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IIT-JAM Geology (GG)

Previous Year Solved Paper (PSP)

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GEOLOGY (GG)

Previous Year Solved Paper 2018

Duration : 180 minutes

Maximum Marks : 100

Read the following instructions carefully.

1. This test paper has a total of 60 questions carrying 100 marks. The entire question paper is divided into **Three Sections A, B and C**. All sections are compulsory. Questions in each section are of different types.
2. **Section – A** contains a total of 30 **Multiple Choice Questions (MCQ)**. Each MCQ type question has four choices out of which only **one** choice is the correct answer. Questions Q.1 – Q.30 belong to this section and carry a total of 50 marks. Q.1 – Q.10 carry 1 mark each and Questions Q.11 – Q.30 carry 2 marks each.
3. **Section – B** contains a total of 10 **Multiple Select Questions (MSQ)**. Each MSQ type question is similar to MCQ but with a difference that there may be one or more than one choice(s) that are correct out of the four given choices. The candidate gets full credit if he/she selects all the correct answers only and no wrong answers. Questions Q.31 – Q.40 belong to this section and carry 2 marks each with a total of 20 marks.
4. **Section – C** contains a total of 20 **Numerical Answer Type (NAT)** questions. For these NAT type questions, the answer is a real number which needs to be entered using the virtual keyboard on the monitor. No choices will be shown for these type of questions. Questions Q.41 – Q.60 belong to this section and carry a total of 30 marks. Q.41 – Q.50 carry 1 mark each and Questions Q.51 – Q.60 carry 2 marks each.
5. In all sections, questions not attempted will result in zero mark. In **Section – A (MCQ)**, wrong answer will result in **NEGATIVE** marks. For all 1 mark questions, 1/3 marks will be deducted for each wrong answer. For all 2 marks questions, 2/3 marks will be deducted for each wrong answer. In **Section – B (MSQ)**, there is **NO NEGATIVE** and **NO PARTIAL** marking provisions. There is **NO NEGATIVE** marking in **Section – C (NAT)** as well.

SECTION-(A) MULTIPLE CHOICE QUESTIONS (MCQ)

Q.1 to Q.10 carry one mark each.

1. Which one among the following planets in the Solar system is most similar in size to the Earth?

(A) Mercury	(B) Venus
(C) Neptune	(D) Uranus

2. In which one of the following tectonic settings are the highest mountain chains and thickest crust found ?

(A) Island arc	(B) Continental arc
(C) Continental collision	(D) Transcurrent

3. The second-most abundant oxide in the Earth's crust is

(A) Al_2O_3	(B) SiO_2
(C) CaO	(D) Na_2O

4. The type of dentition found in *Trigonia* is

(A) schizodont	(B) taxodont
(C) pachyodont	(D) isodont

5. Which one of the following minerals has isolated $(SiO_4)^{4-}$ tetrahedra linked by divalent cations in octahedral coordination ?

(A) Muscovite	(B) Quartz
(C) Beryl	(D) Olivine

6. Which one of the following is NOT found in an extensional setting ?

(A) Normal faults	(B) Horsts
(C) Rifts	(D) Thrust faults

7. The texture characterized by exsolved lamellae of albite in K-feldspar is known as

(A) myrmekite	(B) graphic
(C) perthite	(D) antiperthite

8. Fissility is best shown by

(A) sandstone	(B) siltstone
(C) shale	(D) limestone

9. Petroleum is NOT commercially produced from

(A) Krishna–Godavari basin	(B) Cauvery–Palar basin
(C) Cambay basin	(D) Vindhyan basin

10. Among the following, the mineral showing acicular habit is

(A) kyanite	(B) tourmaline
(C) biotite	(D) sillimanite

Q.11 to Q.30 carry two mark each.

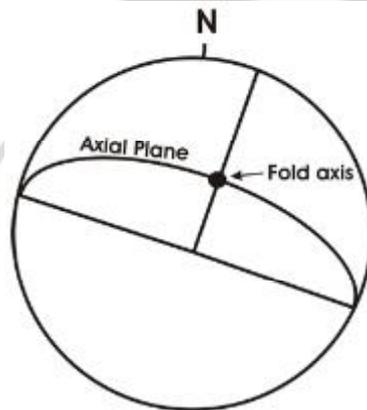
11. Isostasy involves _____ continental mountain belts.
 (A) compensation in (B) creation of
 (C) destruction of (D) thrusting in
12. Identify the pair from the following list that is NOT correctly matched.
 (A) Caldera – stratovolcano
 (B) Pillow basalt – subaerial eruption
 (C) Ropy lava – pahoehoe flow
 (D) Amygdales – filled vesicles
13. Wilson orogenic cycle in continents is initiated by
 (A) collision (B) rifting
 (C) drifting (D) subduction
14. Match the processes in Group I with corresponding geomorphic features in Group II.

Group-I		Group-II	
P. Dissolution		1. Mushroom rocks	
Q. Abrasion		2. Exfoliation domes	
R. Deposition		3. Sinkholes	
S. Onion skin weathering		4. Moraines	

Codes :

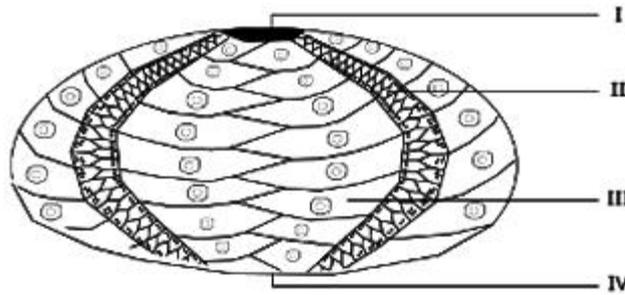
	P	Q	R	S
(A)	1	3	2	4
(B)	3	1	2	4
(C)	3	1	4	2
(D)	2	1	4	3

15. The orientations of the fold axis and axial plane in the given figure indicate



- (A) reclined fold (B) vertical fold
 (C) recumbent fold (D) horizontal fold

16. Identify the correct morphological features corresponding to numbers I – IV in the echinoid illustrated below :



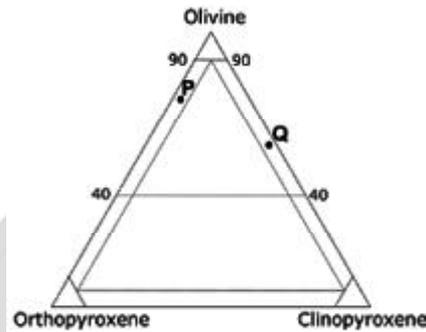
- (A) I-Periproct II-Ambulacra III-Interambulacra IV-Peristome
 (B) I-Periproct II-Interambulacra III-Ambulacra IV-Peristome
 (C) I-Peristome II-Interambulacra III-Ambulacra IV-Periproct
 (D) I-Peristome II-Ambulacra III-Interambulacra IV-Periproct
17. The correct order of marine benthic habitats with increasing water depths is
 (A) abyssal, bathyal, neritic (B) neritic, abyssal, bathyal
 (C) neritic, bathyal, abyssal (D) bathyal, abyssal, neritic
18. Which one of the following invertebrates has the most primitive visual system ?
 (A) Ammonites (B) Brachiopods
 (C) Gastropods (D) Trilobites
19. The correct chronological sequence (older to younger) of the Precambrian stratigraphic units listed below is
 (A) Sargur Group, Chitradurga Group, Alwar Group, Kaimur Group
 (B) Chitradurga Group, Sargur Group, Kaimur Group, Alwar Group
 (C) Sargur Group, Alwar Group, Chitradurga Group, Kaimur Group
 (D) Sargur Group, Chitradurga Group, Kaimur Group, Alwar Group
20. Match the Formations in Group I with corresponding characteristic fossils in Group II.

Group-I		Group-II	
P. Barakar Formation		1. Stegodon	
Q. Uttatur Formation		2. Sauropoda	
R. Dhok Pathan Formation		3. Belemnites	
S. Lameta Formation		4. Glossopteris	

Codes :

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

21. Which one of the following sedimentary structures is NOT used for determining top and bottom of beds ?
- (A) Mud cracks (B) Load and flame structures
(C) Sharp-crested wave ripples (D) Plane lamination
22. Identify the rocks P and Q in the diagram as per the IUGS classification.



- (A) P – Websterite, Q – Wehrlite (B) P – Dunite, Q – Websterite
(C) P – Websterite, Q – Dunite (D) P – Harzburgite, Q – Wehrlite
23. Which one of the following is produced by a closed-system metamorphic reaction between muscovite and quartz ?
- (A) orthoclase + sillimanite (B) orthoclase + biotite
(C) plagioclase + biotite (D) plagioclase + sillimanite
24. The assemblage staurolite + garnet + biotite + muscovite + quartz in pelites is stable in
- (A) greenschist facies (B) amphibolite facies
(C) granulite facies (D) pyroxene hornfels facies
25. Conglomerates are commonly deposited in
- (A) aeolian dunes (B) tidal flats
(C) alluvial fans (D) river flood plains
26. Match the mineral deposits in Group I with corresponding Indian occurrences in Group II.

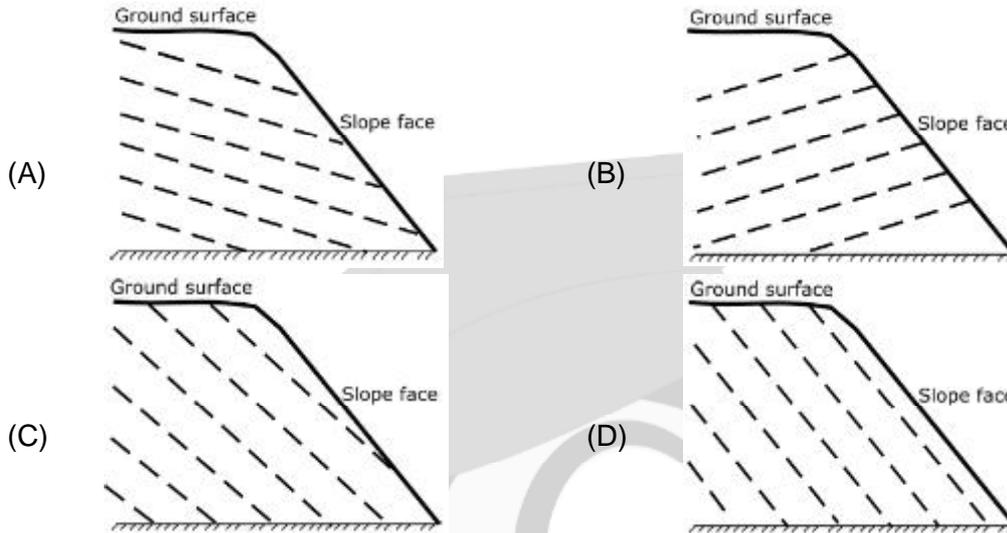
Group-I		Group-II	
P.	Iron	1.	Mangampet, Andhra Pradesh
Q.	Uranium	2.	Balaghat, Madhya Pradesh
R.	Manganese	3.	Narwa Pahar, Jharkhand
S.	Baryte	4.	Hospet, Karnataka

Codes :

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

27. Which one of the following processes is responsible for the formation of syngenetic Ni-Cu sulphide ore in gabbro-neritic rocks ?
- (A) Hydrothermal replacement (B) Volcanic exhalation
(C) Liquid immiscibility (D) Contact metamorphism

28. Dashed lines in the figures given below represent joints. Considering only the orientations of the joints and the slope face, which one of the following represents the most stable slope ?



29. Match the morphological features/life processes in Group I with corresponding organisms in Group II.

Group-I				Group-II			
P.	Water vascular system			1.	Cephalopods		
Q.	Moulting			2.	Echinodermata		
R.	Jet propulsion locomotion			3.	Brachiopoda		
S.	Lophophore			4.	Trilobita		

Codes :

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

30. Match the plutonic rocks in Group I with corresponding volcanic equivalents in Group II.

Group-I				Group-II			
P.	Granite			1.	Andesite		
Q.	Syenite			2.	Basalt		
R.	Diorite			3.	Rhyolite		
S.	Gabbro			4.	Trachyte		

Codes :

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

SECTION-(B) MULTIPLE SELECT QUESTIONS (MSQ)

Q.31 – Q.40 carry two marks each.

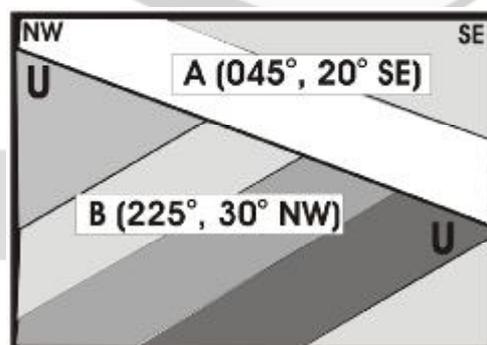
31. Which of the following change(s) when a dipping bed with a plunging lineation is rotated about a vertical axis ?
- (A) Dip amount of bed (B) Plunge amount of lineation
(C) Plunge direction of lineation (D) Strike of bed
32. Which of the following indicate(s) the presence of directed stress in a rock ?
- (A) Porphyritic texture (B) Schistosity
(C) Gneissosity (D) Mylonitic texture
33. The correct combination(s) of ranks and corresponding categories of stratigraphic units is/are
- (A) Formation – Lithostratigraphy (B) System – Chronostratigraphy
(C) Period – Chronostratigraphy (D) Group – Biostratigraphy
34. The correct order(s) of stability of silica polymorphs with increasing pressure is/are
- (A) Quartz – Coesite – Stishovite
(B) Quartz – Stishovite – Coesite
(C) Tridymite – Coesite – Stishovite
(D) Tridymite – Stishovite – Coesite
35. Which of the following statement(s) is/are correct for the upper hemisphere stereographic projection of a crystal given below ?
- (A) Angle between the axes, $\alpha = \beta = \gamma = 90^\circ$
(B) Crystal contains 1 tetrad
(C) Crystal contains 4 diads
(D) Crystal contains 5 mirror planes
- 
36. Which of the following statement(s) is/are correct ?
- (A) An isotropic mineral remains dark through 360° rotation of stage under crossed polars
(B) Pleochroism is the change of colour of a mineral during rotation under crossed polars
(C) Minerals of the Triclinic system are optically uniaxial
(D) Melatope in an interference figure marks the emergence of an optic axis
37. Hermatypic corals are typically found in
- (A) the photic zone (B) warm and clear water
(C) cool deep water (D) reefs
38. Choose the characteristic mineral(s) formed in the supergene enriched zone of a sulphide deposit.
- (A) Psilomelane (B) Covellite
(C) Cassiterite (D) Chalcocite

39. Which of the following is/are true for crystallization of plagioclase phenocrysts from a basic magma forming a layered intrusion ?
- (A) Cumulus texture at the base
 (B) Anorthite-rich early plagioclase at the base
 (C) Albite-rich late plagioclase at the top
 (D) Quench texture at the base
40. Major mass extinction events occurred in the
- (A) end Silurian (B) end Carboniferous
 (C) end Permian (D) early Devonian

SECTION-(C) NUMERICAL ANSWER TYPE QUESTIONS (NAT)

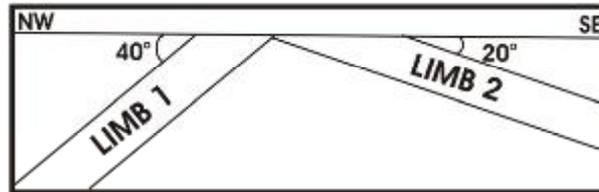
Q.41 – Q.50 carry one mark each.

