

Question Paper
GG : JAM 2023

Section A: Q.1 – Q.10 Carry ONE mark each.

Q.1 Hollandite is an ore mineral of which one of the following elements?

- (A) Fe
- (B) Mn
- (C) Pt
- (D) Cr

Q.2 The transition from spinel to perovskite structure occurs between _____.

- (A) lower mantle and outer core
- (B) outer core and inner core
- (C) upper mantle and lower mantle
- (D) lower crust and upper mantle

Q.3 Which one of the following textures shows cuneiform-shape intergrowth between alkali feldspar and quartz?

- (A) Spherulite texture
- (B) Graphic texture
- (C) Porphyritic texture
- (D) Spinifex texture

Q.4 A pelitic rock consisting of cordierite + garnet + K-feldspar + sillimanite belongs to which one of the following metamorphic facies?

- (A) Granulite
- (B) Eclogite
- (C) Greenschist
- (D) Blueschist

Q.5 Which one of the following dams resists external forces by its own weight?

- (A) Earthen dam
- (B) Gravity dam
- (C) Storage dam
- (D) Detention dam

Q.6 Which one of the following minerals is NOT a framework silicate?

- (A) Feldspar
- (B) Zeolite
- (C) Chlorite
- (D) Quartz

Q.7 Crustal thickness is maximum at the _____.

- (A) ocean-ocean convergent plate boundary
- (B) ocean-continent convergent plate boundary
- (C) continent-continent convergent plate boundary
- (D) continent-continent divergent plate boundary

Q.8 Which one of the following causes sediment movement parallel to shoreline in the coastal area?

- (A) Longshore current
- (B) Rip current
- (C) Backwash
- (D) Edge wave

Q.9 Which one of the following dinosaur fossils is a theropod?

- (A) *Kotasaurus*
- (B) *Titanosaurus*
- (C) *Rajasaurus*
- (D) *Barapasaurus*

Q.10 Spiti Shale was deposited during the _____ time.

- (A) Palaeozoic
- (B) Mesozoic
- (C) Cenozoic
- (D) Proterozoic

Section A: Q.11 – Q.30 Carry TWO marks each.

Q.11 Which one of the following is a gently sloping ($< 10^\circ$) volcanic landform resulting from eruption of basaltic lava?

