IIT JAM 2021 Geology (GG) Question Paper

Time Allowed :3 Hours	**Maximum Marks :**100	**Total questions :**60

General Instructions

General Instructions:

i) All questions are compulsory. Marks allotted to each question are indicated in the margin.

ii) Answers must be precise and to the point.

iii) In numerical questions, all steps of calculation should be shown clearly.

iv) Use of non-programmable scientific calculators is permitted.

v) Wherever necessary, write balanced chemical equations with proper symbols and units.

vi) Rough work should be done only in the space provided in the question paper.

1. Among the following rocks, the one with highest metamorphic grade is

(A) chlorite schist

(B) glaucophane schist

(C) phyllite

(D) gneiss

---

2. The Earth's radius is maximum at which one of the following latitudes?

(A) 0°

(B) 40° N

(C) 60° S

(D) 90°

---

3. The closest value to the percentage of the Earth's surface covered by the oceans is

(A) 30%

(B) 50%

(C) 70%

(D) 90%

---

4. Which is the shallowest among the marine environments listed below?

(A) Neritic

(B) Littoral

(C) Abyssal

(D) Bathyal

---

5. Among the following, the tungsten-bearing mineral is

(A) bornite

(B) cassiterite

(C) scheelite

(D) greenockite

---

6. The host rock of Pb-Zn deposit at Zawar is

(A) quartzite

(B) phyllite

(C) dolomite

(D) gneiss

---

7. Bituminous coal deposits in India occur in which one of the following formations?

(A) Barren Measures Formation

(B) Barakar Formation

(C) Naredi Formation

(D) Cuddalore Formation

---

8. Identify the plant fossil from the following list.

(A) Glossopteris

(B) Fenestella

(C) Productus

(D) Cidaris

---

9. The igneous body with dome or mushroom-like shape is known as a

(A) lopolith

(B) ring dike

(C) sill

(D) laccolith

---

10. Which one of the following stratigraphic units belongs to the Cretaceous?

(A) Lameta Formation

(B) Talchir Boulder Bed

(C) *Fenestella* Shale

(D) Kasauli Formation

---

11. Select the youngest volcanic event out of the following.

(A) Rajmahal volcanics

(B) Dalma volcanics

(C) Panjal volcanics

(D) Deccan volcanics

---

12. Which among the following is the only possible plunge for a lineation located on the foliation plane striking 20° N and dipping 40° southeasterly?

(A) 20° SE

(B) 20° NW

(C) 45° SE

(D) 40° NW

---

13. Which one of the following tectonic plates has the maximum average velocity?

(A) Eurasian

(B) Pacific

(C) African

(D) North American

---

14. A limestone contains lime mud and around 25% allochems, which are separated from each other. The name of the rock as per Dunham's classification is

(A) mudstone

(B) wackestone

(C) packstone

(D) grainstone

---

15. Find the CORRECT statement out of the following.

(A) Convolute laminae form by desiccation.

(B) Load cast is an erosional structure.

(C) Prod mark is found at the bottom of a bed.

(D) Wave ripple occurs at the top of a turbidite deposit.

---

16. Which one of the following crystal forms DOES NOT belong to the di-tetragonal pyramidal class?

(A) c-Pedion

(B) Prism of 1^{st} order

(C) Di-tetragonal prism

(D) Tetragonal dipyramid

---

17. If a coarse-grained igneous rock is composed of ¿90% of plagioclase and ¡10% of olivine and pyroxene, then the name of this rock according to the IUGS classification is

(A) anorthosite

(B) olivine gabbro

(C) tonalite

(D) olivine websterite

---

18. Which one of the following represents the compositional change in plagioclase during the crystallization of mafic magma?

(A) Na/Ca ratio decreases; Al/Si ratio increases

(B) Both Na/Ca and Al/Si ratios increase

(C) Na/Ca ratio increases; Al/Si ratio decreases

(D) Both Na/Ca and Al/Si ratios decrease

---

19. Choose the CORRECT sequence of older to younger formations in the stratigraphy of the Cuddapah Supergroup.

(A) Pulivendla–Gulcheru–Vempalle–Tadpatri

(B) Gulcheru–Vempalle–Pulivendla–Tadpatri

(C) Gulcheru–Pulivendla–Tadpatri–Vempalle

(D) Vempalle–Gulcheru–Tadpatri–Pulivendla

---

20. Match the economic deposits (Group I) with their places of occurrence (Group II).

Group I	**Group II**
P. Iron ore	1. Bhatan
Q. Base metal	2. Sukinda
R. Chromite	3. Rampura–Agucha
S. Uranium	4. Bellary

