

GATE 2022 General Aptitude (GA)

Q.1 – Q.5 Carry ONE mark each.

Q.1	Inhaling the smoke from a burning _____ could _____ you quickly.
(A)	tire / tier
(B)	tire / tyre
(C)	tyre / tire
(D)	tyre / tier

Q.2	A sphere of radius r cm is packed in a box of cubical shape. What should be the minimum volume (in cm^3) of the box that can enclose the sphere?
(A)	$\frac{r^3}{8}$
(B)	r^3
(C)	$2r^3$
(D)	$8r^3$



Q.3	<p>Pipes P and Q can fill a storage tank in full with water in 10 and 6 minutes, respectively. Pipe R draws the water out from the storage tank at a rate of 34 litres per minute. P, Q and R operate at a constant rate.</p> <p>If it takes one hour to completely empty a full storage tank with all the pipes operating simultaneously, what is the capacity of the storage tank (in litres)?</p>
(A)	26.8
(B)	60.0
(C)	120.0
(D)	127.5

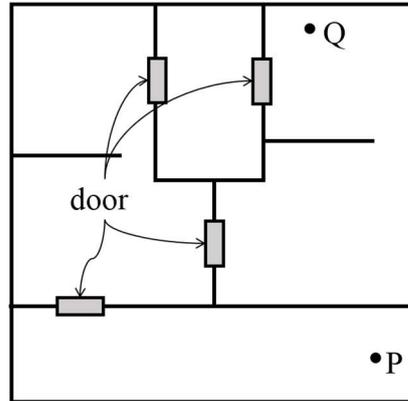


Q.4	<p>Six persons P, Q, R, S, T and U are sitting around a circular table facing the center not necessarily in the same order. Consider the following statements:</p> <ul style="list-style-type: none">• P sits next to S and T.• Q sits diametrically opposite to P.• The shortest distance between S and R is equal to the shortest distance between T and U. <p>Based on the above statements, Q is a neighbor of</p>
(A)	U and S
(B)	R and T
(C)	R and U
(D)	P and S

Q.5

A building has several rooms and doors as shown in the top view of the building given below. The doors are closed initially.

What is the minimum number of doors that need to be opened in order to go from the point P to the point Q?

