

Date : October 11, 2025
Total Marks : 100
Writing Time : 150 minutes (2.5 hours)
Reading Time : 15 minutes (prior to writing time)

1. Write your Registration Number clearly and correctly on the Answer Booklet.
2. The first 15 minutes is to check the number of pages of Question Paper, printing errors, clarify doubts and to read the instructions. You are NOT permitted to write during this time.
3. This paper consists of **TWO SECTIONS**, namely SECTION A & SECTION B:
 - **SECTION A** has two parts:
 - Part I - 30 Multiple Choice Questions
 - Part II - 4 Short Answer QuestionsAll questions under SECTION A are **COMPULSORY**.
 - **SECTION B** consists of two Case Studies. Choose only **ONE** case study and answer the questions of your choice.
4. All answers should be written on the Answer Booklet provided to you. Candidates are not allowed to write anything on the question paper. If required, ask for additional Answer Booklet.
5. All answers should be written with correct numbering of Section, Part and Question Number in the Answer Booklet provided to you. Note that any answer written without indicating the Section, Part and Question Number will NOT be evaluated and no marks will be awarded.
6. Begin each Section and Part on a fresh page of the Answer Booklet.
7. You are not permitted to tear off any sheet(s) of the Answer Booklet as well as the Question Paper.
8. Use of any other paper including paper for rough work is not permitted.
9. **You must hand over the Answer Booklet to the Invigilator before leaving the examination hall.**
10. This paper has **8 printed pages**, including this instruction page.

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SECTION A

PART I: Multiple Choice Questions [30 marks]

Choose the correct answer and write down the letter of your chosen answer in the Answer Booklet against the question number e.g. 31 (d). Each question carries ONE mark. Any double writing, smudgy answers or writing more than one choice shall not be evaluated.

1. Basalts are composed of the following the minerals:

- i. Pyroxene
- ii. Plagioclase
- iii. Quartz
- iv. Orthoclase
- v. Olivine

Chose the correct answer from the options given below:

- a) i, ii and iii only
- b) i, ii and iv only
- c) i, ii and v only
- d) All of the above

2. Arrange the following minerals with increasing order of stability for weathering

- i. Illite
- ii. Olivine
- iii. Calcite
- iv. Ca rich feldspar
- v. Na rich feldspar

Chose the correct answer from the options given below:

- a) ii, iii, iv, v, i
- b) ii, iii, v, iv, i
- c) iii, ii, v, iv, i
- d) iii, ii, iv, v, i

3. Strike-slip faults are examples of plate movement which is

- a) at 45° to the strike of the fault plane
- b) perpendicular to the strike of the fault plane
- c) parallel to the strike of the fault plane
- d) None of above

4. Exfoliation is a form of:

- a) Chemical weathering
- b) Physical weathering
- c) Mass wasting
- d) Biochemical weathering

5. Rock outcrop is seen everywhere on Earth:
 - a) True
 - b) False
6. The study of spatial and temporal relationships between bodies of rock is called
 - a) Paleontology
 - b) Petrology
 - c) Stratigraphy
 - d) Geomorphology
7. The most common rock stratigraphic unit is
 - a) Members
 - b) bed
 - c) Formation
 - d) group
8. Dinosaurs evolved and became dominant during the
 - a) Cenozoic
 - b) Tertiary
 - c) Mesozoic
 - d) Paleozoic
9. The geologic epoch that we currently live is called
 - a) Miocene
 - b) Eocene
 - c) Holocene
 - d) Pleistocene
10. The valueless minerals present in an ore mineral is called?
 - a) Non-metallic minerals
 - b) Metallic minerals
 - c) Flux minerals
 - d) Gangue minerals
11. Ore deposits which are formed simultaneously with the enclosing rocks are called:
 - a) Epigenetic
 - b) Syngenetic
 - c) Magmatic
 - d) Supergene
12. The most common ore of Lead is:
 - a) Sphalerite
 - b) Chromite
 - c) Galena
 - d) Pyrite

13. On the basis of which content igneous rocks are classified as acidic or basic rocks?
- a) Calcium
 - b) Magnetite
 - c) Bauxite
 - d) Silica
14. The ratio of the volume of voids to the total volume of the materials is known as
- a) Permeability
 - b) Porosity
 - c) Specific retention
 - d) Conductivity
15. A fold in which both limbs dip away from the center is called
- a) Syncline
 - b) Monocline
 - c) Dome
 - d) Anticline
16. Karst topography is mainly developed in
- a) Granite
 - b) Gneiss
 - c) Sandstone
 - d) Limestone
17. A cuesta is best described as
- a) A symmetrical ridge
 - b) A dome-shaped hill
 - c) An asymmetrical ridge with a gentle and steep slope
 - d) A volcanic cone
18. The angle of repose of a soil or rock mass is?
- a) The angle of maximum slope at which materials remains stable
 - b) The angle of internal friction
 - c) The dip of bedding planes
 - d) None of the above
19. Uniaxial Compressive Strength (UCS) test is used to measure
- a) Tensile strength of rock
 - b) Shear strength of soil
 - c) Compressive strength of intact rock
 - d) All of the above

