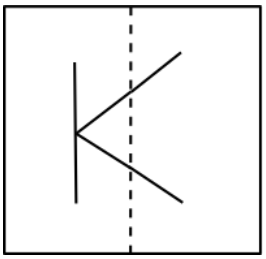
General Aptitude (GA)

Q.1 - Q.5 Multiple Choice Question (MCQ), carry ONE mark each (for each wrong answer: – 1/3).

Q.1	**The people _____ were at the demonstration were from all sections of society.**
(A)	whose
(B)	which
(C)	who
(D)	whom

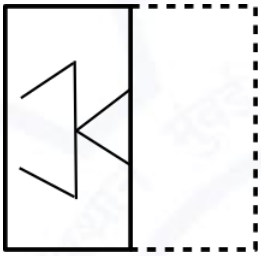
Geology and Geophysics (GG - Geophysics)

Q.2

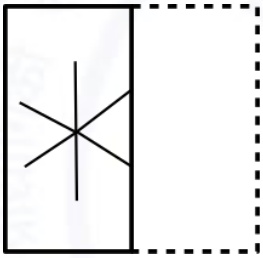


A transparent square sheet shown above is folded along the dotted line. The folded sheet will look like _____.

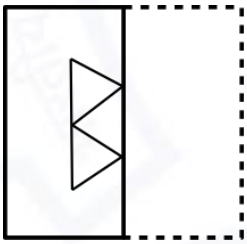
(A)



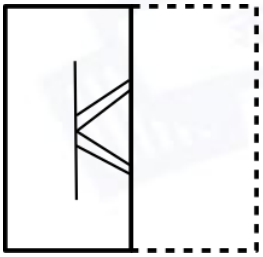
(B)



(C)



(D)



Q.3	**For a regular polygon having 10 sides, the interior angle between the sides of the polygon, in degrees, is:**
(A)	396
(B)	324
(C)	216
(D)	144

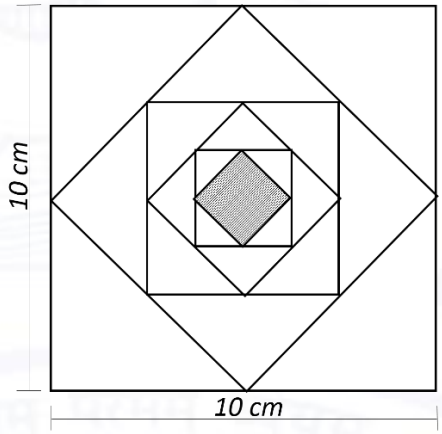
Q.4	**Which one of the following numbers is exactly divisible by $\left(11^{13}+1\right)$?**
(A)	$11^{26}+1$
(B)	$11^{33}+1$
(C)	$11^{39}-1$
(D)	$11^{52}-1$

Q.5	***Oasis* is to *sand* as *island* is to _____** **Which one of the following options maintains a similar logical relation in the above sentence?**
(A)	Stone
(B)	Land
(C)	Water
(D)	Mountain

Geology and Geophysics (GG - Geophysics)