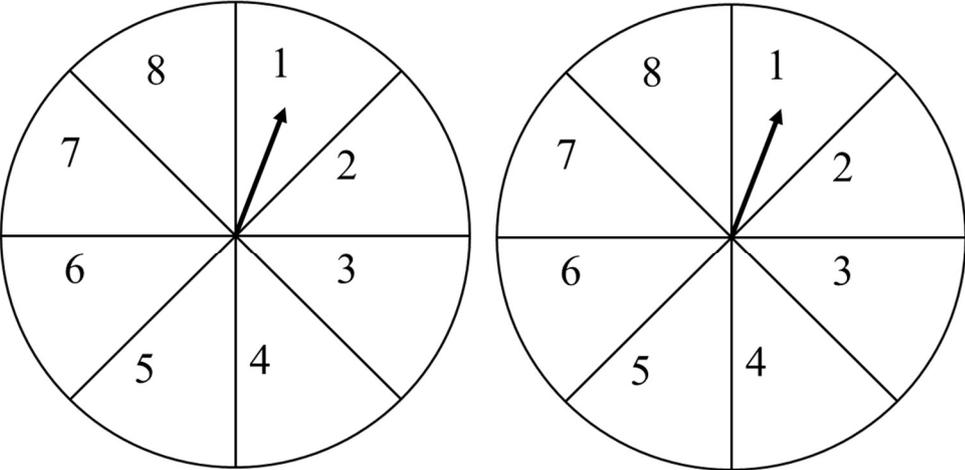


(A) 4

(B) 3

(C) 2

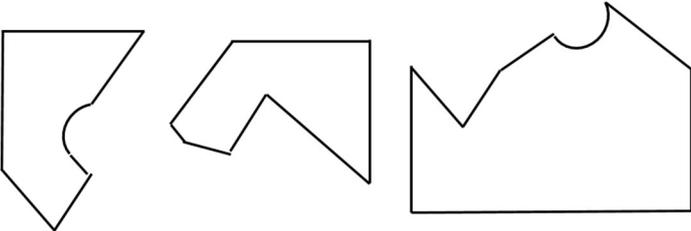
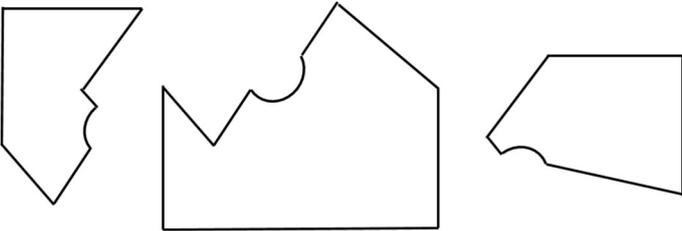
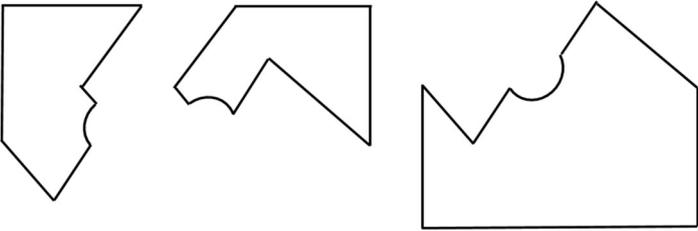
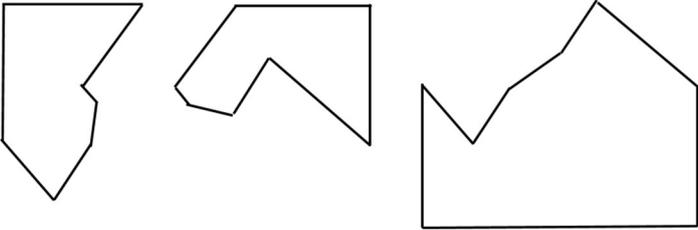
(D) 1

<p>Q.7</p>	<p>A game consists of spinning an arrow around a stationary disk as shown below. When the arrow comes to rest, there are eight equally likely outcomes. It could come to rest in any one of the sectors numbered 1, 2, 3, 4, 5, 6, 7 or 8 as shown.</p> <p>Two such disks are used in a game where their arrows are independently spun.</p> <p>What is the probability that the sum of the numbers on the resulting sectors upon spinning the two disks is equal to 8 after the arrows come to rest?</p> <div style="text-align: center;">  </div>
<p>(A)</p>	<p>$\frac{1}{16}$</p>
<p>(B)</p>	<p>$\frac{5}{64}$</p>
<p>(C)</p>	<p>$\frac{3}{32}$</p>
<p>(D)</p>	<p>$\frac{7}{64}$</p>



Q.8	<p>Consider the following inequalities.</p> <p>(i) $3p - q < 4$</p> <p>(ii) $3q - p < 12$</p> <p>Which one of the following expressions below satisfies the above two inequalities?</p>
(A)	$p + q < 8$
(B)	$p + q = 8$
(C)	$8 \leq p + q < 16$
(D)	$p + q \geq 16$



<p>Q.10</p>	<p>Which one of the following sets of pieces can be assembled to form a square with a single round hole near the center? Pieces cannot overlap.</p>
<p>(A)</p>	
<p>(B)</p>	
<p>(C)</p>	
<p>(D)</p>	

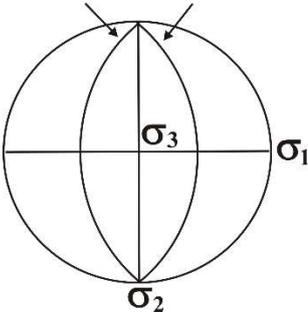
PART A: COMPULSORY SECTION FOR ALL CANDIDATES**Q.11 – Q .17 Carry ONE mark each**

Q.11	Which one of the following is the typical product of ductile deformation?
(A)	Gouge
(B)	Breccia
(C)	Cataclasite
(D)	Mylonite
Q.12	Which one among the following coastal erosional landforms is caused by the action of sea waves?
(A)	Ventifact
(B)	Kettle
(C)	Cirque
(D)	Cliff