20. Which of the following discontinuities is most critical for slope stability?
- a) Vertical joints perpendicular to the slope
 - b) Joints dipping out of the slope
 - c) Fractures parallel to the slope
 - d) Bedding planes dipping into the slope
21. Rock Mass Rating (RMR) system is used for
- a) Identifying mineral composition
 - b) Estimating rock mass quality for engineering purposes
 - c) Measuring permeability of rock
 - d) None of the above
22. Which soil is most susceptible to liquefaction during seismic shaking
- a) Dense sand
 - b) Saturated loose sand
 - c) Clay
 - d) Gravel
23. The presence of clay minerals in soil generally
- a) Increases permeability
 - b) Decreases plasticity
 - c) Increases cohesion and plasticity
 - d) All of the above
24. A joint is
- a) A fracture with displacement
 - b) A type of unconformity
 - c) A fracture with no or negligible movement
 - d) None of the above
25. The Main Central Thrust (MCT) in the Himalayas separates
- a) The Tethyan Himalaya from the Higher Himalayas
 - b) The Siwalik from the Lesser Himalayas
 - c) The Lesser Himalayas from the Higher Himalayas
 - d) The Lesser Himalayas from the Indo-Gangetic plains
26. The Tethyan Himalayan Sequence mainly comprises of
- a) Crystalline basement
 - b) Metamorphic gneiss and schist
 - c) Recent fluvial deposits
 - d) Paleozoic-Mesozoic sedimentary rocks

27. The imbricate thrusting is best observed in
- a) The Higher Himalayas
 - b) The Lesser Himalayas
 - c) The Siwaliks
 - d) Tethyan Himalayas
28. Which of the following structures is the youngest?
- a) The Main Central Thrust (MCT)
 - b) The South Tibetan Detachment System (STDS)
 - c) The Main Boundary Thrust (MBT)
 - d) The Main Frontal Thrust (MFT)
29. Which seismic waves cannot travel through liquid?
- a) P-waves
 - b) S-waves
 - c) Rayleigh waves
 - d) Love waves
30. A V-shaped pattern of contour lines pointing uphill usually represents:
- a) Ridge
 - b) Valley
 - c) Cliff
 - d) Fault

PART II – Short Answer Questions [20 marks]

This part has 4 Short Answer Questions and ALL are compulsory. Each question carries 5 marks

1. List and briefly explain three physical properties used to identify minerals in hand specimen.
2. What is the Principle of Superposition? Explain its significance with appropriate diagram.
3. Explain the term rock cycle with a simple diagram.
4. Explain the difference between porosity and permeability in rocks.

SECTION B: CASE STUDY [50 marks]

Choose either CASE I OR CASE II from this section. Each case study carries 50 marks.

CASE I

Scenario

You are assigned with a task to perform a preliminary slope stability assessment of a hillside located near a recently proposed hydropower project site. The slope has shown signs of minor rockfall and shallow landslides during the last monsoon season. Your task is to evaluate the stability conditions and provide appropriate stabilization measures.

Data provided

- Slope angle: 35°
- Rock type: para-gneiss with foliation dipping 40° towards NE
- Soil overburden thickness: 1.5m, classified as silty clay
- Water table depth: 3m below the slope surface
- Rainfall intensity during monsoon: 120mm/day
- Cohesion (c) of soil: 15 kPa
- Internal angle of friction (ϕ): 25°
- Bulk unit weight of soil: 18 kN/m^3
- Estimated factor of safety (FoS) from simple infinite slope model: 0.86 (unstable if $\text{FoS} < 1.0$)

Task

Write a preliminary slope stability assessment report for the site based on the above data. Your report should address the following:

- **Introduction:** Describe the objective and importance of slope stability assessment at the site. (5 marks)
- **Data Collection:** Summarize the geological and geotechnical data available for the site and any assumptions you made. (8 marks)
- **Analysis and Discussion:** Calculate the factor of safety using an infinite slope model and discuss the implications of the results for slope stability considering geological features. (15 marks)
- **Recommendation:** Suggest at least three mitigation or stabilization measures appropriate for this slope. (10 marks)
- **Limitation of the Study:** Discuss limitations related to the data and methodology used in your assessment. (5 marks)
- **Conclusion:** Summarize your findings and final remarks on the slope condition. (7 marks)

CASE II

Scenario

You are tasked to conduct a geological mapping study in an area of 10 km² of a known mineralized belt to prospect for potential base metal mineralization. The region consists of metamorphosed volcanic and sedimentary rocks with quartz veins and sulfide mineralization occurrences.

Data provided

- Rock types: Amphibolite, schist, quartzite and quartz veins
- Known mineral occurrences: Chalcopyrite and pyrite in quartz veins
- Structural data: Foliation strikes N45°E and dips 60° SE; several brittle faults trending NW-SE
- Geochemical soil anomaly data: Elevated Cu and Fe concentration in southern part of the area
- Previous drilling shows alteration zones near quartz veins

Task

Prepare a geological mapping report that includes:

- **Introduction:** Importance of geological mapping in mineral exploration. **(5 marks)**
- **Data Collection:** Outline the types of data collected during field mapping and laboratory analyses. **(7 marks)**
- **Analysis and Discussion:**
 - Interpret the structural controls on mineralization in the area.
 - Correlate lithology, alteration zones, and geochemical anomalies to identify potential target zones for further exploration. **(20 marks)**
- **Recommendation:** Propose next steps for detailed exploration or drilling programs. **(8 marks)**
- **Limitation of the Study:** Identify challenges or gaps in data that may affect exploration success. **(5 marks)**
- **Conclusion:** Provide a concise summary of mapping results and exploration potential. **(5 marks)**

TASHI DELEK