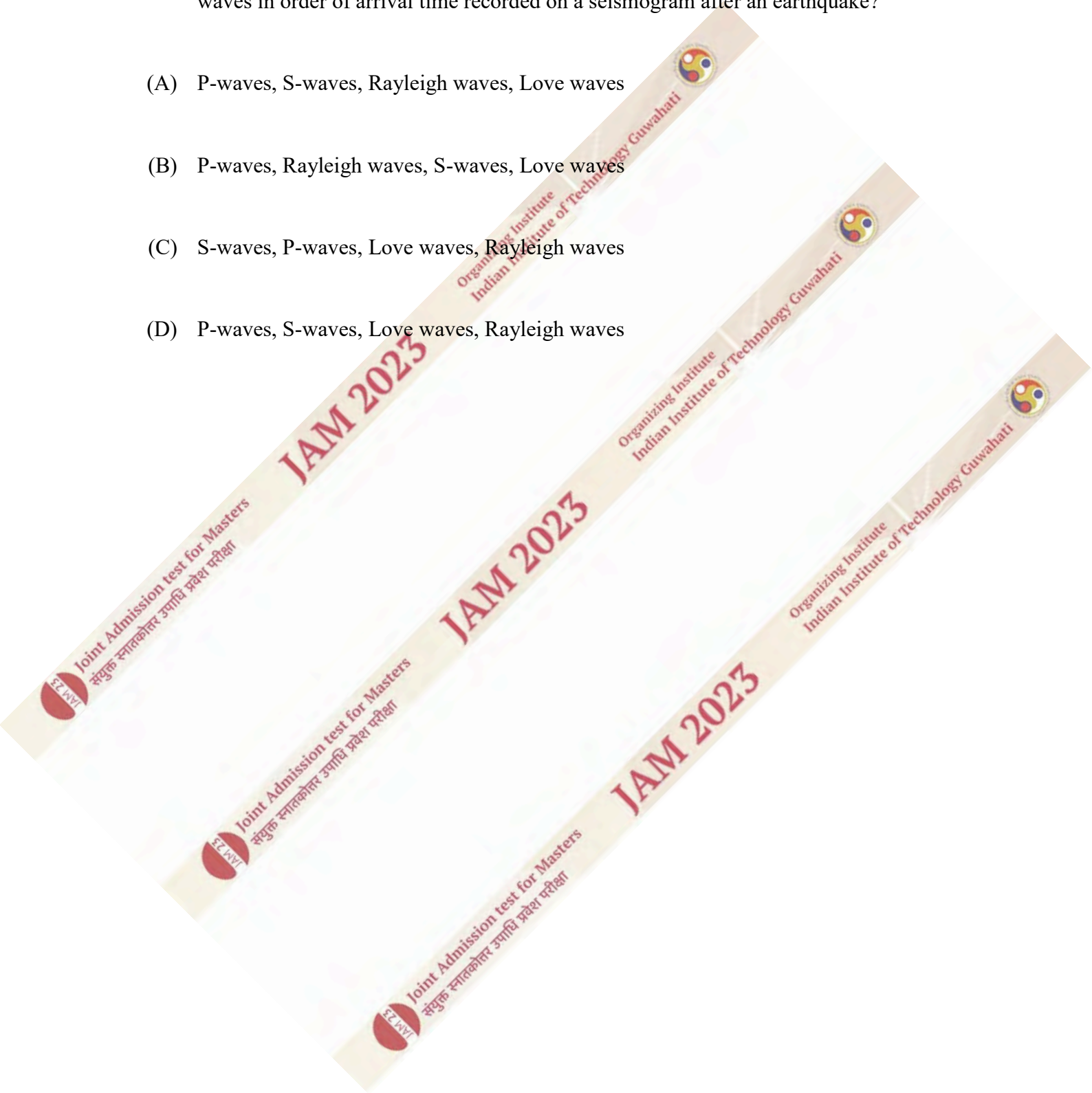
- (A) Shield volcano
- (B) Composite volcano
- (C) Lava dome
- (D) Caldera

Q.12 On the magnetic polarity time scale, the present day epoch/chron is called _____.

- (A) Matuyama
- (B) Gilbert
- (C) Gauss
- (D) Bruhnes

Q.13 Which one of the following options is the CORRECT sequence of seismic waves in order of arrival time recorded on a seismogram after an earthquake?

- (A) P-waves, S-waves, Rayleigh waves, Love waves
- (B) P-waves, Rayleigh waves, S-waves, Love waves
- (C) S-waves, P-waves, Love waves, Rayleigh waves
- (D) P-waves, S-waves, Love waves, Rayleigh waves



Q.14 Match the geomorphic agents in **Column-I** with their corresponding landforms in **Column-II**.

Column-I	Column-II
P. Wind	1. Backswamp
Q. Groundwater	2. Yardang
R. Glacier	3. Doline
S. River	4. Drumlin

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

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

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

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

Q.15 Which one of the following processes is NOT a mechanism for bedload sediment transport in a river channel?

- (A) Cavitation
- (B) Sliding
- (C) Rolling
- (D) Saltation

Q.16 Which one of the following relationships between the topographic contour value (t) and the stratum contour value (x) of a bed must be TRUE for an outcrop of the bed to occur on the topographic surface?

- (A) $t = x$
- (B) $t = 2x$
- (C) $t = 3x$
- (D) $t = 4x$

Q.17 As per Ramsay's classification of folds, the maximum thickening of fold hinge and the maximum thinning of the fold limbs are observed in _____.

- (A) Class 1A
- (B) Class 1B
- (C) Class 2
- (D) Class 3

Q.18 The number of hinge(s) in a monocline is _____.

- (A) 0
- (B) 1
- (C) 2
- (D) 3

Q.19 Which one of the following Gondwana flora is a seed?