Q. 6 – Q. 10 Multiple Choice Question (MCQ), carry TWO marks each (for each wrong answer: – 2/3).

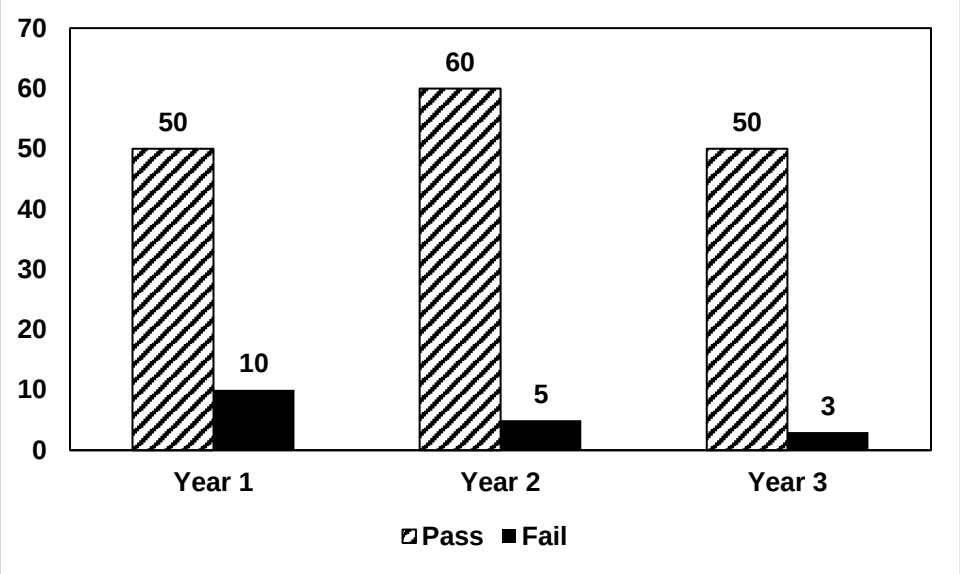
Q.6	**The importance of sleep is often overlooked by students when they are preparing for exams. Research has consistently shown that sleep deprivation greatly reduces the ability to recall the material learnt. Hence, cutting down on sleep to study longer hours can be counterproductive.** **Which one of the following statements is the CORRECT inference from the above passage?**
(A)	Sleeping well alone is enough to prepare for an exam. Studying has lesser benefit.
(B)	Students are efficient and are not wrong in thinking that sleep is a waste of time.
(C)	If a student is extremely well prepared for an exam, he needs little or no sleep.
(D)	To do well in an exam, adequate sleep must be part of the preparation.

Q.7	 **In the figure shown above, each inside square is formed by joining the midpoints of the sides of the next larger square. The area of the smallest square (shaded) as shown, in cm^2 is:**
(A)	12.50
(B)	6.25
(C)	3.125
(D)	1.5625

Geology and Geophysics (GG - Geophysics)

Q.8	**Let X be a continuous random variable denoting the temperature measured. The range of temperature is [0, 100] degree Celsius and let the probability density function of X be $f(x) = 0.01$ for $0 \leq X \leq 100$.** **The mean of X is _____**
(A)	2.5
(B)	5.0
(C)	25.0
(D)	50.0

Q.9



The number of students passing or failing in an exam for a particular subject are presented in the bar chart above. Students who pass the exam cannot appear for the exam again. Students who fail the exam in the first attempt must appear for the exam in the following year. Students always pass the exam in their second attempt.

The number of students who took the exam for the first time in the year 2 and the year 3 respectively, are _____.

A)	65 and 53
(B)	60 and 50
(C)	55 and 53
(D)	55 and 48

Q.10	**Seven cars P, Q, R, S, T, U and V are parked in a row not necessarily in that order. The cars T and U should be parked next to each other. The cars S and V also should be parked next to each other, whereas P and Q cannot be parked next to each other. Q and S must be parked next to each other. R is parked to the immediate right of V. T is parked to the left of U.** **Based on the above statements, the only INCORRECT option given below is:**
(A)	There are two cars parked in between Q and V.
(B)	Q and R are not parked together.
(C)	V is the only car parked in between S and R.
(D)	Car P is parked at the extreme end.

Geophysics (GG)

Q.1 - Q.15 Multiple Choice Question (MCQ), carry ONE mark each (for each wrong answer: – 1/3).

Q.1	**Which of the given planets has the highest average density?**
(A)	Mercury
(B)	Venus
(C)	Earth
(D)	Mars

Q.2	**In a multi-electrode resistivity tomography (ERT) survey, using equally spaced electrodes, which of the given configurations will provide the maximum number of data points?**
(A)	Wenner array
(B)	Axial Dipole-dipole array
(C)	Axial Pole-dipole array
(D)	Schlumberger array

Q.3	**In Electromagnetic methods of prospecting, which one of the given options is CORRECT about frequency and type of current source for the Primary field used?**
(A)	High frequency A.C.
(B)	Low frequency A.C.
(C)	Both high frequency A.C. and D.C.
(D)	Low frequency D.C.

