General Aptitude

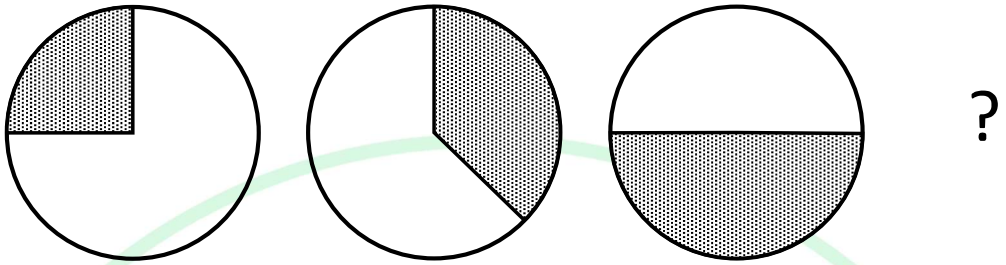
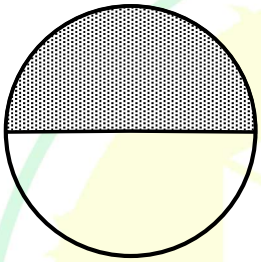
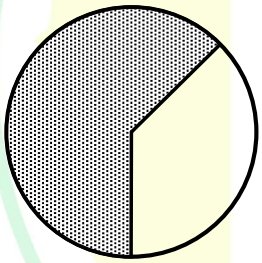
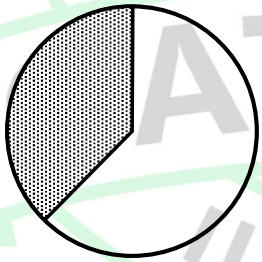
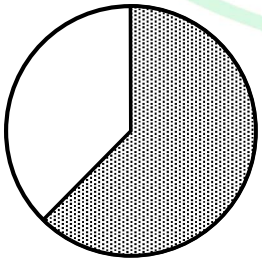
Q.1 – Q.5 Carry ONE mark Each

Q.1	Is there any good show _____ television tonight? Select the most appropriate option to complete the above sentence.
(A)	in
(B)	at
(C)	within
(D)	on

Q.2	As the police officer was found guilty of embezzlement, he was _____ dismissed from the service in accordance with the Service Rules. Select the most appropriate option to complete the above sentence.
(A)	sumptuously
(B)	brazenly
(C)	unintentionally
(D)	summarily

Q.3	The sum of the following infinite series is:
	$\frac{1}{1!}+\frac{1}{2!}+\frac{1}{3!}+\frac{1}{4!}+\frac{1}{5!}+\cdots$
(A)	π
(B)	$1+e$
(C)	$e-1$
(D)	e

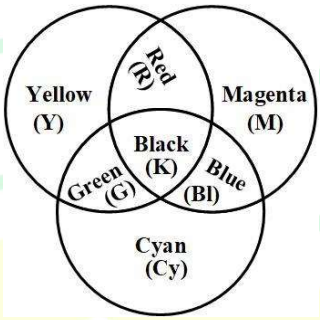
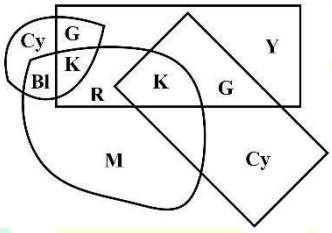
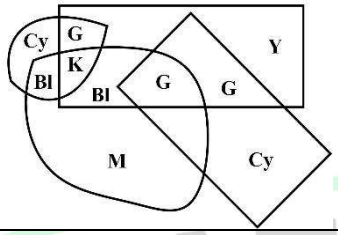
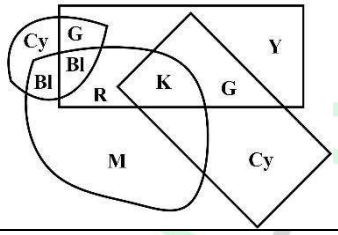
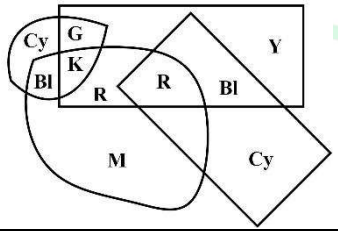
Q.4	A thin wire is used to construct all the edges of a cube of 1 m side by bending, cutting and soldering the wire. If the wire is 12 m long, what is the minimum number of cuts required to construct the wire frame to form the cube?
(A)	3
(B)	4
(C)	6
(D)	12

Q.5	The figures I, II and III are parts of a sequence. Which one of the following options comes next in the sequence at IV?
	 I II III IV
(A)	
(B)	
(C)	
(D)	