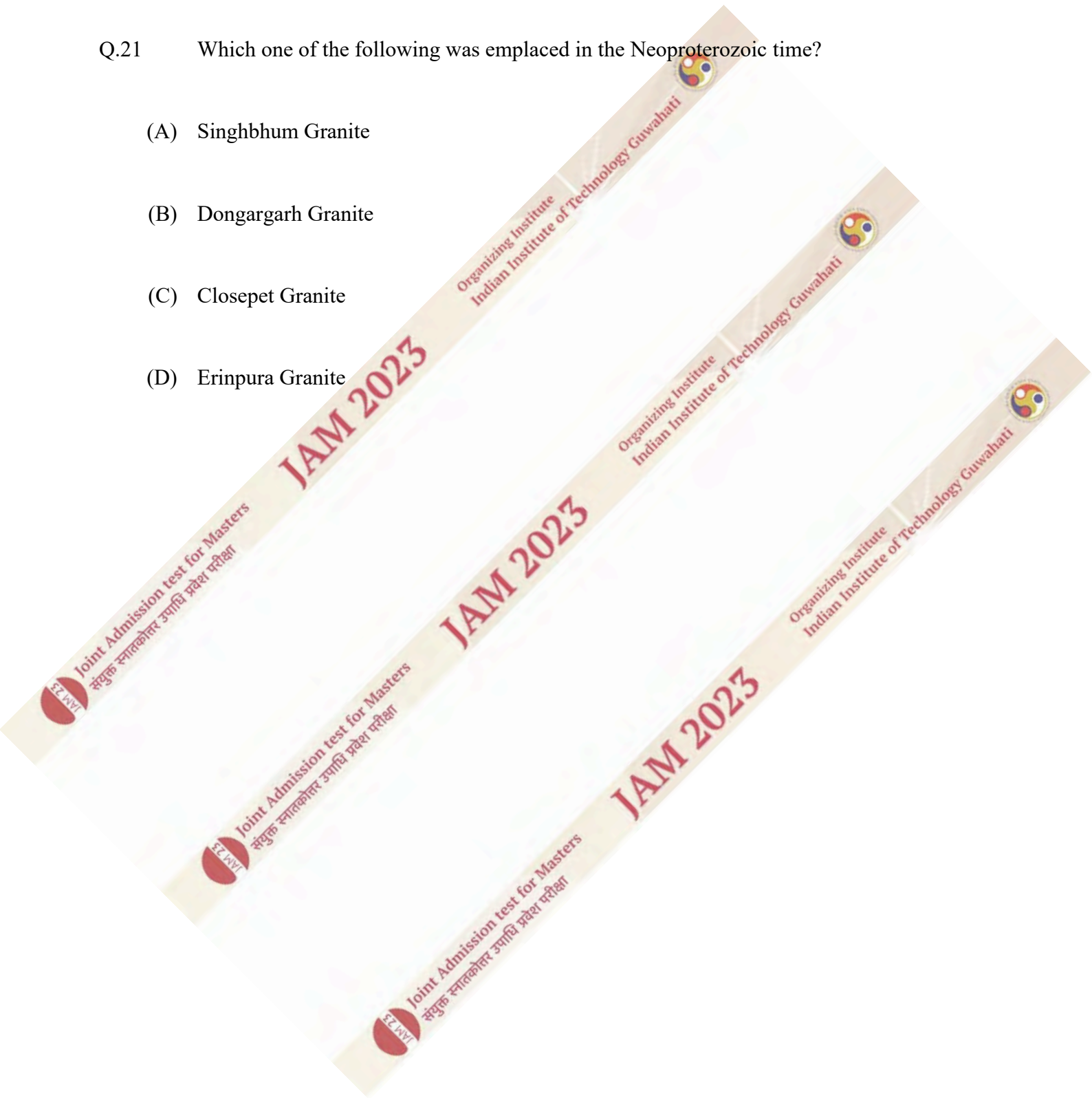
- (A) *Dadoxylon*
- (B) *Cordaicarpus*
- (C) *Taeniopteris*
- (D) *Palaeovittaria*

Q.20 Which one of the following gastropod genera displays sinistral coiling?

- (A) *Physa*
- (B) *Cypraea*
- (C) *Murex*
- (D) *Conus*

Q.21 Which one of the following was emplaced in the Neoproterozoic time?

- (A) Singhbhum Granite
- (B) Dongargarh Granite
- (C) Closepet Granite
- (D) Erinpura Granite



Q.22 Match the lithostratigraphic groups in **Column-I** with their corresponding formations in **Column-II**.

