Question Paper Name: Geology and Geophysics 4th Feb 2017
Subject Name: Geology and Geophysics
Duration: 180
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Organizing Institute:

Indian Institute of Technology Roorkee

Question Number : 1

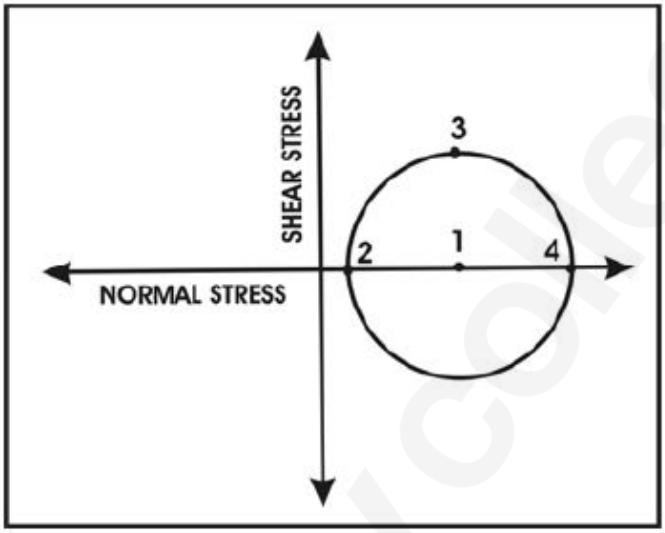
Which one of the following is a continental hotspot?

(A) Reunion (B) Macdonald (C) Hawaii (D) Afar

Question Number : 2

Correct : 1 Wrong : 0.33

The diagram given below shows a Mohr circle for two-dimensional stress with points numbered as shown. The mean stress and the maximum shear stress are given by which one of the following number pairs?

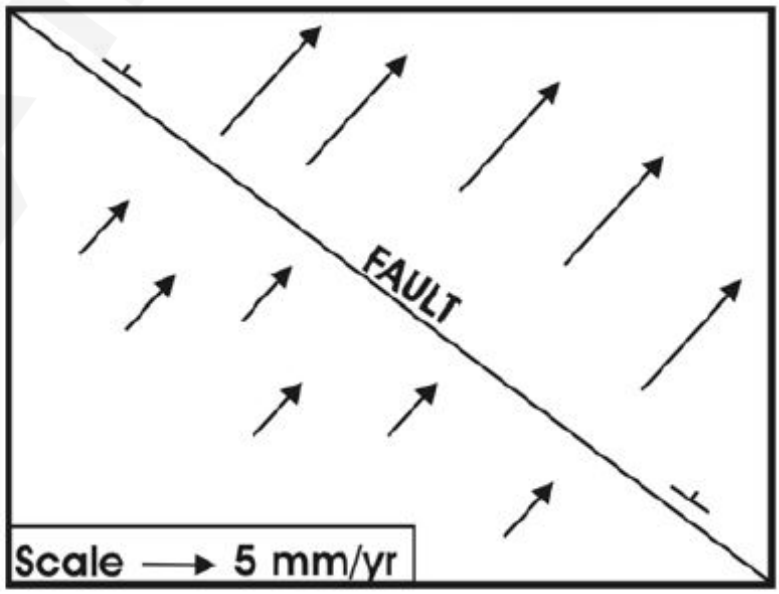


(A) 1, 2
(B) 1, 3
(C) 1, 4
(D) 2, 3

Question Number : 3

Correct : 1 Wrong : 0.33

Which type of fault is developed in the setting shown in the figure below? Velocity vectors on either side of the fault are given in the figure.



(A) Normal
(B) Dextral strike-slip
(C) Sinistral strike-slip
(D) Thrust

Question Number : 4 Correct : 1 Wrong : -0.33

The age of most of the bituminous coal seams of India is

(A) Silurian. (B) Miocene. (C) Carboniferous. (D) Permian.

Question Number : 5 Correct : 1 Wrong : -0.33

The time equivalent of the time-stratigraphic term 'Series' is

(A) Epoch.
(B) Period.
(C) Age.
(D) Stage.

Question Number : 6 Correct : 1 Wrong : -0.33

Match the following stratigraphic units of India (Group-I) with their age (Group-II).

Group-I	**Group-II**
(P) Barakar Formation	(1) Miocene
(Q) Warkalli (Varkala) Formation	(2) Cretaceous
(R) Bagh Beds	(3) Proterozoic
(S) Bhander Limestone	(4) Eocene
	(5) Permian

(A) P-5, Q-1, R-2, S-3 (B) P-1, Q-4, R-2, S-5
(C) P-5, Q-4, R-2, S-3 (D) P-2, Q-3, R-1, S-4

Question Number : 7 Correct : 1 Wrong : -0.33

Universal Transverse Mercator (UTM) is a type of

(A) conical projection. (B) gnomonic projection.
(C) orthogonal projection. (D) cylindrical projection.

Question Number : 8 **Correct : 1 Wrong : -0.33**

The groundwater flow equation $\frac{\partial^2 h}{\partial x^2}+\frac{\partial^2 h}{\partial y^2}+\frac{\partial^2 h}{\partial z^2}=0$, where h refers to the hydraulic head and x, y, z are coordinates, is valid when the flow condition is

(A) steady state in isotropic media.
(B) unsteady state in isotropic media.
(C) steady state in anisotropic media.
(D) unsteady state in anisotropic media.

Question Number : 9 **Correct : 1 Wrong : 0**

Los Angeles abrasion test was conducted for a granite aggregate with an initial weight of 4800 grams. After the test, the aggregate weighed 3504 grams. The Los Angeles abrasion value is_____ %.

Question Number : 10 **Correct : 1 Wrong : -0.33**

Brightness temperature is a function of surface temperature and

(A) transmittance.
(B) reflectance.
(C) refractive index.
(D) emissivity.

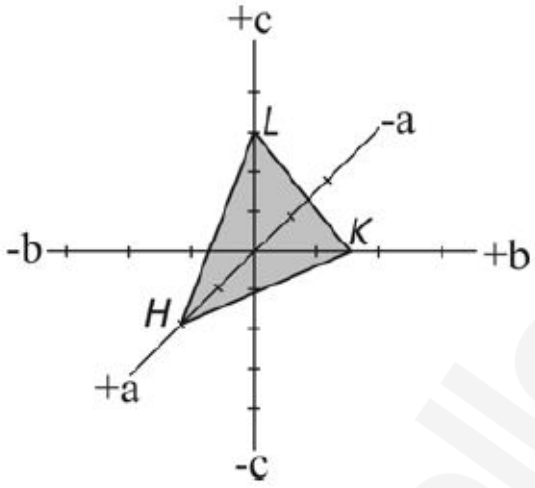
Question Number : 11 **Correct : 1 Wrong : -0.33**

Which one of the following minerals has poor cleavage in all directions?

(A) Fluorite (B) Orthoclase (C) Quartz (D) Muscovite

Question Number : 12 **Correct : 1 Wrong : -0.33**

The figure below shows the intercepts of the plane HKL with the crystallographic axes a, b, c. The Miller index of the plane HKL is



(A) (243) (B) (342) (C) (436) (D) (634)

Question Number : 13 **Correct : 1 Wrong : -0.33**

Match the rocks listed in Group-I with the corresponding general rock classification listed in Group-II.