Q.4	**'Group' is a unit of:**
(A)	Lithostratigraphy
(B)	Sequence stratigraphy
(C)	Biostratigraphy
(D)	Chronostratigraphy

Q.5	**Furongian is an Epoch of:**
(A)	Cambrian
(B)	Ordovician
(C)	Triassic
(D)	Cretaceous

Q.6	**The stage of textural maturity of a clay-rich sandstone containing poorly-sorted and angular framework grains is:**
(A)	Mature
(B)	Supermature
(C)	Immature
(D)	Submature

Q.7	**Which one of the following structures indicates Synsedimentary deformation?**
(A)	Festoon bedding
(B)	Flaser bedding
(C)	Tabular bedding
(D)	Convolute bedding

Q.8	**Low value in SP log as observed in dispersed shales is mainly due to the impeded movement of:**
(A)	Na^+ ion
(B)	Cl ion
(C)	K^+ ion
(D)	OH^- ion

Q.9	**In Radiometric survey, the g-ray spectrometer count rate depends on:**
(A)	Cracks present in the target rock volume
(B)	Solid angle of the target rock about the spectrometer
(C)	Temperature in the target rock
(D)	Pressure in the target rock

Q.10	**The dimension of radiant emittance of a blackbody as per Stefan-Boltzmann law is:**
(A)	$M^0L^1T^{-1}$
(B)	$M^1L^{-1}T^{-2}$
(C)	$M^1L^2T^{-2}$
(D)	$M^1L^0T^{-3}$

Q.11	**A surface geological process that can create a landform called Cirque is:**
(A)	aeolian deposition
(B)	fluvial deposition
(C)	glacial erosion
(D)	deposition of volcanic ash

Q.12	**If α and β are P- and S-wave velocities, respectively, then $\alpha^2 - (4/3)\beta^2$ is equal to:** **(κ is the bulk modulus, μ is shear modulus and ρ is density)**
(A)	κ/ρ
(B)	μ/ρ
(C)	$\kappa + \mu/\rho$
(D)	$\kappa - \mu/\rho$

Q.13	**Which one of the following phases is P-wave that converts to S-wave during passage through the solid inner core?**
(A)	PKIKP
(B)	PKJKP
(C)	PKiKP
(D)	PKPPcP

Q.14	**In reduction of gravity data, the latitude correction is maximum at:**
(A)	35° latitude
(B)	45° latitude
(C)	55° latitude
(D)	65° latitude

Q.15	**The most coaliferous unit of the Gondwana Supergroup is:**
(A)	Talchir Formation
(B)	Barakar Formation
(C)	Karharbari Formation
(D)	Panchet Formation

Q.16 - Q.25 Numerical Answer Type (NAT), carry ONE mark each (no negative marks).

Q.16	**A vertical borehole encounters a shale bed of uniform thickness occurring at a depth of 5 m and dipping 60°. The borehole pierces through this shale bed for a length of 10 m to reach a sandstone layer below. The true thickness of the shale bed is _____ m. [*in integer*]**

Q.17	**The mass and volume of a fully dried soil sample are 2200 gm and 1100 cm^3, respectively. If the specific gravity of the soil particles is 2.5 and water density is 1 gm/cm^3, the void ratio of the soil is _____. [*round off to 2 decimal places*]**

Q.18	**A constant-head permeability test was performed on a vertical sand column of height 40 cm and cross-sectional area of 25 cm^2. During the test, when the loss of head was 50 cm, the volume of water collected in 2 minutes was 300 cm^3. Applying Darcy's law, the calculated coefficient of permeability of the sand column is _____ cm/sec. [*round off to 2 decimal places*]**