41. When plotted on a map of 1:50000 scale, a 2 km long dyke exposed on a horizontal surface has a length of _____ cm (answer in one decimal place).
42. The valency of iron in hematite is _____.
43. A crustal rock is at a lithostatic pressure of 3 kbar and a temperature of 275°C. If the lithostatic pressure increases at a uniform rate of 0.3 kbar/km, and the surface temperature is 25°C, the geothermal gradient (in °C/km) is _____ (answer in one decimal place).
44. The absolute difference in the Moh's hardness values of the two silicates among the minerals listed below is _____.
 Apatite, Corundum, Gypsum, Talc, Topaz
45. Attitudes of beds in sequences A (younger) and B (older), separated by an unconformity UU, are given in the following sectional view. If UU was horizontal when sequence A was deposited, the dip amount of beds in sequence B at that time was _____ (answer in one decimal place).



46. The number of alpha (α) particles emitted to produce a daughter isotope of ^{206}Pb from a parent isotope of ^{238}U by radioactive decay is _____.
47. The dip slip on a fault $000^\circ, 30^\circ\text{E}$ is 10 m. Assuming slip equals separation here, the throw on the fault is _____ m (answer in one decimal place).

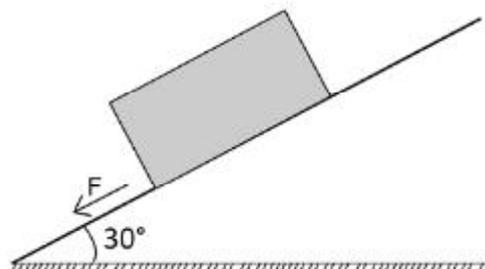
48. A continuous 10 m thick sequence of shale was deposited in 10,000 years at uniform rate of sedimentation. The number of samples that must be collected at equal stratigraphic intervals to sample the succession every 500 years is _____.
49. Attitudes of the two limbs of a non-plunging kink fold shown below are 045° , 20°SE and 045° , 40°NW . The dip amount (in degrees) of the axial plane of the kink fold is _____ (answer in one decimal place).



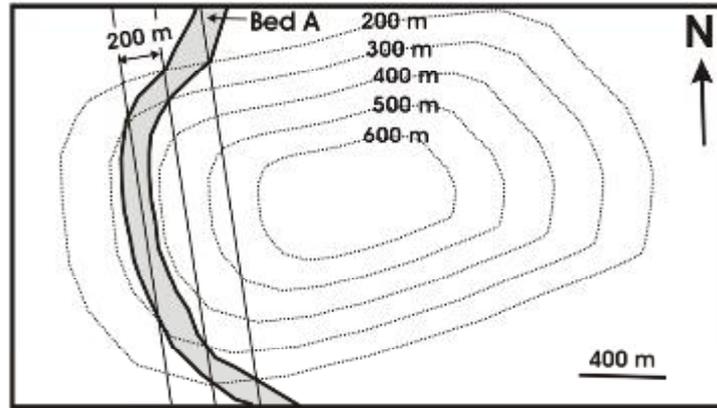
50. In the garnet formula $(\text{Fe}_{2.5}\text{Mg}_{0.3}\text{Ca}_x)\text{Al}_2\text{Si}_3\text{O}_{12}$, x represents the number of atoms of Ca. The mole % of grossular in the garnet is _____ (answer in one decimal place).

Q.51 – Q.60 carry two marks each.

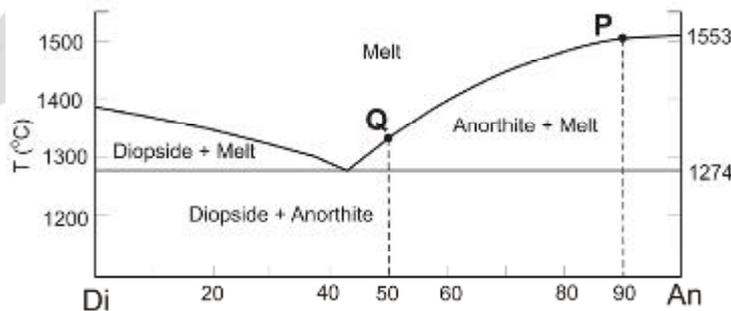
51. Assuming the Earth to be an ideal sphere, the volume % of the core relative to the total volume of the Earth is _____ (answer in one decimal place).
52. Based on 8 oxygen atoms, the number of silicon atoms in a plagioclase of composition $\text{Ab}_{20}\text{An}_{80}$ is _____ (answer in one decimal place).
53. 600 tons of low grade iron ore (40% Fe) are blended with 400 tons of high grade iron ore (65% Fe). The grade of the blended ore is _____ % Fe (answer in one decimal place).
54. The mass of a fully dried rock sample of volume 100 cm^3 is 300 g. The mass of the sample, when fully saturated with water of density 1.00 g/cm^3 , is 325 g. Assuming no volume change, the computed porosity of the rock is _____ % (answer in one decimal place).
55. When a dunite comprising pure forsterite undergoes melting, the weight % of MgO in the melt is _____ (answer in one decimal place; given molecular weights of $\text{SiO}_2 = 60.08$; $\text{MgO} = 40.30$).
56. A block of rock with a mass of 72 kg slides on a surface inclined at an angle of 30° as shown in the figure. Assuming no cohesion and friction, the force 'F' is _____ Newton (answer in one decimal place; acceleration due to gravity = 9.8 m/s^2).



57. The true thickness of Bed A in the map given below is _____ m (answer in one decimal place).



58. A melt containing 900 moles of anorthite and 100 moles of diopside undergoes crystallization. The number of moles of anorthite that crystallizes as the melt composition moves from P to Q is _____.



59. A confined sandstone aquifer with a uniform cross-sectional area of 7 m² and a hydraulic conductivity of 2 m/s, transmits water across a hydraulic gradient of 3.2. Assuming steady state Darcian flow, the volumetric flow rate through the aquifer is _____ m³/s (answer in one decimal place).

60. A diamondiferous lamproite is ultrapotassic and has a molar K₂O/Na₂O ratio of 11. If the Na₂O content of the rock is 0.62 wt%, the K₂O content is _____ wt% (answer in one decimal place; molecular weight of Na₂O = 61.98, and K₂O = 94.20).

ANSWER KEY

SECTION-(A) MULTIPLE CHOICE QUESTIONS (MCQ)

1	2	3	4	5	6	7	8	9	10
B	C	A	A	D	D	C	C	D	D
11	12	13	14	15	16	17	18	19	20
A	B	B	C	A	A	C	D	A	B
21	22	23	24	25	26	27	28	29	30
D	D	A	B	C	D	C	B	C	B

SECTION-(B) MULTIPLE SELECT QUESTIONS (MSQ)

31	32	33	34	35	36	37	38	39	40
C,D	B,C,D	A,B	A,C	A,B,C,D	A,D	A,B,D	B,D	A,B,C	C

SECTION-(C) NUMERICAL ANSWER TYPE QUESTIONS (NAT)

41	42	43	44	45	46	47	48	49	50
4	3	25	7	50	8-8	5	20	70-90	6.6-6.8
51	52	53	54	55	56	57	58	59	60
14-18	2.2	50	25	57-57.5	352.8	89-90	800	44.8	10.3-10.5

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SECTION-(A) MULTIPLE CHOICE QUESTIONS (MCQ)

Q. 1 to Q. 10 carry one mark each.

1. Which one of the following minerals exhibits luminescence when exposed to ultraviolet light ?

(A) Cassiterite	(B) Wolframite
(C) Tantalite	(D) Scheelite

2. In which one of the following mass extinction periods trilobites became extinct ?

(A) Devonian	(B) Permian
(C) Triassic	(D) Cretaceous

3. En-echelon sigmoidal 'gash' veins indicate

(A) ductile shear zone	(B) brittle-ductile shear zone
(C) brittle shear zone	(D) saddle reef structure

4. Which one of the following primary sedimentary structures is NOT used for palaeocurrent analysis?

(A) Current crescent	(B) Flute marks
(C) Symmetrical wave ripples	(D) Imbrication of pebbles

5. The age of the Patcham Formation is

(A) Permian	(B) Triassic
(C) Jurassic	(D) Cretaceous

6. Rivers that receive water from groundwater seepage are termed as

(A) effluent rivers	(B) consequent rivers
(C) influent rivers	(D) braided rivers

7. Conservative plate boundary is represented by

(A) normal fault	(B) growth fault
(C) transform fault	(D) reverse fault

8. Which one of the following prismatic crystal forms belongs to the hexagonal crystal system ?

(A) $\{11\bar{2}0\}$	(B) $\{h0\bar{h}l\}$
(C) $\{0001\}$	(D) $\{hk0\}$

9. The characteristic rock of contact metamorphism is

(A) hornfels	(B) blueschist
(C) eclogite	(D) granulite

10. The volcanic equivalent of nepheline syenite is

(A) rhyolite	(B) basanite
(C) phonolite	(D) andesite

Q. 11 to Q. 30 carry two mark each.

11. Identify the correct match between mineral-ore and its physical property.

- (A) Hematite - Yellow streak
- (B) Barite - High Specific gravity
- (C) Psilomelane - Comb structure
- (D) Azurite - Distinctive green colour

12. Match the mineral deposits in Group I with their Indian occurrences in Group II.

- | Group I | | Group II | |
|---------|--------------------|----------|-------------------------|
| P. | Chromite | 1. | Jhamarkotra, Rajasthan |
| Q. | Magnesite | 2. | Gudur, Andhra Pradesh |
| R. | Mica | 3. | Byrapur, Karnataka |
| S. | Phosphorite | 4. | Chalk Hills, Tamil Nadu |
| (A) | P-1, Q-4, R-3, S-2 | (B) | P-3, Q-2, R-4, S-1 |
| (C) | P-3, Q-4, R-2, S-1 | (D) | P-2, Q-1, R-3, S-4 |

13. A helically coiled ammonite Turrilites is differentiated from externally resembling Gastropoda Turritella by

- (A) apical angle
- (B) number of whorls
- (C) direction of coiling
- (D) chambered shell

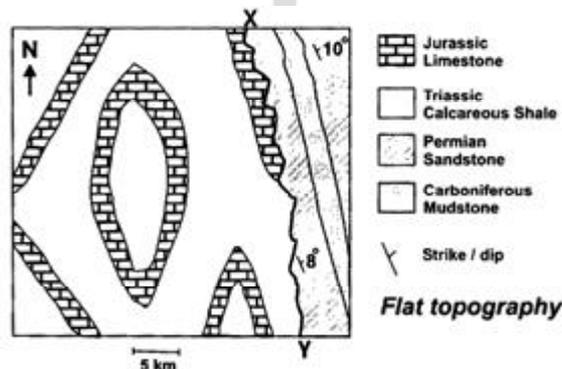
14. The facial suture of trilobites running through the genal angle is known as

- (A) proparian
- (B) marginal
- (C) gonatoparian
- (D) opisthoparian

15. Which one of the following statements is correct for Class 1B (Parallel) folds ?

- (A) Orthogonal thickness at hinge > that at limb
- (B) Axial planar thickness at hinge = that at limb
- (C) Dip isogons are parallel.
- (D) Dip isogons are convergent.

16. In the given map, the X-Y surface has the same orientation as in the Palaeozoic sequence, X Y represents



- (A) angular unconformity
- (B) non-conformity
- (C) normal fault
- (D) thrust

17. Match the sedimentary features in Group I with the corresponding sedimentary environments of their formation in Group II.

Group I		Group II	
P.	Point bar	1.	Tidal
Q.	Barchan	2.	Meandering fluvial channel
R.	Dropstone	3.	Aeolian
S.	Herring-bone cross stratification	4.	Glacial
(A)	P-3,Q-4,R-1,S-2		
(B)	P-2,Q-3,R-4,S-1		
(C)	P-2,Q-4,R-3,S-1		
(D)	P-2,Q-3,R-1,S-4		

18. Which one of the following lithostratigraphic units is of Phanerozoic Eon ?

(A)	Sargur Group	(B)	Semri Group
(C)	Uttatur Group	(D)	Papaghni Group

19. Match the geological processes (Group I) with their examples in Indian stratigraphy (Group II).

Group I		Group II	
P.	Permo-Carboniferous glaciation	1.	Ariyalur Group
Q.	Cretaceous marine transgression	2.	Siwalik Group
R.	Neogene fluvial sedimentation	3.	Talchir Formation
S.	Cretaceous inter-trappean sedimentation	4.	Lameta Formation
(A)	P-3, Q-1, R-2, S-4		
(B)	P-2, Q-3, R-4, S-1		
(C)	P-3, Q-2, R-1, S-4		
(D)	P-4, Q-1, R-2, S-3		

20. Check dams are constructed in association with main dam in the

- (A) upstream of the main dam to check the siltation of the reservoir
 (B) downstream of the main dam to check the siltation of the reservoir
 (C) upstream of the main dam to check the seepage from the reservoir
 (D) downstream of the main dam to check the seepage from the reservoir

21. A geological formation neither containing nor transmitting water is termed as

(A)	aquiclude	(B)	aquitard
(C)	aquifer	(D)	aquifuge

22. Which one of the following sequences of silicate structures indicates an increasing degree of sharing of corners of $(\text{SiO}_4)^{4-}$ tetrahedra ?