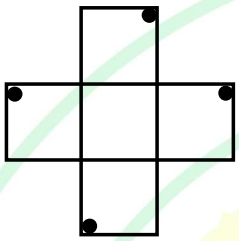
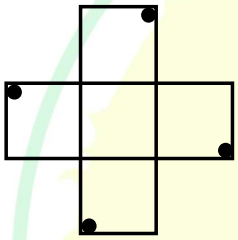
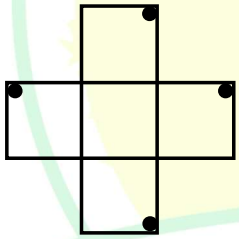
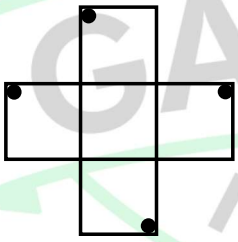
Q.6 – Q.10 Carry TWO marks Each

Q.6	"Why do they pull down and do away with crooked streets, I wonder, which are my delight, and hurt no man living? Every day the wealthier nations are pulling down one or another in their capitals and their great towns: they do not know why they do it; neither do I. It ought to be enough, surely, to drive the great broad ways which commerce needs and which are the life-channels of a modern city, without destroying all history and all the humanity in between: the islands of the past." (From Hilaire Belloc's "The Crooked Streets") Based only on the information provided in the above passage, which one of the following statements is true?
(A)	The author of the passage takes delight in wondering.
(B)	The wealthier nations are pulling down the crooked streets in their capitals.
(C)	In the past, crooked streets were only built on islands.
(D)	Great broad ways are needed to protect commerce and history.

Q.7	Rohit goes to a restaurant for lunch at about 1 PM. When he enters the restaurant, he notices that the hour and minute hands on the wall clock are exactly coinciding. After about an hour, when he leaves the restaurant, he notices that the clock hands are again exactly coinciding. How much time (in minutes) did Rohit spend at the restaurant?
(A)	$64\frac{6}{11}$
(B)	$66\frac{5}{13}$
(C)	$65\frac{5}{11}$
(D)	$66\frac{6}{13}$

Q.8	A color model is shown in the figure with color codes: Yellow (Y), Magenta (M), Cyan (Cy), Red (R), Blue (Bl), Green (G), and Black (K). Which one of the following options displays the color codes that are consistent with the color model?
	
(A)	
(B)	
(C)	
(D)	

Q.9	A circle with center at $(x, y) = (0.5,\ 0)$ and radius = 0.5 intersects with another circle with center at $(x, y) = (1, 1)$ and radius = 1 at two points. One of the points of intersection (x, y) is:
(A)	$(0, 0)$
(B)	$(0.2, 0.4)$
(C)	$(0.5, 0.5)$
(D)	$(1, 2)$

Q.10	An object is said to have an n-fold rotational symmetry if the object, rotated by an angle of $\frac{2\pi}{n}$, is identical to the original. Which one of the following objects exhibits 4-fold rotational symmetry about an axis perpendicular to the plane of the screen? Note: The figures shown are representative.
(A)	
(B)	
(C)	
(D)	

PART A: COMPULSORY SECTION FOR ALL CANDIDATES

Q.11– Q .17 Carry ONE mark Each

Q.11	The most volcanically active body in our Solar System is
(A)	Mars
(B)	Io
(C)	Moon
(D)	Venus
Q.12	A type of fold which is relatively sharp and angular at its synformal and antiformal hinges is known as
(A)	Fan fold
(B)	Drag fold
(C)	Chevron fold
(D)	Dome

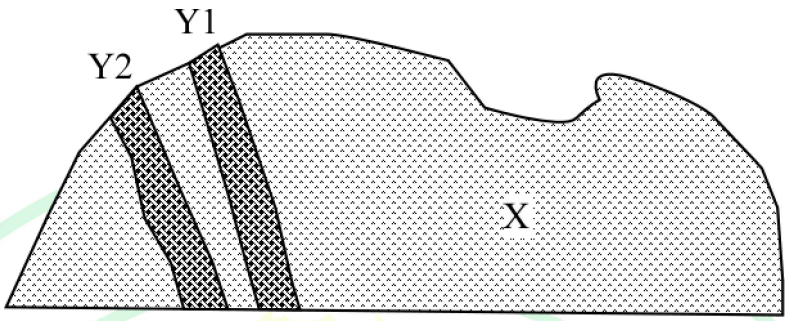
Q.13	Which one of the following geophysical methods can provide information on deep Earth structures (of the order of 1000 km) with highest resolution?
(A)	Seismic methods
(B)	Magnetic methods
(C)	Electrical methods
(D)	Gravity methods
Q.14	The continuous series of Bowen's reaction series is represented by
(A)	the orthoclase - albite feldspar system
(B)	the anorthite - albite system
(C)	the forsterite - fayalite system
(D)	the diopside - anorthite system