Group-I	**Group-II**
P. Granite	1. Extrusive igneous rock
Q. Basalt	2. Biochemical sedimentary rock
R. Gneiss	3. Intrusive igneous rock
S. Sandstone	4. Metamorphic rock
	5. Clastic sedimentary rock

(A) P-1; Q-3; R-5; S-2
(B) P-4; Q-5; R-1; S-2
(C) P-3; Q-1; R-4; S-5
(D) P-3; Q-4; R-1; S-5

Question Number : 14 **Correct : 1 Wrong : -0.33**

Which one of the following oceanic ridges is known to be aseismic?

(A) Carlsberg
(B) Mid Atlantic
(C) Ninety East
(D) Southwest Indian

Question Number : 15 **Correct : 1 Wrong : -0.33**

Isogonic lines are contours of equal magnetic

(A) inclination.
(B) declination.
(C) total field intensity.
(D) horizontal field intensity.

Question Number : 16 **Correct : 1 Wrong : -0.33**

Match the geophysical terms in Group-I with their corresponding units of measurements in Group-II.

Group-I	**Group-II**
P. Transit time	1. mGal
Q. Conductivity	2. nanoTesla
R. Gravity anomaly	3. siemens
S. Magnetic field intensity	4. millivolt
	5. microsecond per feet

(A) P-5; Q-4; R-2; S-1
(B) P-5; Q-4; R-3; S-2
(C) P-5; Q-3; R-1; S-2
(D) P-4; Q-3; R-2; S-1

Question Number : 17 **Correct : 1 Wrong : -0.33**

The Maxwell's equation based on Ampere's law is

(A) $\nabla \times \boldsymbol{E} = -\frac{\partial \boldsymbol{B}}{\partial t}$
(B) $\nabla \times \boldsymbol{H} = j + \frac{\partial \boldsymbol{D}}{\partial t}$
(C) $\nabla \cdot \boldsymbol{B} = 0$
(D) $\nabla \cdot \boldsymbol{E} = \frac{\rho}{\varepsilon}$

Question Number : 18 **Correct : 1 Wrong : -0.33**

The normal gravity formula (for e.g. GRS80) is a function of

(A) geocentric latitude.
(B) geodetic latitude.
(C) longitude.
(D) altitude.

Question Number : 19 Correct : 1 Wrong : -0.33

A seismic reflection survey was carried out over a subsurface consisting of a stack of horizontal isotropic layers. In the common midpoint (CMP) domain, the moveout (traveltime v/s offset) curve for any primary reflection event is best approximated by

(A) an ellipse.
(B) a parabola.
(C) a circle.
(D) a hyperbola.

Question Number : 20 Correct : 1 Wrong : -0.33

Assertion (a): Magnetic stripes are observed around mid-oceanic ridge regions.
Reason (r): The earth's magnetic field undergoes reversals of polarity.

(A) (a) is true but (r) is false.
(B) (a) is false but (r) is true.
(C) Both (a) and (r) are true and (r) is one of the correct reasons for (a).
(D) Both (a) and (r) are true but (r) is not the correct reason for (a).

Question Number : 21 Correct : 1 Wrong : -0.33

A seismic gap refers to a

(A) time gap between two great earthquakes.
(B) distance gap between the epicenters of two great earthquakes.
(C) segment of an active belt where a historical great earthquake has not occurred.
(D) wide gap in the earth created by a great earthquake.

Question Number : 22 Correct : 1 Wrong : 0

The travel time difference between the arrival times of a shear wave (S) and primary wave (P) observed on a seismogram recorded at an epicentral distance of 100km from a near surface earthquake is _____ s.
(Assume the average P and S wave velocities to be 6.0 km/s and 3.5 km/s, respectively).

Question Number : 23 **Correct : 1 Wrong : 0**

The percentage increase in P-wave velocity (km/s) across the Mohorovicic discontinuity from the lower crust to the upper mantle beneath a craton is approximately _____(%).

Question Number : 24 **Correct : 1 Wrong : -0.33**

Which one amongst the following logging tools has the largest depth of investigation?

(A) Density (B) Laterolog 3 (C) Laterolog 8 (D) Neutron

Question Number : 25 **Correct : 1 Wrong : -0.33**

The most abundant radioactive isotope in the continental crust is

(A) ^{40}K (B) ^{232}Th (C) ^{235}U (D) ^{238}U

Geology (Part B) (Section-1)

Question Number : 26 **Correct : 2 Wrong : -0.66**

Stylolitic foliation developed during diagenetic processes is typically

(A) parallel to bedding.
(B) perpendicular to bedding.
(C) oblique to bedding.
(D) vertical.

Question Number : 27 Correct : 2 Wrong : -0.66

A coal seam with an attitude 090°, 50°S outcrops at an elevation of 1400 m in an area that has flat topography. A vertical exploratory drill hole will intersect the seam

(A) north of the outcrop at elevations greater than 1400 m.
(B) north of the outcrop at elevations less than 1400 m.
(C) south of the outcrop at elevations less than 1400 m.
(D) south of the outcrop at elevations greater than 1400 m.

Question Number : 28 **Correct : 2 Wrong : -0.66**

Earthquakes result in the formation of which one of the following features?

(A) Porphyroblast (B) Porphyroclast (C) Pseudotachylite (D) Pressure shadow

Question Number : 29 **Correct : 2 Wrong : 0**

In a bilaterally symmetrical brachiopod fossil, the angle between the hinge line and the median line changes to 45° after deformation. The shear strain observed in the deformed fossil is _____.

Question Number : 30 **Correct : 2 Wrong : -0.66**

The empirical probability distribution of gold (Au) grades shows a unimodal distribution with mode = 2 g/t, median = 3 g/t, and mean = 5 g/t. This probability distribution is

(A) positively skewed.
(B) negatively skewed.
(C) normally distributed.
(D) platykurtic.

Question Number : 31 **Correct : 2 Wrong : 0**

A limb of a non-plunging fold with an attitude 070°, 40°S is rotated about its fold axis 30° clockwise (looking towards ENE). The plunge amount of the pole to the fold limb after rotation is ____ degrees.

Question Number : 32

The Bulk Silicate Earth (BSE) is best approximated by the average

(A) enriched upper mantle composition.
(B) mantle and continental crust composition.
(C) depleted mantle composition.
(D) primitive upper mantle composition.