- (A) Nesosilicate → Single-chain inosilicate → Phyllosilicate → Tectosilicate
 (B) Tectosilicate → Phyllosilicate → Single-chain inosilicate → Nesosilicate
 (C) Nesosilicate → Phyllosilicate → Single-chain inosilicate → Tectosilicate
 (D) Single-chain inosilicate → Nesosilicate → Phyllosilicate → Tectosilicate

23. Match the igneous bodies in Group I with their ages in Group II.

Group I		Group II	
P.	Singhbhum granite	1.	Neoproterozoic
Q.	Malani rhyolite	2.	Cretaceous
R.	Deccan volcanics	3.	Permian
S.	Panjal Traps	4.	Archaean
(A)	P-3, Q-2, R-4, S-1	(B)	P-4, Q-1, R-2, S-3
(C)	P-4, Q-3, R-2, S-1	(D)	P-3, Q-4, R-2, S-1

24. The tube feet in echinoids emerge through

- | | | | |
|-----|------------------------|-----|-------------------|
| (A) | interambulacral plates | (B) | ambulacral plates |
| (C) | bourrelets | (D) | plastron |

25. A mineral with a point group symmetry 2/m

- (A) has two optic axes
 (B) shows inclined extinction in (100) section
 (C) shows straight extinction in (010) section
 (D) is uniaxial

26. The progressive metamorphic isograd that explains Barrovian metamorphism in pelite is

- (A) chlorite→staurolite→biotite→kyanite→silimanite
 (B) chlorite→andalusite→cordierite→silimanite
 (C) chlorite→biotite→garnet→staurolite→kyanite→silimanite
 (D) silimanite→kyanite→staurolite→garnet→biotite→chlorite

27. In metabasic rocks, plagioclase is not stable in

- | | | | |
|-----|--------------------|-----|----------------------------|
| (A) | granulite facies | (B) | episode amphibolite facies |
| (C) | amphibolite facies | (D) | eclogite facies |

28. A sandstone has <5% matrix. The recalculated modal compositions of feldspar, quartz and rock fragments are 45%, 35%, 20%, respectively. The sandstone is classified as

- | | | | |
|-----|-------------------|-----|-----------------|
| (A) | feldspathic wacke | (B) | quartz wacke |
| (C) | lithic arkose | (D) | subfeldsarenite |

29. Match the earth layers (Group I) with corresponding approximate thicknesses (Group II).

Group I		Group II	
P.	Lithosphere	1.	2900 km
Q.	Mantle	2.	2250 km
R.	Outer Core	3.	1200 km
S.	Inner Core	4.	100 km
(A)	P-4, Q-1, R-2, S-3	(B)	P-4, Q-1, R-3, S-2
(C)	P-4, Q-3, R-1, S-2	(D)	P-3, Q-2, R-1, S-4

30. Pressure (1 GPa = 10 kbar) and temperature at the centre of the Earth are estimated to be

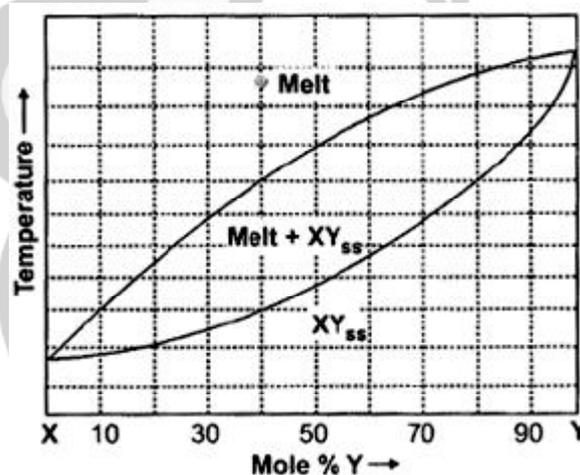
- | | | | |
|-----|-----------------|-----|----------------|
| (A) | 360 GPa, 2600 K | (B) | 450 GPa, 6000K |
| (C) | 360 GPa, 6000 K | (D) | 450 GPa, 2600K |

SECTION-(B) MULTIPLE SELECT QUESTIONS (MSQ)

Q. 31 – Q. 40 carry two marks each.

31. Choose the landsform(s) resulting from glacial erosion.
- (A) Fjords (B) Moraines
(C) Drumlins (D) Cirques
32. Choose the correct combination(s) of type of dentition of Bivalvia and the corresponding representative genus.
- (A) Taxodont - *Nucula*
(B) Isodont - *Spondylus*
(C) Pachyodont - *Hippurites*
(D) Desmodont - *Mya*

33. Shown below is an isobaric binary temperature-composition phase diagram in the system X-Y with complete miscibility between X and Y.



Which of the following statements is/are correct for crystallization of a starting melt of composition $Z_{60} Y_{40}$ (the dot in the diagram) ?

- (A) The first formed crystal has a composition $X_{20} Y_{80}$.
- (B) The final melt composition during equilibrium crystallization is $X_{90} Y_{10}$.
- (C) In case of fractional crystallization, the final melt is enriched in X than $X_{90} Y_{10}$.
- (D) For fractional crystallization, the final crystal composition $X_{90} Y_{10}$.
34. Choose the correct combination(s) of textural features of magmatic rocks with corresponding petrological processes from the following.
- (A) ophitic texture in dolerite - peritectic crystallization
(B) perthite in granite - slow subsolidus cooling
(C) spinifex texture in komatite - eruption of ultramafic lava
(D) orthopyroxene rim around olivine in peridotite - eutectic crystallization

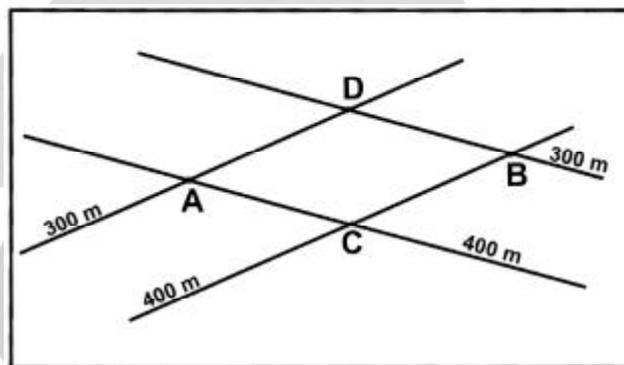
35. Which of the following statements is/are NOT correct ?
- (A) (110) lies in zone [001] (B) (021) lies in zone [100]
 (C) (101) lies in zone [010] (D) (111) lies in zone [$\bar{1}11$]
36. In an outcrop we find that the bedding planes are vertical and cleavage surfaces are horizontal. Which of the following fold types is/are inferred from this observation ?
- (A) Upright fold (B) Recumbent fold
 (C) Vertical fold (D) Neutral fold
37. Which of the following stratigraphic unit(s) is/are coal/lignite bearing ?
- (A) Barakar Formation (B) Barail Group
 (C) Cuddalore Formation (D) Ariyalur Formation
38. The Toposheet No(s). immediately adjacent to Toposheet No. 55J/8 is/are
- (A) 55K/2 (B) 55J/12
 (C) 55J/6 (D) 55K/5
39. Which of the following is/are NOT true for texturally immature sandstone ?
- (A) Clay content is high
 (B) Little or no clay present
 (C) Grains are well sorted
 (D) Grains are rounded
40. P and S waves originate at earthquake focus and travel through the earth. Which of the following statements for these waves is/are correct ?
- (A) S-wave shadow zone is 154° wide
 (B) P-wave shadow zones are 49° wide
 (C) P-wave velocity abruptly increases downward at mantle-core boundary
 (D) P-wave velocity abruptly drops downward at mantle-core boundary

SECTION-(C) NUMERICAL ANSWER TYPE QUESTIONS (NAT)

Q.41 – Q.50 carry one mark each.

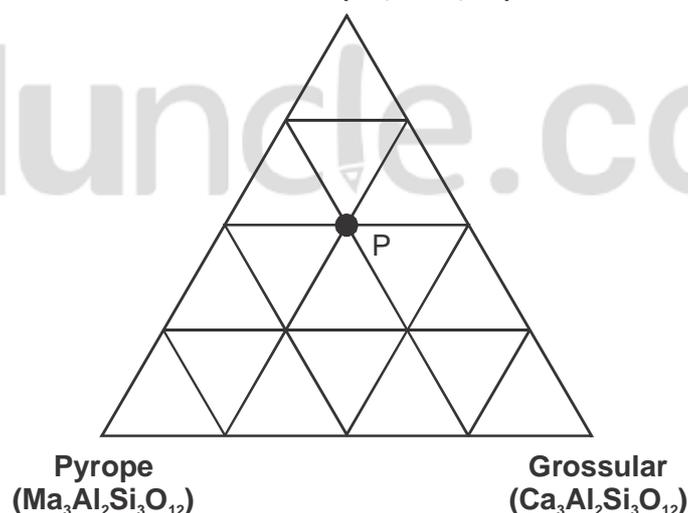
41. An object is spotted at $S60^\circ E$ front bearing from the observer. If the position is interchanged, the front bearing value in degree from North (measured clockwise) is _____.
42. The mole % of forsterite component in olivine with chemical formula $Mg_{1.8} Fe_{0.2} SiO_4$ is _____.
43. The Weiss symbol of a crystal face is $4a: 2b: c$. The value of h in the corresponding Miller Index (hkl) is _____.
44. In a mineral with chemical formula $AT_4 O_8$, the ionic radii of A and O are 1.12 \AA and 1.40 \AA , respectively. The co-ordination number of cation A is _____.

45. Aluminium (Al) can occur in both tetrahedral and octahedral co-ordinations in silicates. The amount of octahedral Al in a pyroxene crystal of composition $Mg_{1.4} Fe_{0.4} Al_{0.4} Si_{1.8} O_6$ is ____ (give answer in one decimal place).
46. The birefringence of a mineral of thickness $30 \mu m$ and retardation $0.27 \mu m$ is ____ (give answer in three decimal places).
47. Two limbs of a vertical chevron fold strike $S70^\circ E$ and $N55^\circ E$. The value of the interlimb angle of the fold is ____ (degree).
48. The schematic map given below shows intersecting strike lines of the same lithological contact. In the map, AB and CD are 5cm and 3.5cm, respectively. The scale of the map is $1 \text{ cm} = 100m$. The plunge of the fold axis is ____ degrees (give answer in one decimal place).



49. The core-rim compositions of a normally zoned plagioclase crystal are as follows:
 Core: $Ca_{0.6} Na_x Al_{1.6} Si_{2.4} O_8$ Rim: $Ca_{0.4} Na_y Al_{1.4} Si_{2.6} O_8$
 The amount of increase of Na atom from core to rim per formula unit of plagioclase is ____ (given answer in one decimal place).
50. Considering garnet chemical formula in 12 oxygen basis, the number of Mg cations in a garnet of chemical composition P (as shown in the figure) is ____ (give answer in two decimal places).

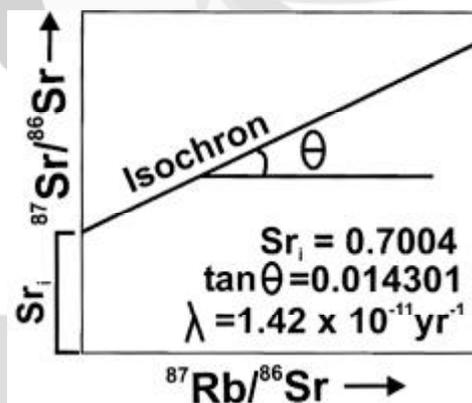
Almandine ($Fe_3Al_2Si_3O_{12}$)



Q.51 – Q.60 carry two marks each.

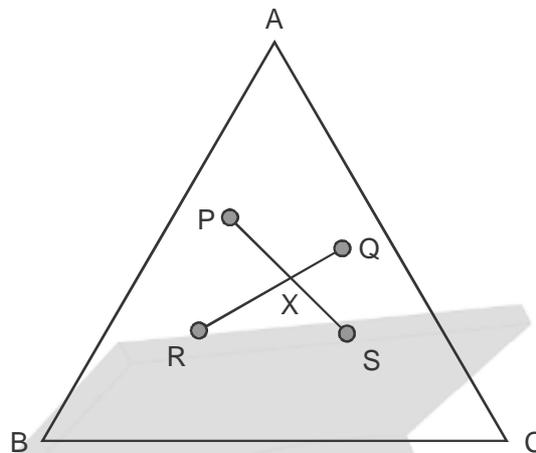
51. A fault surface in an outcrop has slickenside lineation whose pitch is 30° . The horizontal slip on the fault is 1.25 m, as determined from displaced vein. The net slip on the fault is ____ meter (give answer in two decimal places).
52. In an outcrop, we find a Belemnite fossil broken into five rectangular pieces (boudins) of equal size. Long dimension of each boudin is 1.35 cm. Gap between adjacent boudins in all cases is 0.25 cm. Note that the long dimensions of boudins are perfectly aligned. The % elongation is ____ (give answer in one decimal place).
53. A horizontal cylindrical ore body (diameter = 20m, length = 200 m) has 5% metal content and density of 3500 kg/m^3 . The reserve of the ore body is ____ million ton(s) (give answer in two decimal places).
54. A drainage basin of fourth order covers an area of 40 sq. km. Within the basin, total length of 1st order drainage is 12.5 km, 2nd order drainage is 8.8 km, 3rd order drainage is 4.7 km and 4th order drainage is 4.0 km. The drainage density of the basin is ____ km^{-1} (give answer in two decimal places).
55. Age of granitic rocks can be determined using Rb-Sr whole rock radioactive dating method and the following age equation,

$$(^{87}\text{Sr}/^{86}\text{Sr}) = (^{87}\text{Sr}/^{86}\text{Sr})_i + (^{87}\text{Rb}/^{86}\text{Sr}) (e^{\lambda t} - 1)$$
 For a suite of representative co-magmatic granitic rocks, the Rb-Sr whole rock isochron plot and relevant data are shown in the diagram. The age of granite is calculated at ____ Ga ($1\text{Ga} = 10^9$ yrs, give answer in one decimal place).



56. Consider a granulite facies metamorphic rock with peak metamorphic condition at 9 kbar, 850°C . Assume a single layer crust of $\rho = 3000 \text{ kg/m}^3$ and $g = 10\text{m/sec}^2$ during metamorphism. The depth of burial during peak metamorphism is ____ km. $1 \text{ Pascal} = 1 \text{ kg/m/sec}^2$ and $1 \text{ bar} = 10^5$ Pascals.

57. Consider four minerals P, Q, R and S in a three component chemical system (A-B-C) as shown in the figure. For a crossing tie-line relationship, the variance (degree of freedom) of the equilibrium mineral assemblage at X is _____



58. The refractive indices of four minerals (P, Q, R, S) are as follows:

P($\alpha = 1.712$, $\beta = 1.721$, $\lambda = 1.727$),

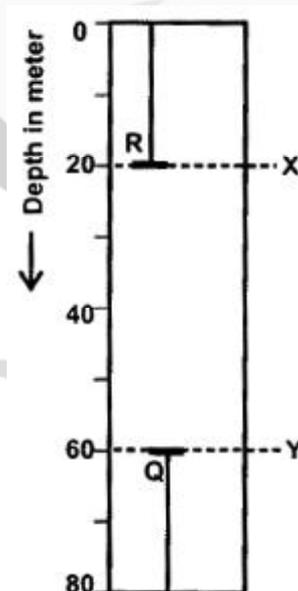
Q($\epsilon = 1.553$, $\omega = 1.544$),

R($\alpha = 1.664$, $\beta = 1.672$, $\lambda = 1.694$) and

S($\omega = 1.658$, $\epsilon = 1.486$)

The value of maximum birefringence among all the minerals is _____ (give answer in two decimal places).

59. In a sedimentary succession shown in the figure, the last occurrence of the fossil species Q (dated 50 Ma) and the first occurrence of the fossil species R (dated 30 Ma) are recorded at Y and X, respectively. The estimated rate of sedimentation is _____ m/million yrs (assume constant rate of sedimentation).



60. The top surface of a coal seam is exposed at 150 m contour level on a hill top at location A. The same surface of the seam is also exposed on a river bed at location B at the 50 m contour level. The aerial distance A-B is 1 km. The amount of dip of the coal seam along A-B is _____(degree). Give answer in one decimal place.

