

General Aptitude (GA)**Q.1 – Q.5 Carry ONE mark Each**

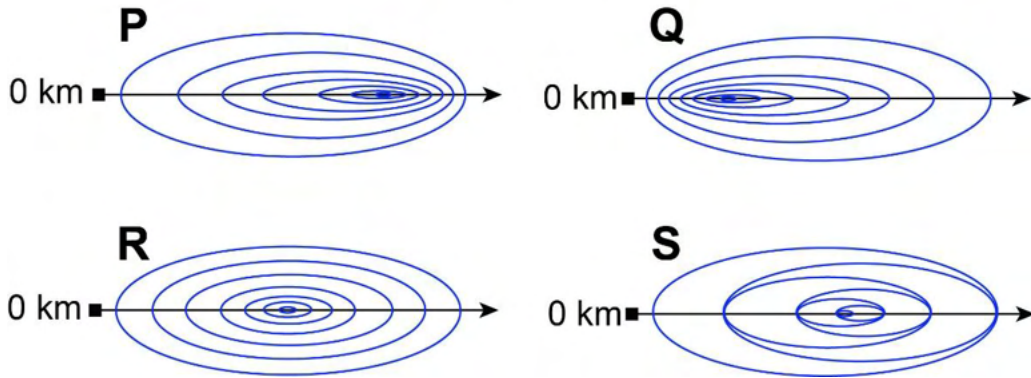
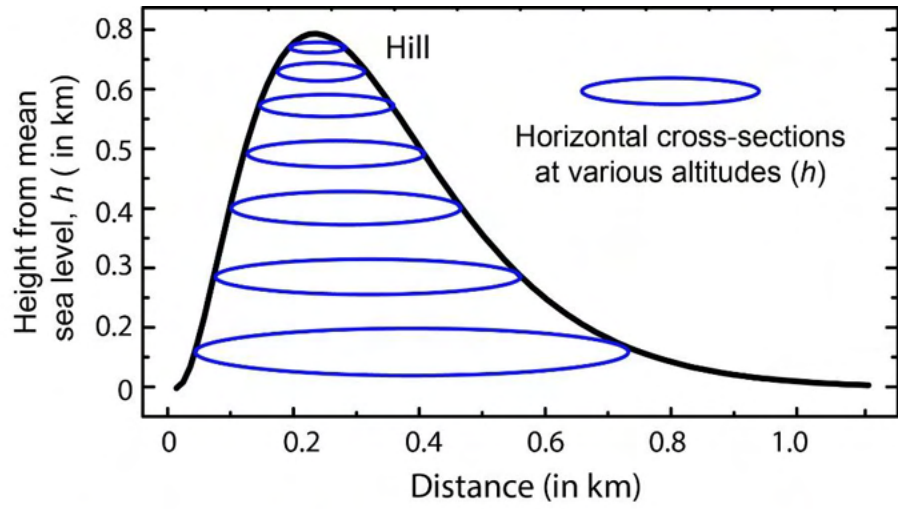
Q.1	The village was nestled in a green spot, _____ the ocean and the hills.
(A)	through
(B)	in
(C)	at
(D)	between

Q.2	Disagree : Protest : : Agree : _____ (By word meaning)
(A)	Refuse
(B)	Pretext
(C)	Recommend
(D)	Refute

Q.3	A 'frabjous' number is defined as a 3 digit number with all digits odd, and no two adjacent digits being the same. For example, 137 is a frabjous number, while 133 is not. How many such frabjous numbers exist?
(A)	125
(B)	720
(C)	60
(D)	80

Q.4	Which one among the following statements must be TRUE about the mean and the median of the scores of all candidates appearing for GATE 2023?
(A)	The median is at least as large as the mean.
(B)	The mean is at least as large as the median.
(C)	At most half the candidates have a score that is larger than the median.
(D)	At most half the candidates have a score that is larger than the mean.

Q.5 In the given diagram, ovals are marked at different heights (h) of a hill. Which one of the following options **P**, **Q**, **R**, and **S** depicts the top view of the hill?



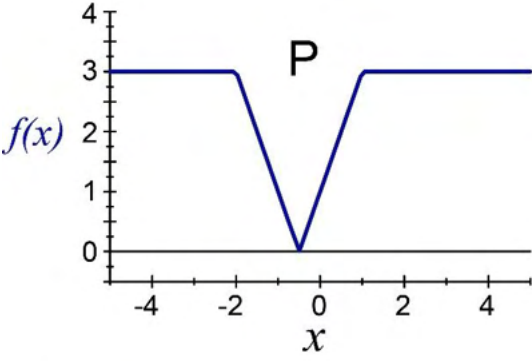
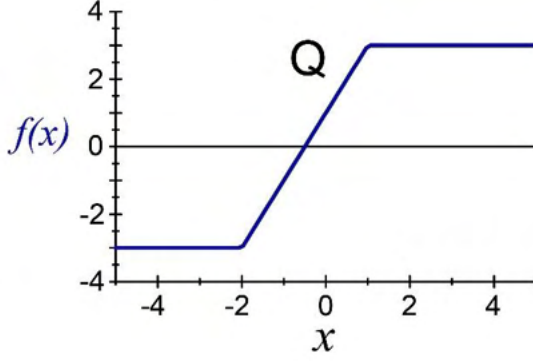
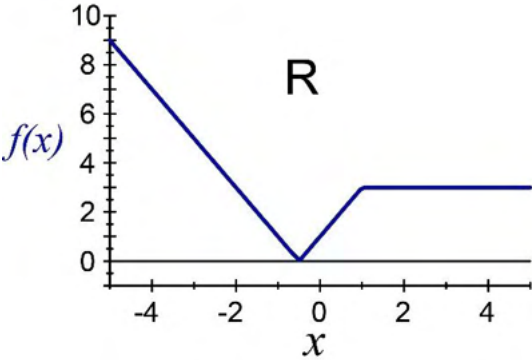
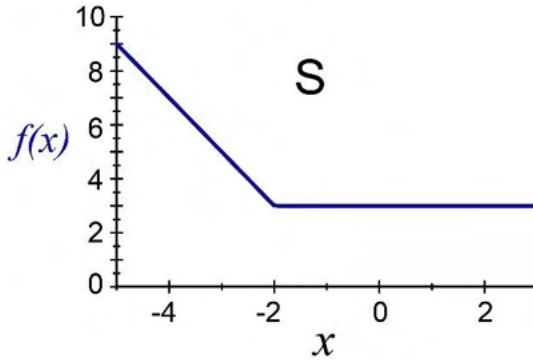
- (A) **P**
- (B) **Q**
- (C) **R**
- (D) **S**