Q.13	In which one of the following regions of the electromagnetic spectrum does the maximum atmospheric scattering occur?
(A)	UV
(B)	IR
(C)	Radiowave
(D)	Microwave
Q.14	Which one of the following is the Poisson's ratio for an incompressible fluid?
(A)	0
(B)	0.25
(C)	1
(D)	0.5
Q.15	Which among the following Period(s) belong(s) to the Paleozoic Era?
(A)	Carboniferous
(B)	Paleogene
(C)	Silurian
(D)	Cretaceous

Q.16	The average bulk density of a fully saturated sandstone reservoir with a fractional porosity of 0.23 is _____ g/cc. [round off to 2 decimal places] [Assume matrix density for sandstone = 2.63 g/cc and fluid density = 1.05 g/cc]
Q.17	For a productive alluvial aquifer with hydraulic conductivity = 105 m/day and hydraulic gradient = 0.01, the flow rate is _____ m/day. [round off to 2 decimal places]

Q.18 – Q .26 Carry TWO marks each

Q.18	<p>The relationship between conjugate shear fractures and the principal stresses in a homogenous, isotropic, deformed body is shown in the stereoplot given below (σ_1, σ_2 and σ_3 are compressive stresses). Which one of the given fault regimes is indicated according to the Anderson's theory of faulting for the formation of conjugate shear fractures under plane strain?</p> <p style="text-align: center;">Conjugate Fractures</p> 
(A)	Dextral strike-slip
(B)	Sinistral strike-slip
(C)	Reverse
(D)	Normal

Q.19	How many independent elastic parameters are needed to describe a homogenous isotropic material?
(A)	21
(B)	2
(C)	36
(D)	3
Q.20	Which one of the following is a mafic volcanic rock?
(A)	Dacite
(B)	Trachyte
(C)	Rhyolite
(D)	Basalt
Q.21	The intercepts of a crystal face on the crystallographic axes are ∞a , $2b$, $3c$. Which one of the following is its Miller Index?
(A)	(032)
(B)	(023)
(C)	(203)
(D)	(320)

Q.22	Match the locations in Group I with the corresponding economic deposits in Group II. <table style="width: 100%; border: none;"> <thead> <tr> <th style="text-align: left; width: 50%;">Group I</th> <th style="text-align: left; width: 50%;">Group II</th> </tr> </thead> <tbody> <tr> <td>P. Wajrakarur</td> <td>1. Chromite</td> </tr> <tr> <td>Q. Sukinda</td> <td>2. Diamond</td> </tr> <tr> <td>R. Malanjkhand</td> <td>3. Barite</td> </tr> <tr> <td>S. Mangampeta</td> <td>4. Copper</td> </tr> </tbody> </table>	Group I	Group II	P. Wajrakarur	1. Chromite	Q. Sukinda	2. Diamond	R. Malanjkhand	3. Barite	S. Mangampeta	4. Copper
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(B)	P-3; Q-1; R-4; S-2										
(C)	P-2; Q-1; R-4; S-3										
(D)	P-2; Q-4; R-1; S-3										
Q.23	Choose the CORRECT statement(s) on seismic wave propagation in an elastic isotropic medium.										
(A)	P-waves are polarized in the direction of propagation.										
(B)	S-waves are polarized in the direction of propagation.										
(C)	Rayleigh waves are elliptically polarized.										
(D)	Love waves are elliptically polarized.										



Q.24	The difference in arrival times of P- and S-waves generated by an earthquake and recorded at a seismological station is one second. Assuming a homogeneous and isotropic Earth, a P-wave velocity (V_P) of 3 km/s, the ratio of P- to S-wave velocities (V_P/V_S) of 2.0, the distance between the station and the hypocenter is _____ km. [round off to 1 decimal place]
Q.25	Assuming the rate of rotation of the Earth is 7.27×10^{-5} radians/s and the radius of Earth is 6371 km, the centrifugal acceleration at 60° latitude for a spherically rotating Earth is _____ $\times 10^{-3}$ m/s ² . [round off to 1 decimal place]
Q.26	The angle of inclination of the remanent magnetization of a volcanic rock measured at a location is 45° . The magnetic latitude of the location of the volcanic rock at the time of its magnetization is _____ $^\circ$ N. [round off to 1 decimal place]