Q.19	**The radius (r) of the oblate spheroid at 45° latitude with ellipticity of polar flattening of 1/298.25 and equatorial radius of 6378140 m is _____ km. [*round off to 2 decimal places*]**

Q.20	**Light passes through two media with refractive indices of 1.75 and 1.55, respectively. The thickness of both the media is 30 mm. The resultant path difference of the yellow light component (λ = 589 nm) is _____ mm. (Take π = 3.141) [*round off to one decimal places*]**

Q.21	**The water table in an unconfined aquifer at a place near the coast is 1 m above the Mean Sea Level. Given the densities of fresh and saline water as 1.001 and 1.025 g/cc, respectively, the fresh-saline water interface at the same location should be at a depth of _____ m from the water table. [*round off to one decimal place*]**

Q.22	**The volume percentage of galena and quartz in an ore body of Pb are 90 and 10, respectively. The densities of galena and quartz are 7.6 and 2.65 g/cc, respectively. The grade of the ore body in terms of weight percent of Pb is _____. (Atomic weights of Pb = 206 and S = 32) [*round off to 2 decimal places*]**

Q.23	**Normal moveout (NMO) for reflected phase of seismic data is 2 milliseconds. Consider the diffraction source at the edge of the same reflector, where the shot point is directly above diffraction source. In this case, the NMO due to diffraction is _____ milliseconds [*in integer*].**

Q.24	**In a 2D seismic survey, first receiver location is at (1000 m, 4000 m), second receiver location is at (2000 m, 4000 m) and the source location is at (2000 m, 1000 m). Consider P-wave velocity as 5000 m/sec. The difference in first arrival time of P-wave phase for the two receivers is _____ seconds. [*round off to 2 decimal places*].**

Q.25	**The potential difference measured between potential electrodes using Wenner array is 500 mV when a current of 2 A is passed through the subsurface between current electrodes. If the computed apparent resistivity is 100 Ωm then the distance between the current electrodes will be _____ m. [*round off to 2 decimal places*] (Use π = 3.141)**

Geology and Geophysics (GG - Geophysics)

Q.26 – Q.42 Multiple Choice Question (MCQ), carry TWO marks each (for each wrong answer: – 2/3).

Q.26	**In a horizontally stratified cuboid rock sample (stratified in vertical *z* direction with various layers of different resistivity), bulk resistivity is measured in three perpendicular directions. If ρ_1, ρ_2, and ρ_3 are the bulk resistivities measured perpendicular to xy, xz and yz planes, respectively, then**
(A)	$\rho_1 < \rho_2 = \rho_3$
(B)	$\rho_1 > \rho_2 = \rho_3$
(C)	$\rho_1 = \rho_2 \neq \rho_3$
(D)	$\rho_1 \neq \rho_2 \neq \rho_3$

Q.27	**Which one is the CORRECT sequence of electromagnetic methods in terms of depth of investigation?** **P – AFMAG method** **Q – VLF method** **R – GPR method** **S – Magnetotelluric method**
(A)	P > Q > S > R
(B)	P > S > R > Q
(C)	S > P > Q > R
(D)	S > Q > R > P

Q.28	**Which Norm gives the maximum weight to the data points having maximum deviation/outlier from the smoothly fitted curve during linearized inversion?**
(A)	L1-Norm
(B)	L2-Norm
(C)	Lp-Norm
(D)	L∞-Norm

Q.29	**Which one of the following statements is CORRECT for the Quenching agent used in the tube of Geiger-Muller counter?**
(A)	It enhances the emission of secondary electrons from the cathode.
(B)	It reduces the emission of secondary electrons from the cathode.
(C)	It enhances the emission of secondary electrons from the anode.
(D)	It reduces the emission of secondary electrons from the anode.