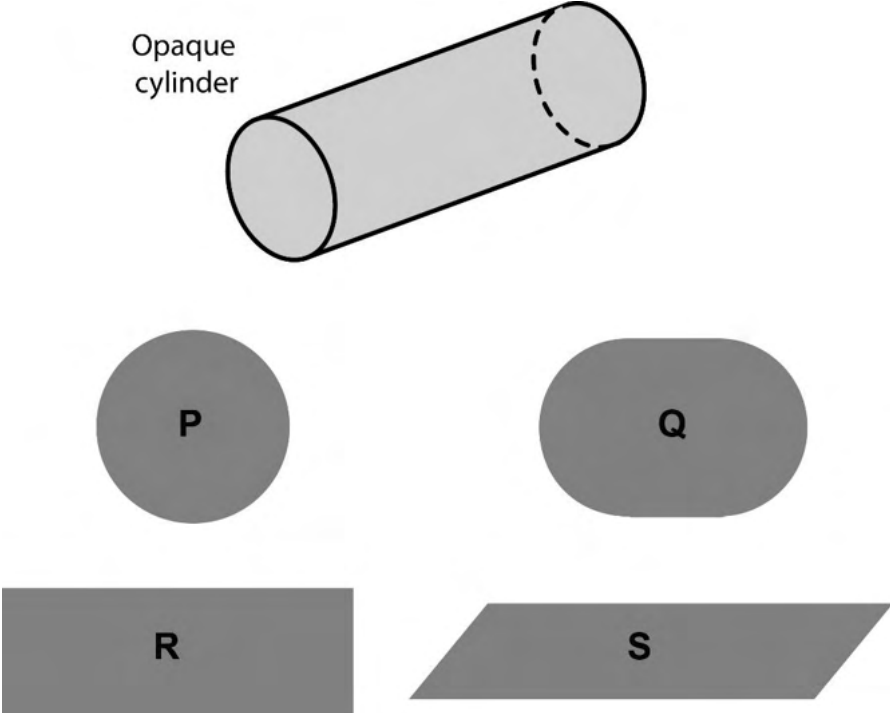
Q.6 – Q.10 Carry TWO marks Each

<p>Q.6</p>	<p>Residency is a famous housing complex with many well-established individuals among its residents. A recent survey conducted among the residents of the complex revealed that all of those residents who are well established in their respective fields happen to be academicians. The survey also revealed that most of these academicians are authors of some best-selling books.</p> <p>Based only on the information provided above, which one of the following statements can be logically inferred with <i>certainty</i>?</p>
<p>(A)</p>	<p>Some residents of the complex who are well established in their fields are also authors of some best-selling books.</p>
<p>(B)</p>	<p>All academicians residing in the complex are well established in their fields.</p>
<p>(C)</p>	<p>Some authors of best-selling books are residents of the complex who are well established in their fields.</p>
<p>(D)</p>	<p>Some academicians residing in the complex are well established in their fields.</p>

<p>Q.7</p>	<p>Ankita has to climb 5 stairs starting at the ground, while respecting the following rules:</p> <ol style="list-style-type: none"> 1. At any stage, Ankita can move either one or two stairs up. 2. At any stage, Ankita cannot move to a lower step. <p>Let $F(N)$ denote the number of possible ways in which Ankita can reach the N^{th} stair. For example, $F(1) = 1$, $F(2) = 2$, $F(3) = 3$.</p> <p>The value of $F(5)$ is _____.</p>
(A)	8
(B)	7
(C)	6
(D)	5

<p>Q.8</p>	<p>The information contained in DNA is used to synthesize proteins that are necessary for the functioning of life. DNA is composed of four nucleotides: Adenine (A), Thymine (T), Cytosine (C), and Guanine (G). The information contained in DNA can then be thought of as a sequence of these four nucleotides: A, T, C, and G. DNA has coding and non-coding regions. Coding regions—where the sequence of these nucleotides are read in groups of three to produce individual amino acids—constitute only about 2% of human DNA. For example, the triplet of nucleotides CCG codes for the amino acid glycine, while the triplet GGA codes for the amino acid proline. Multiple amino acids are then assembled to form a protein.</p> <p>Based only on the information provided above, which of the following statements can be logically inferred with <i>certainty</i>?</p> <p>(i) The majority of human DNA has no role in the synthesis of proteins. (ii) The function of about 98% of human DNA is not understood.</p>
(A)	only (i)
(B)	only (ii)
(C)	both (i) and (ii)
(D)	neither (i) nor (ii)

<p>Q.9</p>	<p>Which one of the given figures P, Q, R and S represents the graph of the following function?</p> $f(x) = x + 2 - x - 1 $
	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>P</p> </div> <div style="text-align: center;">  <p>Q</p> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="text-align: center;">  <p>R</p> </div> <div style="text-align: center;">  <p>S</p> </div> </div>
<p>(A)</p>	<p>P</p>
<p>(B)</p>	<p>Q</p>
<p>(C)</p>	<p>R</p>
<p>(D)</p>	<p>S</p>

<p>Q.10</p>	<p>An opaque cylinder (shown below) is suspended in the path of a parallel beam of light, such that its shadow is cast on a screen oriented perpendicular to the direction of the light beam. The cylinder can be reoriented in any direction within the light beam. Under these conditions, which one of the shadows P, Q, R, and S is NOT possible?</p>
	 <p>The diagram shows an opaque cylinder labeled "Opaque cylinder" tilted at an angle. Below it are four shaded shapes representing possible shadows: P is a circle, Q is an oval, R is a rectangle, and S is a parallelogram.</p>
<p>(A)</p>	<p>P</p>
<p>(B)</p>	<p>Q</p>
<p>(C)</p>	<p>R</p>
<p>(D)</p>	<p>S</p>

PART A: COMPULSORY SECTION FOR ALL CANDIDATES**Q.11 – Q.17 Carry ONE mark Each**

Q.11	Which of the following is a chronostratigraphic unit?
(A)	Member
(B)	Stage
(C)	Acme Zone
(D)	Period
Q.12	During contact metamorphism, with increasing temperature,
(A)	the ratio of volume to surface area of mineral grains increases.
(B)	the ratio of volume to surface area of mineral grains decreases.
(C)	the reaction kinetics becomes slower.
(D)	hydrous minerals become more stable.