ANSWER KEY

SECTION-(A) MULTIPLE CHOICE QUESTIONS (MCQ)

1	2	3	4	5	6	7	8	9	10
D	B	B	C	C	A	C	A	A	C
11	12	13	14	15	16	17	18	19	20
B	C	D	C	D	D	B	C	A	A
21	22	23	24	25	26	27	28	29	30
D	A	B	B	A	C	D	C	A	C

SECTION-(B) MULTIPLE SELECT QUESTIONS (MSQ)

31	32	33	34	35	36	37	38	39	40
A, D	A,B,C,D	A,B,C	B,C	D	B,D	A,B,C	B,D	B,C,D	A,D

SECTION-(C) NUMERICAL ANSWER TYPE QUESTIONS (NAT)

41	42	43	44	45	46	47	48	49	50
300	90	1	8	0.2	0.009	55	15.9	0.2	0.75
51	52	53	54	55	56	57	58	59	60
1.44	14.8	0.22	0.75	1.0	30	1	0.172	2	5.7

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Geology (GG)

Previous Year Solved Paper

Duration : 180 minutes

Maximum Marks : 100

Read the following instructions carefully.

1. This test paper has a total of 60 questions carrying 100 marks. The entire question paper is divided into **Three Sections A, B and C**. All sections are compulsory. Questions in each section are of different types.
2. **Section – A** contains **Multiple Choice Questions (MCQ)**. Each MCQ type question has four choices out of which only one choice is the correct answer. This section has 30 Questions and carry a total of 50 marks. Q.1 – Q.10 carry 1 mark each and Questions Q.11 – Q.30 carry 2 marks each.
3. **Section – B** contains **Multiple Select Questions (MSQ)**. Each MSQ type question is similar to MCQ but with a difference that there may be one or more than one choice(s) that are correct out of the four given choices. The candidate gets full credit if he/she selects all the correct choices only and no wrong choices. This section has 10 Questions and carry 2 marks each with a total of 20 marks.
4. **Section – C** contains **Numerical Answer Type Questions (NAT)**. For these NAT type questions, the answer is a real number which needs to be entered using the virtual numerical keypad on the monitor. No choices will be shown for these type of questions. This section has 20 Questions and carry a total of 30 marks. Q.1 – Q.10 carry 1 mark each and Questions Q.11 – Q.20 carry 2 marks each.

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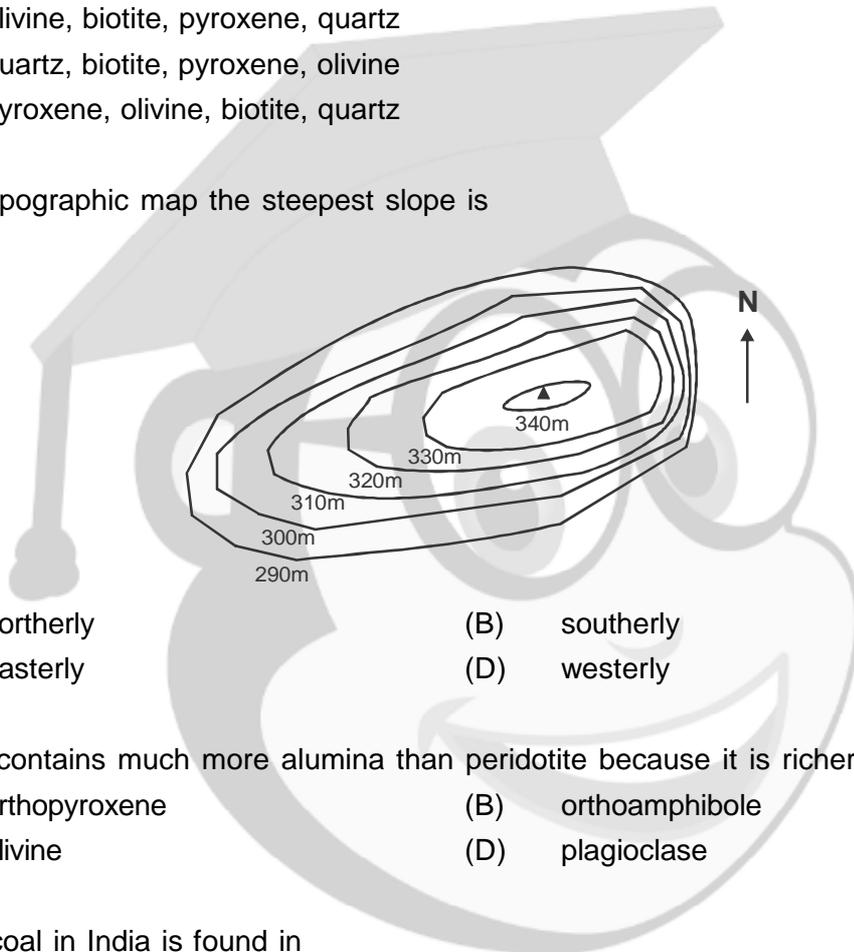
SECTION-(A) MULTIPLE CHOICE QUESTIONS (MCQ)

Q.1 – Q.10 carry one mark each.

1. The most abundant metal (by weight %) in the Earth's crust is
 (A) Al (B) Fe
 (C) Na (D) Mg

2. The correct order of increasing stability of minerals during chemical weathering is
 (A) olivine, pyroxene, biotite, quartz
 (B) olivine, biotite, pyroxene, quartz
 (C) quartz, biotite, pyroxene, olivine
 (D) pyroxene, olivine, biotite, quartz

3. In the topographic map the steepest slope is



- (A) northerly (B) southerly
 (C) easterly (D) westerly

4. Gabbro contains much more alumina than peridotite because it is richer in
 (A) orthopyroxene (B) orthoamphibole
 (C) olivine (D) plagioclase

5. Coking coal in India is found in
 (A) Neyvelli, Tamil Nadu (B) Jharia, Jharkhand
 (C) Palana, Rajasthan (D) Garampani, Meghalya

6. The amplitude of ground motion during an earthquake of magnitude 7 in Richter scale is how many times more than that of a magnitude 5 ?
 (A) 10 (B) 100
 (C) 1000 (D) 10,000

7. The failed arm of a continental rift is called
 (A) hot spot (B) horst
 (C) decollement (D) aulacogen

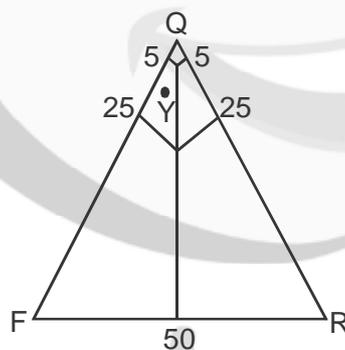
8. The hardest mineral (with the exception of diamond) in the Moh's scale of hardness is
 (A) an oxide (B) a silicate
 (C) a phosphate (D) a carbonate
9. Which one of the following is capable of transporting sediments against the slope ?
 (A) river current (B) turbidity current
 (C) tidal current (D) rip current
10. Which is the most abundant ion in the normal seawater ?
 (A) Cl^- (B) SO_4^-
 (C) Na^+ (D) K^+

Q.11 – Q.30 carry two marks each.

11. Match minerals in **Group I** with the corresponding silicate structure in **Group II**.

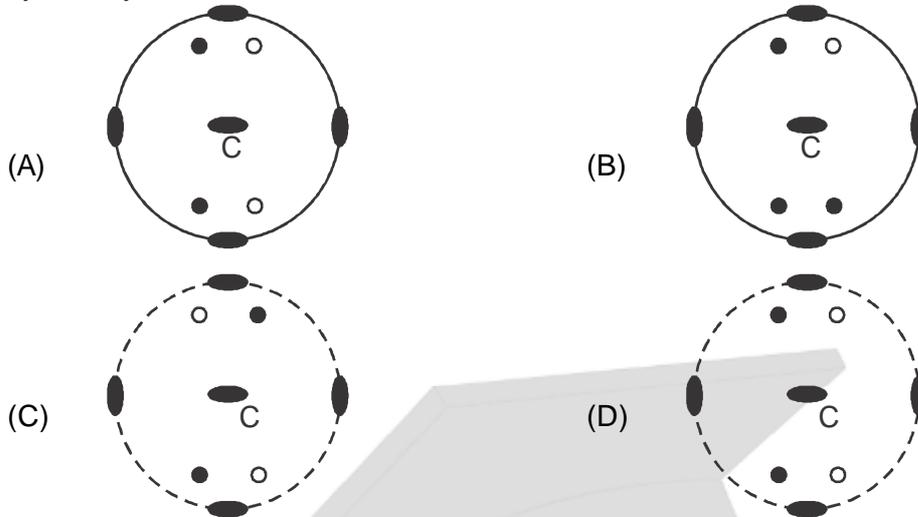
Group I	Group II
(i) Anthophyllite	(P) Cyclosilicate
(ii) Hedenbergite	(Q) Tectosilicate
(iii) Cordierite	(R) Double chain silicate
(iv) Zeolite	(S) Single chain silicate
(A) i-R; ii-S; iii-Q; iv-P	(B) i-S; ii-R; iii-Q; iv-P
(C) i-R; ii-S; iii-P; iv-Q	(D) i-P; ii-Q; iii-R; iv-S

12. The correct name for the well sorted sandstone, whose framework composition plots at Y in the following QFR diagram, is



- (A) arkose (B) subarkose
 (C) lithic arkose (D) quartz arenite
13. Which one of the following optical properties of minerals is NOT observed under crossed nicols?
 (A) Extinction (B) Interference colour
 (C) Interference figure (D) Pleochroism

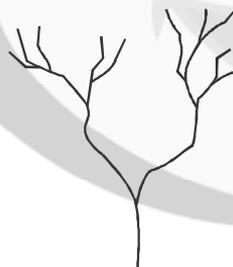
14. Choose the correct stereographic projection among the following that represents 222 crystal symmetry.



15. Match the folds listed in **Group I** with corresponding geometric characteristics in **Group II**.

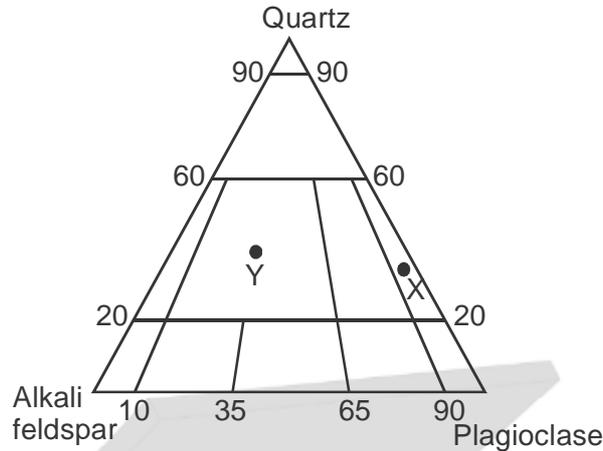
Group I		Group II	
(i)	Parallel	(P)	Angular hinge
(ii)	Chevron	(Q)	Minimum thickness parallel to the axial surface is at the hinge
(iii)	Similar	(R)	Negative inter-limb angle
(iv)	Mushroom	(S)	Constant thickness parallel to the axial surface
(A)	i-Q; ii-R; iii-S; iv-P	(B)	i-S; ii-P; iii-Q; iv-R
(C)	i-Q; ii-P; iii-S; iv-R	(D)	i-S; ii-R; iii-Q; iv-P

16. The number of 4th order stream(s) present in the drainage network shown below, as per hierarchical classification is.

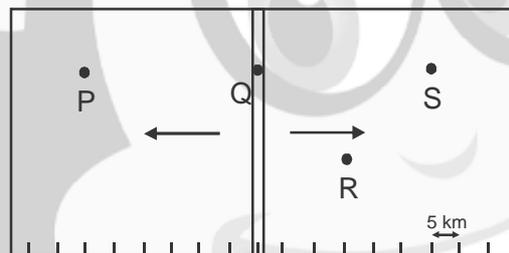


- (A) one
(B) two
(C) three
(D) four
17. During metamorphism, temperature can increase at constant pressure in the case of
- (A) exhumation by erosion
(B) burial by subduction
(C) burial by underthrusting
(D) intrusion of batholith
18. Choose the correct chronological order from oldest to youngest for the following stratigraphic units
P-Chitradurga Group; Q-Sargur Group; R-Ajabgarh Group; S-Udaipur Group
- (A) Q, P, S, R
(B) P, Q, S, R
(C) Q, R, P, S
(D) Q, R, S, P

19. Identify the rock types at X and Y in the following QAP diagram of IUGS.



- (A) X is granodiorite and Y is granite
 - (B) X is granodiorite and Y is alkali feldspar granite
 - (C) X is tonalite and Y is granite
 - (D) X is tonalite and Y is alkali feldspar granite
20. A schematic diagram of a divergent plate boundary, with arrows indicating directions of plate movement, is given below. Which one of the following statements is NOT true for points P, Q, R and S, if the spreading rate for both the plates is uniform and same through time and space?



- (A) The rocks at P and S have the same age
 - (B) The rocks at S are twice as old as those at R
 - (C) The age of rocks at Q is 0 Ma
 - (D) The age of the rocks decreases progressively from P to S
21. Mississippian and Pennsylvanian belong to which period ?
- (A) Permian
 - (B) Devonian
 - (C) Carboniferous
 - (D) Silurian
22. A gravity dam with E–W axis is to be constructed in a narrow river valley between two N–S trending parallel ridges. The river is flowing from south to north. The lithology of the area is represented by 2 to 5 m thick metasedimentary rocks—quartzite, phyllite and schist. Which of the following geological conditions will be most suitable ?
- (A) Beds in both the ridges strike N–S but dip towards each other
 - (B) Beds in both the ridges strike N–S but dip in opposite direction to each other
 - (C) Beds in both the ridges strike E–W and dip towards N (downstream)
 - (D) Beds in both the ridges strike E–W and dip towards S (upstream)

23. Match the ore deposits in **Group I** with the localities in **Group II**

Group I		Group II	
(i)	Copper	(P)	Balaghat, M.P.
(ii)	Lead–Zinc	(Q)	Panchpatmali, Odisha
(iii)	Manganese	(R)	Rampura–Agucha, Rajasthan
(iv)	Bauxite	(S)	Khetri, Rajasthan
(A)	i–S, ii–R, iii–Q, iv–P	(B)	i–S, ii–R, iii–P, iv–Q
(C)	i–P, ii–R, iii–Q, iv–S	(D)	i–S, ii–Q, iii–R, iv–P

24. Match the following stratigraphic units (**Group-I**) with their ages (**Group-II**)

Group I		Group II	
(i)	Cumbum Formation	(P)	Cenozoic
(ii)	Baisakhi Formation	(Q)	Mesozoic
(iii)	Kopili Formation	(R)	Palaeozoic
(iv)	Barakar Formation	(S)	Proterozoic
(A)	i–R, ii–P, iii–Q, iv–S	(B)	i–S, ii–Q, iii–P, iv–R
(C)	i–S, ii–R, iii–P, iv–Q	(D)	i–S, ii–Q, iii–R, iv–P

25. Which one of the following sedimentary structures is related to gravitational instability ?

(A)	groove cast	(B)	load cast
(C)	gutter cast	(D)	flute cast

26. Match features mentioned in **Group-I** with the fossil types in **Group-II**.

Group I		Group II	
(i)	Escutcheon	(P)	Brachiopoda
(ii)	Plastron	(Q)	Nautiloidea
(iii)	Delthyrium	(R)	Echinoidea
(iv)	Siphuncle	(S)	Bivalvia
(A)	i–S, ii–R, iii–Q, iv–P	(B)	i–S, ii–R, iii–P, iv–Q
(C)	i–S, ii–P, iii–Q, iv–R	(D)	i–R, ii–Q, iii–P, iv–S

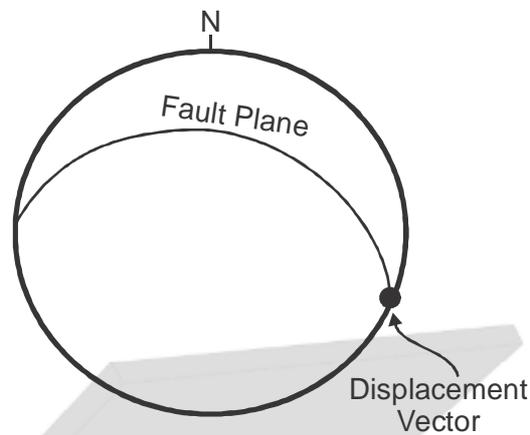
27. Which one of the following is an upper Gondwana flora ?

