General Aptitude (GA)

Q.1 – Q.5 Carry ONE mark Each
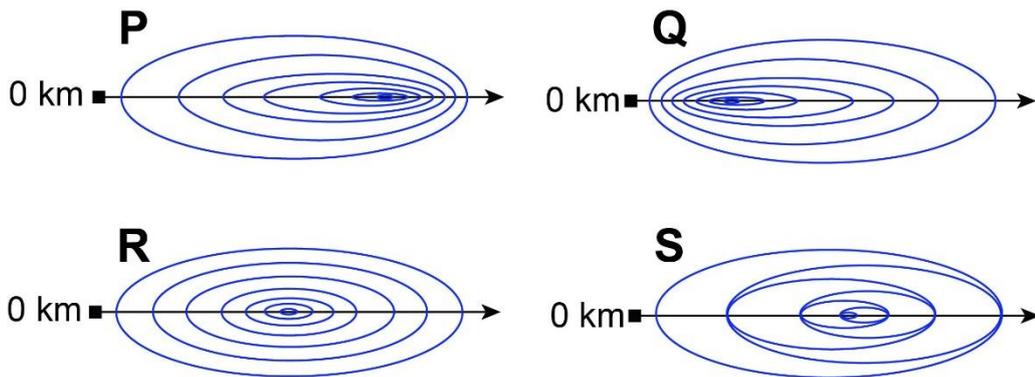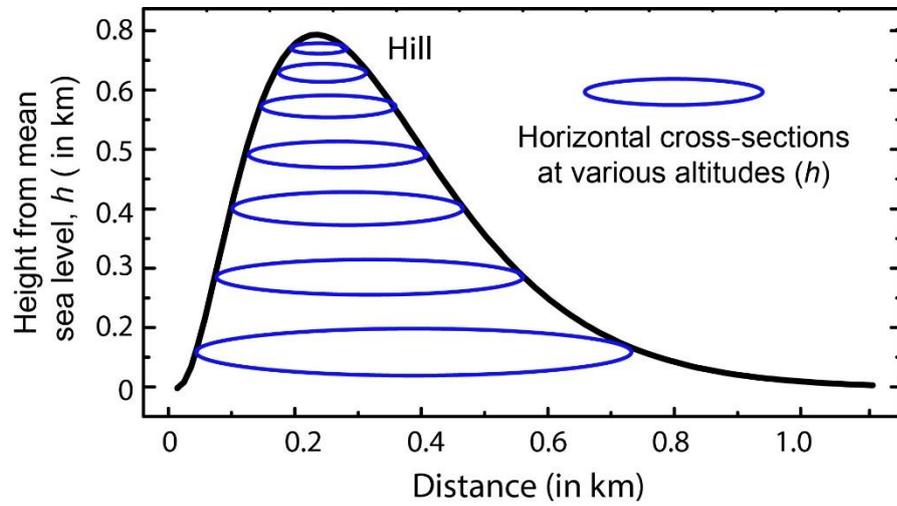
Q.1	The village was nestled in a green spot, _____ the ocean and the hills.
(A)	through
(B)	in
(C)	at
(D)	between

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.

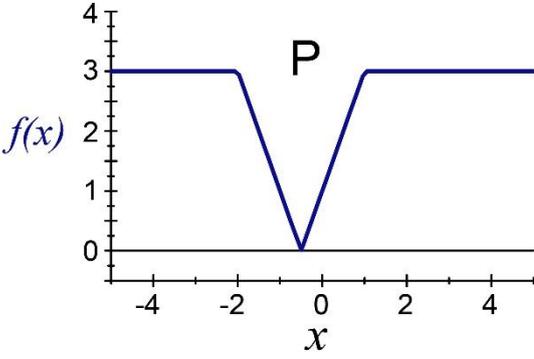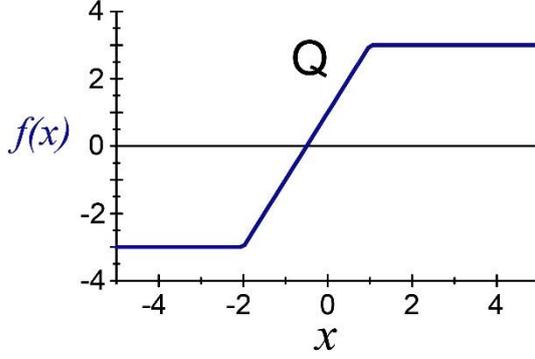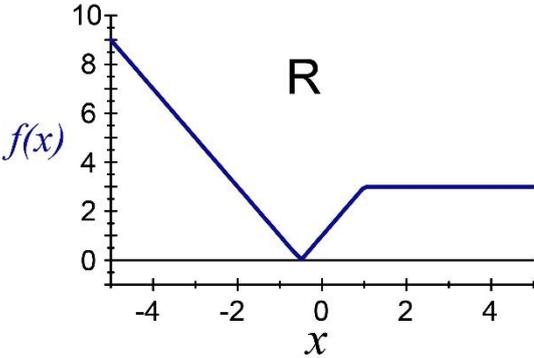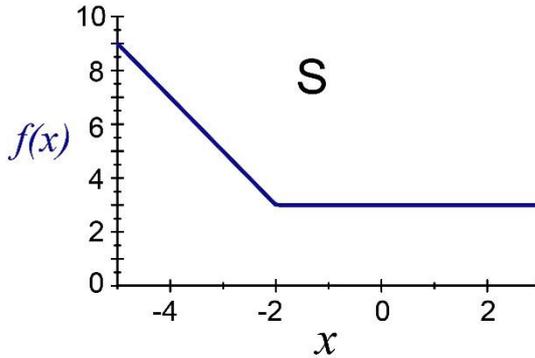| Q.5	In the given diagram, ovals are marked at different heights (*h*) of a hill. Which one of the following options **P**, **Q**, **R**, and **S** depicts the top view of the hill?