PART B (SECTION 2): FOR GEOPHYSICS CANDIDATES ONLY

Q.27 – Q.47 Carry ONE mark Each

Q.27	In 2D stacked seismic sections, the vertical axis corresponds to two-way travel time and the horizontal axis corresponds to _____.
(A)	receiver locations
(B)	source locations
(C)	Offsets
(D)	common midpoint (CMP) locations
Q.28	In a 2D seismic survey acquired on land, head waves were recorded at the surface. Assuming that the subsurface consisted of horizontal, isotropic and homogeneous layers, the moveout of the head wave event(s) would be _____.
(A)	linear
(B)	parabolic
(C)	hyperbolic
(D)	elliptical

Q.31	A current flows from a medium with resistivity ρ_1 to a medium with resistivity ρ_2 . A planar interface separates the two media. The angle of incidence and refraction with respect to the normal to the interface are θ_1 and θ_2 , respectively. If the components of the current density perpendicular to the interface and the components of the electric field horizontal to the interface are continuous, the electrical law of refraction can be expressed as _____.
(A)	$\rho_1 \tan \theta_1 = \rho_2 \tan \theta_2$
(B)	$\rho_1 \sin \theta_1 = \rho_2 \sin \theta_2$
(C)	$\rho_2 \cos \theta_1 = \rho_1 \cos \theta_2$
(D)	$\rho_1 \tan \theta_2 = \rho_2 \tan \theta_1$
Q.32	The convolution of two box-car pulses of positive amplitudes, with unequal and finite durations yields a _____ pulse.
(A)	triangular
(B)	trapezoidal
(C)	rectangular
(D)	sinusoidal

Q.35	Which among the following is/are CORRECT statement(s) about the Van Allen radiation belts?
(A)	The inner belt consists mainly of protons and the belt extends to about 1000-3000 km from the Earth's surface.
(B)	The belts are doughnut-shaped regions coaxial with the geomagnetic field lines of the Earth.
(C)	The pitch of the helical motion of the charged particles increases as the particles approach the surface of the Earth.
(D)	The outer belt occupies regions between 3 to 4 Earth radii and consists primarily of electrons.
Q.36	Which of the following logging methods can be used to measure the resistivity of the flushed zone?
(A)	Lateral log
(B)	Long normal log
(C)	Microlaterolog
(D)	Microspherically focused log

Q.37	Which of the following statement(s) is/are CORRECT about the continuation of the gravity field?
(A)	Continuation of the gravity field from one surface to another is permissible only when there are no masses present between the two surfaces.
(B)	In upward continuation, the longer wavelength anomalies are attenuated more than the shorter wavelength anomalies.
(C)	Downward continuation may enhance noise and uncertainties.
(D)	Upward continuation is a smoothing process.

Q.38	An oceanic plate formed at a mid-oceanic ridge 27 million years ago. The plate has been moving with a uniform half-spreading rate of 4 cm/year ever since its formation. The current distance between the edge of this plate and the centre of the ridge is _____ km. [round off to 1 decimal place]
Q.39	An artificial neural network (ANN) is trained to classify between shale and sand formations. The final layer of the ANN consists of a single neuron with a sigmoid activation function given by $\sigma(x) = \frac{1}{1 + e^{-x}}$. If the input to the final neuron is 0, then the output is _____. [round off to 1 decimal place]
Q.40	A current electrode introduces a 2 Ampere current at a point (P) on the surface of a uniform half space. If the resistivity of the half space is 5 Ω -m, the magnitude of the electric field (due to the current) in the half space at a distance of 1 m from P is _____ V/m. [round off to 2 decimal places]

Q.41	The relative dielectric permittivity of a homogeneous isotropic medium is 10 and the relative magnetic permeability of the same medium is 1. If the velocity of the electromagnetic wave propagating through this medium is v and the velocity of light in vacuum is c , then the ratio v/c is _____. [<i>round off to 2 decimal places</i>]
Q.42	A mountain of height 8 km above mean sea level is in isostatic equilibrium with a 42 km thick continental crust. As predicted by Airy's hypothesis, the root beneath this mountain is _____ km. [<i>round off to 1 decimal place</i>] [Assume, density of mantle = $3.7 \times 10^3 \text{ kg m}^{-3}$ and density of crust = $2.7 \times 10^3 \text{ kg m}^{-3}$]
Q.43	In wet soil of resistivity $100 \Omega\text{m}$, the skin depth of a GPR signal of 100 MHz is _____ m. [<i>round off to 2 decimal places</i>] [Assume: $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$]
Q.44	A Wadati diagram was prepared for a local earthquake occurring in a homogeneous crust. If the crust is assumed to be a Poisson solid, the slope of the straight line in the Wadati diagram is _____. [<i>round off to 2 decimal places</i>]