(A)	<i>Ptilophyllum</i>	(B)	<i>Phyllothea</i>
(C)	<i>Glossopteris</i>	(D)	<i>Schizoneura</i>

28. Choose the correct match of items in **Group I** with the items in **Group II**.

Group I		Group II	
(i)	Eutectic crystallisation	(P)	Perthitic texture
(ii)	Fractional crystallisation	(Q)	Graphic texture
(iii)	Exsolution	(R)	Pillow structure
(iv)	Submarine eruption	(S)	Crystal zoning
(A)	i–Q, ii–S, iii–R, iv–P	(B)	i–Q, ii–S, iii–P, iv–R
(C)	i–S, ii–Q, iii–P, iv–R	(D)	i–S, ii–Q, iii–R, iv–P

29. The fault for which the orientation and displacement vector are given in the following lower hemisphere stereographic projection is a



- (A) vertical fault (B) thrust fault
(C) normal fault (D) strike-slip fault
30. The change in coordination number of silicon (Si) when α -quartz transforms to stishovite, which has octahedral coordination, is
- (A) 2 (B) 4
(C) 6 (D) 8

SECTION-(B) MULTIPLE SELECT QUESTIONS (MSQ)

Q.31 – Q.40 carry two marks each.

31. Which of the following is/are found only in the brittle shear zones ?
- (A) Cataclasite (B) Mylonite
(C) Pseudotachylite (D) Gouge
32. Which among the following statements related to headward erosion by river is/are correct ?
- (A) Length of tributaries increases (B) Length of the main channel increases
(C) Streams get captured (D) Channel gradient increases upstream
33. In a thin section of 30 μm thickness, the R.I. of a mineral are: $\epsilon = 1.565$ and $\omega = 1.468$. Choose the correct statement(s) about its optical properties.
- (A) Uniaxial +ve (B) Uniaxial -ve
(C) 1st order interference colour (D) low to moderate relief
34. Which of the following statements is/are NOT true for equilibrium crystallization of plagioclase from a melt in the binary system $\text{NaAlSi}_3\text{O}_8$ - $\text{CaAlSi}_2\text{O}_8$ at constant pressure ?
- (A) Composition of the first-formed solid depends on the initial composition of the melt.
(B) Solid composition is always more anorthitic than the coexisting melt.
(C) Composition of the final solid is the same as the initial composition of the melt.
(D) Equilibrium crystallization leads to the formation of zoned crystals.

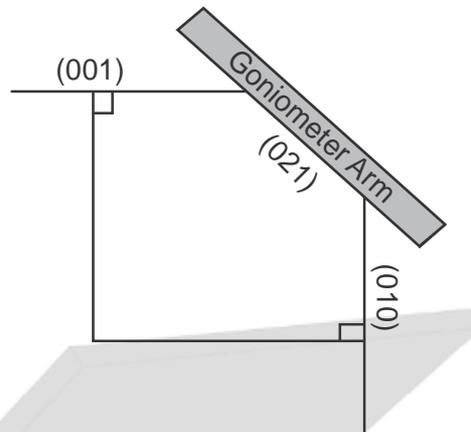
35. The value of gravity at the Earth's surface is dependent on
 (A) latitude (B) altitude
 (C) composition of underlying material (D) relative position of Sun–Earth
36. Choose the burrowing form(s) of bivalve.
 (A) *Mya* (B) *Teredo*
 (C) *Pecten* (D) *Venus*
37. Which of the following environments is/are characterized by predominant deposit of mud ?
 (A) Barrier bar (B) Lagoon
 (C) Fluvial flood plain (D) Fluvial channel
38. Which of the following stratigraphic units belong(s) to Cretaceous ?
 (A) Bhuj Formation (B) Ariyalur Group
 (C) Patcham Formation (D) Katrol Formation
39. Which of the following ore deposit(s) is/are formed only by hydrothermal process ?
 (A) 'Sn–W' ore associated with greissenised rock
 (B) Layered type chromite ore associated with dunite–peridotite–pyroxenite
 (C) Vein type gold ore associated with greenstone belt
 (D) Ni–Cu sulphide ore associated with gabbroic rocks.
40. Migmatite is a rock
 (A) in which mafic–rich parts are intermixed with pods or layers of granitic composition
 (B) with melanosome and leucosome
 (C) with a solid residue and partial melt
 (D) which forms at high grade metamorphic conditions

SECTION-(C) NUMERICAL ANSWER TYPE QUESTIONS (NAT)

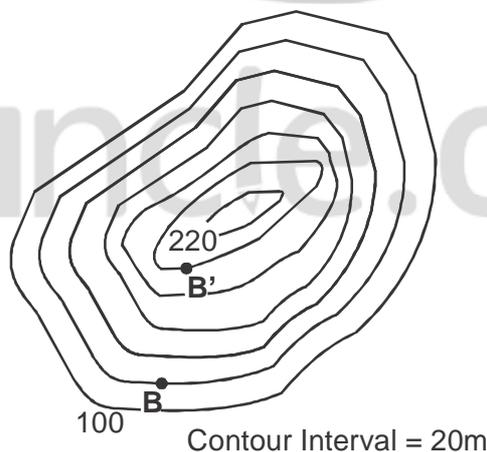
Q.41 – Q.50 carry one mark each.

41. Based on the ideal end member formula of diopside, the mole proportion (%) of CaO for plotting the mineral on a CaO–MgO–SiO₂ triangular diagram is _____.
42. The phi (ϕ) value of a sediment particle having 4mm diameter is _____.
43. Calcite, quartz, wollastonite and CO₂ fluid were present in equilibrium during the formation of a calc-silicate rock. In the chemical system CaO–SiO₂–CO₂, the degree of freedom of this assemblage is _____.
44. The weight of a 10 cm³ medium grained sandstone block with 20% (v/v) porosity, in dry state is 26g. The density of the block when fully saturated with water is _____ g/cm³.

45. In the following figure, the exterior angle measured between $(001) \wedge (021)$ with a goniometer in a crystal is 40° . The interior angle between $(010) \wedge (021)$ in degrees is _____.



46. If the elevation of a wave cut platform is 55 m above the sea level and the age of the erosional surface is 120 kilo years, the rate of rock uplift at this coastal location is _____m/kilo years (give answer in two decimal places).
47. A foliation plane has strike 025° and 60° easterly dip. A mineral lineation on this foliation plane has a rake/pitch of 90° . The plunge direction of the mineral lineation in whole circle bearing is _____degrees.
48. Two outcrops on a 1 : 25000 map are 12 cm apart. The ground distance between the two outcrops is _____ km.
49. Fine muds are deposited at a rate of 1 cm per 1000 y. Assuming constant sedimentation rate and absence of compaction, a 1 km thick sequence would be deposited in _____million years.
50. B and B' are two points on the topographic map shown below. The distance between B and B' along the linear traverse BB' is 220m. The angle of the slope along this traverse is _____ degree (give answer in two decimal places).

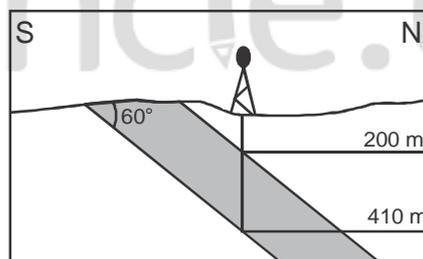


Q.51 – Q.60 carry two marks each.

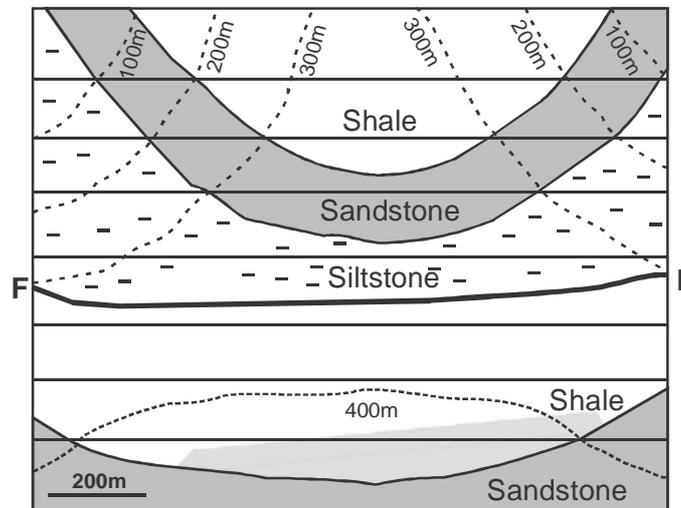
51. The half life of a radionuclide A is double that of a radionuclide B. The fraction of A remaining when B is reduced to $1/64$ is _____. Give answer in three decimal places.
52. The total metal content of a mineable $40\text{m} \times 40\text{m} \times 3\text{m}$ ore block having bulk density $2.75\text{g}/\text{cm}^3$ and assay value 1.5 wt % Cu is _____ metric tonnes.
53. The temperature at the Earth's surface is 25°C . The temperature at the base of the Earth's crust (30 km thick), if the geothermal gradients are $25^\circ\text{C}/\text{km}$ up to 15km depth and $15^\circ\text{C}/\text{km}$ further down, is _____ $^\circ\text{C}$.
54. A melt in the binary system $\text{MgO}-\text{SiO}_2$ contains 89.92 wt% SiO_2 . If all the magnesium is consumed to form enstatite (MgSiO_3), how many moles of this mineral will crystallize from 100 grams of the melt ? Give answer in two decimal places.
Molecular weight : MgO = 40.3, SiO_2 = 60.1
55. A lherzolite xenolith from the mantle contains 50 volume % olivine, the rest being equal proportions of orthopyroxene and clinopyroxene. If the densities of the minerals are (in g/cc) olivine = 3.42, orthopyroxene = 3.28 and clinopyroxene = 3.46, the bulk density of the xenoliths in g/cc is _____ (give answer in two decimal places).
56. The SiO_2 value, recalculated on volatile free basis, of the rock whose major oxide (wt%) composition given below is _____. Give answer in two decimal places.

SiO_2	45.58
Al_2O_3	12.49
FeO (T)	12.44
MgO	11.36
CaO	09.93
Na_2O	02.25
K_2O	01.67
Total	95.72

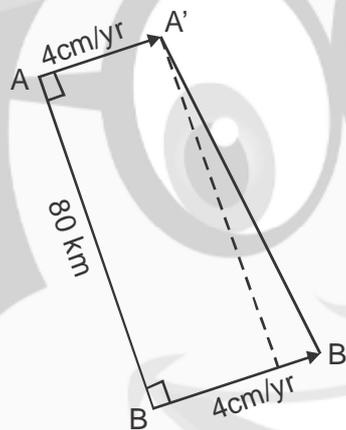
57. As shown in the following figure, a vertical well intersects the top and bottom of an inclined bed at 200 m and 410 m depths, respectively. If the true dip of the bed is 60° to the north, the true thickness of the bed is _____ metres.



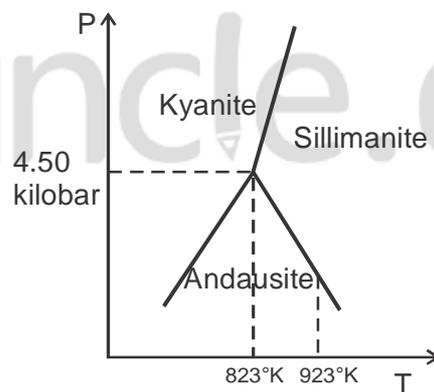
58. In the given geologic map, the horizontal lines are stratum contours. The throw on the fault (F-F) is _____ meters.



59. Two localities A and B on a continental plate as shown in the figure below, are separated by a distance of 80 km. The plate velocities measured at A and B are 4 cm/yr and 5 cm/yr, respectively. Assuming no faulting in the area, the new distance between A and B will be _____ km in one million years. Give answer in two decimal places.



60. In the following schematic diagram, the aluminosilicate triple point is located at the pressure of 4.50 kbar and temperature of 823°K. If the reaction andalusite = sillimanite has negative slope with a value of $-18.22 \text{ bar/}^\circ\text{K}$, the pressure of the reaction at 923°K is _____ kbar (give answer in two decimal places).



(Figure not to scale)

ANSWER KEY

SECTION-(A) MULTIPLE CHOICE QUESTIONS (MCQ)

1	2	3	4	5	6	7	8	9	10
A	A	C	D	B	B	D	A	C	A
11	12	13	14	15	16	17	18	19	20
C	B	D	C	C	A	D	A	C	D
21	22	23	24	25	26	27	28	29	30
C	D	B	B	B	B	A	B	D	C

SECTION-(B) MULTIPLE SELECT QUESTIONS (MSQ)

31	32	33	34	35	36	37	38	39	40
A,C,D	B,C,D	A,D	D	A,B,C,D	A,D	B,C	A,B	A,C	A,B,C,D

SECTION-(C) NUMERICAL ANSWER TYPE QUESTIONS (NAT)

41	42	43	44	45	46	47	48	49	50
25	-2	1.0	2.8	130	0.46	115	3	100	21.32
51	52	53	54	55	56	57	58	59	60
0.125	198	625	0.25	3.40	47.61	105	400	80.62	2.68

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Geology (GG)

Previous Year Solved Paper

Duration : 180 minutes

Maximum Marks : 100

Read the following instructions carefully.

1. This test paper has a total of 60 questions carrying 100 marks. The entire question paper is divided into **Three Sections A, B and C**. All sections are compulsory. Questions in each section are of different types.
2. **Section – A** contains **Multiple Choice Questions (MCQ)**. Each MCQ type question has four choices out of which only one choice is the correct answer. This section has 30 Questions and carry a total of 50 marks. Q.1 – Q.10 carry 1 mark each and Questions Q.11 – Q.30 carry 2 marks each.
3. **Section – B** contains **Multiple Select Questions (MSQ)**. Each MSQ type question is similar to MCQ but with a difference that there may be one or more than one choice(s) that are correct out of the four given choices. The candidate gets full credit if he/she selects all the correct choices only and no wrong choices. This section has 10 Questions and carry 2 marks each with a total of 20 marks.
4. **Section – C** contains **Numerical Answer Type Questions (NAT)**. For these NAT type questions, the answer is a real number which needs to be entered using the virtual numerical keypad on the monitor. No choices will be shown for these type of questions. This section has 20 Questions and carry a total of 30 marks. Q.1 – Q.10 carry 1 mark each and Questions Q.11 – Q.20 carry 2 marks each.