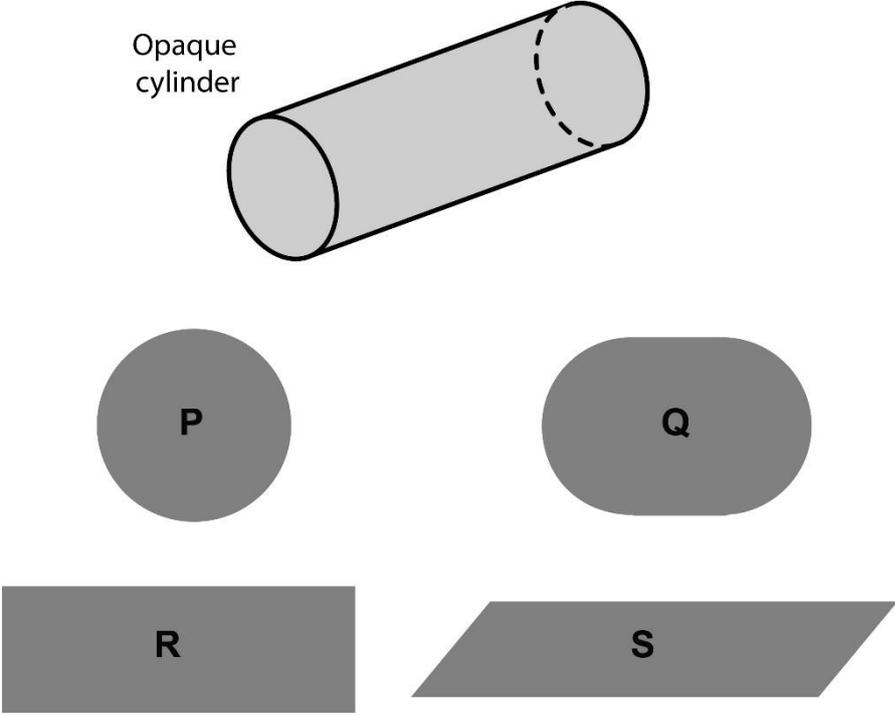| (A)	**P**
(B)	**Q**
(C)	**R**
(D)	**S**

Q.6 – Q.10 Carry TWO marks Each

Q.6	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. Based only on the information provided above, which one of the following statements can be logically inferred with *certainty*?
(A)	Some residents of the complex who are well established in their fields are also authors of some best-selling books.
(B)	All academicians residing in the complex are well established in their fields.
(C)	Some authors of best-selling books are residents of the complex who are well established in their fields.
(D)	Some academicians residing in the complex are well established in their fields.

Q.7	Ankita has to climb 5 stairs starting at the ground, while respecting the following rules:
	1. At any stage, Ankita can move either one or two stairs up.
	2. At any stage, Ankita cannot move to a lower step.
	Let $F(N)$ denote the number of possible ways in which Ankita can reach the Nth stair. For example, $F(1) = 1$, $F(2) = 2$, $F(3) = 3$.
	The value of $F(5)$ is _____.
(A)	8
(B)	7
(C)	6
(D)	5

Q.8	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.
	
	Based only on the information provided above, which of the following statements can be logically inferred with *certainty*?
	
	    (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.