(A) P–4, Q–1, R–2, S–3

(B) P–2, Q–4, R–3, S–1

(C) P–2, Q–3, R–1, S–4

(D) P–4, Q–3, R–2, S–1

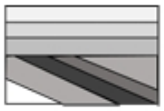
---

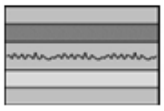
21. Select the answer that is a CORRECT match for the three types of unconformities. (Grey bands = sediments, [+] = igneous rock).

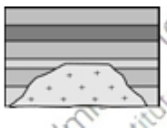
P. Disconformity 1.

Q. Non-conformity 2.

R. Angular Unconformity 3.







(A) P–2; Q–3; R–1

(B) P–2; Q–1; R–3

(C) P–1; Q–3; R–2

(D) P–3; Q–2; R–1

---

22. Which one of the following statements is FALSE?

(A) Ammonites have fluted septa.

(B) Brachiopods have a pedicle.

(C) Echinods have genal spines.

(D) Trilobites have a pygidium.

---

23. In the context of phylogeny of horses, the CORRECT chronological order from old to young is

(A) *Hyracotherium, Mesohippus, Merychippus, Equus*

(B) *Hyracotherium, Merychippus, Mesohippus, Equus*

(C) *Equus, Merychippus, Mesohippus, Hyracotherium*

(D) *Merychippus, Equus, Mesohippus, Hyracotherium*

---

24. Choose the CORRECT match between items in Group I with the items in Group II.

Group I	**Group II**
P. Polarity zone	1. Biostratigraphy
Q. Formation	2. Chronostratigraphy
R. Biozone	3. Magnetostratigraphy
S. Epoch	4. Lithostratigraphy

(A) P–1; Q–2; R–3; S–4

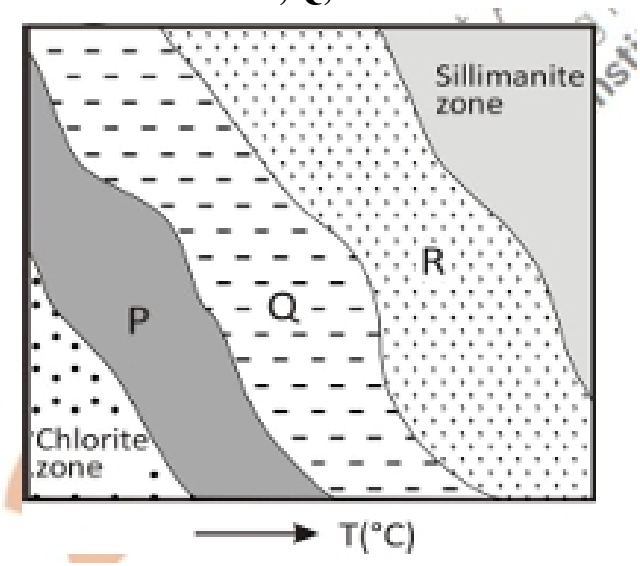
(B) P–2; Q–3; R–1; S–4

(C) P–3; Q–4; R–1; S–2

(D) P–3; Q–4; R–2; S–1

---

25. The following diagram represents the prograde sequence of metamorphic zones that develop during Buchan-type of metamorphism (¡4 kbar) of typical pelites. Identify the zones labelled P, Q, and R.



(A) P – Biotite zone; Q – Garnet zone; R – Kyanite zone

(B) P – Garnet zone; Q – Kyanite zone; R – Staurolite zone

(C) P – Biotite zone; Q – Cordierite zone; R – Andalusite zone

(D) P – Andalusite zone; Q – Biotite zone; R – Cordierite zone

---

26. Match the minerals in Group I with the corresponding composition in Group II.

Group I	**Group II**
P. Leucite	1. $(K,Na)AlSi_3O_8$
Q. Andradite	2. $NaAlSi_2O_6$
R. Sanidine	3. $KAlSi_2O_6$
S. Jadeite	4. $Ca_3Fe_2Si_3O_{12}$