Q.15	Which of the following time boundaries correspond(s) to major mass extinction events?
(A)	Cretaceous - Paleogene
(B)	Paleogene - Neogene
(C)	Permian - Triassic
(D)	Precambrian - Cambrian
Q.16	A watershed has an area of 74 km^2. The stream network within this watershed consists of three different stream orders. The stream lengths in each order are as follows: I^{st} order streams: 3 km, 2.5 km, 4 km, 3 km, 2 km, 5 km II^{nd} order streams: 10 km, 15 km, 7 km III^{rd} order streams: 30 km The drainage density of the watershed is _____ km/km^2 *(Round off to two decimal places)*

Q.17	A sample contains 7 wt% CaO and 5 wt% MgO. The molar ratio of CaO to MgO in the sample is _____ *(Round off to two decimal places)*

Q.18 – Q .26 Carry TWO marks Each

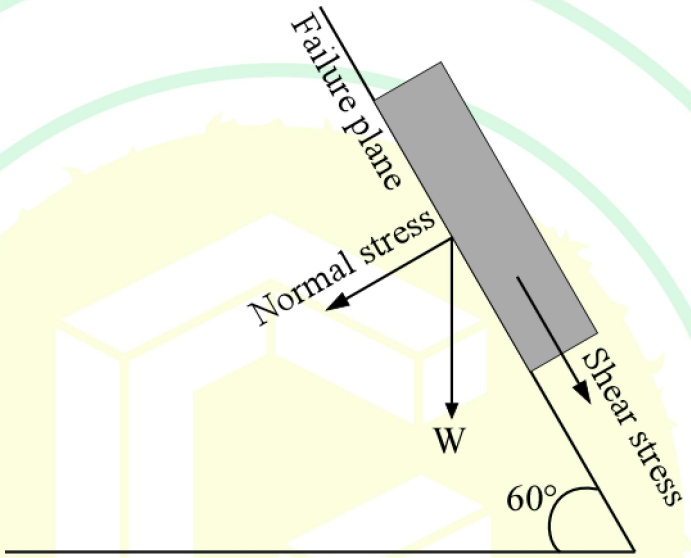
Q.18	Select the option that lists oxide minerals only.
(A)	Spinel, Corundum, Rutile
(B)	Olivine, Pyroxene, Magnetite
(C)	Apatite, Galena, Monazite
(D)	Fluorite, Halite, Calcite

Q.19	Consider two intersecting, north-easterly striking and south-easterly dipping dikes Y1 and Y2, which are exposed on an east-west trending vertical wall of a granite (X) quarry as shown below.  The angle that the dikes make with the horizontal on the quarry wall is
(A)	true dip
(B)	apparent dip
(C)	rake
(D)	attitude of foliation

Q.20	The ratio of P-wave to S-wave velocities, V_p/V_s, within the Earth depends on
(A)	bulk modulus
(B)	shear modulus
(C)	density
(D)	coefficient of internal friction
Q.21	Three pixels P, Q, and R in an image are characterized by the NDVI values of + 0.84, + 0.01, and – 0.89, respectively. Which of the following options is/are correct?
(A)	P is from vegetation area and Q is from barren land
(B)	Q is from water body and R is from barren land
(C)	Q is from barren land and R is from water body
(D)	P is from vegetation area and Q is from water body

Q.22	Which of the following can indicate the presence of significant sub-surface iron mineralization?
(A)	Free air gravity anomaly
(B)	Bouguer gravity anomaly
(C)	Magnetic anomaly
(D)	Electrical resistivity measurements
Q.23	Which of the following statements is/are correct regarding the magnetic field lines of the Earth, at the magnetic poles and the magnetic equator?
(A)	Horizonal at the equator
(B)	Vertical at the poles
(C)	Horizonal at the poles
(D)	Vertical at the equator

Q.24	If the lowest Digital Number (DN) value in an image of 10-bit radiometric resolution is 0, then the maximum DN value of that image is _____ (*Answer in integer*)
Q.25	If one liter of water at pH 7 is mixed with one liter of water at pH 6, the resulting pH of the mixture is _____ *(Round off to two decimal places)*