Column-I	Column-II
P. Papaghni Group	1. Kajrahat Formation
Q. Uttatur Group	2. Nagri Formation
R. Siwalik Group	3. Vempalle Formation
S. Semri Group	4. Karai Formation

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

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

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

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

Q.23 Which one of the following symmetry elements is an INCORRECT representation of rotoinversion operation?

(A) $1A_3 + \text{inversion centre} = \bar{3}$

(B) $1A_2 = \bar{4}$

(C) Mirror plane = $\bar{2}$

(D) $1A_3/m = \bar{6}$

Q.24 A plutonic igneous rock is composed of 50% orthopyroxene, 45% olivine and 5% clinopyroxene. What is the appropriate name of the rock according to the IUGS classification?

(A) Norite

(B) Wehrlite

(C) Troctolite

(D) Harzburgite

Q.25 Which one of the following is NOT a sediment-gravity flow?

- (A) Hypopycnal flow
- (B) Cohesive debris flow
- (C) Turbidity flow
- (D) Mud flow

Q.26 Which one among the following mineral pairs crystallise early during the cooling of a basaltic melt?

- (A) Forsterite and albite
- (B) Biotite and anorthite
- (C) Enstatite and bytownite
- (D) Forsterite and quartz

Q.27 Match the ore deposits in **Column-I** with their corresponding ores in **Column-II**.

Column-I	Column-II
P. Malanjkhand	1. Uranium ore
Q. Tummalapalle	2. Gold ore
R. Bhukia	3. Tin ore
S. Tosham	4. Copper ore

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

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

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

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

Q.28 Which one of the following statements is CORRECT?

- (A) Banded Iron Formations are of chemogenic origin
- (B) Porphyry-type deposits are formed purely by sedimentary processes
- (C) Quartz-Pebble Conglomerate hosted gold deposits are formed by supergene enrichment
- (D) Fullerene is formed by residual concentration process

Q.29 Which one of the following statements about the hydrological cycle is CORRECT?

- (A) Groundwater represents the largest share of fresh water on Earth
- (B) 'Precipitation rate greater than infiltration rate' is a necessary condition to generate surface runoff
- (C) All precipitation falling on the land finally ends up as groundwater
- (D) Groundwater flows in curved and concave-upward path

Q.30 Which one of the following mineral deposits is NOT related to the mining for energy production?

- (A) Narwapahar
- (B) Rampura-Agucha
- (C) Jaduguda
- (D) Turamdih

Section B: Q.31 – Q.40 Carry TWO marks each.

Q.31 At which of the following locations do lignite deposits occur in India?

- (A) Raniganj
- (B) Singrauli
- (C) Barmer
- (D) Neyveli

Q.32 Which of the following types of dunes form(s) primarily by uni-directional wind?

- (A) Linear dunes
- (B) Parabolic dunes
- (C) Barchan dunes
- (D) Star dunes

Q.33 The attitude of a fault plane was measured to be 350° , 75°E . The rake of the slickenline on the fault plane was found to be 90° . Which of the faults listed below satisfy(ies) these observations?

- (A) Dip-slip fault
- (B) Normal fault
- (C) Reverse fault
- (D) Strike-slip fault

Q.34 What type(s) of fossil remains is/are studied in ichnology?