Question Number : 33

Correct : 2 Wrong : -0.66

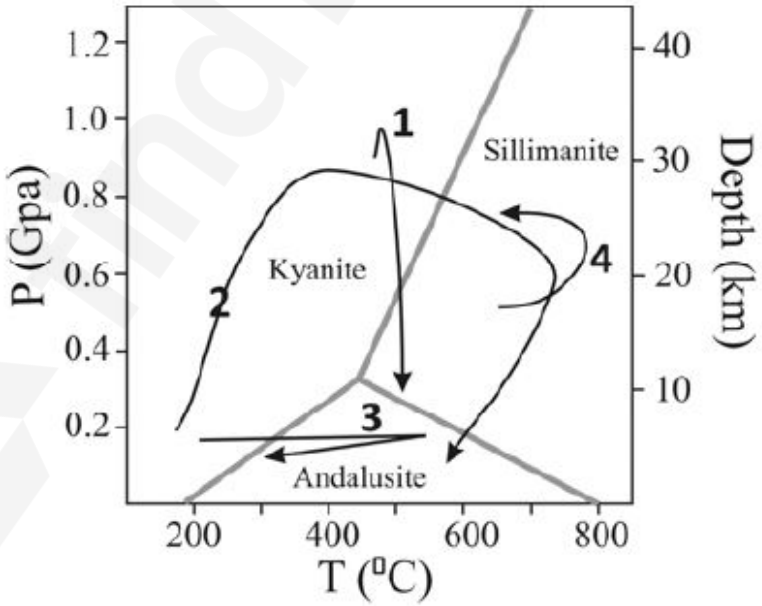
Which one of the following is the stable mineral assemblage in metamorphism of a rock with pelitic bulk composition under granulite facies?

(A) staurolite + muscovite + sillimanite + K-feldspar
(B) phengite + garnet + chloritoid + biotite
(C) garnet + orthopyroxene + clinopyroxene + plagioclase
(D) garnet + cordierite + K-feldspar + sillimanite

Question Number : 34

Correct : 2 Wrong : -0.66

The given P–T diagram shows four distinct metamorphic paths designated as 1, 2, 3 and 4. Which one of these P–T paths represents crustal thickening in a collisional tectonic setting?



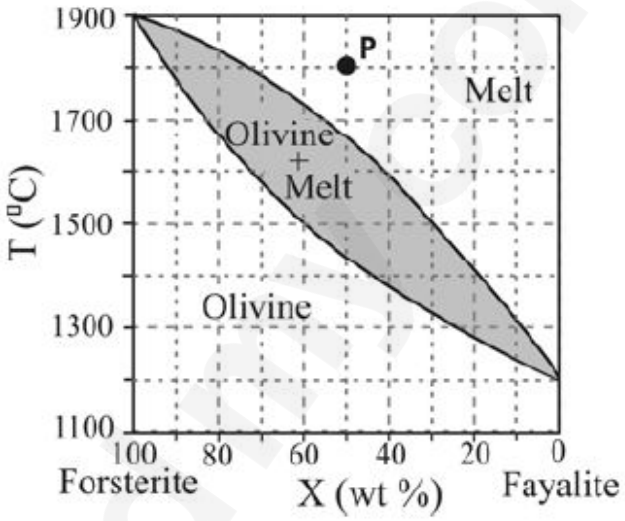
(A) 1 (B) 2 (C) 3 (D) 4

Question Number : 35 **Correct : 2 Wrong : 0**

The pressure on a rock overlain by a 7 km thick basaltic crust ($\rho = 3100$ kg m^{-3}) is _____ kilobar.
(Use g = 9.8 m s^{-2}; 10^5 Pa = 1 bar)

Question Number : 36 **Correct : 2 Wrong : 0**

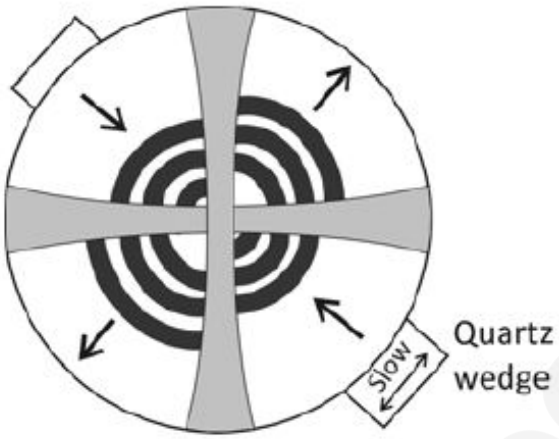
The given T–X diagram shows the phase relations in olivine solid solution at 1 bar pressure. If 'P' is the initial position of melt, the proportion of melt at 1500°C is _____ %.



Question Number : 37 **Correct : 2 Wrong : 0**

Fluorite crystal (CaF_2) adopts face-centered cubic structure with lattice parameter a = 5.463 Å. If the ionic radius of anion (F^-) is 1.71 Å, the ionic radius of cation (Ca^{+2}) is _____ Å.

The diagram below shows the interference figure of a mineral. The mineral is



(A) uniaxial positive.
(B) biaxial negative.
(C) uniaxial negative.
(D) biaxial positive.

Question Number : 39 Correct : 2 Wrong : 0

The standard thermodynamic data for enstatite ($Mg_2Si_2O_6$), quartz (SiO_2) and forsterite (Mg_2SiO_4) is given in the table below. The Gibb's free energy of the reaction $Mg_2SiO_4 + SiO_2 = Mg_2Si_2O_6$ at 600 K and 1 bar is _____ J.
(Assume $C_p = 0$ for all minerals in the reaction)

Mineral	$\Delta H^\circ_{f,298}$ (kJ)	S° (JK^{-1})
Enstatite	-3090.47	132.5
Quartz	-910.83	41.5
Forsterite	-2172.2	95.1

Question Number : 40 Correct : 2 Wrong : 0

The modal abundance in an ultramafic rock and the partition coefficients of lutetium (Lu) in clinopyroxene, orthopyroxene, olivine and plagioclase are tabulated below. The bulk distribution coefficient of lutetium (D_{Lu}) in the ultramafic rock is _____.

Mineral	Modal abundance (%)	Partition coefficient
Clinopyroxene	45	0.506
Orthopyroxene	40	0.42
Olivine	10	0.045
Plagioclase	05	0.019

Question Number : 41 **Correct : 2 Wrong : -0.66**

Match the following classical ore deposits (Group-I) with their associated ore minerals (Group-II)

Group-I	**Group-II**
P. Sudbury type deposit	1. Molybdenite
Q. Mississippi valley type deposit	2. Uraninite and chalcopyrite
R. Climax type deposit	3. Pentlandite
S. IOCG type deposit	4. Psilomelane
	5. Sphalerite and Galena

(A) P-4; Q-3; R-2; S-1
(B) P-3; Q-5; R-1; S-2
(C) P-5; Q-2; R-4; S-1
(D) P-3; Q-5; R-2; S-4

Question Number : 42 **Correct : 2 Wrong : -0.66**

Which one of the following microfossils is commonly used in biostratigraphic correlation of Palaeozoic marine strata?

(A) Angiosperm pollen (B) Diatoms (C) Dinoflagellates (D) Chitinozoans

Question Number : 43 **Correct : 2 Wrong :-0.66**

Given below are pairs of "living fossils". Which one of the following is a brachiopod-mollusc pair?

(A) *Lingula*, *Nautilus*
(B) *Ginkgo*, *Metasequia*
(C) *Syntexis*, *Notiothauma*
(D) Coelacanths, *Sikhotealinia*

Question Number : 44 Correct : 2 Wrong : -0.66

Match the sedimentary rocks and their features listed in Group I with depositional environments listed in Group II.