Q.30	**Which one of the following statements is CORRECT regarding the property of Laplacian operator for vector/scalar fields?**
(A)	Laplacian of a vector field is zero if the Laplacian of each of its components are zero.
(B)	Laplacian of a vector field is zero if the Laplacian of any one of its component is zero.
(C)	If the Laplacian of a scalar field is zero then the scalar field is not harmonic.
(D)	If the Laplacian of a scalar field is finite (non-zero) then the scalar field is harmonic.

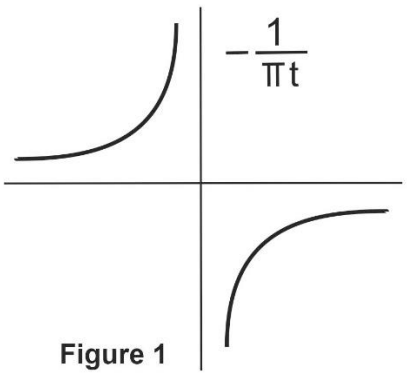
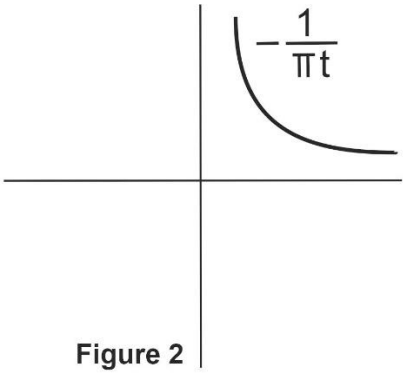
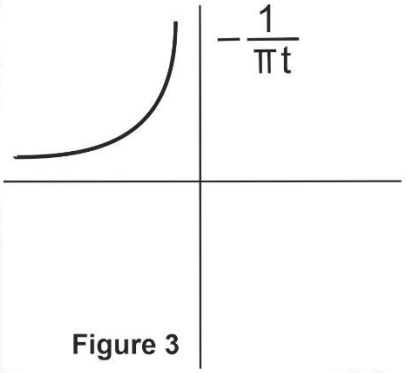
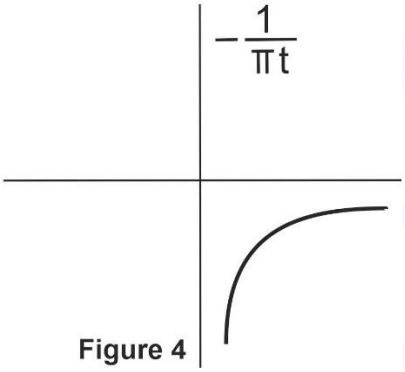
Q.31	**The most desirable interaction of γ-ray with matter for γ-ray spectroscopy is**
(A)	Photoelectric effect only
(B)	Both Photoelectric effect and Compton scattering
(C)	Both Compton Scattering and Pair production
(D)	Photoelectric effect, Compton scattering and Pair production

Q.32	**Which one of the following is the CORRECT sequence for a 2D seismic reflection data processing prior to Time-depth conversion?**
(A)	Migration → Deconvolution → Filtering → Equalization → Coherency
(B)	Deconvolution → Migration → Filtering → Coherency → Equalization
(C)	Filtering → Deconvolution → Migration → Equalization → Coherency
(D)	Deconvolution → Filtering → Equalization → Migration → Coherency

Q.33	**Choose the CORRECT procedure to avoid the area of cracked, altered formation in Sonic log.**
(A)	Measure interval transit times using long-spacing sonic tools.
(B)	Use more number of sets of sources.
(C)	Measure interval transit times using short-spacing sonic tools.
(D)	Use more number of sets of detectors.

Q.34	**The factor that DOES NOT influence measurement of Nuclear Magnetic Resonance log is**
(A)	mineral composition of the rock.
(B)	bound water (irreducible water).
(C)	free water.
(D)	pore fluid pressure.