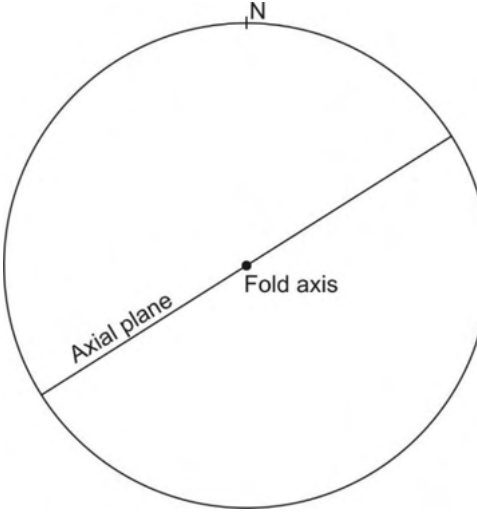
Q.13	The dimension of dynamic viscosity is
(A)	$M^1L^{-1}T^{-2}$
(B)	$M^1L^{-1}T^{-1}$
(C)	$M^0L^2T^{-1}$
(D)	$M^0L^0T^0$
Q.14	At a depth of about 400 km inside the Earth, which one of the following occurs?
(A)	Conversion of most silicates to perovskite structure
(B)	Conversion of plagioclase-peridotite to spinel-peridotite
(C)	Transformation of olivine to spinel structure
(D)	Conversion of spinel-peridotite to plagioclase-peridotite

Q.15	Equatorial radius of which one of the following planets is closest to that of the Earth?
(A)	Mercury
(B)	Venus
(C)	Mars
(D)	Neptune
Q.16	Variation of Bouguer anomaly obtained along a profile after applying all the necessary corrections is due to
(A)	topographic undulation above the datum plane.
(B)	increase in densities of crustal rocks with depth.
(C)	lateral density variations.
(D)	vertical density contrast across Moho.

Q.17	<p>The heat production (Q_r) of a granitic rock due to decay of the radioactive elements U, Th and K having concentration C_U, C_{Th}, and C_K, respectively, is given by the expression</p> $Q_r = \alpha C_U + \beta C_{Th} + \gamma C_K$ <p>Which one of the following correctly represents the relation between the magnitude of coefficients α, β, γ (in μWkg^{-1})?</p>
(A)	$\alpha > \beta > \gamma$
(B)	$\alpha < \beta > \gamma$
(C)	$\alpha > \beta < \gamma$
(D)	$\alpha < \beta < \gamma$

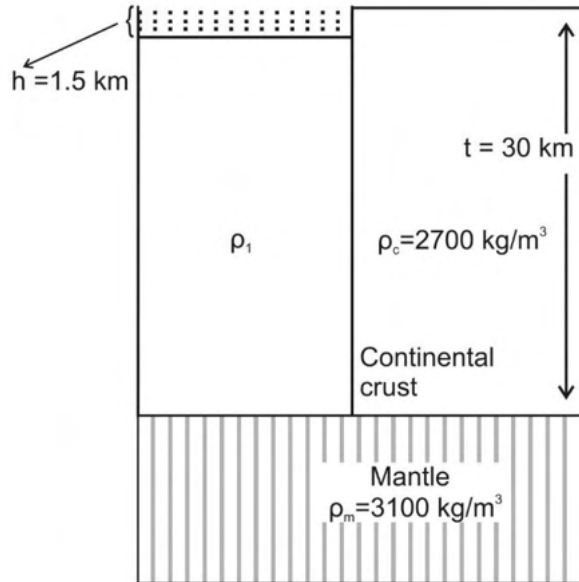
Q.18 – Q.26 Carry TWO marks Each

Q.18	Which one of the following Phanerozoic periods has the shortest duration of time?								
(A)	Cambrian								
(B)	Devonian								
(C)	Cretaceous								
(D)	Silurian								
Q.19	Based on the given mineral proportions, which one of the following statements is CORRECT? <table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Rock</th> <th style="text-align: left;">Mineral Proportion</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>Olivine : Orthopyroxene : Clinopyroxene :: 50 : 30 : 20</td> </tr> <tr> <td>Y</td> <td>Plagioclase : Alkali feldspar : Quartz :: 25 : 45 : 30</td> </tr> <tr> <td>Z</td> <td>Biotite : Plagioclase : Alkali feldspar : Quartz :: 20 : 25 : 35 : 20</td> </tr> </tbody> </table>	Rock	Mineral Proportion	X	Olivine : Orthopyroxene : Clinopyroxene :: 50 : 30 : 20	Y	Plagioclase : Alkali feldspar : Quartz :: 25 : 45 : 30	Z	Biotite : Plagioclase : Alkali feldspar : Quartz :: 20 : 25 : 35 : 20
Rock	Mineral Proportion								
X	Olivine : Orthopyroxene : Clinopyroxene :: 50 : 30 : 20								
Y	Plagioclase : Alkali feldspar : Quartz :: 25 : 45 : 30								
Z	Biotite : Plagioclase : Alkali feldspar : Quartz :: 20 : 25 : 35 : 20								
(A)	Y is more felsic compared to X & Z								
(B)	X is more felsic compared to Y & Z								
(C)	Z is more felsic compared to X & Y								
(D)	Y is the most felsic and Z is the most mafic								

Q.20	The CORRECT sequence(s) of electromagnetic radiations in terms of increasing wavelength is/are
(A)	Gamma ray < UV < Near-IR
(B)	X-ray < Visible light < Thermal IR
(C)	Microwave < Visible light < Radio wave
(D)	Microwave < Thermal IR < Near-IR
Q.21	Which of the given folds is/are represented by the stereoplot?
	
(A)	Horizontal fold
(B)	Vertical fold
(C)	Upright fold
(D)	Recumbent fold

Q.22	The bulk density and water content of a soil are 1800 kg/m^3 and 18%, respectively. The dry density of the soil calculated from the given information is _____ kg/m^3 . [round off to 2 decimal places]
Q.23	In a seismic reflection survey over a two-layered Earth model having densities and seismic velocities $\rho_1=2000 \text{ kg/m}^3$, $V_1=1800 \text{ m/s}$ for the first layer and $\rho_2=3000 \text{ kg/m}^3$, $V_2=2100 \text{ m/s}$ for the second layer, the normal incidence P-wave reflection coefficient is _____. [round off to 3 decimal places]
Q.24	The resistivity of a rock, 100% saturated with water of resistivity $0.25 \text{ } \Omega\text{m}$, is $60 \text{ } \Omega\text{m}$. Assuming tortuosity and cementation exponents to be 1 and 2, respectively, the porosity of the rock is _____ (in %). [round off to 2 decimal places]
Q.25	Let us consider that a student misses cancelling the self-potential between potential electrodes before injecting current into the subsurface, in a Wenner electrical resistivity survey using DC resistivity meter over a horizontally stratified Earth. In direct and reverse modes of measurement (when current flows from C1 to C2 and C2 to C1, respectively) with the same magnitude of current flow, the potential differences recorded are $+158 \text{ mV}$ and -214 mV , respectively. The self-potential between the potential electrodes before injecting current was _____ mV . [in integer]

Q.26 For the given figure, considering Pratt’s model of isostatic compensation at the crust mantle boundary, the crustal density (ρ_1) that explains 1.5 km deep lake is _____ kg/m^3 . (Consider density of water $\rho_w = 1000 \text{ kg/m}^3$) [round off to 2 decimal places]



PART B (SECTION 2): FOR GEOPHYSICS CANDIDATES ONLY

Q.27 – Q.44 Carry ONE mark Each

Q.27	Young's Modulus of granite is
(A)	5×10^{10} to 7×10^{10} Newton/m ² .
(B)	5×10^{10} to 7×10^{10} Newton/cm ² .
(C)	5×10^{10} to 7×10^{10} Newton.
(D)	5×10^{10} to 7×10^{10} Newton m.
Q.28	The resultant stress obtained from normal stress measurements that are corrected for the mean stress is
(A)	hydrostatic stress.
(B)	lithostatic stress.
(C)	deviatoric stress.
(D)	shear stress.