Group I	Group II
(P) Sandstone with herring-bone cross bedding	(1) Eolian
(Q) Chalk with coccolith	(2) Glacial
(R) Well sorted arenite with large cross bedding (5-10 m thick)	(3) Sabhka
(S) Poorly sorted sediments with faceted and striated pebbles	(4) Tidal
	(5) Pelagic

(A) P-2, Q-1, R-4, S-5
(B) P-4, Q-5, R-1, S-2
(C) P-4, Q-1, R-2, S-5
(D) P-5, Q-1, R-2, S-3

Question Number : 45 Correct : 2 Wrong : -0.66

Arrange the following stratigraphic formations sequentially from older to younger.

(P) Jodhpur Sandstone
(Q) Cambay Shale
(R) Kajrahat Limestone
(S) Tipam Sandstone

(A) P, R, Q, S
(B) R, Q, P, S
(C) P, S, R, Q
(D) R, P, Q, S

Question Number : 46 Correct : 2 Wrong : 0

2 g air dried coal contains 0.2 g moisture, 0.3 g ash and 0.5 g volatile matter. The volatile matter content in the coal in dry mineral matter free (d.m.f) basis is _____ %.
(mineral matter content = 1.1×ash content)

Question Number : 47 Correct : 2 Wrong : -0.66

The approximate temperature for 'oil window' ranges from

(A) 30°C to 50°C
(B) 60°C to 160°C
(C) 180°C to 250°C
(D) 260°C to 350°C

Question Number : 48 Correct : 2 Wrong : -0.66

Which one of the following biopolymers is the major source of liquid hydrocarbons?

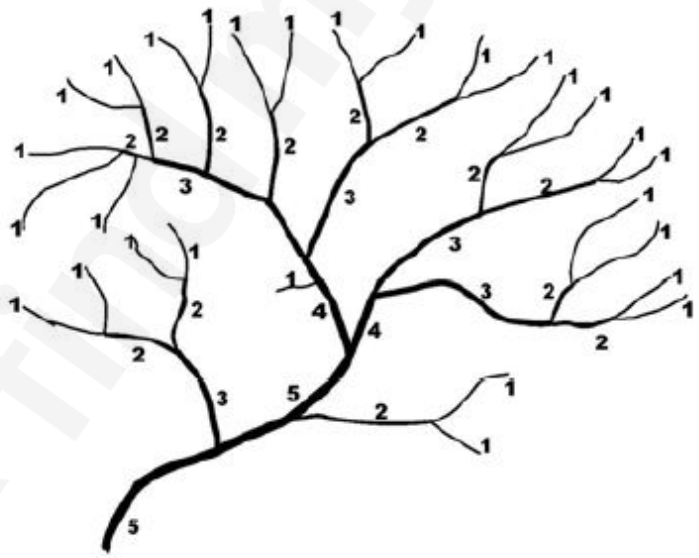
(A) Lignin
(B) Proteins
(C) Lipids
(D) Carbohydrates

Question Number : 49 Correct : 2 Wrong : 0

The hydraulic conductivity (K) of an isotropic aquifer is 10 m/day. If the hydraulic head within the aquifer drops 4 m over a distance of 750 m, the groundwater flow velocity within the aquifer is _____ m/day.
(Up to third decimal place)

Question Number : 50 Correct : 2 Wrong : 0

Drainage network of a watershed ordered as per the Strahler method is given below. Maximum observed bifurcation ratio for the given network is _____.



Question Number : 51 Correct : 2 Wrong : 0

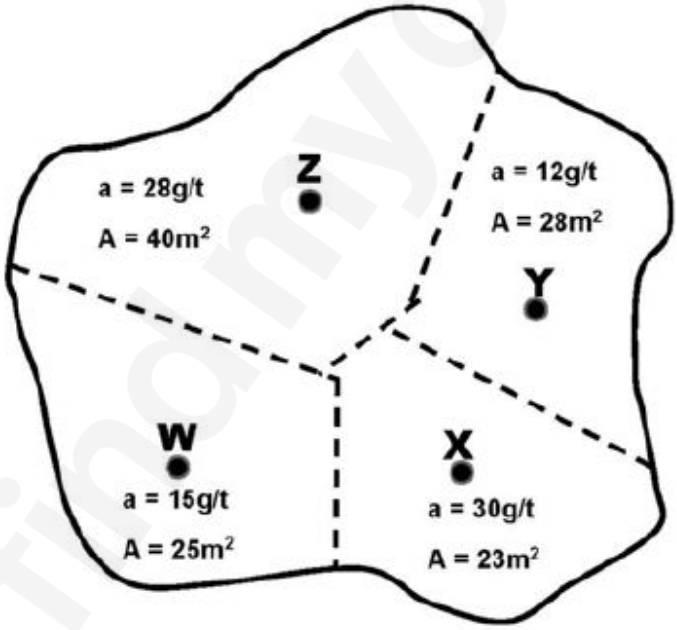
In a vertical aerial photo, the top and bottom of a tower built on a flat terrain is displaced by 2 mm. In the photograph, the distance between top of the tower and nadir point is 100 mm. The flying height of the aircraft was 3000 m above the ground. The estimated height of the tower is _____ m.

Question Number : 52 **Correct : 2 Wrong : 0**

Brazilian test was conducted on a rock sample having radius of 27 mm and thickness of 22 mm. The failure load was 5 kN. The tensile strength of the rock is _____ N/mm^2.

Question Number : 53 **Correct : 2 Wrong : 0**

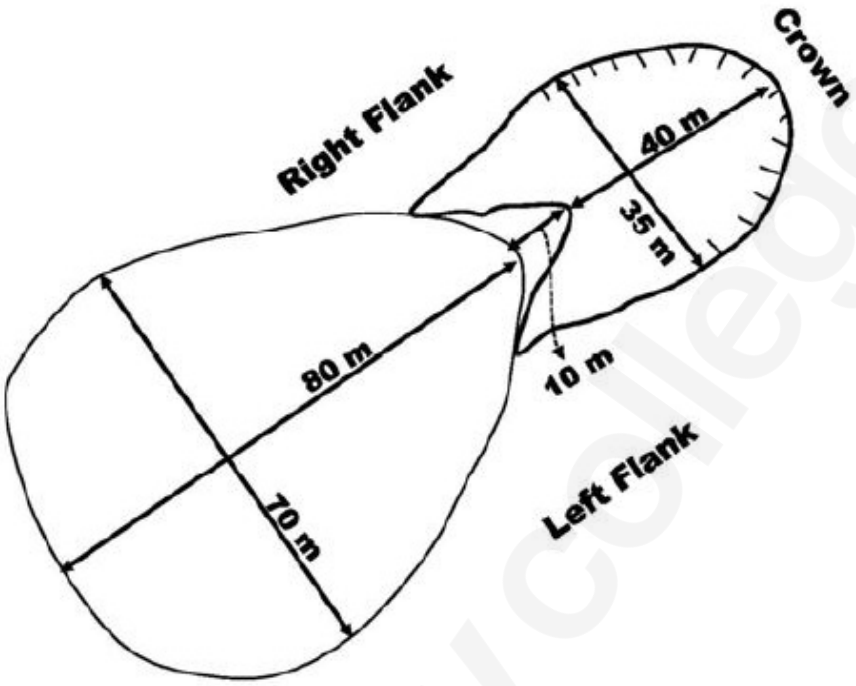
The average assay (a) and area of influence (A) of a placer gold deposit of uniform thickness sampled at four locations W, X, Y and Z are given below. The weighted average assay of the ore body is _____ g/t.