(A) P–3; Q–1; R–4; S–2

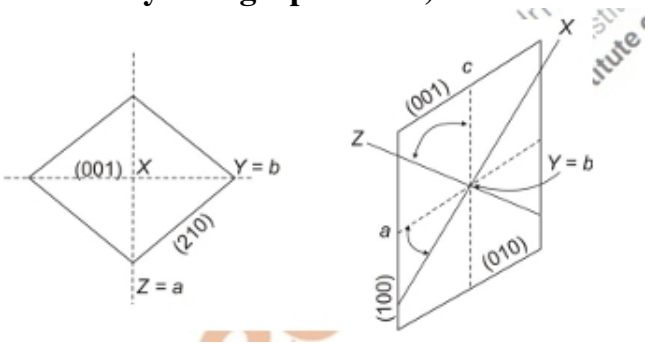
(B) P–2; Q–3; R–1; S–4

(C) P–1; Q–4; R–2; S–3

(D) P–3; Q–4; R–1; S–2

---

27. Choose the CORRECT pair of crystal systems that represents the optic orientation shown in the figure. (X, Y, Z are the principal optical vibration directions and a, b, c are the crystallographic axes).



(A) Orthorhombic – Triclinic

(B) Orthorhombic – Monoclinic

(C) Cubic – Hexagonal

(D) Tetragonal – Monoclinic

---

28. Match the environment representing physical geological processes in Group I with the corresponding geomorphic landform/feature in Group II.

Group I	**Group II**
P. Aeolian	1. Drumlin
Q. Glacial	2. Tombolo
R. Fluvial	3. Yardang
S. Coastal	4. Natural levee

(A) P–2; Q–1; R–4; S–3

(B) P–2; Q–4; R–1; S–3

(C) P–3; Q–1; R–4; S–2

(D) P–3; Q–4; R–1; S–2

---

29. Match the items in Group I with the corresponding items in Group II.

Group I	**Group II**
P. Chalcocite	1. Supergene enrichment
Q. Bauxite	2. Mechanical accumulation
R. Monazite placers	3. Magmatic crystallization
S. Chromite	4. Residual processes

(A) P–1; Q–4; R–2; S–3

(B) P–2; Q–3; R–4; S–1

(C) P–2; Q–4; R–1; S–3

(D) P–1; Q–3; R–2; S–4

---

30. Which one of the following statements is FALSE?

(A) Perched water table exists within the zone of aeration.

(B) Juvenile water is derived from sediment diagenesis.

(C) Zone of aeration lies above the zone of saturation.

(D) Both aquiclude and aquifuge are impermeable.

---

31. Fossils from which of the following invertebrate classes show pentameral symmetry?

(A) Echinoidea

(B) Anthozoa

(C) Cephalopoda

(D) Trilobita

---

32. The attitude of the two limbs of a fold was measured as striking 4° N, dipping 85° easterly and striking 30° N, dipping 60° easterly. Which of the following is/are TRUE for describing the geometry of the fold?

(A) Synform

(B) Antiform

(C) Overturned

(D) Plunging

---

33. Which of the following statement(s) is/are CORRECT regarding ophitic texture?

(A) Plagioclase laths are completely enclosed by large pyroxene crystals.

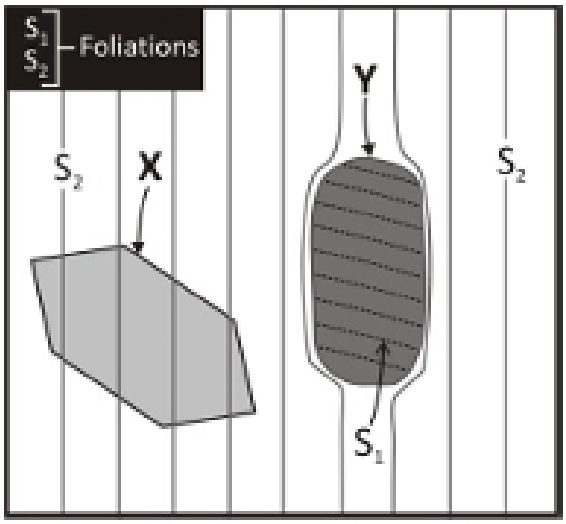
(B) Intergrowth occurs between quartz and alkali-feldspar.

(C) It is a variety of poikilitic texture.

(D) It is a texture observed in peridotite.

---

34. On the basis of the following schematic diagram, choose the CORRECT statement(s).



(A) Minerals X and Y predate matrix foliation (S_2).