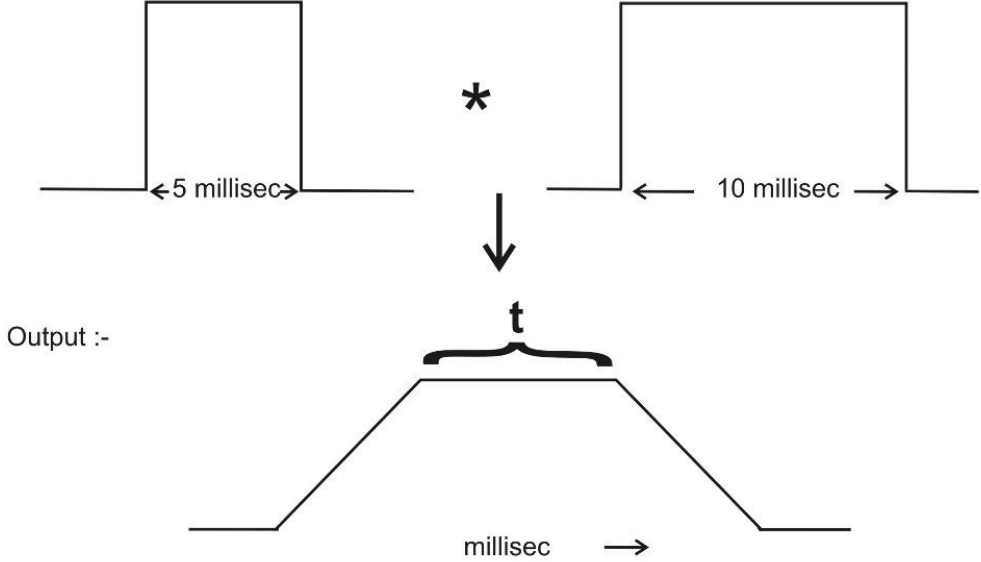
Q.29	Which one of the following options is CORRECT for the arrangement of magnetic moment of dipoles in ferrimagnetic material?
(A)	Equal and anti-parallel in nature
(B)	Unequal and anti-parallel in nature
(C)	Equal and parallel in nature
(D)	Unequal and parallel in nature
Q.30	Choose the CORRECT earthquake body wave phase which travels as S-wave through the inner core of the Earth.
(A)	SKIKS
(B)	SKKS
(C)	PKJKP
(D)	PKiKP

Q.32	If the divergence and curl of a vector field are zero, then the field will be
(A)	solenoidal and irrotational.
(B)	solenoidal but not irrotational.
(C)	irrotational but not solenoidal.
(D)	neither solenoidal nor irrotational.
Q.32	The equipotential surface due to a line current electrode placed horizontally over the surface of a homogeneous Earth is
(A)	cylindrical.
(B)	spherical.
(C)	half-cylindrical.
(D)	hemi-spherical.

Q.33	The basic working principle of a standard Proton Precession Magnetometer is based on
(A)	Faraday's law of induction.
(B)	Nuclear magnetic resonance.
(C)	Zeeman effect.
(D)	Gauss's law for magnetization.
Q.34	The working principle of a modern absolute gravimeter is based on
(A)	free-fall method.
(B)	simple pendulum method.
(C)	Hooke's law.
(D)	principle of zero length spring.

Q.35	The given figure shows the self-potential (S.P.) anomaly observed over a polarized spherical body. The direction of polarization with respect to horizontal is
(A)	0°
(B)	45°
(C)	60°
(D)	90°
Q.36	Geiger-Muller counter responds primarily to
(A)	α -radiation.
(B)	β -radiation.
(C)	γ -radiation.
(D)	α , β , γ -radiations all, equally.

Q.37	The damping parameter in the Damped Least-squares solution of a geophysical inverse problem is primarily used to
(A)	stabilize the inverse solution.
(B)	increase the resolution of estimated model parameters.
(C)	decrease the non-uniqueness of the solution.
(D)	obtain a unique solution.
Q.38	A seismic wave with a wavelength of 25 m propagates through a sedimentary basin with a phase velocity of 280 m/s. The rate of change of phase velocity with respect to wavelength is 4 per second. The group velocity of the seismic wave propagating in the same dispersive medium is _____ m/s. [<i>round off to nearest integer</i>]
Q.39	The gravity anomaly value estimated at the base of a 10 m tall building is 20 mGal. The gravity anomaly value at the top of the building is _____ mGal. (Ignore the mass of the building in both cases) [<i>round off to 1 decimal place</i>]
Q.40	In a VLF EM measurement, the vertical and horizontal components of secondary magnetic field observed at any observation point are +10 SI units and -2 SI units, respectively. If the magnitude of the primary magnetic field at the observation point is +50 SI units, then magnitude of the measured dip angle with respect to the horizontal at the observation point is _____ degree. [<i>round off to 2 decimal place</i>]

<p>Q.41</p>	<p>A geothermal gradient of 32 °C/km is measured in the upper few meters of sediments covering the ocean floor. If the mean thermal conductivity of the oceanic sediments is $1.9 \text{ Wm}^{-1}\text{C}^{-1}$, then the absolute value of local heat flow is _____ milli-Wm^{-2}. [round off to 1 decimal place]</p>
<p>Q.42</p>	<p>A seismic refraction survey is done over a two-layered Earth having P-wave velocities of 2000 m/s and 3500 m/s for the first and second layers, respectively. Given the thickness of the first layer to be 2000 m, the critical distance for the refracted wave is _____ m. [round off to nearest integer]</p>
<p>Q.43</p>	<p>The given figure shows the time domain convolution of two boxcar functions. The duration (t) of the output pulse as shown in the figure is _____ milli-second. [in integer]</p>
	<p>Input :-</p>  <p>Output :-</p>
<p>Q.44</p>	<p>For a given rock formation, the porosity (ϕ) is 23 % and water saturation (S_w) is 25 %. The proportion of water (bulk volume of water) in the total rock formation is _____. [round off to 2 decimal places]</p>

Q.45 – Q.65 Carry TWO marks Each

Q.45	Electrical Resistivity Tomography (ERT) survey is performed in a noisy background along a 1000 m long profile with 10 m equi-spaced electrodes using different electrode configurations. Which electrode configuration will produce maximum number of negative apparent resistivity data?
(A)	Dipole-dipole configuration
(B)	Wenner-Schlumberger configuration
(C)	Wenner configuration
(D)	All configurations will produce the same number of negative apparent resistivity data
Q.46	Consider a signal whose original real part is given by $f(t) = \sin(t)$ and its Hilbert transform is given by $f(t)_H$. Then, the complex signal f_C is
(A)	$\sin(t) - i \sin(t)$
(B)	$\cos(t) - i \cos(t)$
(C)	$\sin(t) - i \cos(t)$
(D)	$\cos(t) - i \sin(t)$