Question Number : 54 **Correct : 2 Wrong : 0**

The minimum and maximum values of the digital number (DN) of a remote sensing image are 8 and 32 respectively. The digital data was linearly stretched between 0 and 255 by using min-max linear stretching method. The post stretched integer DN value of a pixel with an original DN value of 27 will be _____.

The length and width of concave and convex sides of a landslide is shown in the figure below. The Dilation Index of the landslide is _____.



Geophysics (Part B) (Section-2)

Question Number : 56 **Correct : 2 Wrong : -0.66**

Which one of the following seismic phases is observable in the P-wave shadow zone?

(A) P (B) PmP (C) PcS (D) PKiKP

Question Number : 57 **Correct : 2 Wrong : -0.66**

Consider a geological body buried at the equator at a certain depth. If the same body were to be buried at the North pole at the same depth, how would the gravity and magnetic field responses measured over the body differ? Assume the same magnetic susceptibility and density contrasts. (Consider only geomagnetic induction).

(A) Both gravity and magnetic field responses do not change.
(B) Both gravity and magnetic field responses change significantly.
(C) Gravity field response changes significantly but magnetic field response does not change.
(D) Gravity field response does not change but magnetic field response changes significantly.

Question Number : 58 **Correct : 2 Wrong : 0**

Given the Bouguer density of 2.8 g/cc, the Bouguer correction for a gravity station at an elevation of 30 m above the datum is _____ mGals.
(Use π=3.14).

Question Number : 59 **Correct : 2 Wrong : 0**

Given the following data for a resistivity sounding experiment over a two-layered half-space, the resistivity transform for the top layer is _____ Ωm.
(Data: resistivity of top layer ρ_1 =10 Ωm, resistivity of half space ρ_2 =100 Ωm, thickness of top layer h_1=10 m and current electrode spacing AB/2 = 5 m).

Question Number : 60 **Correct : 2 Wrong : -0.66**

The ratio of eccentricity to the polar flattening of an ellipsoidal Earth with equatorial radius 'e' and polar radius 'p' can be expressed as

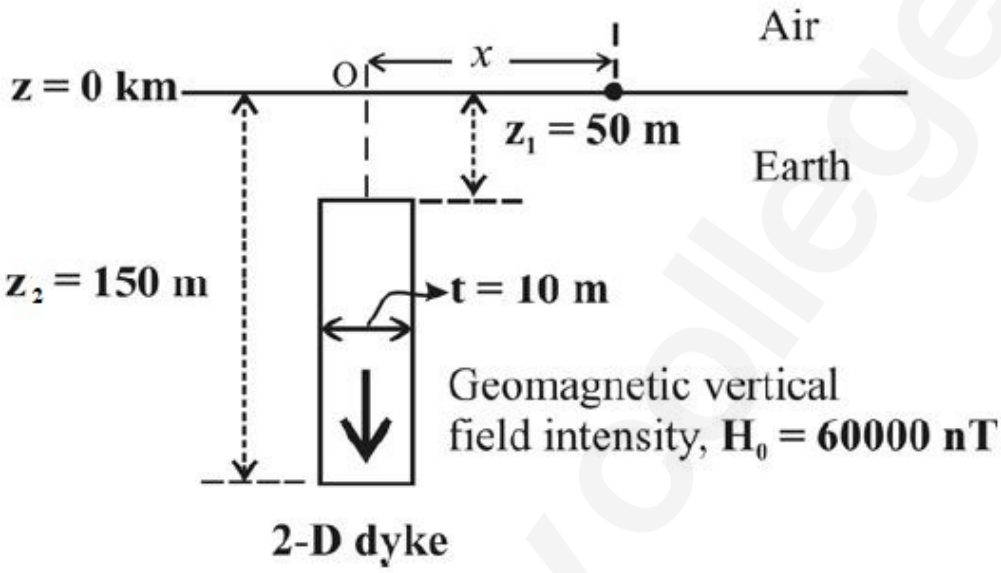
(A) $\frac{\sqrt{e^2+p^2}}{\sqrt{e-p}}$ (B) $\frac{\sqrt{e^2-p^2}}{\sqrt{e+p}}$ (C) $\frac{\sqrt{e+p}}{\sqrt{e-p}}$ (D) $\frac{\sqrt{e^2+p^2}}{\sqrt{e+p}}$

Question Number : 61 Correct : 2 Wrong : 0

The vertical field intensity anomaly Δz due to a vertically polarized vertical dyke is given by

$$\Delta z = 2Mt\left(\frac{z_1}{z_1^2+x^2} - \frac{z_2}{z_2^2+x^2}\right),$$

where M is the magnitude of intensity of magnetization. All relevant parameters are provided in the figure below. The dyke has 1% magnetite (magnetic susceptibility of magnetite =0.5 SI unit) distributed homogeneously. Then, the magnitude of peak vertical field intensity over the dyke is _____ nT.



Question Number : 62 Correct : 2 Wrong : 0

In a magneto-telluric (MT) experiment over a homogeneous and isotropic half-space, the apparent resistivity is 50 Ωm for an electric field intensity of 12 mV/km and time period of 10 s. Then, the magnetic field strength is_____ nT.

Question Number : 63 Correct : 2 Wrong : 0

The apparent resistivity for Wenner and Schlumberger configurations in an electrical sounding experiment is the same for a certain electrode spacing 'a' (Wenner configuration). Given the current electrode spacing of 18 m and the potential electrode spacing of 2 m for a Schlumberger configuration, the value of 'a' is _____ m.

Question Number : 64 **Correct : 2 Wrong : 0**

In a time-domain (T-D) induced polarization experiment with a steady voltage of 10 mV during the current flow interval, the voltage decay after the current cut-off is given by $v(t) = 4.0e^{-0.3t}$ mV. The chargeability after current cut-off between $t_1 = 1$ s and $t_2 = 4$ s is _____ ms.

Question Number : 65 **Correct : 2 Wrong : -0.66**

Which one of the following statements is TRUE for a near surface earthquake occurring in a homogeneous, isotropic Earth?

(A) Rayleigh waves are generated.
(B) Love waves are generated.
(C) Shear waves are split.
(D) P waves undergo refraction.

Question Number : 66 **Correct : 2 Wrong : 0**

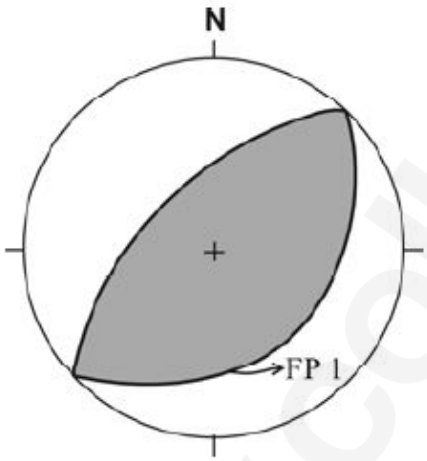
A dynamic range of 60 dB in power corresponds to an increase in amplitude by a factor of _____.