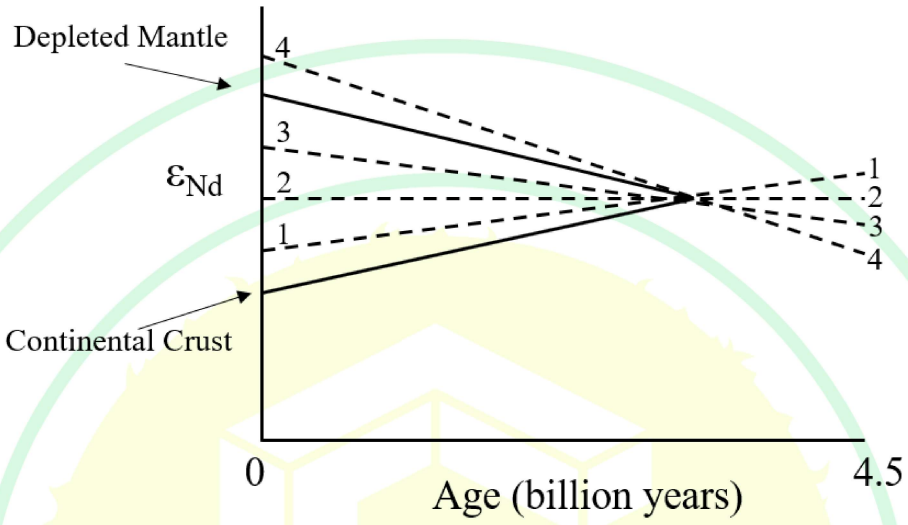
Q.26	A hillslope is shown below. If the area over the failure plane is 50 m^2 and the weight of the hillslope material (W) is 2000 tons, the Factor of Safety (FOS) for this hillslope in dry conditions is _____ (Cohesion along failure plane = 196 KPa, dip of failure plane = 60°, and internal friction angle = 30°). *(Round off to two decimal places)* 

PART B (SECTION 1): FOR GEOLOGY CANDIDATES ONLY

Q.27 – Q.44 Carry ONE mark Each

Q.27	Which one of the following statements explains why elements Li, Be, and B have low cosmic abundance?
(A)	These elements have low masses and hence, they break apart easily
(B)	These elements have low binding energies which makes them unstable at high temperatures at the core of stars
(C)	The low abundance of these elements is a unique feature of big stars with masses greater than 10 times that of our Sun
(D)	These elements are highly reactive and hence, unstable
Q.28	During a geochemical exploration survey in a hilly terrain, Cu concentration of stream sediments from a third order basin outlet was measured to be 3000 ppm. Considering a catchment area of 10 km^2 and a Cu background value of 200 ppm, which one of the following options is the productivity of this catchment for Cu?
(A)	1.5×10^6 m^2
(B)	2.8×10^6 m^2
(C)	3.0×10^6 m^2
(D)	3.2×10^6 m^2

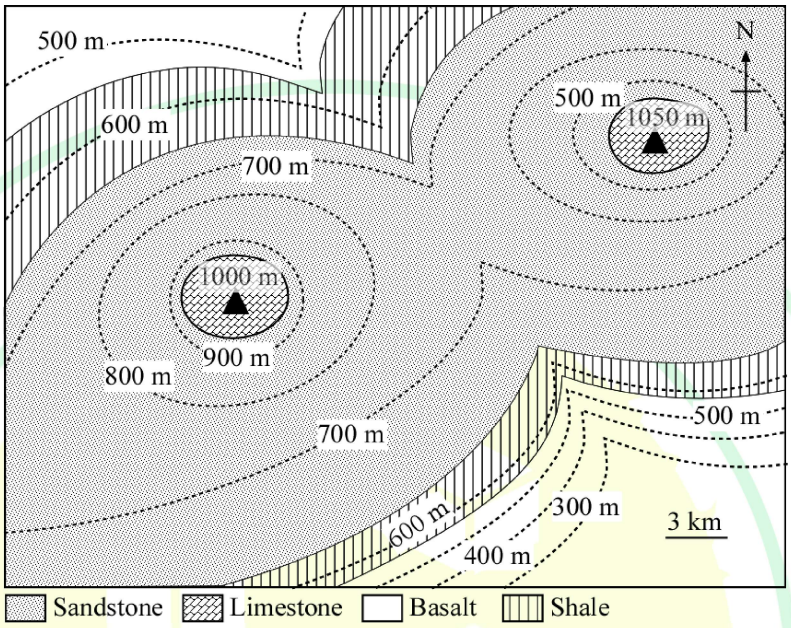
Q.29	The combinations listed below represent major minerals observed in four igneous rocks: (i) Olivine and Anorthite, (ii) K-feldspar and Quartz, (iii) Mg-Ca-pyroxene and Ca-Na-plagioclase, (iv) Amphibole and Na-Ca-plagioclase Arrange these mineral combinations based on decreasing temperature of magma crystallization.
(A)	(i) > (ii) > (iii) > (iv)
(B)	(i) > (iii) > (iv) > (ii)
(C)	(i) > (iv) > (iii) > (ii)
(D)	(ii) > (i) > (iv) > (iii)

Q.30	Shown below is a schematic plot of ε_{Nd} (deviation of $^{143}Nd/^{144}Nd$ in a sample relative to CHUR) versus time. The two solid lines represent the evolution curves for the depleted mantle reservoir and the continental crust. Which one of the four dashed lines, marked 1, 2, 3, and 4, represents the evolution of the CHUR? 
(A)	Line 1
(B)	Line 2
(C)	Line 3
(D)	Line 4