(B) Mineral X grew after the development of matrix foliation (S_2).

(C) Mineral Y grew during or after the development of internal foliation (S_1).

(D) Minerals X and Y postdate matrix foliation (S_2).

---

35. A marine organic-rich, black shale with tiny pyrite crystals shows complete absence of body or trace fossils. Which of the following statement(s) is/are TRUE?

(A) The sediments were deposited in low-energy conditions.

(B) The deposition took place in dysoxic to anoxic conditions.

(C) The rate of sedimentation was high.

(D) The environment was stressful for survival of living organisms.

---

36. Which mineral(s) among the following represent(s) AB_2O_4 composition?

(A) Spinel

(B) Magnetite

(C) Chromite

(D) Ilmenite

37. Which among the following statement(s) is/are TRUE?

(A) Attrition is more dominant in aeolian than in glacial environment.
(B) Centrifugal force drives the sediment-laden water outward when the river channel meanders.
(C) U-shaped valley is a common fluvial geomorphic feature.
(D) The downstream water velocity in a river channel increases upward from the channel bed towards the water surface.

---

38. Which of the following statement(s) regarding hydrocarbon occurrence is/are CORRECT?

(A) Gandhar field is in Cambay basin.
(B) Oil and gas occur in Mesozoic reservoir rocks in Bombay High field.
(C) Digboi field is in Assam basin.
(D) Hydrocarbon occurs in limestone reservoir in Ankleshwar field.

---

39. Following are the statements regarding types of sandstone as per Pettijohn's classification. Which is/are the CORRECT statement(s) out of the following?

(A) Arkose contains more than 25% feldspar.
(B) Greywacke contains more than 90% matrix.
(C) Litharenite contains more than 25% lithic fragment.
(D) Quartz arenite contains more than 95% quartz.

---

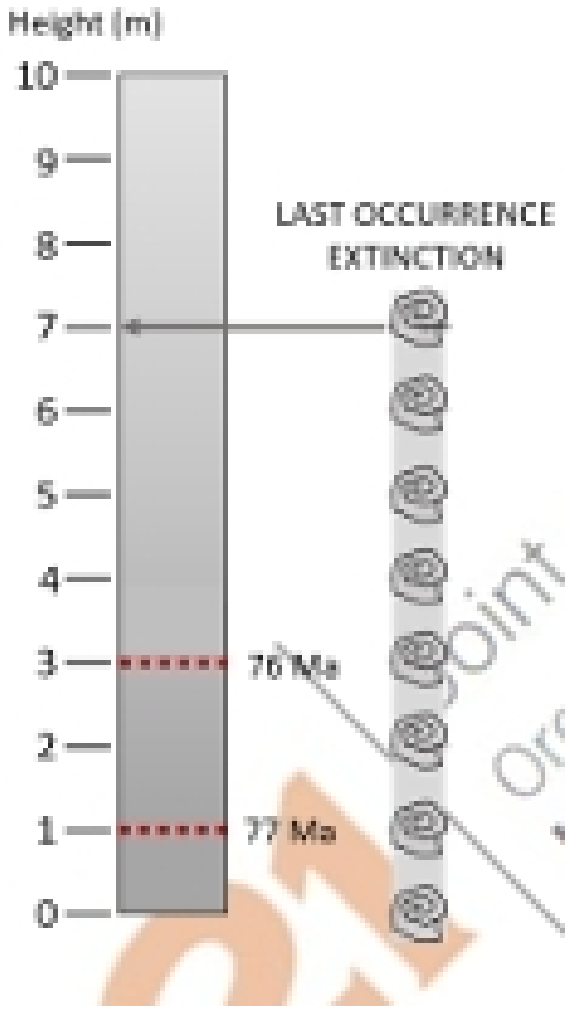
40. Choose the CORRECT statement(s) out of the following.

(A) Shoreline shifts landward during transgression.
(B) Shoreline shifts seaward during transgression.
(C) Delta deposits preserve the record of transgression.

(D) Incised river valley forms because of transgression.

---

41. The given section with uniform lithology and sedimentation rate records two ash layers dated at 77 Ma and 76 Ma, respectively. An index fossil species present in the lower part of the section becomes extinct at a horizon 7 m above the base. The estimated age of the extinction event is _____ Ma. (Answer in integer.)