Q.45 – Q.65 Carry TWO marks Each

<p>Q.45</p>	<p>The gravitational potential of the spheroidal Earth can be expressed as $U_G = -G \frac{E}{r} \left[1 - \sum_{n=2}^{n=\infty} \left(\frac{R}{r} \right)^2 J_n P_n(\cos \theta) \right]$, where G is the gravitation constant, E is the mass of the Earth, r is the radial distance from the centre of the Earth, R is the radius of Earth, J_n are the coefficients obtained from satellite geodesy, P_n represents the Legendre polynomial of order n, and θ is the colatitude. Which among the following is described by the term corresponding to $n = 2$?</p> <p>[Given: $P_2(\cos \theta) = \frac{1}{2}(3 \cos^2 \theta - 1)$]</p>
<p>(A)</p>	<p>Gravitational potential due to a spherical Earth</p>
<p>(B)</p>	<p>Deviations from the ellipsoid that correspond to a pear-shaped Earth</p>
<p>(C)</p>	<p>The effect of the polar flattening on the Earth's gravitational potential</p>
<p>(D)</p>	<p>The gravitational potential of the Earth-Moon system</p>
<p>Q.46</p>	<p>The magnetic potential of a dipole at any external point (P) can be expressed as $V = C_m \frac{\vec{m} \cdot \hat{r}}{r^2}$, $r \neq 0$, where \vec{m} is the dipole moment, \hat{r} is a unit normal along the vector directed from the centre of the dipole to the external point (P) and C_m is a constant. If θ is the angle between \vec{m} and \hat{r}, the radial component of \vec{B} is:</p>
<p>(A)</p>	<p>$B_r = 2C_m \frac{m \cos \theta}{r^3}$</p>
<p>(B)</p>	<p>$B_r = C_m \frac{m \cos \theta}{r^3}$</p>
<p>(C)</p>	<p>$B_r = C_m \frac{m \sin \theta}{r^3}$</p>
<p>(D)</p>	<p>$B_r = 2C_m \frac{m \sin \theta}{r^3}$</p>

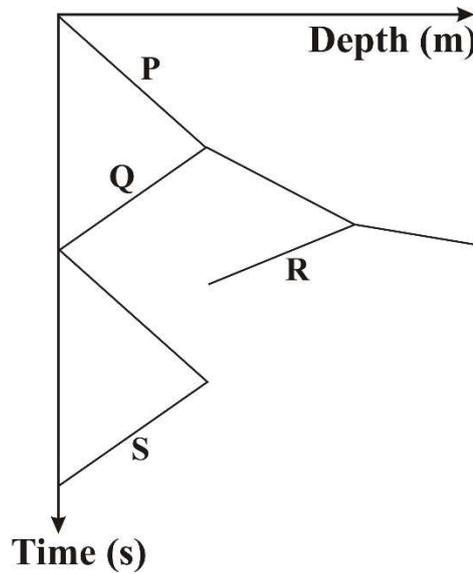
<p>Q.47</p>	<p>The functions $g(t)$ and $G(\omega)$ constitute a Fourier Transform pair [$g(t) \leftrightarrow G(\omega)$] as per the convention: $g(t) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} G(\omega) e^{j\omega t} d\omega$ and $G(\omega) = \int_{-\infty}^{+\infty} g(t) e^{-j\omega t} dt$</p> <p>Which ONE among the following is the correct Fourier transform pair?</p>
<p>(A)</p>	<p>$\frac{dg(t)}{dt} \leftrightarrow G(\omega)$</p>
<p>(B)</p>	<p>$\frac{dg(t)}{dt} \leftrightarrow j\omega G(\omega)$</p>
<p>(C)</p>	<p>$\frac{dg(t)}{dt} \leftrightarrow -j\omega G(\omega)$</p>
<p>(D)</p>	<p>$\frac{dg(t)}{dt} \leftrightarrow \omega G(\omega)$</p>
<p>Q.48</p>	<p>Gauss' divergence theorem is given by</p> $\int_V \vec{\nabla} \cdot \vec{a} \, dV = \int_S \vec{a} \cdot \vec{dS}$ <p>where \vec{a} is a vector field and V is the volume enclosed by the surface S. If $\vec{a} = \nabla\phi + \vec{\nabla} \times \vec{\psi}$, then the application of divergence theorem to \vec{a} yields:</p>
<p>(A)</p>	<p>$\int_V \nabla^2 \phi \, dV = \int_S \nabla\phi \cdot \vec{dS}$</p>
<p>(B)</p>	<p>$\int_V \vec{\nabla} \cdot \vec{\psi} \, dV = \int_S \vec{\psi} \cdot \vec{dS}$</p>
<p>(C)</p>	<p>$\int_V \nabla^2 \phi \, dV = \int_S (\vec{\nabla} \times \vec{\psi}) \cdot \vec{dS}$</p>
<p>(D)</p>	<p>$\int_V \phi \, dV = \int_S \vec{\psi} \cdot \vec{dS}$</p>