Q.31	Which one of the following expressions represents porosity of a rock?
(A)	(Solid volume – Pore volume) / Solid volume
(B)	(Bulk volume – Pore volume) / Bulk volume
(C)	(Bulk volume – Solid volume) / Solid volume
(D)	(Bulk volume – Solid volume) / Bulk volume
Q.32	Choose the correct option where both organisms do NOT secrete any $CaCO_3$ (calcite or aragonite).
(A)	Foraminifera and Coccolithophore
(B)	Diatom and Radiolaria
(C)	Diatoms and Corals
(D)	Foraminifera and Radiolaria

Q.33	From the following optical properties of minerals, select an appropriate option to identify the direction of analyzer and polarizer if the available microscope is without a cross-hair.
(A)	Pleochroism of common hornblende
(B)	Extinction of diopside
(C)	Extinction of glaucophane
(D)	Pleochroism of biotite

Q.34	Which one of the following minerals has crystallographic axes a1 = a2 ≠ c and all interaxial angles equal to 90°?
(A)	Beryl
(B)	Barite
(C)	Plagioclase
(D)	Zircon

Q.35	Which one of the following statements correctly describes the features in the geological map? 
(A)	Horizontal sedimentary beds above a basalt basement
(B)	Anticline consisting of sedimentary rocks and basalt
(C)	Syncline consisting of sedimentary rocks and basalt
(D)	Steep south-dipping sedimentary beds above a basalt basement

Q.36	In which one of the following rivers does helical flow play an important role in controlling river dynamics and channel morphology?
(A)	Meandering rivers
(B)	Straight rivers
(C)	Braided rivers
(D)	Bedrock rivers

Q.37	Which of the following statements is/are NOT correct for stratigraphy of the Himalaya?
(A)	Tethyan Sedimentary Sequence rocks are of Precambrian age
(B)	The Lesser Himalayan Sequence rocks are younger than the Higher Himalayan Crystallines
(C)	The Sub-Himalayan Sequence rocks are younger than the Lesser Himalayan rocks
(D)	Collisional Himalayan orogeny occurred in the Cenozoic Era

Q.38	Which of the following factors will REDUCE the chances of landslide failure?
(A)	Increase in shear stress
(B)	Increase in water content of pore spaces
(C)	Increase in angle of internal friction
(D)	Increase in cohesion of soil grains

Q.39	Which of the following rock and texture combinations is/are CORRECT?
(A)	Komatiite and Spinifex
(B)	Gabbro and Ophitic
(C)	Marble and Granoblastic
(D)	Basalt and Porphyroblastic

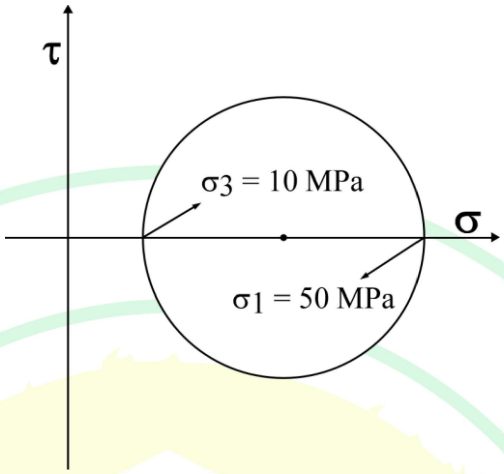
Q.40	Which of the following statements regarding marine organisms is/are NOT true?
(A)	Foraminifera are multicellular marine organisms
(B)	Sponges form their spicules with silica
(C)	Coccolithophores are sea-surface dwelling organisms
(D)	Species diversity of benthic foraminifera is less than that of planktonic foraminifera

Q.41	Which of the following rocks is/are characteristic of fossil subduction zones?
(A)	Wollastonite and scapolite bearing skarn
(B)	Andalusite and staurolite bearing hornfels
(C)	Garnet and glaucophane bearing blueschist
(D)	Garnet and omphacite bearing eclogite

Q.42	Compared to Fe, Mg, and Ca, the content of K is extremely low in igneous clinopyroxene. Which of the following CANNOT explain its low abundance?
(A)	K^{+} has a larger ionic radius than Fe^{2+}, Mg^{2+} and Ca^{2+}
(B)	K is incompatible and hence, enriched in the continental crust
(C)	K is fluid mobile and hence, easily leached out of clinopyroxene
(D)	K has multiple oxidation states
Q.43	The sediment yield at the outlet of a river having a catchment area of 8 km^2 is 6000 tons/year. If the sediment density is 1.5 g/cm^3, the average erosion rate of the river basin is _____ mm/yr. *(Round off to two decimal places)*
Q.44	In a hypothetical rock, the K_d values of element E in minerals M1, M2, and M3 are 1.5, 1.0, and 0.5, respectively. The modal abundances of M1, M2, and M3 are 10%, 40%, and 50%, respectively. The bulk partition coefficient of element E in this rock is _____ *(Round off to two decimal places)*