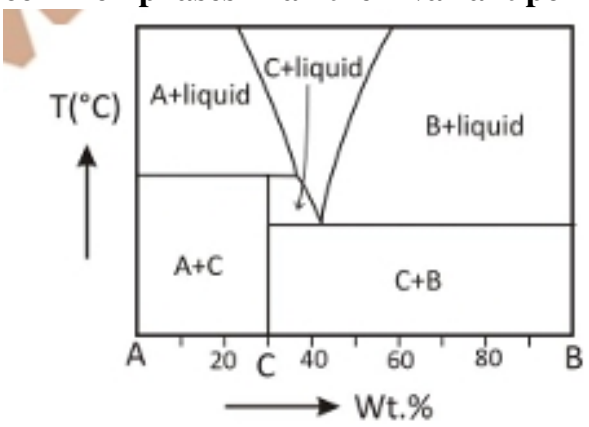


---

42. A hollow discoid (cylindrical) microfossil has an outer diameter of 20 μm, height 10 μm and wall thickness 1 μm. The internal volume that can be occupied by the organism is _____ μm^3. (Use = 3.14) (Round off to one decimal place.)

---

43. In the following isobaric temperature–composition diagram, the number of common phases in all the invariant points is _____ (Answer in integer).



---

44. A muscovite has the following composition in which iron is ferrous. The amount of 'Al' in the tetrahedral site is _____ (per formula unit). (Round off to two decimal places.)

Muscovite composition: $KAl_{2.50}Fe_{0.25}Si_{3.25}O_{10}(OH)_2$

---

45. The density of a 200 g gabbro sample, cut in the form of a cube, is 3125 kg/m^3. The length of the sample is _____ mm. (Answer in integer.)

---

46. A drill run of 3 m was carried out in a coalfield site, where rock core samples were recovered only for a cumulative length of 255 cm. The core loss in percentage is equal to _____. (Answer in integer.)

---

47. During concretionary growth of a spherical grain of radius 2 Å, the rate of change of surface area with respect to change in radius of the grain is _____ $\times 10^{-8}$ cm. (Use π = 3.14) (Round off to two decimal places.)

---

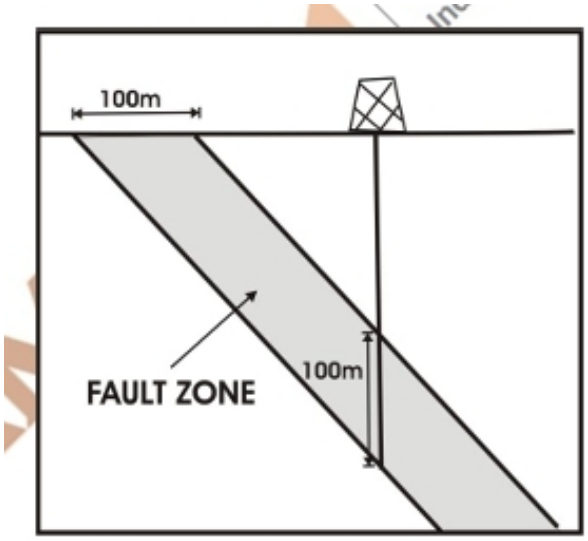
48. The weight loss during the conversion of 1 mole of gypsum to anhydrite is _____. (Atomic weights: Ca = 40.0, S = 32.0, O = 16.0, H = 1.0) (Round off to two decimal places.)

---

49. A bed with an attitude 020°, 30° NW is rotated 55° counter-clockwise (looking northerly) along its strike line. The dip of the bed after rotation will be _____° NW. (Answer in integer.)

---

50. The width of the outcrop of a fault zone on a flat surface is 100 m. A vertical borehole through the fault zone measured its vertical thickness to be 80 m. The true thickness of the fault zone is _____ m. (Round off to two decimal places.)



---

51. In an oblique slip fault with an attitude 000°, 30° E, the net slip vector has a length of 20 m and a rake of 30° S on the fault plane. The displacement of a horizontal bed along the fault trace in a plane perpendicular to the strike of the fault is _____ m. (Answer in integer.)