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SECTION-(A) MULTIPLE CHOICE QUESTIONS (MCQ)

Q. 1 to Q. 10 carry one mark each.

1. Which amongst the following planets has the highest number of known satellites?

(A) Mars	(B) Uranus
(C) Venus	(D) Mercury

2. Identify the mineral which has specific gravity > 5, hardness < 3 and gives grey streak.

(A) Barite	(B) Sphalerite
(C) Graphite	(D) Galena

3. A unit which is semi-permeable and does not yield any significant quantity of groundwater is called:

(A) Aquiclude	(B) Aquifer
(C) Aquitard	(D) Artesian Aquifer

4. A sandstone with less than 15% matrix content is known as:

(A) Siltstone	(B) Mudstone
(C) Greywacke	(D) Arenite

5. Which of the following mineral deposit is formed exclusively by surface geological processes?

(A) Wollastonite	(B) Asbestos
(C) Corundum	(D) Bauxite

6. Graphic texture is indicative of:

(A) Eutectic crystallization	(B) Crystal settling
(C) Fractional crystallization	(D) Magma mixing

7. Which of the following is NOT a form of the isometric system ?

(A) Octahedron	(B) Tetrahedron
(C) Trapezohedron	(D) Rhombohedron

8. Which of the following group of fossils became extinct at the Permo-Triassic boundary?

(A) Graptolite	(B) Trilobite
(C) Ammonite	(D) Ediacaran

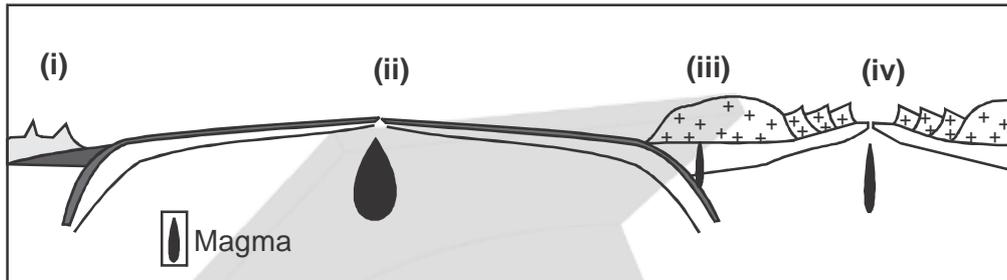
9. Arrange the following granitoid bodies in order of their decreasing age.

(P) Erinpura Granite	
(Q) Closepet Granite	
(R) Singhbhum Granite	
(S) Ladakh Granitoids	
(A) R-P-Q-S	(B) S-Q-R-P
(C) R-Q-P-S	(D) Q-R-S-P

10. Which of the following Brachiopod genera is considered as "living fossil" ?
- (A) Lingula (B) Productus
(C) Atrypa (D) Spirifer

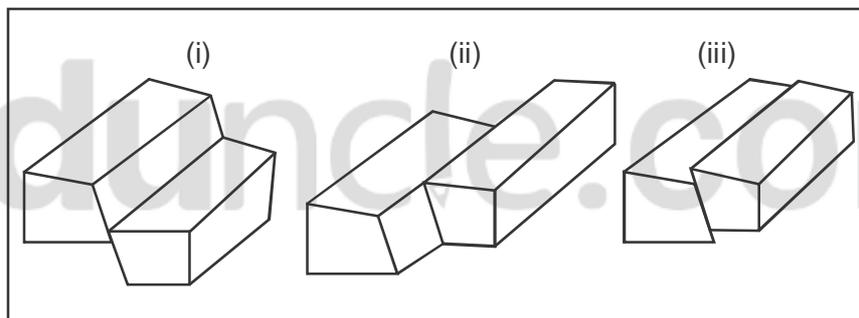
Q.11 – Q.30 carry two marks each.

11. In the given figure (i), (ii), (iii), and (iv) denote the plate tectonic settings: Mid Oceanic Ridge (M), Island Arc (I), Continental Arc (C) and Rift Zone (R).



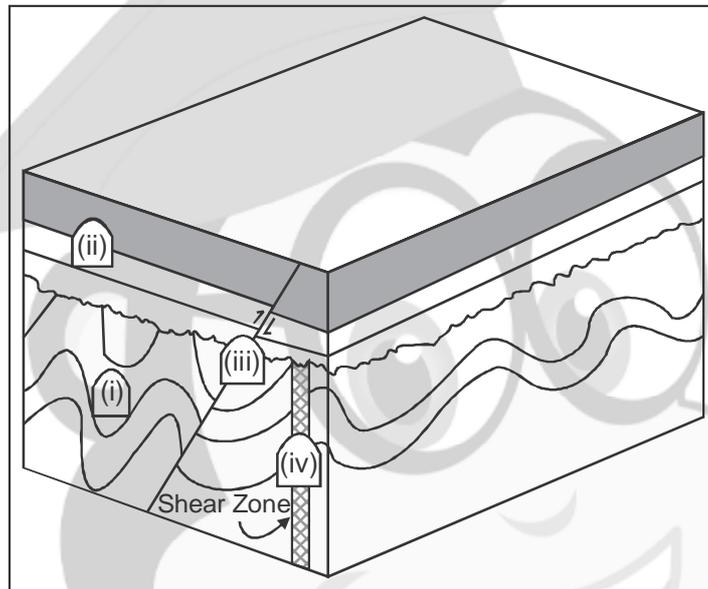
Which one of the following options is correctly matched?

- (A) (i) – M, (ii) – I, (iii) – C, (iv) – R (B) (i) – R, (ii) – I, (iii) – M, (iv) – C
(C) (i) – I, (ii) – R, (iii) – M, (iv) – C (D) (i) – I, (ii) – M, (iii) – C, (iv) – R
12. In an undulated topography, a set of uniformly inclined beds show 'V'-shaped outcrop pattern with apex pointing downstream in a valley. This indicates:
- (A) The dip of the beds is more than the slope of the valley
(B) The dip of the beds is less than the slope of the valley
(C) The beds are vertical
(D) The beds are horizontal
13. Silica-rich viscous magmas often produce:
- (A) Stratovolcano (B) Shield volcano
(C) Dome (D) Fissure eruption
14. Identify the faults in the diagrams (i), (ii), and (iii)



- (A) (i) – Normal, (ii) – Dextral strike slip, (iii) – Reverse
(B) (i) – Normal, (ii) – Sinistral strike slip, (iii) – Reverse
(C) (i) – Reverse, (ii) – Dextral strike slip, (iii) – Normal
(D) (i) – Reverse, (ii) – Sinistral strike slip, (iii) – Normal

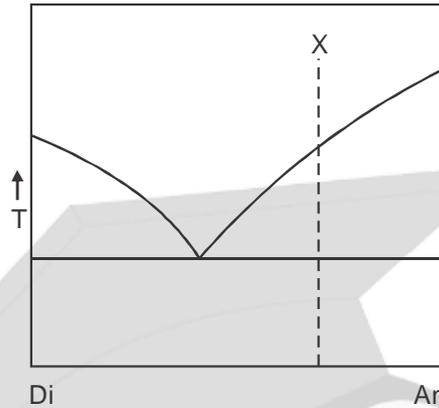
15. A mine excavation made along the strike of a 2 meter thick tabular ore body dipping 30° is called:
 (A) Crosscut (B) Raise
 (C) Drive (D) Shaft
16. An ore body showing 'saddle reef' structure is formed by:
 (A) Early magmatic crystallization process
 (B) Liquid immiscibility
 (C) Hydrothermal process
 (D) Metamorphic process
17. In the given block diagram, select the most suitable site amongst (i), (ii), (iii), and (iv) for constructing a tunnel.



- (A) (i) (B) (ii)
 (C) (iii) (D) (iv)
18. Match the metals listed in **Group-I** with their ores in **Group-II**.
- | Group - I | Group - II |
|------------------|-------------------|
| (i) Tin | (P) Scheelite |
| (ii) Tungsten | (Q) Pyrolusite |
| (iii) Copper | (R) Cassiterite |
| (iv) Manganese | (S) Bornite |
- (A) (i) – R, (ii) – P, (iii) – S, (iv) – Q (B) (i) – Q, (ii) – P, (iii) – S, (iv) – R
 (C) (i) – R, (ii) – Q, (iii) – P, (iv) – S (D) (i) – P, (ii) – S, (iii) – R, (iv) – Q
19. Which one of the following minerals is correctly matched with its optical property?
 (A) Sillimanite – Isotropic
 (B) Orthoclase – High relief
 (C) Pyroxene – Nearly orthogonal cleavage
 (D) Garnet – Lamellar twinning

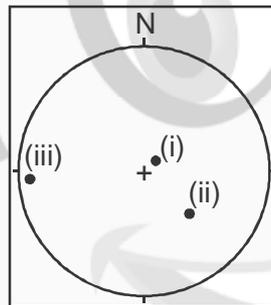
20. The mineral coesite is expected to be stable in which of the following metamorphic facies?
 (A) Greenschist (B) Blueschist
 (C) Eclogite (D) Granulite

21. In the given phase diagram, the sequence of minerals crystallizing from a magma of composition "X" under equilibrium conditions is:



- (A) An → Di (B) An → An + Di
 (C) Di → An (D) Di → Di + An

22. In the given stereo plot, poles to three bedding planes are plotted as points (i), (ii) and (iii). Find the correct order of increasing dips of the beds.



- (A) (i) – (ii) – (iii) (B) (i) – (iii) – (ii)
 (C) (ii) – (i) – (iii) (D) (iii) – (i) – (ii)

23. Size of a kettle lake depends upon :
 (A) Size of the sediment carried by the glacier
 (B) Width of the glacier valley
 (C) Height of the valley through which the glacier moves
 (D) Size of the buried ice block within moraines

24. Match the sedimentary rocks given in **Group-I** with their characteristics in **Group-II**

- | Group – I | Group – II |
|--|--|
| (i) Sandstone | (P) Chemical sediment |
| (ii) Arkose | (Q) Grain size 1/16 – 2 mm |
| (iii) Limestone | (R) Feldspar-rich |
| (iv) Shale | (S) Grain size < 1/16 mm |
| (A) (i) – R, (ii) – P, (iii) – S, (iv) – Q | (B) (i) – Q, (ii) – R, (iii) – P, (iv) – S |
| (C) (i) – Q, (ii) – R, (iii) – S, (iv) – P | (D) (i) – P, (ii) – S, (iii) – R, (iv) – Q |

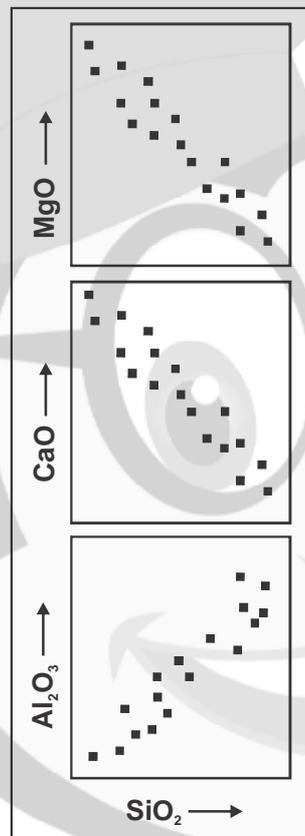
25. Arrange the following formations of the Gondwana Supergroup in order of their decreasing age:
- (i) Raniganj Formation
 - (ii) Barakar Formation
 - (iii) Kulti Formation
 - (iv) Karharbari Formation
- (A) (i) – (iii) – (ii) – (iv) (B) (i) – (ii) – (iii) – (iv)
 (C) (iv) – (iii) – (ii) – (i) (D) (iv) – (ii) – (iii) – (i)
26. Match the Lamellibranchia genera in **Group-I** with their dentition pattern in **Group-II**
- | Group – I | Group – II |
|------------------|-------------------|
| (i) Glycimeris | (P) Schizodont |
| (ii) Trigonia | (Q) Taxodont |
| (iii) Lucina | (R) Dysodont |
| (iv) Mytilus | (S) Heterodont |
- (A) (i) – Q, (ii) – P, (iii) – S, (iv) – R
 (B) (i) – P, (ii) – Q, (iii) – R, (iv) – S
 (C) (i) – Q, (ii) – P, (iii) – R, (iv) – S
 (D) (i) – S, (ii) – R, (iii) – Q, (iv) – P
27. Drainage density of a basin is defined as:
- (A) Sum of the number of streams of all orders divided by the area of the basin
 - (B) Total length of streams of all orders divided by the area of the basin
 - (C) Total number of the highest order streams divided by the total number of the next lower order streams
 - (D) Length of the largest stream divided by the area of the basin
28. S-wave is terminated at:
- (A) Crust—Mantle boundary
 - (B) Lithosphere—Asthenosphere boundary
 - (C) Mantle—Core boundary
 - (D) Inner and Outer core boundary
29. Arrange the elements Fe, O, H, He, Si in decreasing order of their abundance in the solar system.
- (A) H > He > O > Si > Fe (B) He > H > Si > O > Fe
 - (C) H > He > O > Fe > Si (D) Si > Fe > H > He > O
30. A dolerite dyke metamorphosed under amphibolite facies condition is expected to have the mineral assemblage:
- (A) Chlorite + Actinolite + Albite
 - (B) Lawsonite + Glaucofane + Epidote
 - (C) Orthopyroxene + Clinopyroxene + Plagioclase
 - (D) Hornblende + Plagioclase

SECTION-(B) MULTIPLE SELECT QUESTIONS (MSQ)

Q.1 – Q.10 carry two marks each.