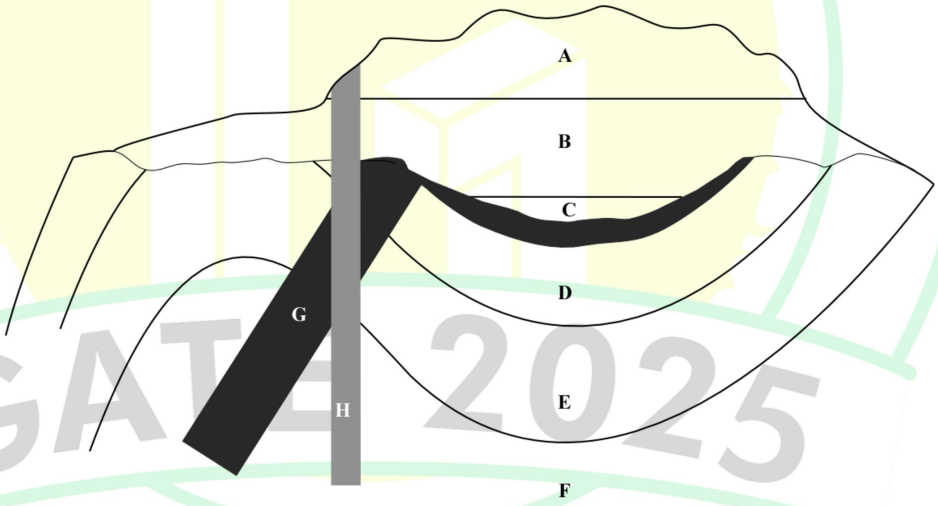
Q.45 – Q .65 Carry TWO marks Each

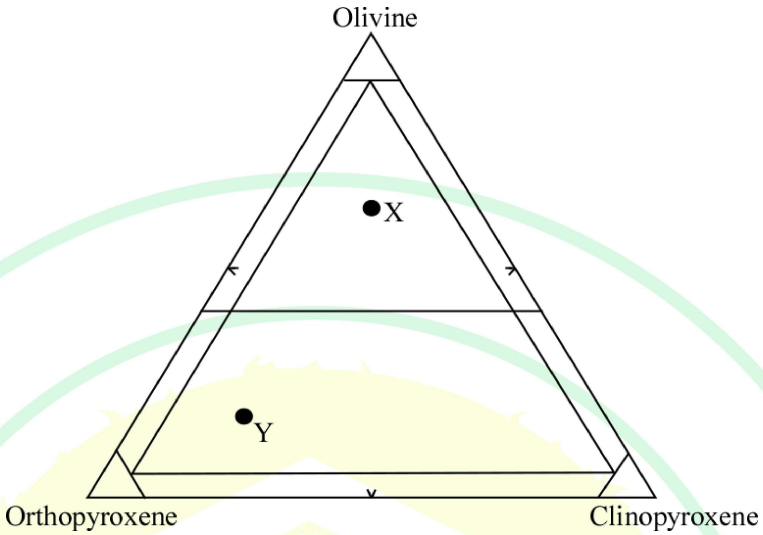
Q.45	A particular Index of Alteration (IA) is defined as the molar concentration ratio (expressed as weight percentage) of fluid immobile element(s) to fluid mobile element(s) and is expressed by $100 \times ([Al_2O_3] / \{[Al_2O_3] + [Na_2O] + [K_2O]\})$. For chemical weathering of silicate rocks, which one of the following statements is correct?
(A)	High IA values (> 85) indicate intense chemical weathering
(B)	Low IA values (< 15) indicate intense chemical weathering
(C)	The IA values do not vary for silicate rocks
(D)	The minimum IA value for an unweathered granite is 0

Q.46	What is the value of the maximum shear stress in a rock, for which the state of stress is given by the following Mohr circle? 
(A)	20 MPa
(B)	40 MPa
(C)	50 MPa
(D)	60 MPa

Q.47	In a hypothetical scenario, the element Y has 4 stable isotopes ^{197}Y, ^{198}Y, ^{199}Y and ^{200}Y. The isotope ^{199}Y is radiogenic and is formed by β^- decay of the isotope ^{199}X of the element X with a half-life of 3.51 billion years. An igneous rock, which has behaved as a closed system, has three different minerals P, Q, and R, which crystallized from the same magma 2 billion years ago, with initial X/Y ratios of 1.75, 2.05, and 0.75, respectively. Which one of the following statements is true for the ratio $^{199}Y/^{200}Y$ in this igneous rock in the present day?
(A)	P > Q > R
(B)	R > P > Q
(C)	Q > P > R
(D)	Q > R > P
Q.48	Which one of the following factors governs the inclination of the slip face (leeward side) of ripples?
(A)	Velocity of the transporting medium
(B)	Sediment supply
(C)	Internal friction angle
(D)	Drag force