Q.47	Mathematically, the geometrical factor for a Two-electrode array and Wenner array is the same. Which one of the following statements is CORRECT?
(A)	Lateral resolution of Two-electrode array is better than the Wenner array
(B)	Lateral resolution of Wenner array is better than the Two-electrode array
(C)	Lateral resolution of both arrays will be the same
(D)	Vertical resolution of both arrays will be the same
Q.48	Laminar shale, structural shale and dispersed shale can be distinguished by which one of the following cross-plots?
(A)	Self-potential (SP) log value and formation water resistivity (R_w)
(B)	Laterolog Deep (LLD) resistivity and formation resistivity (R_t)
(C)	Sonic log value and Sonic porosity
(D)	Neutron porosity and Density porosity

Q.49	The factor by which the magnetic field decreases with respect to the gravity field caused by the same source at a distance (r) is
(A)	$\frac{1}{r}$
(B)	r
(C)	$\frac{1}{\sqrt{r}}$
(D)	$\frac{1}{r^2}$
Q.50	The total excess mass of an irregular shaped body can be calculated from the corresponding gravity anomaly measured over a horizontal plane on the surface of the Earth using
(A)	Divergence theorem.
(B)	Stoke's theorem.
(C)	Newton's law of gravity.
(D)	Laplace's equation.

Q.51	Select the CORRECT equation for Euler deconvolution solution of the total magnetic field B_T observed along a profile on the surface of the Earth for i^{th} point, with background magnetic field value B , and structural index N .
(A)	$(x_i - x') \left(\frac{\partial B_T}{\partial x} \right)_i + (z_i - z') \left(\frac{\partial B_T}{\partial z} \right)_i = NB - N(B_T)_i$
(B)	$(x_i - x') \left(\frac{\partial B_T}{\partial x} \right)_i + (z_i - z') \left(\frac{\partial B_T}{\partial z} \right)_i = N(B - B_T)$
(C)	$x_i \left(\frac{\partial B_T}{\partial x} \right)_i + NB_T = x' \left(\frac{\partial B_T}{\partial x} \right)_i + z' \left(\frac{\partial B_T}{\partial z} \right)_i + NB$
(D)	$x_i \left(\frac{\partial B_T}{\partial x} \right)_i + N(B_T)_i = x' \left(\frac{\partial B_T}{\partial x} \right)_i + z' \left(\frac{\partial B_T}{\partial z} \right)_i + NB$
Q.52	The potential field U due to a source follows a spherical symmetry. Which among the following is/are CORRECT statement(s)?
(A)	$\frac{\partial U}{\partial r} = \frac{\partial U}{\partial \theta} = 0$
(B)	$\frac{\partial U}{\partial \theta} = \frac{\partial U}{\partial \phi} = 0$
(C)	$\frac{\partial U}{\partial r} \neq 0, \frac{\partial U}{\partial \theta} = 0$
(D)	$\frac{\partial U}{\partial r} \neq 0, \frac{\partial U}{\partial \phi} = 0$

Q.53	In Magnetotelluric survey, three magnetic field components (H_x , H_y , H_z) and two electric field components (E_x and E_y) are measured and two apparent resistivities ρ_{xy} and ρ_{yx} are computed. Which of the following is/are CORRECT?
(A)	$\rho_{xy} = \rho_{yx}$ over horizontally stratified layered structure
(B)	$\rho_{xy} = \rho_{yx}$ when 2D strike is in x-direction
(C)	$\rho_{xy} = \rho_{yx}$ when 2D strike is in y-direction
(D)	$\rho_{xy} = \rho_{yx}$ when 2D strike is at 45° from x-direction
Q.54	Singular Value Decomposition (SVD) decomposes a matrix A into 3 orthogonal matrices. If V is one of the orthogonal matrices, then which among the following is/are CORRECT? (superscript T-represents transpose and I is the Identity matrix)
(A)	$V^T V = V V^T \neq I$
(B)	$V^T V \neq V V^T \neq I$
(C)	$V^T V = I$
(D)	$V V^T = I$

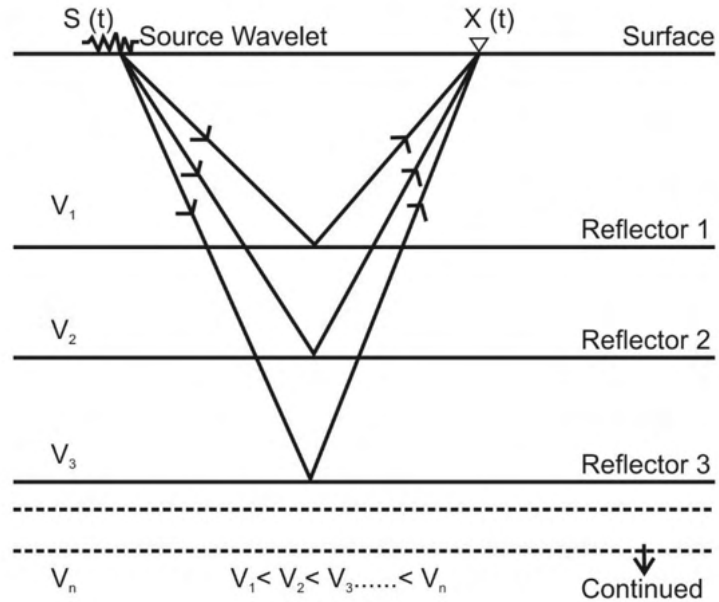
Q.55	If g_A , g_B and g_C are the observed gravity values in a valley below mean sea level, on a plane surface at mean sea level and on the top of a mountain above mean sea level at the same latitude, respectively, then which of the following option(s) is/are CORRECT?
(A)	g_A and g_B less than g_C
(B)	g_A and g_C less than g_B
(C)	g_A and g_B more than g_C
(D)	g_C and g_B less than g_A