1. A pyrite-chalcocopyrite-bearing copper ore body has undergone supergene enrichment. Choose the correct statement(s).
 - (A) Limonite is present in the gossan zone
 - (B) Cuprite is present in the zone of oxidation
 - (C) Chalcocite is present in the zone of supergene enrichment
 - (D) Malachite is present in the primary zone

2. The geochemical trends illustrated in the diagrams for a suite of cogenetic and coeval igneous rocks indicate :



- (A) Olivine crystallization
 - (B) Clinopyroxene crystallization
 - (C) Plagioclase crystallization
 - (D) Alkali feldspar crystallization
3. Which of the following chronostratigraphic unit(s) is/are correctly matched with the corresponding geochronologic unit(s) ?
 - (A) System—Period
 - (B) Stage—Era
 - (C) Series—Epoch
 - (D) Chronozone—Age

 4. Which of the following statements related to depositional environments is/are correct ?
 - (A) Herringbone cross-stratification indicates glacio-fluvial environment
 - (B) Dune is characterized by the presence of finer-grains at the top and coarser-grains at the bottom
 - (C) Dropstone is of glacial origin
 - (D) Bouma sequence indicates turbidite deposit

5. Which of the following fossil genera is/are invertebrate ?

(A) Megalodon	(B) Spondylus
(C) Stegodon	(D) Telemastodon

6. Which of the following trilobites have two to four thoracic segments and are eyeless?

(A) Agnostus	(B) Olenellus
(C) Calymene	(D) Microdiscus

7. Which of the following formation(s) was/were deposited in glacial and/or fluvial environment?

(A) Subathu Formation	(B) Karewa Formation
(C) Indus Formation	(D) Blaini Formation

8. Which of the following statements is/are correct?

(A) Rajpura-Dariba in Rajasthan is a working Pb-Zn deposit	(B) Iron ore is mined in Noamundi, Odisha
(C) The largest copper mine in India is located in Malanjkhand, Madhya Pradesh	(D) Manganese deposit is found in the Mansar Formation, Maharashtra

9. Which of the following stratigraphic units are correctly matched with their ages and geographical localities?

(A) Niniyur Formation – Cretaceous – Cauvery basin	(B) Long Formation – Oligocene – Andaman-Nicobar
(C) Zewan Formation – Permian – Kashmir-Lidar valley	(D) Bhandar Group – Early Proterozoic – Vindhyan basin

10. Petroleum producing basins of India belong to:

(A) Cambrian	(B) Cretaceous
(C) Tertiary	(D) Quaternary

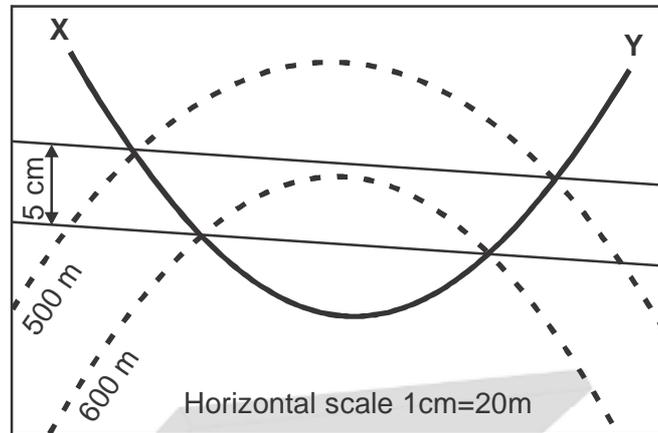
SECTION-(C) NUMERICAL ANSWER TYPE QUESTIONS (NAT)

Q. 1 – Q. 10 carry one mark each.

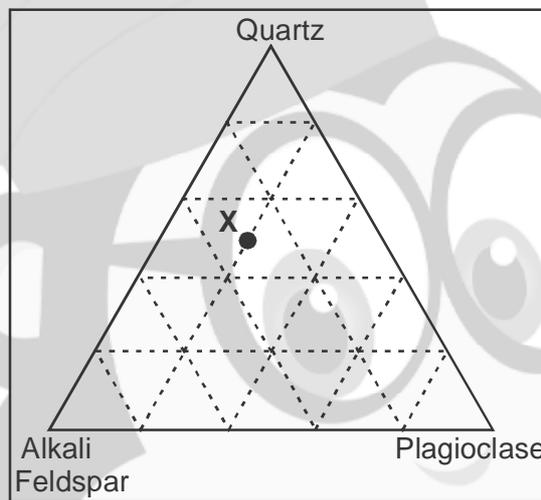
1. On a toposheet of 1:50,000 scale, the distance between upper and lower traces of a bed is 5 cm. The actual distance on ground in kilometers is_____.

2. On a flat topography the outcrop width of a bed is 30m. If the true dip of the bed is 30°, the actual thickness of the bed in meters is_____.

3. In the given map, the true dip (in degree) of the bedding plane X-Y is _____.

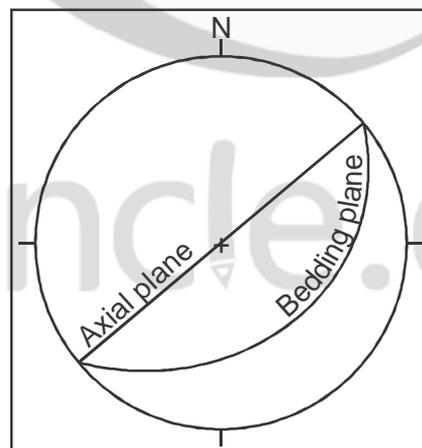


4. In the given diagram, the percentage of Plagioclase in a rock of composition 'X' is _____.



5. The birefringence of a uniaxial mineral having refractive indices of 1.658 and 1.486 is _____.

6. In the given stereoplots, the plunge amount of the fold axis is _____.

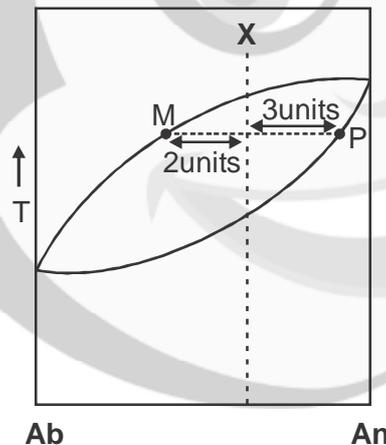


7. A crystal face has the following intercepts for the crystallographic axes: $1a_1$, $1a_2$, $\frac{1}{2}a_3$, ∞c . The Miller-Bravais indices for the face is _____.

8. Total number of mirror planes in the $\frac{4}{3} \bar{3} \frac{2}{m}$ point group is_____.
9. A radioactive isotope has 1024 atoms. How many atoms will remain after 4 half-lives?
10. Waste water discharged from a coal mine has hydrogen ion [H⁺] concentration of 10⁻⁶ moles/liter. The pH of the water is_____.

Q.11 – Q.20 carry two marks each.

11. An ore body is dipping 30° towards west on a flat topography. At what distance (in meters) should a borehole be placed so that it intersects the ore body perpendicularly at a vertical depth of 70 meters ?
12. Using the phase rule, the maximum number of phases in a 3 (three) component geological system having 1 (one) degree of freedom is_____.
13. The lithostatic pressure in Mega Pascal (MPa) at a depth of 10 km in a granite batholith having density 2700 kg/m³ is_____. (Acceleration due to gravity = 9.8 m/s²)
14. In the given phase diagram, the weight percent of melt at point 'M' for a crystallizing magma of bulk composition 'X' is_____.



15. Calculate the average atomic weight (answer to be given up to 3 decimal places) of Rubidium using the given data.

Isotope	Abundance (%)	Atomic weight (a.m.u.)
⁸⁵ Rb	72.17	84.912
⁸⁷ Rb	27.83	86.909

16. In an oblique slip fault having 30° dip, the net slip is 10 meters at an angle of 45° to the strike of the fault plane. The dip slip component of the fault in meters is_____. (Answer to be given up to 2 decimal places).

17. A 10 cm³ sandstone block has a mass of 20 grams. If the average density of sand grains is 2.5 g/cm³, the porosity (in percent) of the sandstone is_____.
18. A mineral has a weight of 4.5 grams in air and 3.2 grams in water. Assuming density of water to be 1g/cm³, the specific gravity (up to 2 decimal places) of the mineral is_____.
19. The duration of the Proterozoic Eon in Ma is_____.
20. From the given equation, calculate how many moles of magnetite will be produced by the reduction of 1 (one) mole of hematite (answer to be given up to 3 decimal places). .



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ANSWER KEY

SECTION-(A) MULTIPLE CHOICE QUESTIONS (MCQ)

1	2	3	4	5	6	7	8	9	10
B	D	C	D	D	A	D	B	C	A
11	12	13	14	15	16	17	18	19	20
D	A	C	B	C	C	B	A	C	C
21	22	23	24	25	26	27	28	29	30
B	A	D	B	D	A	B	C	A	D

SECTION-(B) MULTIPLE SELECT QUESTIONS (MSQ)

1	2	3	4	5	6	7	8	9	10
A,B,C	A,B	A,C	C,D	A,B	A,D	B,D	A,B,C,D	A,C,	B,C

SECTION-(C) NUMERICAL ANSWER TYPE QUESTIONS (NAT)

1	2	3	4	5	6	7	8	9	10
2.5	15	45	20	0.172	0	1120	9	64	6
11	12	13	14	15	16	17	18	19	20
161.63 -161.67	4	264.6	60	85.466	7.07	20	3.46	1900-2000	0.666-0.667

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Geology

Previous Year Solved Paper

Duration : 180 minutes

Maximum Marks : 100

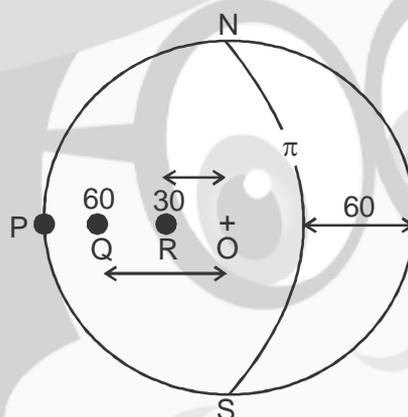
Note : Part-I consists of 35 objective type questions. The first ten questions carry one mark each and the rest of the objective questions carry two marks each. There will be negative marks for wrong answers. For each 1 mark question the negative mark will be 1/3 and for each 2 mark question it will be 2/3.

Part-II consists of 8 descriptive type questions each carrying five marks.

PART-I : OBJECTIVE TYPE QUESTION

Q. 1 to Q. 10 carry one marks each.

1. Identify the pole to the great circle π in the given stereographic projection.



- | | |
|-------|-------|
| (A) P | (B) Q |
| (C) R | (D) O |
2. Transform fault is a
- | | |
|-----------------------|------------------|
| (A) strike-slip fault | (B) normal fault |
| (C) reverse fault | (D) thrust fault |
3. In what type of country rock do sink-holes develop?
- | | |
|---------------|---------------|
| (A) Phyllite | (B) Gneiss |
| (C) Limestone | (D) Sandstone |
4. The Gutenberg discontinuity lies between
- | | |
|---------------------------------|-----------------------------------|
| (A) crust and mantle | (B) lithosphere and asthenosphere |
| (C) outer core and lower mantle | (D) inner core and outer core |
5. Among the following ores, of which is gossan a characteristic surface indicator ?
- | | |
|----------------------------|-------------------------|
| (A) pyrite-chalcopyrite | (B) chromite-magnetite |
| (C) pyrolusite-psilomelane | (D) columbite-tantalite |

6. Which of the following physical properties characterize galena?
 (A) Prismatic form (B) Cherry red streak
 (C) Yellow colour (D) High specific gravity
7. In which of the following rocks does groundwater flow obey Darcy's law ?
 (A) Shale (B) Sandstone
 (C) Marble (D) Granite
8. Which of the following minerals belongs to the cubic system?
 (A) Orthoclase (B) Quartz
 (C) Garnet (D) Apatite
9. Which one of the following rocks has maximum compressive strength?
 (A) Marble (B) Slate
 (C) Sandstone (D) Granite
10. From the sedimentary rocks listed below, select the most fine-grained
 (A) Sandstone (B) Conglomerate
 (C) Siltstone (D) Claystone

Qs. 11 to 35 carry two marks each

11. Which combination of geological entities occurs in the same craton?
 (A) Chitradurga schist belt-Closepet Granite-Hutti gold mine
 (B) Bhilwara Supergroup-Sittampundi anorthositic-Zawar Pb-Zn deposit
 (C) Kolar schist belt-Malani rhyolite-Malanjkhand copper deposit
 (D) Mansar Formation-Makrana marble-Sukinda chromite deposit
12. Choose the correct statement from the following :
 (A) Vindhyan Supergroup is devoid of limestone
 (B) The top of the Cuddapah Supergroup is Phanerozoic
 (C) Kaladgi basin is situated in the Baster Craton
 (D) The Mesozoic Bhuj Formation consists predominantly of sandstone
13. Identify the correct chronostratigraphic sequence of the Siwalik Group from the following (oldest to youngest):
 (A) Pinjor-Nagri-Dhok Pathan-Tatrot (B) Nagri-Dhok Pathan-Tatrot-Pinjor
 (C) Dhok Pathan-Tatrot-Nagri-Pinjor (D) Tatrot-Pinjor-Nagri-Dhok Pathan
14. If the strike of an inclined bed is $N15^{\circ}E$, the dip direction can be
 (A) $S75^{\circ}W$ (B) $N75^{\circ}E$
 (C) $S75^{\circ}E$ (D) $S15^{\circ}W$

15. Parallel fold is one in which
 (A) the orthogonal thickness is same all around the fold
 (B) the thickness is same parallel to the axial plane of the fold
 (C) the outer and inner arcs have same curvature
 (C) the dip isogons are parallel to each other
16. 'Comb structure' with 'symmetrical banding' is formed by
 (A) Early magmatic process (B) Hydrothermal process
 (C) Chemical sedimentary process (D) Residual concentration process

17. Match the items of **Group-I** with appropriate items in **Group-II**.

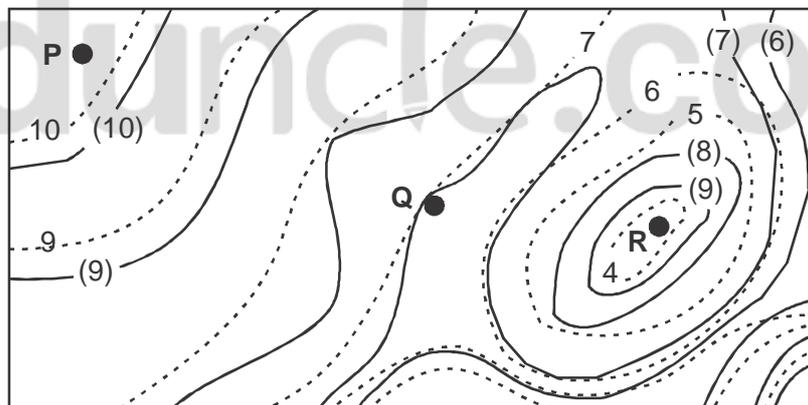
Group-I		Group-II	
P.	Banded Iron Formation	1.	Copper
Q.	Andesite porphyry	2.	Diamond
R.	Lamproite	3.	Rare metals
S.	Pegmatite	4.	Blue dust

Codes :

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

18. Which one of the following minerals is commonly used for determination of vibration direction of the polarizer in a petrological microscope ?
 (A) Muscovite (B) Hornblende
 (C) Augite (D) Tourmaline
19. A mafic rock in the eclogite facies may contain the assemblage
 (A) chlorite-epidote-albite
 (B) garnet-clinopyroxene-hornblende-plagioclase
 (C) garnet-clinopyroxene
 (D) garnet-clinopyroxene-orthopyroxene-plagioclase

20. Elevation contours of ground surface (values in parenthesis) and groundwater table (values in normal font) are given in the figure below.



— Elevation of ground surface (m)
 - - - - - Elevation of groundwater table (m)

What do the points P, Q and R represent ?

- (A) P-recharge area, Q-spring, R-discharge area
- (B) P-discharge area, Q-spring, R-recharge area
- (C) P-spring, Q-recharge area, R-discharge area
- (D) P-discharge area, Q-recharge area, R-spring

21. Airy's model of isostasy

- (A) requires mountains to have higher density than the oceanic crust
- (B) requires mountains to have lower density than the oceanic crust
- (C) requires mountains to have the same density as oceanic crust
- (D) does NOT consider the densities of mountain and oceanic crust

22. Choose the correct statement about the igneous forms, lopolith and laccolith.

- (A) Both are concordant; lopolith is convex upward while laccolith is concave upward
- (B) Both are discordant; both are convex upward
- (C) Both are concordant; laccolith is convex upward, while lopolith is convex downward
- (D) Both are discordant; both are convex downward

23. Which one of the following belongs to the Equidae family ?

- (A) Stegodon
- (B) Stegolophodon
- (C) Ramapithecus
- (D) Gigantopithecus

24. Which one of the following flora is a conifer ?

- (A) Glossopteris
- (B) Gangamopteris
- (C) Buriadia
- (D) Schizoneura

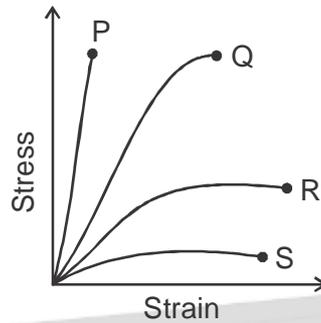
25. Match sedimentary features in **Group-I** with the processes in **Group-II**.