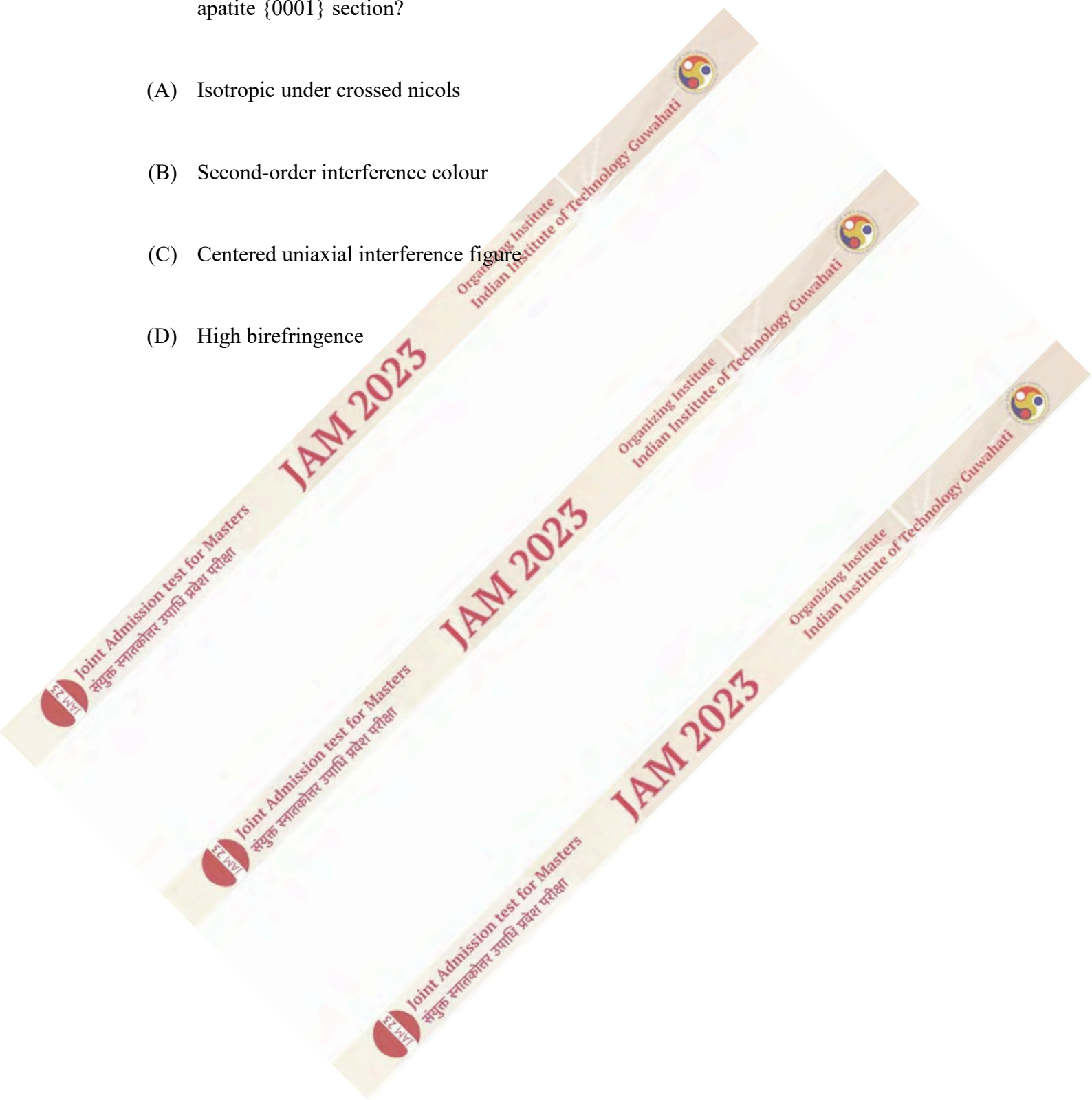
- (A) Fishes and amphibians
- (B) Spores and pollens
- (C) Tracks and trails
- (D) Burrows and bioturbation

Q.35 Which of the following combinations of Basin and Formation is/are CORRECT?

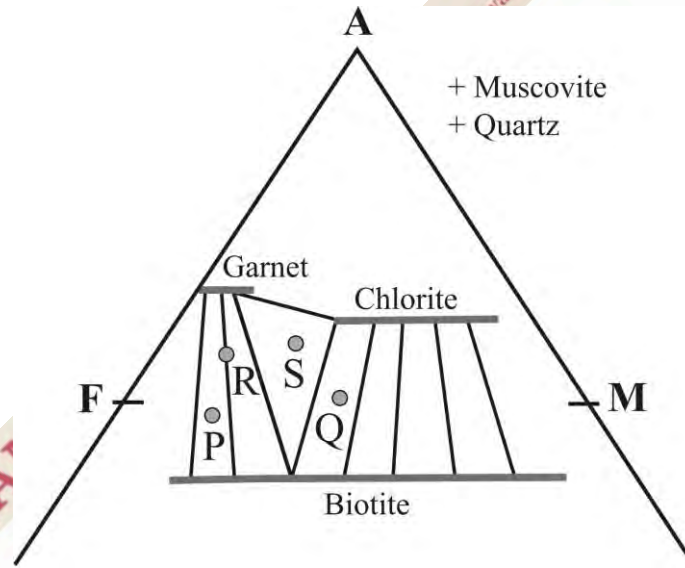
- (A) Cauvery Basin – Niniyur Formation
- (B) Assam Basin – Tipam Formation
- (C) Bengal Basin – Jalangi Formation
- (D) Kutch Basin – Dhok Pathan Formation