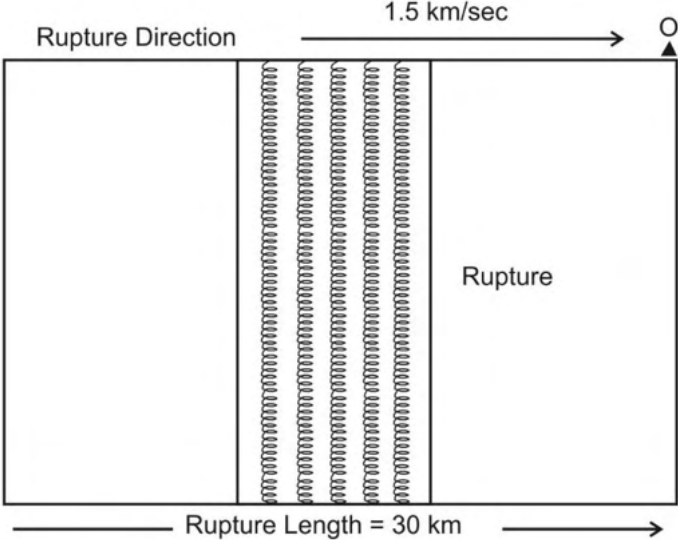
<p>Q.56</p>	<p>The CORRECT option(s) for the generation of point M in a seismic reflection survey as shown in the given figure is/are</p>
<p>(A)</p>	<p>The curvature of the reflector is greater than that of the incident wavefront</p>
<p>(B)</p>	<p>Focusing effect</p>
<p>(C)</p>	<p>Migration</p>
<p>(D)</p>	<p>The curvature of the incident wavefront is greater than that of the reflector.</p>

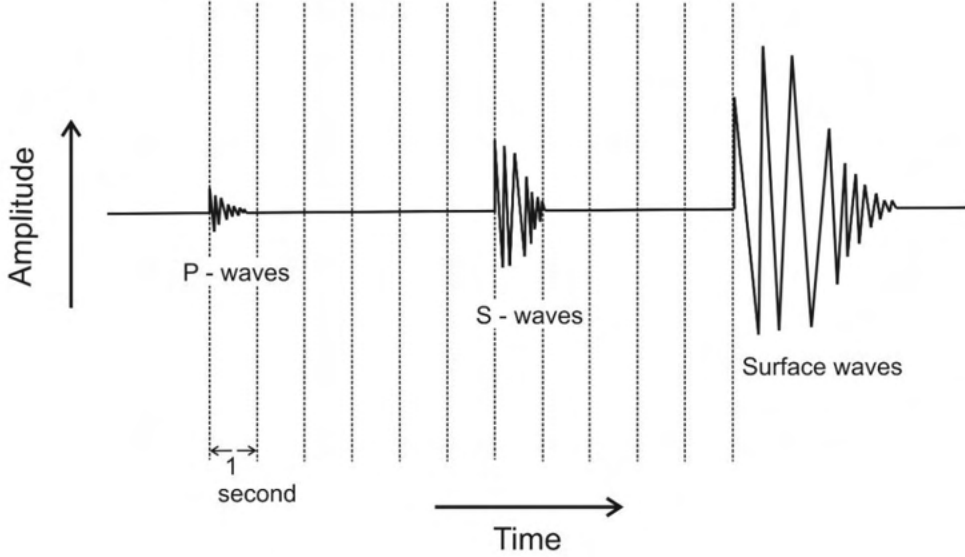
Q.57	<p>In the $X^2 - T^2$ seismic reflection method, the travel time (T) is expressed as</p> $T^2 = T_0^2 + \frac{X^2}{\bar{C}_2^2} - \frac{(\bar{C}_4^4 - \bar{C}_2^4)X^4}{4T_0^2\bar{C}_2^{-8}}$ <p>T_0 is the normal incidence two-way travel time at zero offset distance ($X = 0$), RMS velocities $\bar{C}_2 < \bar{C}_4$. Which of the following options apply(ies) to the third term?</p>
(A)	Heterogeneous medium
(B)	Isotropic medium.
(C)	Homogeneous medium
(D)	Geometrical spreading to correct AVO data.
Q.58	<p>The coefficient of electrical anisotropy and mean resistivity of a horizontally stratified rock sample is 1.10 and 150 Ωm, respectively. The longitudinal resistivity of the rock sample is _____ Ωm. [<i>round off to 2 decimal places</i>]</p>
Q.59	<p>The amplitude of a plane EM wave travelling vertically downward in a homogeneous medium of resistivity 'ρ' decreases with depth as $e^{-(1.75 \times 10^{-2})z}$, where z is depth. If the frequency of the EM wave is 10 kHz, then the resistivity of the medium is _____ Ωm. (use $\mu = \mu_0 = 4\pi \times 10^{-7} \text{H/m}$ and $\pi = 3.14$) [<i>round off to nearest integer</i>]</p>

Q.60

In a seismic survey using a Vibroseis source, the source wavelet used is $S(t) = (0.3, 0.5, 0.6, 0.7)$ and the data acquired is $X(t) = (0.5, 0.3, 0.7, 0.2)$ (as shown in the figure). Consider the unit delay (lag) to be 0.1 second (i.e., two-way travel time), which corresponds to a depth of 300 m. The cross correlation of $S(t)$ with $X(t)$ leads to maximum cross-correlated value of _____. [round off to 2 decimal places]



<p>Q.61</p>	<p>In the given figure, the rupture propagates from left to right along a fault with a rupture velocity of 1.5 km/sec. Given the P-wave velocity of the medium to be 6 km/sec, the apparent rupture time observed at point 'O' at the right edge of the fault is _____ sec. [round off to nearest integer]</p>
	
<p>Q.62</p>	<p>Given the following well logging parameters</p> <p>Flushed zone resistivity $R_{XO} = 0.4 \Omega m$, Formation resistivity $R_t = 5 \Omega m$, Mud-filtrate resistivity $R_{mf} = 0.02 \Omega m$, Formation water resistivity $R_w = 0.10 \Omega m$, Tortuosity factor $a = 1$, and Cementation and Saturation exponents $m = n = 2$, Porosity = 30 %.</p> <p>The movable hydrocarbon saturation is _____%. [round off to 1 decimal places]</p>
<p>Q.63</p>	<p>The horizontal and vertical components of the geomagnetic field at a location are 40000 nT and 30000 nT, respectively. If the horizontal and vertical components of the induced field at the same location are -1000 nT and -600 nT, respectively, then the total magnetic field anomaly for that location is _____ nT. [round off to nearest integer]</p>

<p>Q.64</p>	<p>There is a major water supply well in a fully saturated sandy medium which has a porosity of 40% and a density of 2600 kg/m^3. Water extracted from this well creates a depression in the shape of a vertical cylinder to a depth of 300 m from the surface and with a radius of 1000 m about the well. The maximum change in gravity anomaly due to the 100% extraction of water is _____ mGal. (use $\pi = 3.14$ and $G = 6.67 \times 10^{-11} \text{ Nm}^2\text{kg}^{-2}$) [round off to 2 decimal places]</p>
<p>Q.65</p>	<p>The given figure is a seismogram of a local earthquake which occurred at a depth of 10 km. Considering the P-wave and S-wave velocities as 6 km/s and 3 km/s respectively for the medium, the epicentral distance is _____ km. [round off to nearest integer]</p>
	