Q.49	The angular frequency (ω) and wavenumber (k) for an electromagnetic wave is related by the expression $\omega^2 = \alpha k + \beta k^3$, where α and β are constants. The wavenumber k_0 for which the group velocity equals the phase velocity is _____.
(A)	$3 \sqrt{\frac{\alpha}{\beta}}$
(B)	$\frac{1}{3} \sqrt{\frac{\alpha}{\beta}}$
(C)	$\sqrt{\frac{\alpha}{\beta}}$
(D)	$\frac{1}{2} \sqrt{\frac{\alpha}{\beta}}$

Q.50

The schematic represents P-wave arrivals from a zero-offset Vertical Seismic Profiling (VSP) experiment conducted over a horizontally layered and isotropic Earth. Match the four events labelled in the schematic and their listed descriptions.

Schematic	Description
	<ol style="list-style-type: none"> 1. Primary reflection from the first reflector 2. Direct arrival 3. First order multiple 4. Primary reflection from the second reflector

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

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

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

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

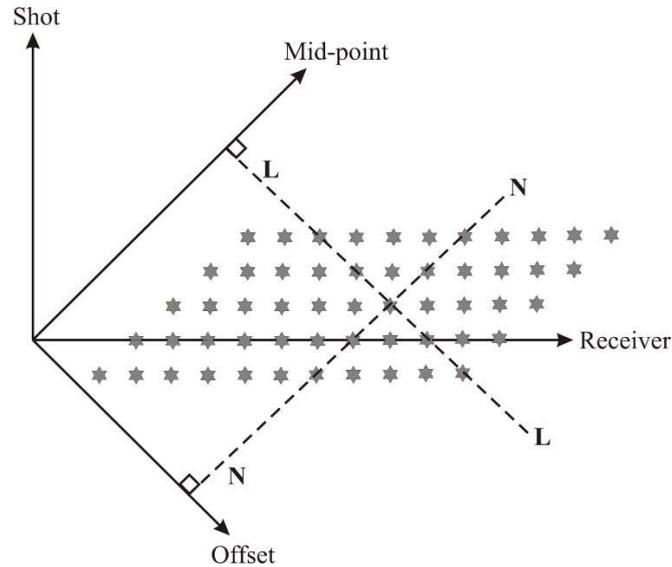


Q.51	The transfer function of a linear system is given as $(s) = \frac{2s+1}{s^2+5s+6}$. The poles of this function are _____.
(A)	-3 and -2
(B)	-3 and 2
(C)	3 and -2
(D)	3 and 2
Q.52	The eigenvalues of the given matrix A are _____. $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 0 & 1 \\ 1 & 1 & 2 \end{bmatrix}$
(A)	-1, 2 and 3
(B)	1, 2 and 3
(C)	0, 2 and 3
(D)	0, 2 and 2

Q.53	The apparent resistivity values obtained from a vertical electrical sounding (VES) survey over a horizontally layered 1-D Earth are indicated by $\rho_1, \rho_2, \rho_3, \rho_4$, where the subscript refers to the n^{th} layer from the surface. Match the VES curve types listed in Group-I with the corresponding ordering of resistivity values listed in Group-II.	
	Group-I	Group-II
(A)	P-4; Q-3; R-1; S-2	
(B)	P-2; Q-3; R-4; S-1	
(C)	P-4; Q-3; R-2; S-1	
(D)	P-3; Q-1; R-2; S-4	