Q.36 Which of the following optical properties CORRECTLY identify(ies) the apatite {0001} section?

- (A) Isotropic under crossed nicols
- (B) Second-order interference colour
- (C) Centered uniaxial interference figure
- (D) High birefringence



Q.37 The AFM diagram given below shows stability of minerals in the garnet zone. If P, Q, R and S represent the compositions of different pelitic rocks, which of the following is/are characterised by the equilibrium assemblage of muscovite + garnet + biotite + quartz?



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

Q.38 Which of the following sedimentary structures is/are tool marks?

- (A) Bounce marks
- (B) Wrinkle marks
- (C) Prod marks
- (D) Skip marks

Q.39 Which of the following is/are NOT copper-bearing mineral(s)?

- (A) Bornite
- (B) Chalcocite
- (C) Braunite
- (D) Chrysocolla

Q.40 Which of the following is/are used to estimate the strength of a rock mass?

- (A) API gravity
- (B) Resistivity
- (C) Kriging
- (D) RQD

Section C: Q.41 – Q.50 Carry ONE mark each.

Q.41 The amplitude recorded at a station for a magnitude 5 earthquake is x . If another earthquake recorded at the same station has an amplitude of $15x$, then the magnitude of this earthquake is _____. (Round off to two decimal places)

Q.42 If the intercepts of crystallographic axes are $0.5a : 1b : 0.75c$ on a crystallographic plane $\{h k l\}$, the value of ' l ' is _____. (In integer)

Q.43 An ocean wave with a wavelength of 200 m approaches the coast. If water depth at the observation point is 75 m, the wave velocity is _____ m/s. (Round off to two decimal places) (Use $g = 10 \text{ m/s}^2$)

Q.44 A bed with an attitude $045^\circ, 20^\circ\text{SE}$ is rotated 60° clockwise (looking down) about a vertical axis. The strike value (in the azimuthal convention following right hand rule) of the rotated bed is _____ degrees. (*In integer*)

Q.45 A one-meter deep and sheet-like waterflow on a sandy beach developed antidunes. The minimum velocity of the waterflow was _____ m/s. (*Round off to two decimal places*) (Use $g = 10 \text{ m/s}^2$)

Q.46 If the angular aperture of a 20X objective is 46° , the numerical aperture of the water immersion objective is _____. (*Round off to two decimal places*) (Use RI of water = 1.33)

Q.47 A metamorphic rock is composed of grossular garnet ($\text{Ca}_3\text{Al}_2\text{Si}_3\text{O}_{12}$), kyanite (Al_2SiO_5), anorthite ($\text{CaAl}_2\text{Si}_2\text{O}_8$) and quartz (SiO_2). If these minerals show an univariant reaction relationship, the number of components in this assemblage is _____. (*In integer*)

Q.48 If the dip separation vector on a normal fault plane has an attitude $60^\circ \rightarrow 040^\circ$ and a magnitude of 6 m, the heave on the fault is _____ m. (*In integer*)

Q.49 A hillslope with an angle of 40° consists of soil having an internal friction angle of 30° . The factor of safety of the hillslope is _____.
(Round off to two decimal places)

Q.50 The water table over an area of 1 km^2 was lowered by 4 m. If the porosity of rock is 30% and the specific retention is 10%, the change in the groundwater storage is _____ $\times 10^3 \text{ m}^3$ (In integer)