(A)	only (i)
(B)	only (ii)
(C)	both (i) and (ii)
(D)	neither (i) nor (ii)

Q.9	Which one of the given figures P, Q, R and S represents the graph of the following function?

$$f(x) = || x + 2| - |x - 1||$$

(A)	P

(B)	Q

(C)	R

(D)	S

Q.10	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?
(A)	**P**
(B)	**Q**
(C)	**R**
(D)	**S**

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	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 $$Q_r = \alpha C_U + \beta C_{Th} + \gamma C_K$$ Which one of the following correctly represents the relation between the magnitude of coefficients α, β, γ (in μWkg^{-1})?
(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?

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
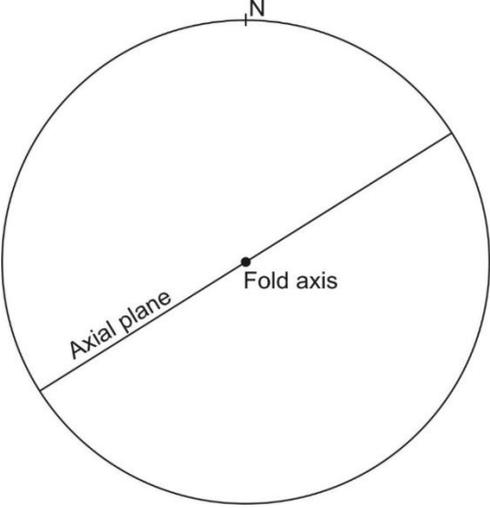
Q.22	The bulk density and water content of a soil are 1800 kg/m^3 and 18%, respectively. The dry density of the soil calculated from the given information is _____ kg/m^3. [*round off to 2 decimal places*]

Q.23	In a seismic reflection survey over a two-layered Earth model having densities and seismic velocities ρ_1=2000 kg/m^3, V_1=1800 m/s for the first layer and ρ_2=3000 kg/m^3, V_2=2100 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 Ωm, is 60 Ωm. 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 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/m³. (Consider density of water $\rho_w = 1000$ kg/m³) [*round off to 2 decimal places*]
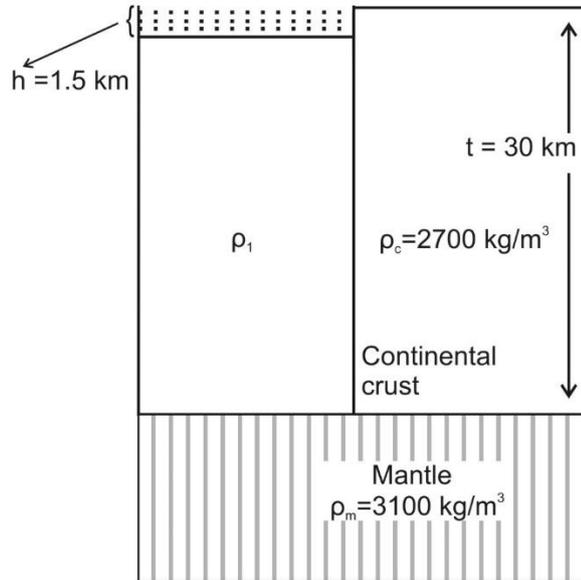
PART B (SECTION 2): FOR GEOPHYSICS CANDIDATES ONLY

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. [*round off to nearest integer*]
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) [*round off to 1 decimal place*]
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. [*round off to 2 decimal place*]

Q.41	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 Wm^{-1}°C^{-1}, then the absolute value of local heat flow is _____milli-Wm^{-2}. [*round off to 1 decimal place*]
Q.42	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*]
Q.43	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*]
Q.44	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*]
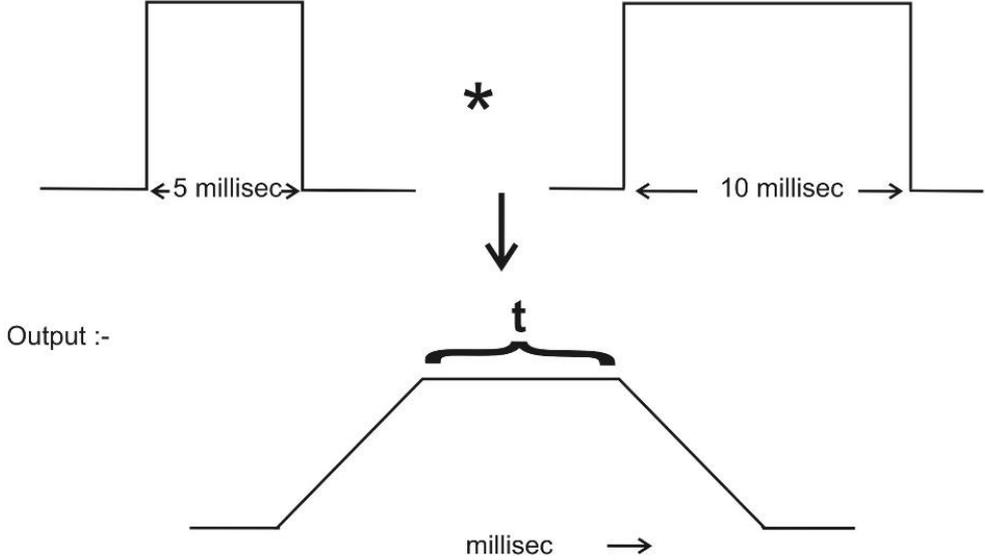
Q.45 – Q.65 Carry TWO marks Each