Group-I		Group-II	
P.	Flute cast	1.	Deformation of sediments
Q.	Convolute lamination	2.	Erosion
R.	Cross-stratification	3.	Fluctuating current
S.	Flaser bedding	4.	Migration of bed forms

Codes :

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

26. Stress-strain deformation curves for four rocks P, Q, R and S are given below. The dots at the ends of the curves indicate the respective failure points of each rock. Choose the rock with the highest brittle strength.



- (A) P (B) Q
(C) R (D) S
27. A closed form belonging to crystal class $\frac{4}{3} \frac{2}{m}$ intercepts the axes at $a = 1$, $b = 1$ and $c = \infty$. The name and the Miller Indices of the form are
- (A) Octahedron (111) (B) Hexoctahedron (321)
(C) Cube (100) (D) Dodecahedron (110)

28. Match the mineral deposits in **Group-I** with the localities of their occurrences in **Group-II**.

Group-I		Group-II	
P.	Lignite	1.	Dariba
Q.	Fluorite	2.	Noamundi
R.	Chromite	3.	Panandhro
S.	Sphalerite-Galena	4.	Amba Dongar
		5.	Naushahi

Codes :

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

29. Match the minerals in **Group-I** with their optical properties in **Group-II**.

Group-I		Group-II	
P.	Quartz	1.	Oblique extinction
Q.	Hornblende	2.	Isotropic
R.	Muscovite	3.	Mottled extinction
S.	Garnet	4.	Uniaxial positive

Codes :

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

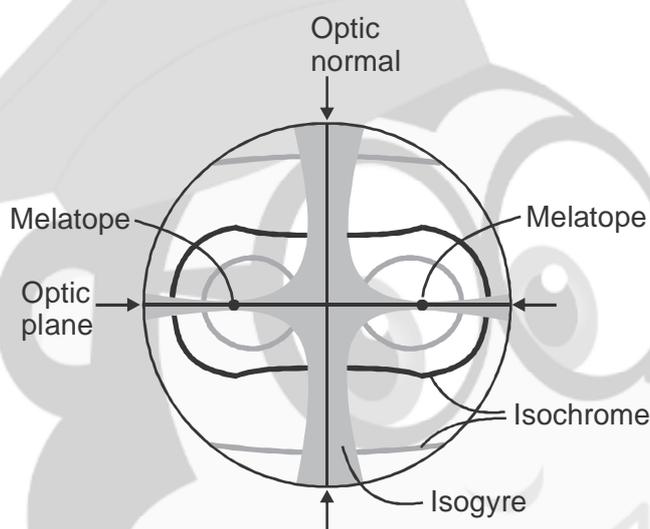
30. Two minerals, P and Q, were studied under the microscope. Mineral P is characterized by two orthogonal cleavages. Mineral Q has more than one set of cleavage, but these are NOT at right angles; Q also changes relief on rotation of the stage. Identify P and Q from the following alternatives:

- (A) P-hornblende, Q-calcite (B) P-calcite, Q-diopside
 (C) P-diopside, Q-hornblende (D) P-diopside, Q-calcite

31. A potash-rich ultrabasic rock containing phlogopite both as megacrysts and groundmass is

- (A) leucite syenite (B) K-rich granite
 (C) carbonatite (D) kimberlite

32. Identify the interference figure given below



- (A) Biaxial optic normal figure (B) Biaxial acute bisectrix figure
 (C) Uniaxial optic axis figure (D) Uniaxial flash figure

33. Match the genera in **Group-I** with the phyla in **Group-II**.

Group-I		Group-II	
P.	Mya	1.	Echinodermata
Q.	Micraster	2.	Mollusca
R.	Olenoides	3.	Brachiopoda
S.	Leptaena	4.	Arthropoda

Codes :

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

34. Match the landforms given in **Group-I** with the causative processes given in **Group-II**.

Group-I		Group-II	
P.	Strath	1.	Glacial deposition
Q.	Drumlins	2.	Glacial erosion
R.	Cirque	3.	Fluvial deposition
S.	Point bar	4.	Fluvial erosion

Codes :

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

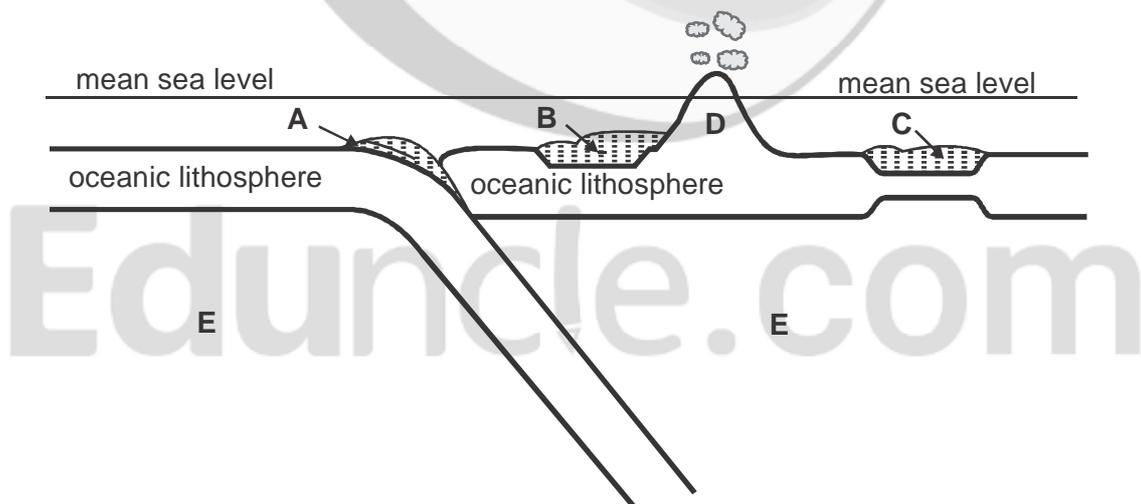
35. Which of the following symbols indicates a synform?



PART-II : DESCRIPTIVE QUESTIONS

Q. 36 to Q. 43 carry five marks each.

36. The figure below is a schematic section across an ocean-ocean subduction zone. Identify the features A, B and C that are characterized by sedimentary accumulations. What does the elevated zone D represent ? What is the zone E that lies on both sides of the subducting oceanic lithosphere ?



- A :
- B :
- C :
- D :
- E :

37. Given below is a list of gastropods.

Conus, Turritella, Vermetus, Calliostoma, Aporrhais, Acteonella, Schizostoma, Bellerophon
 Identify the biconical, discoidal and turreted forms.

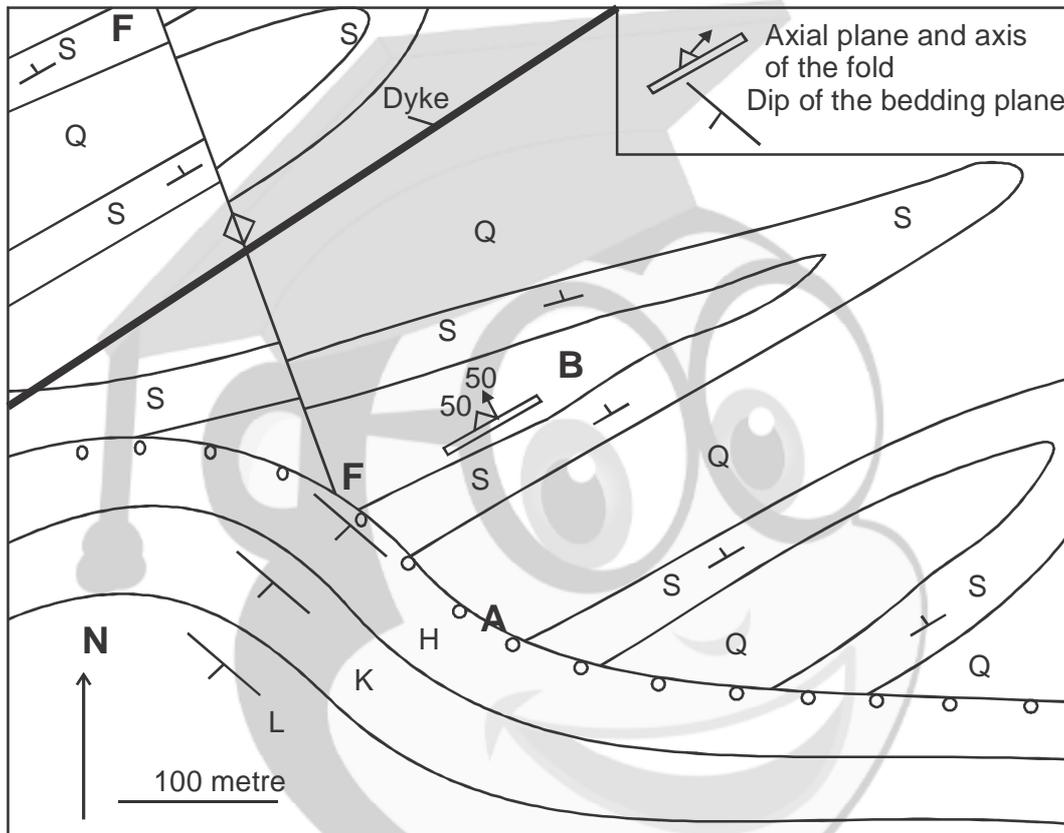
Biconical :

Discoidal :

Turreted :

Distinguish between holostomatous and siphonostomatous apertures in gastropods.

38. Based on the geological map, answer the questions below.



Identify the nature of the surface passing through A.

Identify the sets of beds and the relative ages of those sets.

Identify the nature of the fold at B.

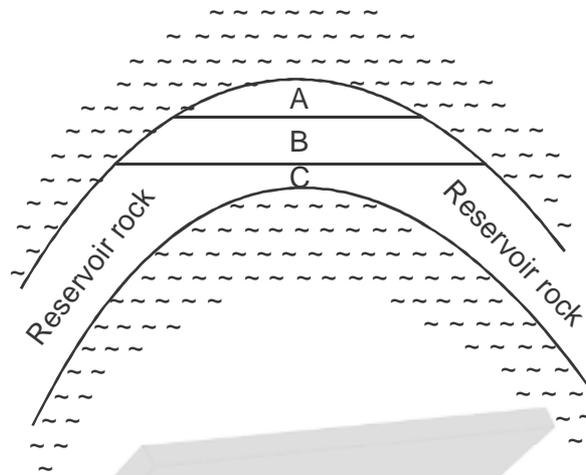
In the map, vertical fault F-F cuts across the dyke and adjacent beds. Find the nature of slip along the fault.

Why is the dyke NOT displaced by the fault ?

39. Which type of topography and climatic conditions are suitable for formation of plateau-type bauxite deposits ?

Name two essential minerals found in bauxite.

The figure below shows an idealized anticlinal hydrocarbon reservoir containing oil, gas and water. Which zone out of A, B and C will be occupied predominantly by oil, and why ?



40. Study the textural relations given below:



In what sequence are the minerals garnet, chlorite and staurolite formed? Give reasons for your answer.

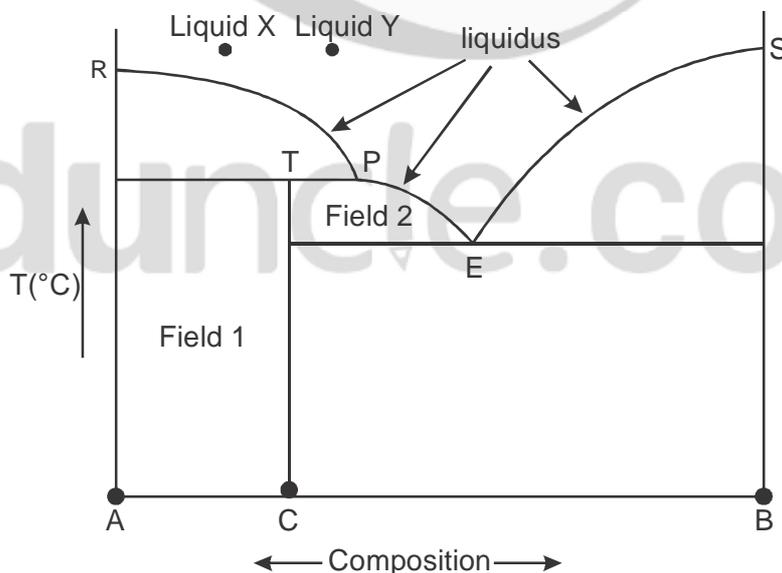
Two pelitic rocks, A and B, contain the following assemblages:

A : Quartz-sillimanite-garnet-muscovite-biotite-graphite

B : Quartz-sillimanite-garnet-K-feldspar-biotite-graphite

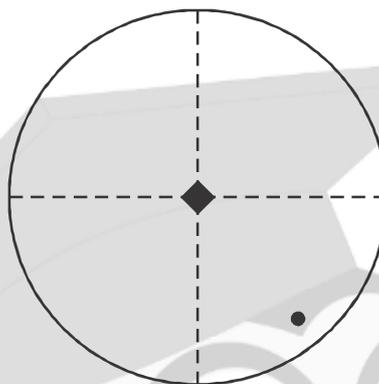
Which of the following can be called a 'khondalite', and why?

41. The figure below represents an isobaric binary system involving the solid phases A, B and C and their liquidus phase relations. Based on the figure, answer the following questions.



What phases (among A, B, C and liquid) are stable in Field 1 and Field 2, respectively ?
 At which point in this figure can a 'corona' texture develop ?
 Trace the equilibrium crystallization histories of liquid X and liquid Y.

42. The figure below is a stereographic projection of the symmetry elements in the class 4/m of the Tetragonal system, with a tetrad axis normal to a plane of symmetry. Given the projection of one face (marked by a dot in the figure), how many faces will the form have? What is the name of this form?



Write the Si:O ratios of **olivine**, **diopside** and **nepheline**.

43. A stratigraphic column, consisting of formations A, B and C (from bottom to top), having mutual gradational contacts, is characterized as follows:
 C – shore-face sandstone
 B – inner to middle shelf sandstone-shale alternation
 A – outer shelf mud with occasional thin sandstone

What does this stratigraphic column indicate – transgression or regression ? Justify.
 Which formation has the sandstone with the least matrix, and why ?
 Which formation has the most rounded sand grains ?

ANSWER KEY

1	2	3	4	5	6	7	8	9	10
B	A	C	C	A	D	B	C	D	D
11	12	13	14	15	16	17	18	19	20
A	D	B	C	A	B	A	D	C	A
21	22	23	24	25	26	27	28	29	30
C	C	B	C	B	A	D	B	C	D
31	32	33	34	35					
D	B	D	A	A					