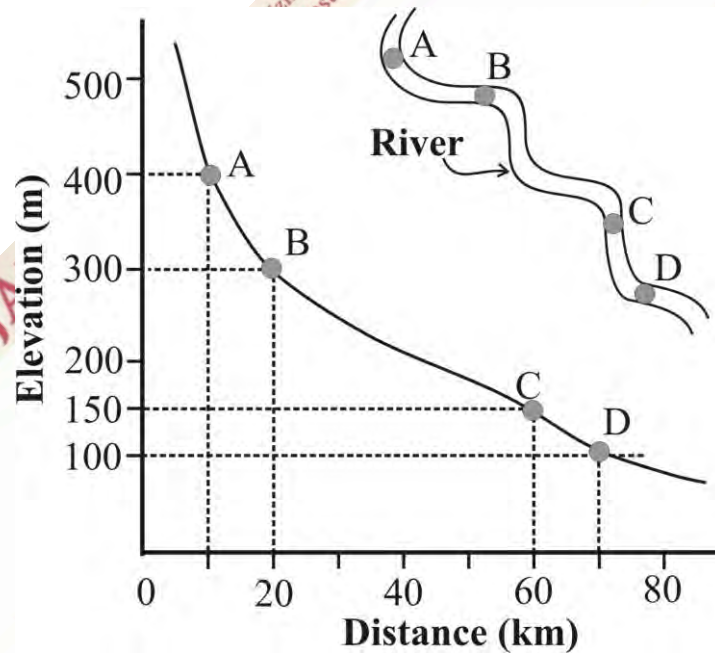
Section C: Q.51 – Q.60 Carry TWO marks each.

Q.51 The $\frac{^{143}\text{Nd}}{^{144}\text{Nd}}$ and $\frac{^{147}\text{Sm}}{^{144}\text{Nd}}$ ratios of a rock are 0.516 and 0.389, respectively. The rock evolved as a closed system. As per the exact parent-daughter relationship equation, the $\frac{^{143}\text{Nd}}{^{144}\text{Nd}}$ ratio of the rock 4.6×10^9 years ago was _____.
(Round off to three decimal places)
(Use decay constant for $^{147}\text{Sm} = 6.54 \times 10^{-12} \text{ y}^{-1}$)

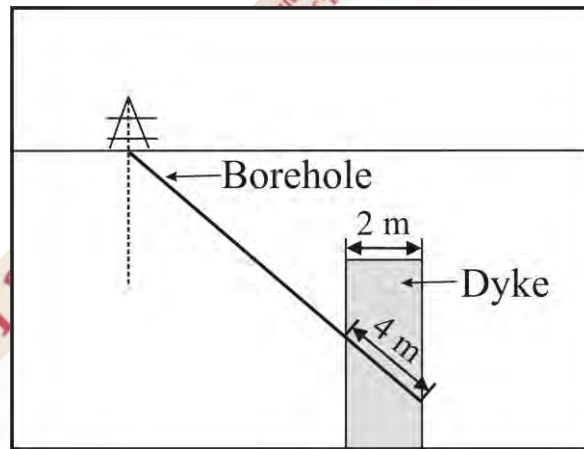
Q.52

A longitudinal profile of a river is shown in the figure below. If the average discharge of the river at reach AB is $200 \text{ m}^3/\text{s}$ and increases to $300 \text{ m}^3/\text{s}$ at reach CD, then the stream power from the reach AB to CD will change by a factor of _____ . (Round off to two decimal places)

(Use $g = 10 \text{ m/s}^2$, $\rho_{\text{water}} = 1000 \text{ kg/m}^3$)



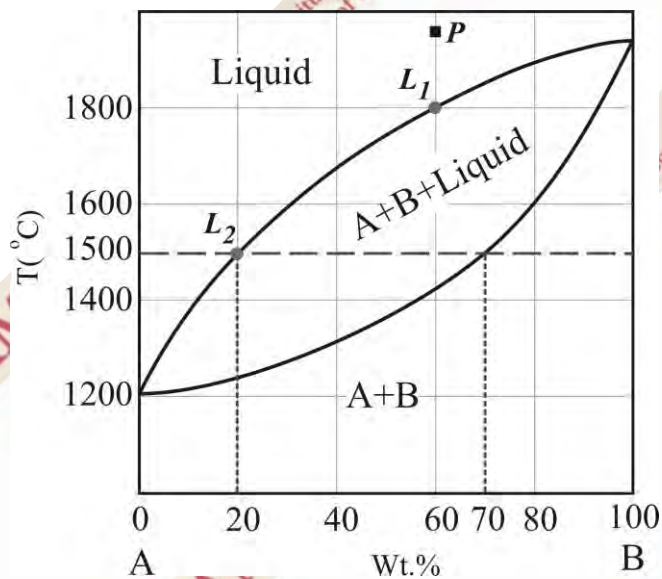
- Q.53 An underground vertical dyke is intercepted by an inclined borehole as shown in the figure below. The length of the dyke core intercepted by the borehole is 4 m. If the true thickness of the dyke is 2 m, the inclination of the borehole from the vertical is _____ degrees. (*In integer*)