Q.35	**Consider a time-invariant geophysical filter with the given input as: $x(t) = e^{-\alpha t}$ when $t \geq 0$; $x(t) = 0$ when $t < 0$ and output $y(t) = e^{-\beta t}$ when $t \geq 0$; $y(t) = 0$ when $t < 0$. The transfer function for the given input and output of time-invariant filter will be:**
(A)	$\frac{\alpha + i\omega}{\beta - i\omega}$
(B)	$\frac{\alpha + i\omega}{\beta + i\omega}$
(C)	$\frac{\alpha - i\omega}{\beta + i\omega}$
(D)	$\frac{\alpha - i\omega}{\beta - i\omega}$

Q.36	**Which of the given figures is the Hilbert transform of the Dirac delta function $\delta(\xi)$:**  Figure 1  Figure 2  Figure 3  Figure 4
(A)	Figure 1
(B)	Figure 2
(C)	Figure 3
(D)	Figure 4

Q.37	**If a mountain range is 100% isostatically compensated (Airy's type), what would be the expected nature of the Bouguer anomaly and free air anomaly?**
(A)	Bouguer anomaly is very large and negative; free air anomaly is small and positive.
(B)	Bouguer anomaly is very large and negative; free air anomaly is large and positive.
(C)	Bouguer anomaly is exactly zero; free air anomaly is very large and positive.
(D)	Bouguer anomaly is very large and negative; free air anomaly is large and negative.

Q.38	**Which of the following is INCORRECT for a recorded nuclear explosion event?**
(A)	The first P-wave from an explosion to arrive at any seismic station, irrespective of Azimuth, should be compressional.
(B)	Nuclear explosions are not as good as earthquakes at generating surface waves or S-waves.
(C)	In general, earthquakes have Mb values same those for nuclear explosions with same Ms values.
(D)	Nuclear explosions have all been shallower than 2 km depth.

Q.39	**Focal depth can be determined from measurement of the difference in the travel time between:**
(A)	pP and P
(B)	PP and P
(C)	PcP and P
(D)	PPP and P

Q.40	**Of the following options, at which discontinuity both P-wave and S-wave have maximum velocity drop?**
(A)	Conard
(B)	Mohorovicic
(C)	Gutenberg
(D)	Lehman

Q.41	**In data enhancement techniques, what is the advantage of magnetic anomaly being 'Reduced to the pole'?**
(A)	Enhances the signal to noise ratio.
(B)	Estimates the depth to the basement.
(C)	Takes care of variation of the magnetic anomaly with latitude.
(D)	Helps in pseudo-gravity transformation.

Q.42	**Match the source in Group – I with their half-width ($X_{1/2}$) / δg_{max} and depth (d) relation in Group –II** **Group - I** — **Group - II** **P. Sphere** — **1.** $d = 0.7X_{1/2}$ **Q. Horizontal Cylinder** — **2.** $d \leq 0.86 \times \left\{ \delta g_{max} \Big/ \left(\frac{dg}{dx}\right)_{max} \right\}$ **R. Steeply dipping sheet** — **3.** $d = 1.3X_{1/2}$ **S. Irregular body** — **4.** $d = X_{1/2}$
(A)	P-1, Q-2, R-4, S-3
(B)	P-1, Q-4, R-3, S-2
(C)	P-3, Q-4, R-1, S-2
(D)	P-3, Q-1, R-4, S-2

Q.43 – Q.55 Numerical Answer Type (NAT), carry TWO mark each (no negative marks).