END OF QUESTION PAPER

Q. No.	Session	Question Type (QT) MCQ/MSQ/NAT	Subject Name (SN)	Key/Range (KY)	Mark (MK)
1	5	MCQ	GA	D	1
2	5	MCQ	GA	C	1
3	5	MCQ	GA	D	1
4	5	MCQ	GA	C	1
5	5	MCQ	GA	B	1
6	5	MCQ	GA	MTA	2
7	5	MCQ	GA	A	2
8	5	MCQ	GA	D	2
9	5	MCQ	GA	A	2
10	5	MCQ	GA	D	2
11	5	MCQ	GG	B	1
12	5	MCQ	GG	A	1
13	5	MCQ	GG	B	1
14	5	MCQ	GG	C	1
15	5	MCQ	GG	B	1
16	5	MCQ	GG	C	1
17	5	MCQ	GG	A	1
18	5	MCQ	GG	D	2
19	5	MCQ	GG	A	2
20	5	MSQ	GG	A, B	2
21	5	MSQ	GG	B, C	2
22	5	NAT	GG	1525.41 to 1525.43	2
23	5	NAT	GG	0.272 to 0.274	2
24	5	NAT	GG	6.45 to 6.46	2
25	5	NAT	GG	-28 to -28	2
26	5	NAT	GG	2789.00 to 2790.00	2
27	5	MCQ	GG	A	1
28	5	MCQ	GG	C	1
29	5	MCQ	GG	B	1
30	5	MCQ	GG	C	1
31	5	MCQ	GG	A	1
32	5	MCQ	GG	C	1
33	5	MCQ	GG	B	1
34	5	MCQ	GG	A	1
35	5	MCQ	GG	A	1
36	5	MCQ	GG	B	1
37	5	MCQ	GG	A	1
38	5	NAT	GG	180 to 180	1
39	5	NAT	GG	16.7 to 17.0	1
40	5	NAT	GG	10.50 to 12.50	1
41	5	NAT	GG	60.5 to 61.1	1
42	5	NAT	GG	2784 to 2786	1
43	5	NAT	GG	5 to 5	1
44	5	NAT	GG	5.50 to 6.00	1
45	5	MCQ	GG	A	2

46	5	MCQ	GG	C	2
47	5	MCQ	GG	B	2
48	5	MCQ	GG	D	2
49	5	MCQ	GG	A	2
50	5	MCQ	GG	A	2
51	5	MCQ	GG	A	2
52	5	MSQ	GG	B, C, D	2
53	5	MSQ	GG	A, D	2
54	5	MSQ	GG	C, D	2
55	5	MSQ	GG	C, D	2
56	5	MSQ	GG	A, B	2
57	5	MSQ	GG	A, D	2
58	5	NAT	GG	136.00 to 137.00	2
59	5	NAT	GG	125 to 131	2
60	5	NAT	GG	0.92 to 0.92	2
61	5	NAT	GG	14 to 16	2
62	5	NAT	GG	27.1 to 27.7	2
63	5	NAT	GG	-1160 to -1159	2
64	5	NAT	GG	17.01 to 17.31	2
65	5	NAT	GG	34 to 35	2

MTA = Marks to All

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

GATE 2024

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 ⁽ⁱ⁾ the potential for a spectacle. The crowd ⁽ⁱⁱ⁾ 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 ⁽ⁱⁱⁱ⁾ in an abrupt stop on his left foot. As his body ^(iv) 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

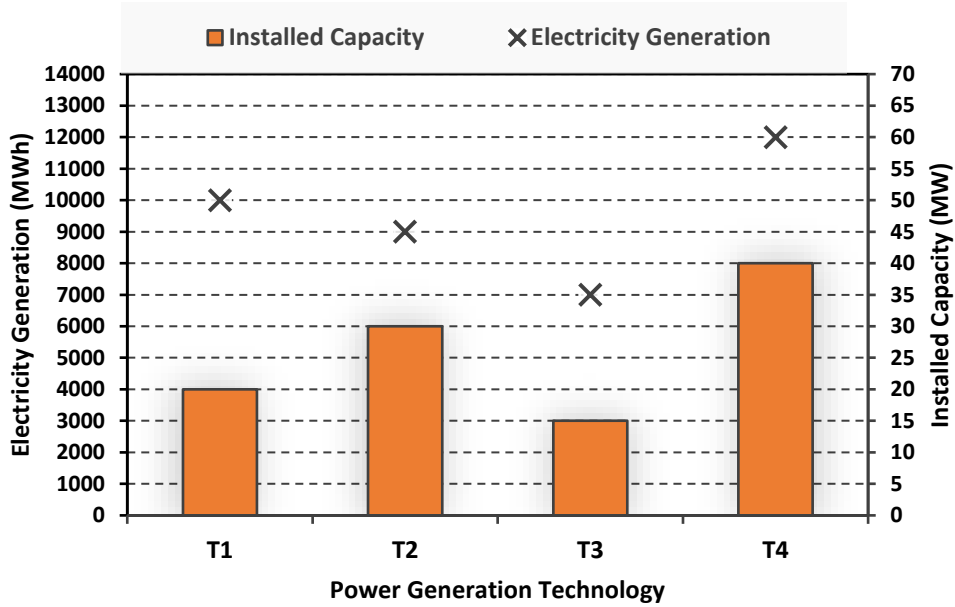
Q.7 Three distinct sets of indistinguishable twins are to be seated at a circular table that has 8 identical chairs. Unique seating arrangements are defined by the relative positions of the people.

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

GATE 2024

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 4×4 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° , the ratio of the Earth-Sun and Earth-Moon distances is closest to

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

GATE 2024

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

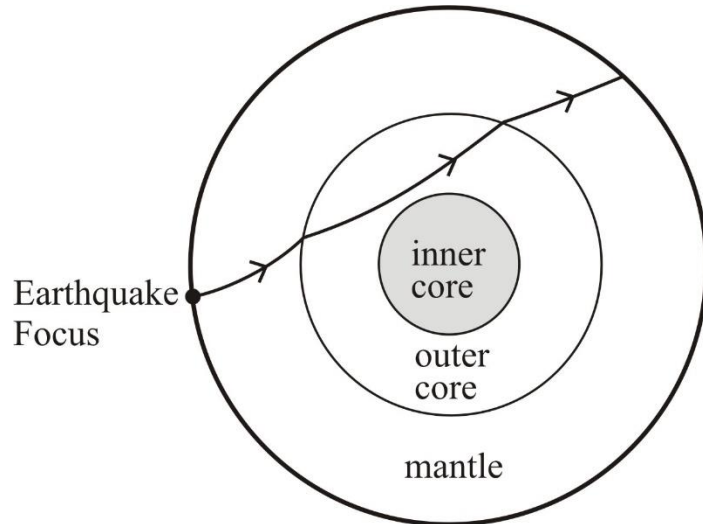
Q.16 Which of the following hydrocarbon fields is/are located in the western offshore of India?