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.

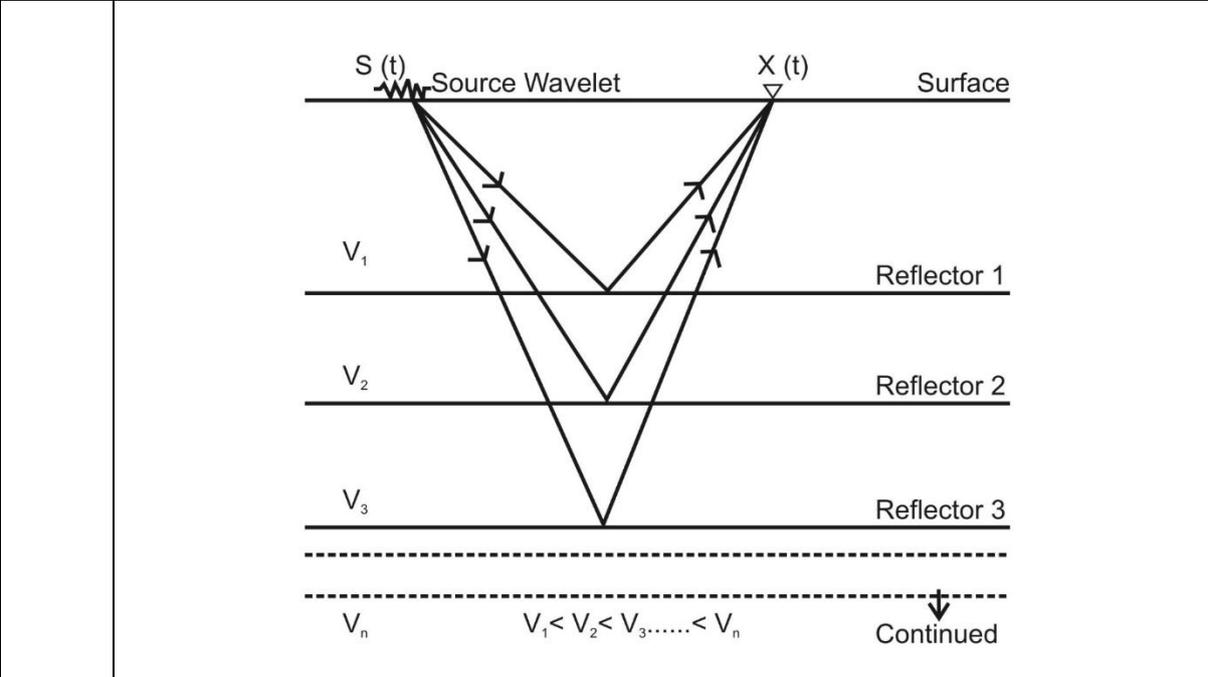| Q.51	Select the CORRECT equation for Euler deconvolution solution of the total magnetic field B_T observed along a profile on the surface of the Earth for i^{th} point, with background magnetic field value B, and structural index N.
(A)	$(x_i - x')\left(\dfrac{\partial B_T}{\partial x}\right)_i + (z_i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