- Q.54 A cylindrical copper ore body has a vertical thickness of 45 m and a diameter of 14 m with a density of 2.9 g/cm^3 . The reserve of the copper ore body is _____ tons. (*In integer*)

- Q.55 The density of a FCC unit cell is 6.5 g/cm^3 . If the mass of a single atom is 60 g/mol, the diagonal length of the face $\{100\}$ is _____ Å. (*Round off to two decimal places*) (Use $N_A = 6.022 \times 10^{23}$)

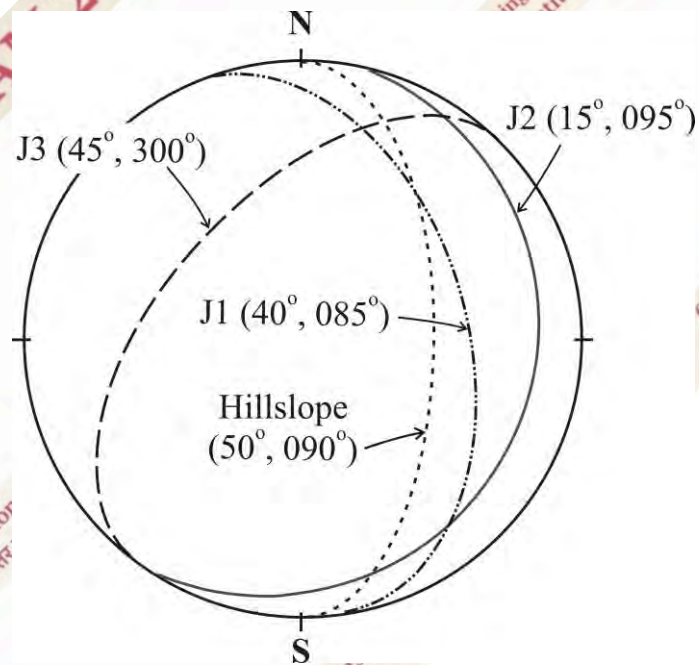
Q.56 The following figure shows an isobaric temperature-composition (T-X) phase diagram for the binary system A-B. If 'P' is the initial composition of liquid, the amount of liquid that remains in the system when the liquid cools from 1800 °C (point L_1) to 1500 °C (point L_2) is _____%. (In integer)



Q.57 A water flow transports spherical particles (diameter = 2 mm; density = 3 g/cm^3) in suspension mode. If additional particles of density 2 g/cm^3 are added into the flow, then the diameter of the particles that can be transported without a change in terminal fall velocity, using Stokes law, is _____ mm. (Round off to two decimal places) (Use density of water = 1 g/cm^3)

Q.58 If an iron ore body contains 50% hematite (Fe_2O_3) and 50% magnetite (Fe_3O_4), then the grade of the iron ore body is _____%. (Round off to two decimal places) (Use atomic weight of Fe = 55.85 amu and O = 16 amu).

Q.59 The schematic stereographic projection below shows dip amount and dip direction of three sets of joints (J1, J2 and J3) on a hillslope. If the internal friction angle of the hillslope material is 30° , the strike of the potential failure joint plane (in azimuthal convention following right hand rule) is _____ degrees. (In integer)



Q.60 The hydraulic conductivity of a 100 cm long cylindrical core is estimated as 1.2 cm/min when hydraulic head difference is 20 cm in an experimental setup. If the effective porosity of the core is 20%, then, assuming steady state Darcy flow, the average interstitial velocity of groundwater through the core is _____ m/day. (Round off to two decimal places)