Q.49	High intensity rainfall in the Higher Himalayan region causes extensive damage, because of its large droplet size. Which one of the following relationships between the kinetic energy of raindrop (E) and droplet diameter (D) explains this process?
(A)	$E \propto D^{1/2}$
(B)	$E \propto D^{2}$
(C)	$E \propto D^{3}$
(D)	$E \propto D^{4}$

Q.50	The units A to H marked on the figure represent different rock formations. Select the option that describes the chronological sequence from old to young. 
(A)	F, E, D, G, C, B, A, H
(B)	F, E, D, C, B, A, G, H
(C)	F, E, D, G, C, H, B, A
(D)	F, E, D, H, G, C, B, A

Q.51	In the IUGS classification diagram for mafic and ultramafic rocks shown below, choose the correct option for the rocks labelled X and Y. 
(A)	X: Harzburgite and Y: Olivine Websterite
(B)	X: Lherzolite and Y: Olivine Websterite
(C)	X: Dunite and Y: Clinopyroxenite
(D)	X: Anorthosite and Y: Wehrlite

<table>
<tr><td>Q.52</td><td>Choose the correct combination of minerals (listed in Group A) with the corresponding locations of their deposits (listed in Group B).
<table>
<tr><th><u>Group-A</u></th><th><u>Group-B</u></th></tr>
<tr><td>M. Magnesite</td><td>1. Bikaner</td></tr>
<tr><td>N. Uraninite</td><td>2. Nausahi</td></tr>
<tr><td>O. Clay minerals</td><td>3. Salem</td></tr>
<tr><td>P. Platinum group elements</td><td>4. Jaduguda</td></tr>
</table>
</td></tr>
<tr><td>(A)</td><td>M-1; N-2; O-3; P-4</td></tr>
<tr><td>(B)</td><td>M-4; N-3; O-2; P-1</td></tr>
<tr><td>(C)</td><td>M-3; N-4; O-1; P-2</td></tr>
<tr><td>(D)</td><td>M-2; N-4; O-1; P-3</td></tr>
</table>

Q.53	Choose the explanation(s) for negative Eu anomalies in upper crustal rocks like granite and granodiorite.
(A)	These rocks are end-products of magmatic differentiation
(B)	These rocks were formed by melting of the mantle, which was already depleted in Eu
(C)	Most of the Eu was incorporated in other minerals
(D)	The melt residues contain plagioclase which are enriched in Eu

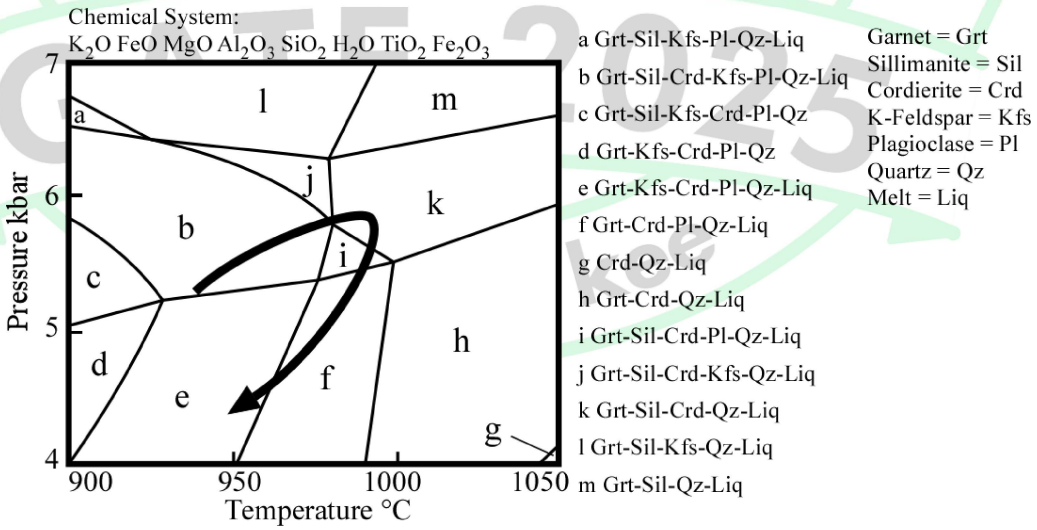
Q.54	Which characteristic feature(s) best explain(s) the HIMU mantle reservoir?
(A)	Magmas derived from this reservoir have high $^{208}Pb/^{204}Pb$ and $^{206}Pb/^{204}Pb$
(B)	Magmas derived from this reservoir have high $^{207}Pb/^{204}Pb$ and $^{206}Pb/^{204}Pb$
(C)	This reservoir has evolved with high Th/U
(D)	This reservoir has evolved with high U/Pb

Q.55	Choose the correct option(s) related to tectonic settings and associated rock types.
(A)	Tholeiitic basalts and alkali basalts are both associated with mid-oceanic ridges
(B)	Andesites are commonly found in convergent plate boundaries
(C)	Tholeiitic basalts and alkali basalts can both be associated with plume-related volcanism
(D)	Volcanic rocks from subduction zones have high volatile content