Q.54	Choose the CORRECT statement(s) from the following on the solution of systems of linear equations without the application of regularization.
(A)	An under-determined system of linearly independent equations has either a trivial solution or an infinite number of solutions.
(B)	An ill-conditioned system of linear equations can yield stable solutions in the presence of noise.
(C)	An over-determined system of linearly independent equations does not have an exact solution.
(D)	A system of linearly independent equations with the number of equations equal to the number of unknowns is a mixed-determined system.
Q.55	In seismic spiking deconvolution with an unknown source wavelet, the wavelet can be deconvolved most effectively under which of the following condition(s)?
(A)	The source wavelet is minimum phase.
(B)	The source wavelet is zero phase.
(C)	The autocorrelation of the reflectivity series in time domain can be approximated by a delta function.
(D)	The autocorrelation of the reflectivity series in time domain can be approximated to be identically zero.

Q.56 The stacking chart for an end-on 2D seismic survey is shown in the figure. The shot, receiver, mid-point and offset coordinate axes are as indicated in the figure, while each star represents a unique seismic trace. With reference to the stacking chart, which of the following is/are CORRECT statement(s)?



(A) The traces along LL constitute a common mid-point (CMP) gather.

(B) The traces along LL constitute a common shot gather.

(C) The traces along NN constitute a common offset gather.

(D) The traces along NN constitute a common receiver gather.

Q.57 Suppose $x_{1/5}$ defines the half-width at $1/5^{\text{th}}$ of the maximum gravity value measured over a buried sphere of uniform density. If d is the distance from the surface to the centre of the sphere, the value of $\frac{x_{1/5}}{d}$ is _____. [round off to 2 decimal places]

<p>Q.58</p>	<p>In a reservoir zone, the deep induction log reads $3 \Omega\text{m}$ for a formation whose porosity is 19%. The hydrocarbon saturation of that formation as estimated from Archie's equation is _____. [round off to 1 decimal place]</p> <p>[Assume: $a=1$, $n=2$, $m=1.5$, formation water resistivity = $0.04 \Omega\text{m}$]</p>
<p>Q.59</p>	<p>The heat flow q (mW/m^2) is related to the age t (My) of the ocean floor as $t = (510/q)^2$. Assuming the temperature gradient and the thermal conductivity at a site in the Indian ocean to be $55 \text{ }^\circ\text{C}/\text{km}$ and $2.3 \text{ W}/\text{m }^\circ\text{C}$, respectively, the age of the site is _____ My. [round off to 2 decimal places]</p> <p>[Use the magnitude of the calculated value of q]</p>
<p>Q.60</p>	<p>The radioactive isotopes ^AX and ^BX of an element X at the time of formation of a rock sample were in equal proportions. Subsequently, in a closed system, it was found that the abundances of the isotopes were in the ratio $^B\text{X} / ^A\text{X} = 128.55$. The elapsed time since the formation of the sample is _____ years. [round off to 1 decimal place]</p> <p>[Assume: decay rate of $\lambda_A = 9.85 \times 10^{-3} \text{ y}^{-1}$, $\lambda_B = 1.55 \times 10^{-3} \text{ y}^{-1}$].</p>
<p>Q.61</p>	<p>A two-layered planet consists of a core and a mantle of uniform but unequal densities. The density of the core is 7150 kg m^{-3} and the mean density of the planet is 5620 kg m^{-3}. If the mantle enclosing the core occupies $2/3^{\text{rd}}$ of the radius of the planet from the surface, then the density of the mantle is _____ kg m^{-3}. [round off to 1 decimal place]</p>