- (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	Group-II
P. Magnetic	1. Chargeability
Q. Gravity	2. Electrical conductivity
R. Magnetotelluric	3. Susceptibility
S. Induced Polarization	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 mW/m^2 and 22 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} cm/s . Considering a steady flow, the transmissivity of the aquifer in m^2/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 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 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 ϵ_1 and ϵ_2 , respectively, the reflection coefficient at normal incidence is

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

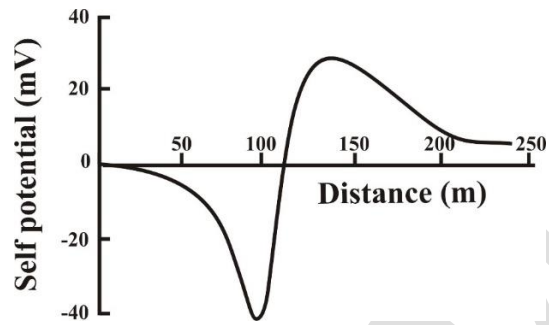
(B) $\frac{\sqrt{\epsilon_1} + \sqrt{\epsilon_2}}{\sqrt{\epsilon_1} - \sqrt{\epsilon_2}}$

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

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

GATE 2024

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?

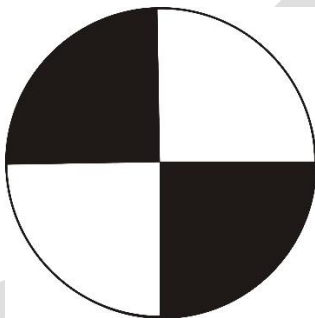


- (A)
- (B)
- (C)
- (D)

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 γ -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 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 σ , 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 Ω -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° geocentric latitude
- (C) 45° geocentric latitude
- (D) 30° 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 ϕ 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 θ_1 and θ_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

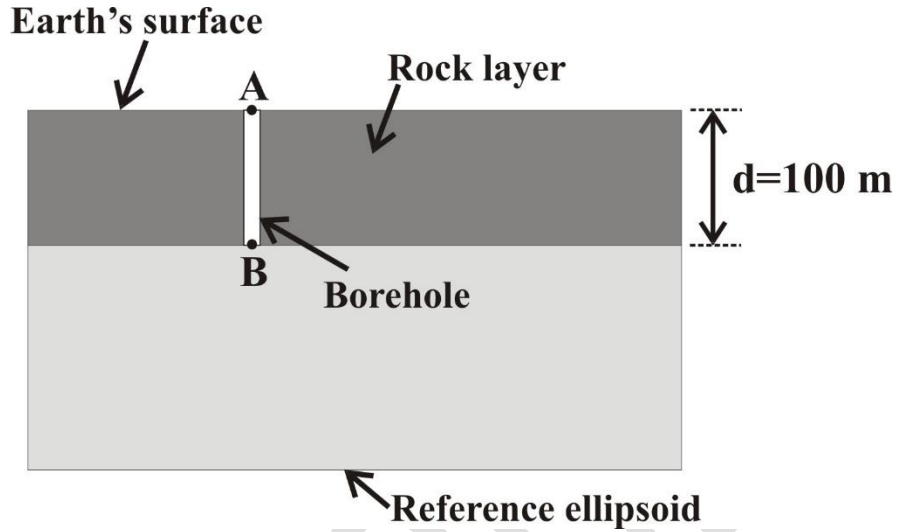
Q.58 A magnetic field (**B**) of strength 50000 nT induces a magnetization (**M**) of magnitude 5 A/m in a rock. Given the magnetic permeability of free space $\mu_0 = 4\pi \times 10^{-7}$ H/m, the susceptibility of the rock is _____(rounded off to three decimal places).

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° 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 (ρ) in g/cc, ignoring terrain corrections is _____(rounded off to two decimal places).





GRADUATE APTITUDE TEST IN ENGINEERING 2024

अभियांत्रिकी स्नातक अभिक्षमता परीक्षा २०२४

ORGANISING INSTITUTE: INDIAN INSTITUTE OF SCIENCE, BENGALURU



Geology & Geophysics - Geophysics (GG-2) Final Answer Key

Q. No.	Session	Question Type	Section	Key/Range	Mark
1	3	MCQ	GA	B	1
2	3	MCQ	GA	A	1
3	3	MCQ	GA	A	1
4	3	MCQ	GA	D	1
5	3	MCQ	GA	C	1
6	3	MCQ	GA	D	2
7	3	MCQ	GA	A	2
8	3	MCQ	GA	A	2
9	3	MCQ	GA	C	2
10	3	MCQ	GA	B	2
11	3	MCQ	GG	B	1
12	3	MCQ	GG	D	1
13	3	MCQ	GG	C	1
14	3	MCQ	GG	C	1
15	3	MCQ	GG	B	1
16	3	MSQ	GG	A;D	1
17	3	NAT	GG	40 to 40	1
18	3	MCQ	GG	B	2
19	3	MCQ	GG	A	2
20	3	MCQ	GG	B	2
21	3	MSQ	GG	A;B	2
22	3	MSQ	GG	A	2
23	3	MSQ	GG	A;C;D	2
24	3	NAT	GG	2 to 2	2
25	3	NAT	GG	86.3 to 86.5	2
26	3	NAT	GG	50 to 50	2
27	3	MCQ	GG2	B	1
28	3	MCQ	GG2	A	1
29	3	MCQ	GG2	A	1
30	3	MCQ	GG2	D	1
31	3	MCQ	GG2	A	1

32	3	MCQ	GG2	A	1
33	3	MCQ	GG2	A	1
34	3	MCQ	GG2	C	1
35	3	MCQ	GG2	B	1
36	3	MCQ	GG2	B	1
37	3	MCQ	GG2	B	1
38	3	MCQ	GG2	B	1
39	3	MCQ	GG2	C	1
40	3	MSQ	GG2	D	1
41	3	NAT	GG2	6 to 6	1
42	3	NAT	GG2	140 to 140	1
43	3	NAT	GG2	75.0 to 80.0	1
44	3	NAT	GG2	41.5 to 42.5	1
45	3	MCQ	GG2	A	2
46	3	MCQ	GG2	C	2
47	3	MCQ	GG2	A	2
48	3	MCQ	GG2	A	2
49	3	MCQ	GG2	A	2
50	3	MCQ	GG2	C	2
51	3	MCQ	GG2	C	2
52	3	MSQ	GG2	B;C	2
53	3	MSQ	GG2	A;C;D	2
54	3	MSQ	GG2	B;C	2
55	3	MSQ	GG2	B;D	2
56	3	MSQ	GG2	A;B	2
57	3	MSQ	GG2	B;C	2
58	3	NAT	GG2	0.142 to 0.146	2
59	3	NAT	GG2	0.023 to 0.027	2
60	3	NAT	GG2	30.0 to 30.0	2
61	3	NAT	GG2	40.0 to 41.6	2
62	3	NAT	GG2	30.0 to 30.0	2
63	3	NAT	GG2	5.50 to 5.80	2
64	3	NAT	GG2	1.5 to 1.7	2
65	3	NAT	GG2	2.9 to 3.3	2