Question Number : 67 **Correct : 2 Wrong : 0**

The slope of the Wadati plot obtained using the P and S arrival times of a local earthquake is 1.0. The corresponding Vp/Vs ratio of the subsurface medium is _____.

Question Number : 68 **Correct : 2 Wrong : 0.66**

The beach ball figure given below depicts the focal mechanism of an earthquake. The shaded and unshaded portions indicate compressional and dilatational quadrants, respectively. FP1 is the fault plane solution. The focal mechanism and FP1 represent



(A) a thrust fault with strike 45° and dip 30° with the tension axis in the compression quadrant.
(B) a normal fault with strike 45° and dip 30° with the tension axis in the compression quadrant.
(C) a thrust fault with strike 225° and dip 60° with the pressure axis in the compression quadrant.
(D) a normal fault with strike 225° and dip 60° with the pressure axis in the compression quadrant.

Question Number : 69 **Correct : 2 Wrong : 0.66**

The characteristic log responses of a thick coal seam are

(A) low transit time, low resistivity and high gamma ray count.
(B) low transit time, high resistivity and low gamma ray count.
(C) high transit time, high resistivity and low gamma ray count.
(D) high transit time, low resistivity and high gamma ray count.

Question Number : 70 **Correct : 2 Wrong : 0**

The SP response of a thick, clean sandstone bed is -54 mV. Given the mud filtrate resistivity to be 0.45 Ωm at a formation temperature (T_f) of 130° F and the coefficient, K = 77.29, the formation water resistivity is_____ Ωm.

Question Number : 71 **Correct : 2 Wrong : -0.66**

Which one of the following log responses is TRUE for a porous and permeable sandstone bed, when the resistivity of the mud filtrate used is equal to the resistivity of the formation water?

(A) A large negative SP is observed.
(B) A large positive SP is observed.
(C) LLs and LLm logs show appreciably large separation.
(D) LLm and LLd logs overlap with each other.

Question Number : 72 **Correct : 2 Wrong : 0**

The number of half-lives ($T_{1/2}$) required for a certain amount of radioactive isotope in a rock to reduce to 3% of its original amount is _____ .

Question Number : 73 **Correct : 2 Wrong : -0.66**

VLF fields can be measured over continental distances (r) because

(A) the magnetic field decreases at the rate $\frac{1}{r}$ and the output power at the transmitting station is 1 to 10 kW.
(B) the magnetic field decreases at the rate $\frac{1}{r^3}$ and the output power at the transmitting station is 1 to 10 kW.
(C) the magnetic field decreases at the rate $\frac{1}{r}$ and the output power at the transmitting station is 100 to 1000 kW.
(D) the magnetic field decreases at the rate $\frac{1}{r^2}$ and the output power at the transmitting station is 100 to 1000 kW.

Question Number : 74 **Correct : 2 Wrong : -0.66**

Convolution of two box car functions of different widths yields a

(A) step function.
(B) trapezoidal function.
(C) box car function.
(D) sinc function.

Question Number : 75 **Correct : 2 Wrong : 0**

Assuming the Z -transform to be defined with Z as the unit delay operator, the pole of the infinite sequence $[\,1, \frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \ldots.]$ is at $Z =$ _____.

Question Number : 76 **Correct : 2 Wrong : -0.66**

Normal moveout (NMO) correction was applied to seismic data in the common midpoint (CMP) domain. The frequency distortion due to "NMO stretch" is highest for

(A) larger offsets of deeper reflections.
(B) smaller offsets of shallower reflections.
(C) larger offsets of shallower reflections.
(D) smaller offsets of deeper reflections.

Question Number : 77 **Correct : 2 Wrong : 0**

Consider a hypothetical zero-offset seismic reflection survey acquired over a reflector whose dip is 30°. The velocity of the medium above the reflector is 2 km/s and the trace spacing is 25 m. The maximum unaliased frequency in the data is _____ Hz.
(Hint: The difference in traveltime between adjacent traces should be less than or equal to half a cycle.)

Question Number : 78 **Correct : 2 Wrong : -0.66**

In statistical wavelet deconvolution, the reflectivity series is assumed to be a random sequence. Then, the autocorrelation of the wavelet is

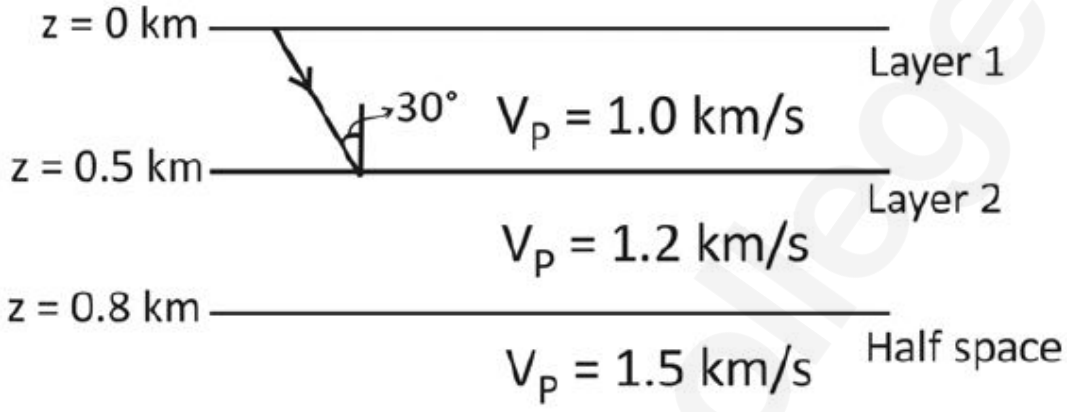
(A) a scaled version of the autocorrelation of the seismic trace.
(B) a random sequence.
(C) zero.
(D) dirac-delta function.

Question Number : 79 **Correct : 2 Wrong : 0**

A vector field $\boldsymbol{u}$ is expressed by its Helmholtz decomposition as $\boldsymbol{u} = \nabla\phi + \nabla \times \boldsymbol{\psi}$, with $\phi = \frac{1}{2}(x^2 - y^2 + z^2)$ and $\boldsymbol{\psi} = zy^2\,\boldsymbol{i} + xz\,\boldsymbol{j} + x^2\,\boldsymbol{k}$. The magnitude of the divergence of the vector field $\boldsymbol{u}$ at (1, 1, 1) is _____.

Question Number : 80 **Correct : 2 Wrong : 0**

In the figure shown below, a ray corresponding to a P-wave is incident on the interface between layer 1 and layer 2 at an angle of 30°. The P-wave velocity is 1 km/s, 1.2 km/s and 1.5 km/s in layer 1, layer 2 and the half space, respectively. The emergence angle of the ray into the half space is ____ degrees.