Q.62

A reflection seismic survey is conducted over a two-layered medium with a single horizontal, homogeneous, isotropic layer underlain by a homogeneous, isotropic half-space. The Shuey two-term approximation for the P-wave reflection coefficient for the interface separating the media is given by:

$$R(\theta) = 0.025 - 0.1 \sin^2 \theta,$$

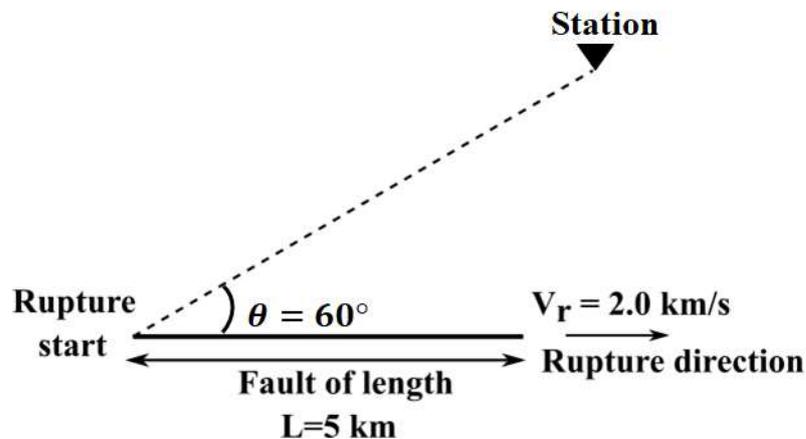
where θ is the angle of incidence of the P-wave with respect to the normal to the interface. Assuming the validity of the approximation, the offset-to-depth ratio (offset/depth) at which a polarity reversal can be observed in a CMP gather from the survey is _____. [round off to two decimal places]

[Hint: A change in the sign of the reflection coefficient leads to polarity reversal]

Q.63

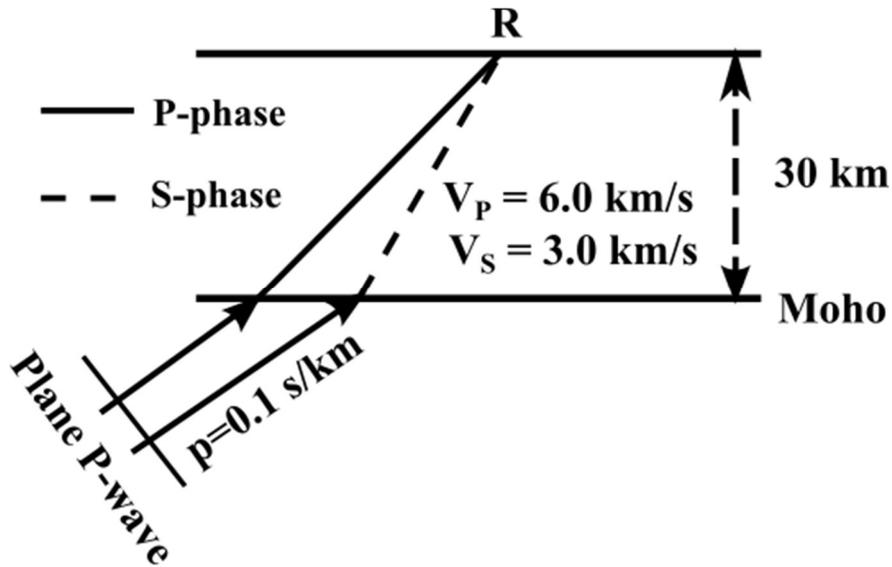
The given figure shows the rupture of a unilateral fault with the rupture velocity (V_r) of 2 km/s. According to the simple Haskell source model, the rupture time associated with the entire length of the fault as estimated at the station is _____ sec. [round off to 2 decimal places]

[Assume: Shear wave speed = 3.5 km/s]



Q.64

The given figure shows ray paths for direct P and P-to-S converted phases recorded at a station on the surface (R) for a teleseismic event. Given that the ray parameter (p) is 0.1 s/km, the arrival time difference between the P-to-S converted phase and the direct P-phase at the receiver R is _____ sec. [round off to 2 decimal places]



Q.65

A land seismic survey is conducted over a horizontally layered and isotropic Earth. The thickness and the P-wave velocity of the homogeneous weathered layer are 5 m and 800 m/s, respectively. The shots are fired at a depth of 5 m below the surface and the receivers are placed on the surface at mean sea level (MSL). If the datum plane is defined to be 5 m below the MSL, the magnitude of the P-wave static correction to be applied to the data is _____ milliseconds. [round off to 2 decimal places]