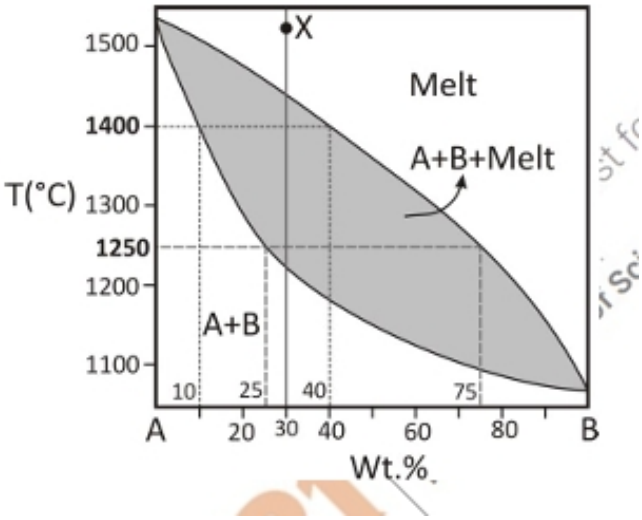
---

52. If the activity of a radioactive mineral falls from 800 counts/s to 500 counts/s in 80 minutes, the half-life of the mineral is _____ minutes. (Round off to two decimal places.)

53. In a laboratory experiment, water discharge through a porous rock sample in 2 hours was 10 cm^3. The cylindrical rock sample is 10 cm long and has a diameter of 50 mm. If the discharge occurred at a constant head of 300 cm, the coefficient of permeability of the rock sample is _____ $\times 10^{-6}$ cm/s. (Round off to two decimal places.)

---

54. The following diagram represents a binary phase diagram for the system A–B at atmospheric pressure. If 'X' is the initial composition of melt, then the amount of melt that converts to solid when the magma cools from 1400 °C to 1250 °C is _____ %. (Round off to two decimal places.)



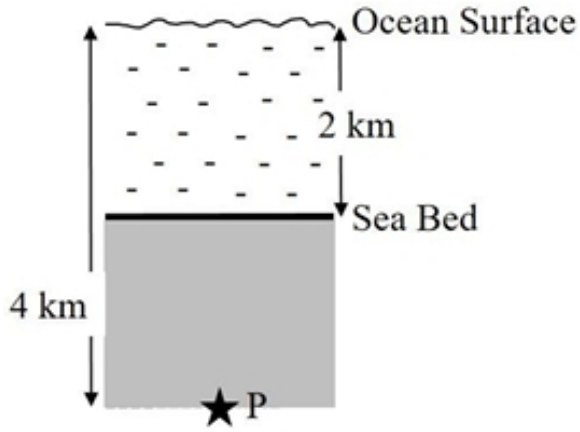
---

55. The following table shows modal abundance and mineral composition data of a plutonic igneous rock. The amount of SiO_2 in bulk composition of the rock is _____ %. (Round off to two decimal places.)

Mineral	Mode (%)	SiO_2 (wt%)	CaO (wt%)
Olivine	45	34	0
Clinopyroxene	35	55	25
Orthopyroxene	20	58	8

---

56. Refer to the schematic sketch given (not to scale). Assume average saturated density of oceanic crustal rocks = 3200 kg/m^3, density of ocean water = 1000 kg/m^3, and acceleration due to gravity = 10 m/s^2. The overburden pressure at a point (P) located 2 km below seabed and 4 km below the ocean surface is _____ MPa. (Answer in integer.)



---

57. If the indices of refraction of a uniaxial section are $\epsilon = 1.653$ and $\omega = 1.544$, and the retardation between the two rays is 550 nm, then the thickness of the section is _____ µm. (Round off to two decimal places.)

---

58. A crystal has lattice parameters of $a = 4.26$ Å, $b = 10.0$ Å and $c = 3.44$ Å, respectively. A plane intercepts on the a, b, c axes at 2.13 Å, 10 Å and 1.72 Å, respectively. The Miller Indices for the plane, written as an integer, is _____. (Answer in integer.)

---

59. In the uvarovite garnet ($Ca_3Cr_2Si_3O_{12}$), Ca is in cubic coordination, Cr is in octahedral coordination, and Si is in tetrahedral coordination. The electrostatic bond strength of the Ca^{2+} central ion is _____. (Round off to two decimal places.)

---

60. In a structurally controlled fluvial setting, an asymmetric flight of river terraces T1, T2, and T3 shown in the figure was sampled at location L1. The age of the sample at L1 was 30 ka (kiloyears). Assuming that the terraces were formed entirely due to

deformation-related uplift, the average uplift rate in the past 30 ka in the region was _____ mm/yr. (Answer in integer.)