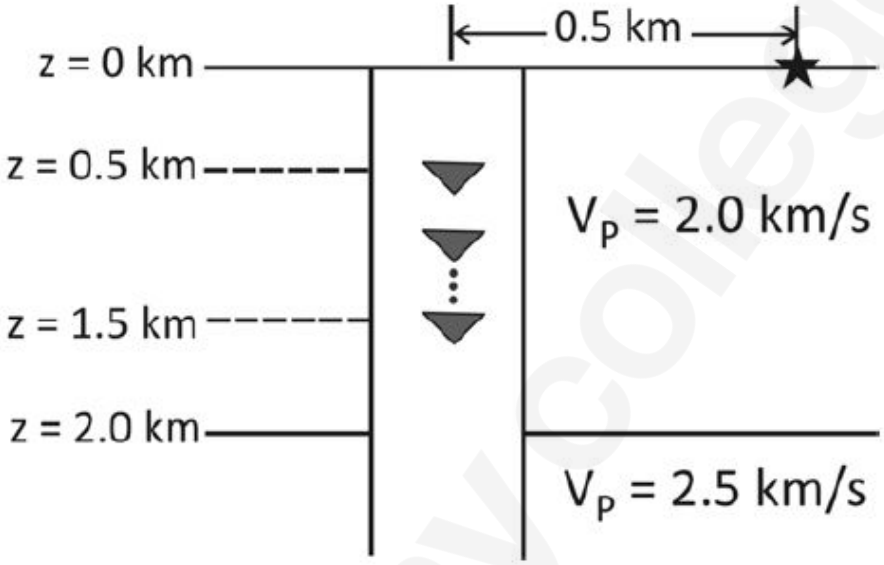
Question Number : 81 **Correct : 2 Wrong : -0.66**

How do the P-wave velocity (V_P), S-wave velocity (V_S), and Poisson's ratio (σ) change from a water saturated sandstone to a gas saturated sandstone?

(A) V_P increases, V_S decreases and σ increases.
(B) V_P decreases, V_S remains the same and σ decreases.
(C) V_P decreases, V_S increases and σ decreases.
(D) V_P, V_S, and σ all remain constant.

Question Number : 82 **Correct : 2 Wrong : 0**

Consider a Vertical Seismic Profiling (VSP) data acquisition experiment as shown in the figure below. The subsurface consists of a horizontal layer of 2 km thickness underlain by a semi-infinite half-space. The P-wave velocities (V_P) in the first layer and the half-space are 2.0 km/s and 2.5 km/s, respectively. The vertical well has a string of receivers (denoted by inverted triangles) spaced 10 m apart, with the shallowest receiver at a depth of 0.5 km and the deepest receiver at a depth of 1.5 km. The source (denoted by star) is placed 0.5 km from the well head. The traveltime of the primary reflection event at the deepest receiver is _____ s.



Question Number : 83 **Correct : 2 Wrong : -0.66**

Which one of the following sets of vectors $\{v_1, v_2, v_3\}$ is linearly dependent?

(A) $v_1 = (0, -1, 3),\ v_2 = (2, 0, 1),\ v_3 = (-2, -1, 3)$
(B) $v_1 = (2, -2, 0),\ v_2 = (0, 1, -1),\ v_3 = (0, 4, 2)$
(C) $v_1 = (2, 6, 2),\ v_2 = (2, 0, -2),\ v_3 = (0, 4, 2)$
(D) $v_1 = (1, 4, 7),\ v_2 = (2, 5, 8),\ v_3 = (3, 6, 9)$

Question Number : 84 **Correct : 2 Wrong : 0**

The condition number for the matrix $A = \begin{bmatrix} 2 & 1 \\ 0 & 3 \end{bmatrix}$ is ___.

Question Number : 85 **Correct : 2 Wrong : -0.66**

Match the items listed in Group I with their respective analytical expressions in Group II.

Group I	Group II
(P) Wave equation	(1) $\lvert\nabla u\rvert^2 = 1$
(Q) Heat conduction equation	(2) $\frac{\partial^2 u}{\partial t^2} - \nabla^2 u = 0$
(R) Eikonal equation	(3) $\nabla^2 u = -4\pi\sigma$
(S) Poisson's equation	(4) $\frac{\partial u}{\partial t} - \nabla^2 u = 0$
	(5) $\frac{\partial u}{\partial t} + u.\nabla u = 0$

(A) P-2, Q-3, R-4, S-1
(B) P-2, Q-4, R-1, S-3
(C) P-4, Q-2, R-5, S-3
(D) P-4, Q-3, R-1, S-5

General Aptitude

Question Number : 86 **Correct : 1 Wrong : -0.33**

The ways in which this game can be played _____ potentially infinite.

(A) is (B) is being (C) are (D) are being

Question Number : 87 **Correct : 1 Wrong : -0.33**

If you choose plan P, you will have to _____ plan Q, as these two are mutually_____.

(A) forgo, exclusive
(B) forget, inclusive
(C) accept, exhaustive
(D) adopt, intrusive

Question Number : 88 **Correct : 1 Wrong : -0.33**

If a and b are integers and $a - b$ is even, which of the following must always be even?

(A) ab (B) $a^2 + b^2 + 1$ (C) $a^2 + b + 1$ (D) $ab - b$

Question Number : 89 **Correct : 1 Wrong : -0.33**

A couple has 2 children. The probability that both children are boys if the older one is a boy is

(A) 1/4 (B) 1/3 (C) 1/2 (D) 1

Question Number : 90 **Correct : 1 Wrong : -0.33**

P looks at Q while Q looks at R. P is married, R is not. The number of pairs of people in which a married person is looking at an unmarried person is

(A) 0 (B) 1 (C) 2 (D) Cannot be determined

Question Number : 91 **Correct : 2 Wrong : -0.66**

"If you are looking for a history of India, or for an account of the rise and fall of the British Raj, or for the reason of the cleaving of the subcontinent into two mutually antagonistic parts and the effects this mutilation will have in the respective sections, and ultimately on Asia, you will not find it in these pages; for though I have spent a lifetime in the country, I lived too near the seat of events, and was too intimately associated with the actors, to get the perspective needed for the impartial recording of these matters."

Which of the following is closest in meaning to 'cleaving'?

(A) deteriorating (B) arguing (C) departing (D) splitting

Question Number : 92 Correct : 2 Wrong : -0.66

X bullocks and Y tractors take 8 days to plough a field. If we halve the number of bullocks and double the number of tractors, it takes 5 days to plough the same field. How many days will it take X bullocks alone to plough the field?

(A) 30 (B) 35 (C) 40 (D) 45

Question Number : 93 Correct : 2 Wrong : -0.66

There are 4 women P, Q, R, S, and 5 men V, W, X, Y, Z in a group. We are required to form pairs each consisting of one woman and one man. P is not to be paired with Z, and Y must necessarily be paired with someone. In how many ways can 4 such pairs be formed?

(A) 74 (B) 76 (C) 78 (D) 80

Question Number : 94 Correct : 2 Wrong : -0.66

All people in a certain island are either 'Knights' or 'Knaves' and each person knows every other person's identity. Knights NEVER lie, and knaves ALWAYS lie.

