

Serial No.

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C-HFP-L-HMB

## GEOLOGY

### Paper—II

Time Allowed : Three Hours

Maximum Marks : 200

### INSTRUCTIONS

*Candidates should attempt SIX questions in all including Question No. 1, which is compulsory, from Part—I and attempt ONE question each from Sections A, B, C, D and E from Part—II.*

*The number of marks carried by each question is indicated at the end of the question.*

*Answers must be written only in ENGLISH.*

*Symbols and abbreviations are as usual.*

*Neat sketches may be drawn to illustrate answers, wherever required.*

### PART—I

1. Write brief explanatory notes on any TEN of the following :— 5×10=50
- (a) Birefringence
  - (b) Laccolith
  - (c) Tonalite
  - (d) Boninite

- (e) Skarns
- (f) Blueschist facies
- (g) Silt and sand
- (h) Turbulent flow
- (i) Terrestrial planets
- (j) Transitional elements
- (k) Porphyroclasts
- (l) Tsunamis.

**PART—II**  
**SECTION—A**

2. Displacive and reconstructive phase transformations explain the stability relations of crystalline  $\text{SiO}_2$  group of minerals — Write a critique. 30
3. Write at least two characteristic optical properties to distinguish the following minerals :— 6×5=30
  - (a) Quartz and plagioclase
  - (b) Kyanite and sillimanite
  - (c) Chlorite and chloritoid
  - (d) Hornblende and epidote
  - (e) Muscovite and biotite.

**SECTION—B**

4. With suitable balanced chemical reactions, describe the mineralogical changes that take place during prograde metamorphism of a basaltic rock from greenschist to granulite facies. 30

5. Attempt the following with terse and precise answers :— 6×5=30

- (a) What are the differences between aphanitic and porphyritic textures ?
- (b) On simple thermodynamic rationale, explain why some mineralogical reactions are suitable for thermometry, while others are good barometers.
- (c) With a suitable sketch, describe the IUGS classification of igneous rocks.
- (d) Comment on the age, mineralogy, chemistry and origin of anorthosites.
- (e) Enumerate the nature of magmatism that takes place in the island arcs.

### SECTION—C

6. With neat sketches, describe the primary depositional sedimentary structures. 30

7. Attempt the following with terse and precise answers :— 6×5=30

- (a) With schematic sketches and using at least two indicators explain how you can perform paleocurrent analysis in a sedimentary terrain.
- (b) Explain how grain sorting in sedimentary rocks affects their porosity.
- (c) Explain the relationship between kurtosis and sedimentary particle size.
- (d) Describe the utilitarian aspects of sedimentary basin analysis.

- (e) Define Stokes law and enumerate its significance in Sedimentology.

### SECTION—D

8. With a schematic sketch, describe the geochemical cycle for the whole Earth system. Briefly illustrate and explain the oxygen and carbon cycles. 10+20=30
9. Attempt the following with terse and precise answers :— 6×5=30
- (a) A granite contains 25% quartz and 75% alkali feldspar. If the feldspar contains 66 weight %  $\text{SiO}_2$ , calculate the amount of  $\text{SiO}_2$  in the granite.
- (b) Consider a rock containing 2 weight %  $\text{K}_2\text{O}$  metamorphosed to form a granulite and a quarter of it melt to give a granite containing 4 weight %  $\text{K}_2\text{O}$ . How much of  $\text{K}_2\text{O}$  will the residual granulite contain ?
- (c) Differentiate between the Nernst distribution coefficient and bulk distribution coefficients. Calculate the bulk distribution coefficient for the element Er in a garnet lherzolite containing 60 weight % olivine (Ol), 25 weight % orthopyroxene (Opx), 10 weight % clinopyroxene (Cpx), and 5 weight % (Grt), from the following mineral-melt distribution Nernst distribution coefficients :

	Ol	Opx	Cpx	Grt
Er	0.026	0.023	0.583	4.7

- (d) Which nucleosynthetic processes are responsible for the synthesis of elements heavier than Fe and Ni ? Also list the likely astrophysical settings of these processes.
- (e) What are rare earth elements (REE) ? How would the REE pattern of a melt formed from plagioclase-lherzolite source be different from that of a garnet-lherzolite source, for the same degree of partial melting ?

### SECTION—E

10. Attempt the following with terse and precise answers :— 6×5=30
- (a) What are the causes behind formation of acid water associated with mining and how can we overcome the problem of acid drainage by suitable chemical treatment ?
- (b) Explain how groundwater is-contaminated.
- (c) With schematic sketches, briefly describe various slope failures..
- (d) Briefly discuss the factors that affect river flooding.
- (e) With schematic sketch, describe the various types of soil horizons. Add a brief note on the effect of parent rock on the soil composition.
11. Describe the various parameters that constitute earthquake *risks* and enumerate the subsequent *hazards*. 15+15=30