Q.56	Which of the following options is/are correct for movement of warm-base glaciers?
(A)	Movement is dominated by basal sliding
(B)	Internal deformation involving slippage within and between ice crystals leads to glacial movement
(C)	Internal deformation is governed by shear stress following Power Law
(D)	Vertical profile of glacier flow velocity is maximum at the base and decreases upwards

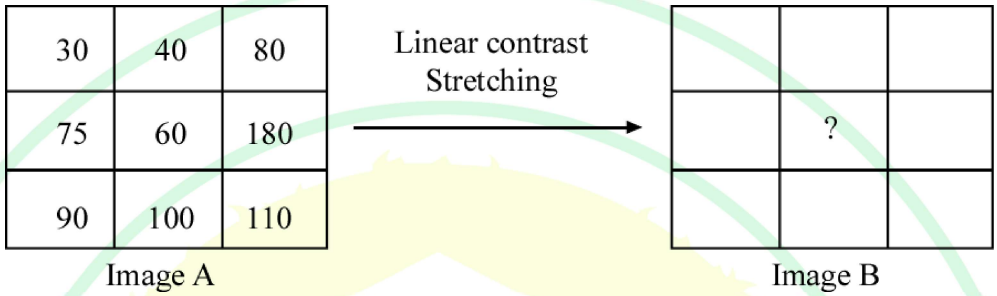
Q.57	Choose the correct option(s) that describe(s) the properties of clay minerals.
(A)	Kaolinite is two-layered
(B)	Illite is two-layered
(C)	Montmorillonite is two-layered
(D)	Montmorillonite swells in contact with water

Q.58	Which of the following statements is/are correct for electromagnetic (EM) radiation?
(A)	At room temperature, natural objects emit EM radiation
(B)	Blackbody radiation is proportional to square of the absolute temperature of the body
(C)	Wien's displacement law provides the dominant wavelength of EM emission
(D)	EM energy decreases with increase in wavelength
Q.59	Which of the following options can be linked to rise in CO_2 concentration in the atmosphere?
(A)	Rise in seawater pH and sea surface temperature
(B)	Decrease in seawater pH and increase in bicarbonate ion concentration in seawater
(C)	Warming of surface ocean water and decrease in carbonate ion concentration in seawater
(D)	Decrease in seawater pH and decrease in bicarbonate ion concentration in seawater

Q.60	A sediment core of 4 cm diameter and 35.81 cm height was collected. This core had an initial weight of 1000.00 g and upon drying the sediment, the weight decreased by 133.75 g. This core has a void ratio of 0.42857, where void ratio is defined as the ratio of volume of void to the volume of solid (V_V/V_S). The average density of the sediment in the core is _____ g/cm^3. *(Round off to two decimal places)*
Q. 61	On a normal fault plane dipping 60° towards east, the measured heave and throw are 5 m and 12 m, respectively. If the strike-slip component of the fault is 13 m, the magnitude of true displacement of the fault is _____ m. *(Round off to one decimal place)*
Q.62	In the isochemical phase diagram shown below, the curved arrow represents the P-T path. The variance at peak metamorphism is _____  *(Answer in integer)*

Q.63

A 3×3 image (Image A) has been linearly stretched to get the maximum contrast in an 8-bit display system. Digital Number (DN) values of the pixels in Image A are shown. The value of the pixel marked as '?' in the output Image B after linear stretching is _____



(Answer in integer)

Q.64

^{230}Th and ^{226}Ra are intermediate nuclides in the decay series of ^{238}U to ^{206}Pb. The half-lives of ^{238}U, ^{230}Th, and ^{226}Ra are 4.47 billion years, 75,000 years, and 1600 years, respectively. At secular equilibrium, when activities are equal, 10 billion atoms of ^{238}U are present. The number of atoms of ^{226}Ra present at equilibrium is _____

(Answer in integer)

Q.65

The following table provides the mineral chemistry of a garnet. All oxides are in weight percentage and cations in atoms per formula unit. Total oxygen is taken as 12 based on the ideal garnet formula. Consider Fe as Fe^{total} and $Fe^{3+} = 0$. The X_{pyrope} of this garnet is _____

Oxides	Wt %	Cations	apfu
SiO_2	39.51	Si	2.998
TiO_2	0.05	Ti	0.003
Al_2O_3	22.35	Al	1.999
Cr_2O_3	0.00	Cr	0.000
FeO	26.25	Fe	1.666
MnO	0.00	Mn	0.000
MgO	10.80	Mg	1.221
CaO	1.40	Ca	0.114
Na_2O	0.00	Na	0.000
K_2O	0.00	K	0.000
Total	100.36	Total cation	8.001

(Round off to three decimal places and do not multiply by hundred)