Q.43	**If a gravity determination is made at an elevation of 150 m above mean sea level, the Bouguer correction required for a density contrast of 250 kg m^{-3} with the surroundings is_____ mgal. [*round off to 2 decimal places*]**

Q.44	**An infinite horizontal cylinder of radius 40 km is buried at a depth of 100 km and yields the same maximum gravity anomaly as that of an infinite horizontal cylinder of radius 1 km, buried at a depth of 1 km having density contrast with the surroundings of 200 kgm^{-3}. The density contrast of the deeper cylinder with respect to the surrounding is _____ kg/m^3. [*round off to one decimal place*]**

Q.45	**An earthquake causes an average of 25 m strike slip displacement over a 50 km long, 25 km deep portion of a transform fault. Assuming that the rock rigidity is 3×10^{10} Nm^{-2}, the moment magnitude (Mw) of the earthquake is _____ . [*round off to 2 decimal places*]**

Q.46	**Lithological unit X is sandwiched between Y1 above and Y2 below it. Now consider a log across lithology X, where Gamma ray (GR) reading is given by 100API; Y_1 lithology, where minimum GR reading is 10API; and Y_2 lithology of shale, where GR reading is 200API. Then the shale-free fractional volume in the X lithology will be_____. [*round off to 2 decimal places*]**

Q.47	**In a 2D seismic survey, 25 receivers are placed in a group and 25 sources are placed in another group, where random noise is present. The signal to noise ratio for this arrangement will be_____. [*in integer*]**

Q.48	**In a VSP survey, the tube wave passage through borehole causes cross-section area change from 0.79 m^2 to 1.13 m^2. The transmission coefficient will be _____. [*round off to 2 decimal places*]**

Q.49	**In a cratonic region, radioactive heat generation decreases exponentially with depth. Assuming characteristic depth as 10 km and surface heat generation as 3 μWm^{-3} and neglecting mantle heat flow, the heat production per unit volume for a 30 km thick layer will be_____ μWm^{-3}. [*round off to 2 decimal places*]**

Q.50	**In an Induced Polarization survey, 50 milliseconds chargeability was measured for steady state voltage (full saturation reached) of 200 V between potential electrodes. When the current was switched off, the voltage across potential electrodes drops instantaneously (time t = 0 s) to a level V_a and thereafter decays linearly with time and becomes zero in 10 seconds. The magnitude of instantaneous voltage V_a (at time t = 0 s) will be_____ mV. [*in integer*]**

Q.51	**Apparent resistivity sounding data for Schlumberger array is theoretically generated by the teacher for the following 4-layer model as: ρ_1 = 100 Ωm, ρ_2 = 20 Ωm, ρ_3 = 500 Ωm, ρ_4 = 10 Ωm and layer thicknesses h_1 = 50 m, h_2 = 20 m and h_3 = 50 m. If the student interprets this theoretical sounding data for ρ_3 as 750 Ωm, then according to the Principle of Equivalence, the thickness h_3 would be _____ m. [*round off to 2 decimal places*]**

Q.52	**A 3D conducting body is located at a depth of 50 m in a homogeneous medium of resistivity 500 Ωm. A frequency of f_1 Hz is appropriate to detect this conducting body in a plane wave EM survey. When the same conducting body is located in a host medium of resistivity 100 Ωm at the same depth then a frequency of f_2 Hz is found to be appropriate. Then the value of $\frac{f_2}{f_1}$ will be _____. [*round off to 2 decimal places*]**

Q.53	**The apparent resistivity and phase computed for MT measurement at 10^{-3} Hz frequency is 500 Ωm and 30°, respectively. Ratio of Imaginary to Real component of the Impedance tensor is _____. [*round off to 2 decimal places*]**

Q.54	**The diagonal elements of a covariance matrix computed for a linearized inverse problem having model parameters m_1, m_2, m_3, m_4, m_5 are 49, 15, 3, 200, 40, respectively. The standard deviation (uncertainty) in the estimation of model parameters m_4 is _____. [*round off to 2 decimal places*]**

Q.55	**Electric current density incident at an angle 40° from vertical at the horizontal interface between two layers with resistivity ρ_1 = 100 Ωm and ρ_2 = 500 Ωm (from layer 1 to layer 2). The current density will enter into the second layer at an angle _____ degrees from vertical. [*round off to 2 decimal places*]**

END OF THE QUESTION PAPER