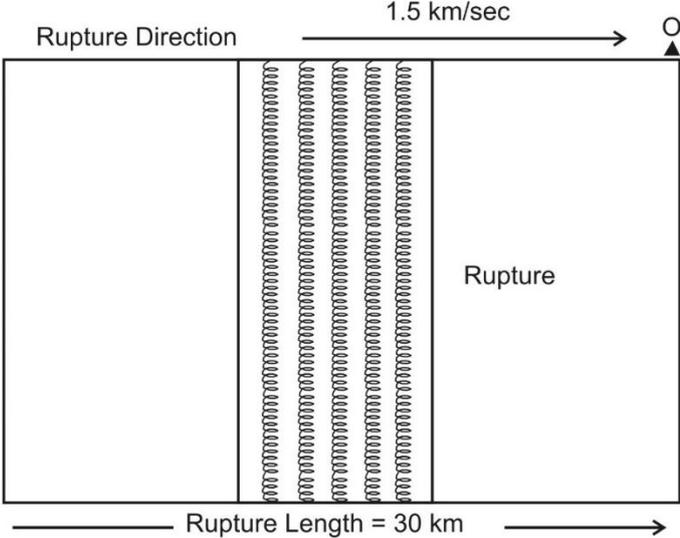| Q.53	In Magnetotelluric survey, three magnetic field components (H_x, H_y, H_z) and two electric field components (E_x and E_y) are measured and two apparent resistivities ρ_{xy} and ρ_{yx} are computed. Which of the following is/are CORRECT?
(A)	$\rho_{xy} = \rho_{yx}$ over horizontally stratified 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

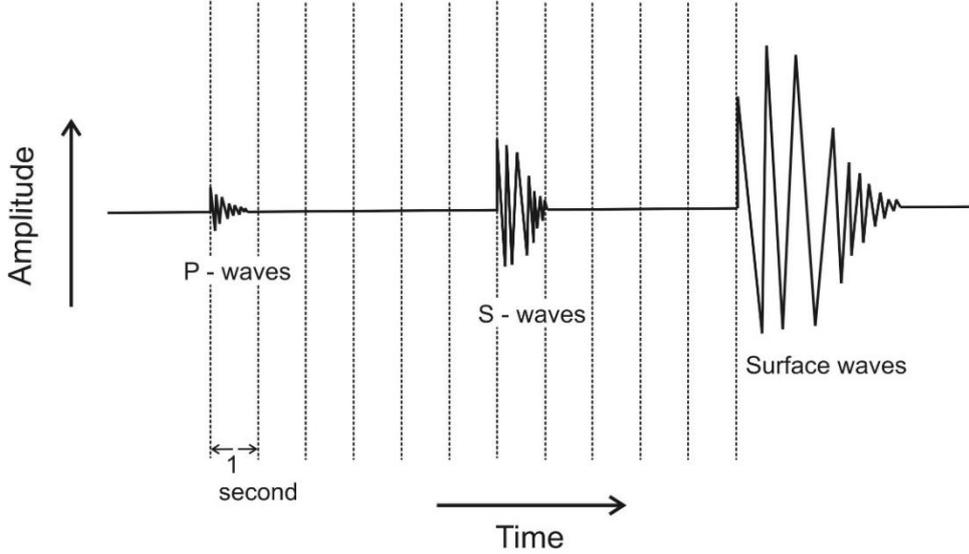| Q.56	The CORRECT option(s) for the generation of point M in a seismic reflection survey as shown in the given figure is/are
(A)	The curvature of the reflector is greater than that of the incident wavefront
(B)	Focusing effect
(C)	Migration
(D)	The curvature of the incident wavefront is greater than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

Q.57	In the $X^2 - T^2$ seismic reflection method, the travel time (T) is expressed as $$T^2 = T_0{}^2 + \frac{X^2}{\bar{C}_2^2} - \frac{(\bar{C}_4^4 - \bar{C}_2^4)X^4}{4T_0^2 C_2^{-8}}$$ 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?
(A)	Heterogeneous medium
(B)	Isotropic medium.
(C)	Homogeneous medium
(D)	Geometrical spreading to correct AVO data.
Q.58	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. [*round off to 2 decimal places*]
Q.59	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 $\mu = \mu_0 = 4\pi \times 10^{-7} H/m$ and $\pi = 3.14$) [*round off to nearest integer*]

| 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*] |

Q.61	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*]
Q.62	Given the following well logging parameters Flushed zone resistivity $R_{XO} = 0.4$ Ωm, Formation resistivity $R_t = 5$ Ωm, Mud-filtrate resistivity $R_{mf} = 0.02$ Ωm, Formation water resistivity $R_w = 0.10$ Ωm, Tortuosity factor $a = 1$, and Cementation and Saturation exponents $m = n = 2$, Porosity = 30 %. The movable hydrocarbon saturation is_____%. [*round off to 1 decimal places*]
Q.63	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*]

Q.64	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 $G = 6.67 \times 10^{-11}$ Nm^{2}kg^{-2}) [*round off to 2 decimal places*]
Q.65	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*]

END OF QUESTION PAPER