-----------------------------------|--------------------|
| P. Very Low Frequency             | 1. 10 MHz – 1 GHz  |
| Q. Radio Magnetotelluric          | 2. 1 Hz – 20 kHz   |
| R. Ground Penetrating Radar       | 3. 100 kHz – 1 MHz |
| S. Control Source Magnetotelluric | 4. 15 kHz – 30 kHz |

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

Q.50 A geophysical forward problem is expressed as  $d = 7m_1^2m_2 + 6m_2$ , where  $m_1$  and  $m_2$  represent the model parameters and  $d$  represents the data. Then, the relationship between data and model parameters is

- (A) explicit and linear
- (B) implicit and linear
- (C) explicit and non-linear
- (D) implicit and non-linear

Q.51 Assuming that the polar flattening of the Earth  $f = 3.353 \times 10^{-3}$ , the difference between the geodetic and geocentric latitudes is maximum at

- (A) the poles
- (B)  $60^\circ$  geocentric latitude
- (C)  $45^\circ$  geocentric latitude
- (D)  $30^\circ$  geocentric latitude

Q.52 Which of the following statements related to an equipotential surface is/are CORRECT ?

- (A) Work is done on moving a test particle on an equipotential surface
- (B) Only one equipotential surface can exist at any point in space
- (C) The potential is constant on an equipotential surface
- (D) Field lines at any point are always parallel to their equipotential surface

Q.53 If  $\mathbf{B}$  is the magnetic field in a region free of currents, then which of the following statements is/are correct?

(A)  $\mathbf{B} = -\nabla\phi$ , where  $\phi$  is the scalar potential

(B)  $\mathbf{B}$  is rotational

(C)  $\nabla \times \mathbf{B} = \mathbf{0}$

(D)  $\nabla \cdot \mathbf{B} = \mathbf{0}$

Q.54 Which of the following operations performed in the time-domain with any two causal seismic signals result(s) in the **subtraction of their corresponding phase spectra** in the frequency domain?

(A) Convolution

(B) Crosscorrelation

(C) Deconvolution

(D) Subtraction

Q.55 Choose the CORRECT statement(s) on the phenomenon of spatial aliasing of seismic data.

- (A) Spatial aliasing can be reduced by increasing the geophone (group) spacing
- (B) Spatial aliasing is more likely to occur for higher temporal frequencies in the data
- (C) Subsurface formations with higher interval velocities increase the likelihood of spatial aliasing
- (D) Reflections from steep dips are more likely to be spatially aliased

Q.56 The speed of a ship is given as  $V_1$  and  $V_2$  in km/h and knots, respectively. The latitude of observation and the direction of the ship with respect to the North are represented as  $\theta_1$  and  $\theta_2$ , respectively. The CORRECT expression(s) for the Eötvös correction in mGal is/are

- (A)  $4.040 V_1 \cos \theta_1 \sin \theta_2 + 0.001211 V_1^2$
- (B)  $7.503 V_2 \cos \theta_1 \sin \theta_2 + 0.004154 V_2^2$
- (C)  $4.040 V_2 \cos \theta_2 \sin \theta_1 + 0.001211 V_2^2$
- (D)  $7.503 V_1 \cos \theta_1 \sin \theta_2 + 0.004154 V_1^2$

Q.57 Which of the following statements pertaining to the interpretation of Neutron log is/are CORRECT ?

- (A) Overpressured shale shows very low neutron porosity
- (B) Neutron log primarily measures liquid (water/oil) filled porosity
- (C) Neutron porosity for a gas-bearing clean sandstone formation is lower than the actual porosity of the same formation
- (D) A low neutron porosity indicates high Hydrogen Index of the formation

Q.58 A magnetic field (**B**) of strength 50000 nT induces a magnetization (**M**) of magnitude 5 A/m in a rock. Given the magnetic permeability of free space  $\mu_0 = 4\pi \times 10^{-7}$  H/m, the susceptibility of the rock is \_\_\_\_\_(rounded off to three decimal places).

Q.59 The amplitude of a monochromatic 1000 Hz EM wave reduces by a factor of  $1/e$  after penetrating to a depth of 100 m in a homogeneous medium. Given the magnetic permeability of free space  $\mu_0 = 4\pi \times 10^{-7}$  H/m, the electrical conductivity of the medium in S/m is \_\_\_\_\_(rounded off to three decimal places).

Q.60 A plane P-wave is incident at an angle of  $60^\circ$  with respect to the normal to a horizontal reflector. If the incident medium is a homogeneous Poisson solid (Poisson's ratio of 0.25), the angle of the reflected, mode-converted S-wave in degrees with respect to the normal is \_\_\_\_\_(rounded off to one decimal place).

- Q.61 A marine seismic survey was performed in a region with a flat, horizontal sea bed at a depth of 100 m from the sea surface. The datum of the stacked seismic section was fixed at the sea surface. If the P-wave velocity in water is 1600 m/s, the radius of the first Fresnel zone at the sea bed at a frequency of 50 Hz corresponding to the stacked seismic section is \_\_\_\_\_(rounded off to one decimal place).
- Q.62 A stacked seismic section shows a single dipping event with a slope of 0.5 s/km. Stolt migration with a constant velocity of 2 km/s is applied to the data. The dip of the event in the migrated section in degrees is \_\_\_\_\_(rounded off to one decimal place).
- Q.63 The number of half-lives ( $t_{1/2}$ ) required for a radioactive isotope to decrease to 2 % of its original abundance is \_\_\_\_\_(rounded off to two decimal places).
- Q.64 A monochromatic cosine wave with frequency of 0.24 Hz and wavelength 16 km interferes with another monochromatic cosine wave with frequency 0.3 Hz and wavelength 10 km. The group velocity of the resulting wave in km/s is \_\_\_\_\_(rounded off to one decimal place).



- Q.65 The given figure shows a homogeneous rock layer of thickness 100 m. A vertical borehole is drilled through the rock layer and gravity measurements are acquired at points **A** and **B**. If the difference in measurements at **A** and **B** is 5 mGal, the density of the rock layer ( $\rho$ ) in g/cc, ignoring terrain corrections is \_\_\_\_\_ (rounded off to two decimal places).