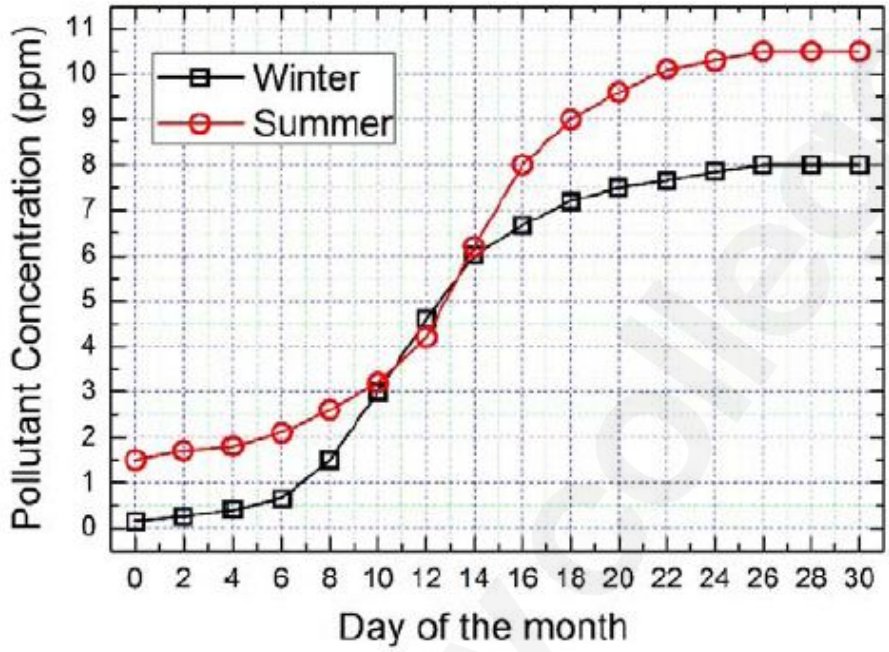
P says "Both of us are knights". Q says "None of us are knaves".

Which one of the following can be logically inferred from the above?

(A) Both P and Q are knights
(B) P is a knight; Q is a knave
(C) Both P and Q are knaves
(D) The identities of P, Q cannot be determined

Question Number : 95 **Correct : 2 Wrong : -0.66**

In the graph below, the concentration of a particular pollutant in a lake is plotted over (alternate) days of a month in winter (average temperature 10 °C) and a month in summer (average temperature 30 °C).



Consider the following statements based on the data shown above:

i. Over the given months, the difference between the maximum and the minimum pollutant concentrations is the same in both winter and summer.

ii. There are at least four days in the summer month such that the pollutant concentrations on those days are within 1 ppm of the pollutant concentrations on the corresponding days in the winter month.

Which one of the following options is correct?

(A) Only i (B) Only ii (C) Both i and ii (D) Neither i nor ii

Q. No.	Type	Section	Key	Marks
1	MCQ	GG-C	D	1
2	MCQ	GG-C	B	1
3	MCQ	GG-C	A	1
4	MCQ	GG-C	D	1
5	MCQ	GG-C	A	1
6	MCQ	GG-C	A	1
7	MCQ	GG-C	D	1
8	MCQ	GG-C	A	1
9	NAT	GG-C	27 to 27	1
10	MCQ	GG-C	D	1
11	MCQ	GG-C	C	1
12	MCQ	GG-C	B	1
13	MCQ	GG-C	C	1
14	MCQ	GG-C	C	1
15	MCQ	GG-C	B	1
16	MCQ	GG-C	C	1
17	MCQ	GG-C	B	1
18	MCQ	GG-C	B	1
19	MCQ	GG-C	D	1
20	MCQ	GG-C	C	1
21	MCQ	GG-C	C	1
22	NAT	GG-C	11.8 to 12.0	1
23	NAT	GG-C	12 to 22	1
24	MCQ	GG-C	B	1
25	MCQ	GG-C	A	1
26	MCQ	GG-1	A	2
27	MCQ	GG-1	C	2
28	MCQ	GG-1	C	2
29	NAT	GG-1	1 to 1	2
30	MCQ	GG-1	A	2
31	NAT	GG-1	20 to 20	2
32	MCQ	GG-1	B	2
33	MCQ	GG-1	D	2
34	MCQ	GG-1	B	2
35	NAT	GG-1	2.0 to 2.2	2
36	NAT	GG-1	32 to 34	2

37	NAT	GG-1	2.1 to 2.2	2
38	MCQ	GG-1	C	2
39	NAT	GG-1	-5300 to -4700	2
40	NAT	GG-1	0.39 to 0.41	2
41	MCQ	GG-1	B	2
42	MCQ	GG-1	D	2
43	MCQ	GG-1	A	2
44	MCQ	GG-1	B	2
45	MCQ	GG-1	D	2
46	NAT	GG-1	33.5 to 34.5	2
47	MCQ	GG-1	B	2
48	MCQ	GG-1	C	2
49	NAT	GG-1	0.05 to 0.055	2
50	NAT	GG-1	2.55 to 2.65	2
51	NAT	GG-1	60 to 60	2
52	NAT	GG-1	2.50 to 3.00	2
53	NAT	GG-1	21.00 to 22.00	2
54	NAT	GG-1	201 to 204	2
55	NAT	GG-1	2 to 2	2
56	MCQ	GP-1	D	2
57	MCQ	GP-1	D	2
58	NAT	GP-1	3.3 to 3.7	2
59	NAT	GP-1	9.7 to 10.8	2
60	MCQ	GP-1	C	2
61	NAT	GP-1	76 to 84	2
62	NAT	GP-1	2.3 to 2.5	2
63	NAT	GP-1	19 to 21	2
64	NAT	GP-1	580 to 590	2
65	MCQ	GP-1	A	2
66	NAT	GP-1	1000 to 1000	2
67	NAT	GP-1	2 to 2	2
68	MCQ	GP-1	A	2
69	MCQ	GP-1	C	2
70	NAT	GP-1	0.08 to 0.10	2
71	MCQ	GP-1	D	2
72	NAT	GP-1	5.05 to 5.07	2
73	MCQ	GP-1	C	2

74	MCQ	GP-1	B	2
75	NAT	GP-1	2 to 2	2
76	MCQ	GP-1	C	2
77	NAT	GP-1	40 to 40	2
78	MCQ	GP-1	A	2
79	NAT	GP-1	1 to 1	2
80	NAT	GP-1	48 to 49	2
81	MCQ	GP-1	B	2
82	NAT	GP-1	1.20 to 1.35	2
83	MCQ	GP-1	D	2
84	NAT	GP-1	1.7 to 2.4	2
85	MCQ	GP-1	B	2
86	MCQ	GA	C	1
87	MCQ	GA	A	1
88	MCQ	GA	D	1
89	MCQ	GA	C	1
90	MCQ	GA	B	1
91	MCQ	GA	D	2
92	MCQ	GA	A	2
93	MCQ	GA	C	2
94	MCQ	GA	D	2
95	MCQ	GA	B	2