

Junior Research Fellowship in Geology, 2016

The candidates for Junior Research Fellowship in Geology will have to take two tests: Test GEA (forenoon session) and Test GEB (afternoon session).

Syllabus (GEB)

Structural Geology and tectonics

Interpretation of geological maps. Concepts of stress and strain, plastic and viscous flow; theory of brittle fracture. Fold and fault – their geometry, classification and mechanics. Superposed folds and their recognition. Classification and genesis of foliation, lineation and joints. Outline of the structure of the Himalayas. Isostasy and gravity anomalies.

Plate tectonics and mobile belts, seismicity and seismic zones. Ophiolites and their tectonic significance, Epirogeny, Rifts, Mantle Plumes.

Mineralogy

Principles of mineral optics, methods of mineral identification and properties of common rock forming minerals.

Petrology

Phase equilibria studies of various silicate systems with reference to petrogenesis. Various types of magmas, magmatic differentiation and assimilation. Petrogenetic study of important igneous or groups of igneous rocks – granites, alkaline rocks, andesite, basalt. Processes of generation of magmas in the crust and upper mantle – correlation with plate tectonics. Controls of metamorphism, nature of metamorphic reactions, chemical equilibrium. Metamorphic facies concept: mineral assemblages and important reactions in different metamorphic facies. Relationship between metamorphism, ultrametamorphism and granitization. Petrogenetic problems of Khondalite, Charnockite and other metamorphic rocks of India.

Geochemistry and Geochronology

Radioactivity : Radioactive decay, age and event dating, nuclear clocks. Geochemical classification and distribution of elements in the earth. Law of ionic substitution, concept of solid solution and controlling factors.

Sedimentology

Classification of sedimentary rocks. Transport of sediments by fluids. Sedimentary structures. Texture of sedimentary rocks. Environments of deposition and resulting succession of sedimentary structures and lithologies. Processes and products of continental, transitional to marine and marine depositional environments. Sedimentary facies analysis. Lithification and diagenesis of sediments. Statistical analysis of grain size and shape. Palaeocurrents and basin analysis. Major controls of sedimentation.

Economic geology

Principles of classification of mineral deposits. Characters of common ore forming minerals. Processes of formation of economic mineral deposits. Strategic, critical and essential minerals of India.

Palaeontology

Evolution of life. Fossils, their nature, modes of preservation and uses. Migration, dispersal and extinction of animals and plants. Morphology, classification and evolution of important invertebrate and vertebrate fossil groups. Microfossils – techniques of their study and importance in geology. Fundamentals of palaeoecology. Brief study of the important Gondwana flora and fauna of India.

Stratigraphy

Principles of stratigraphy. Stratigraphic Units. Standard geological time scale. Principles of palaeogeographic reconstruction. Principles of stratigraphic correlation. Outline of sequence stratigraphy. Study of the important geological formations of India. Age and correlation problem in Indian stratigraphy.

GIS and Remote Sensing

Elementary concepts and definitions of Geographical Information System, Remote Sensing, and Global Positioning System. Spatial coordinate systems, map projections and basics of coordinate transformation. Methods of storing vector map data (geometric and non-geometric attributes) in digital formats. Methods of storing remotely sensed image information in digital formats. Sensors, energy sources, and characteristics of satellite images. Elementary techniques of analyzing vector and raster geospatial data.

Indian Statistical Institute
Junior Research Fellowship in Geology, Entrance Examination
2016
Sample Questions

BOOKLET No.

TEST CODE: **GEB**

Afternoon

Time: 2 hours

Part I - one question	1 X 25 = 25
Part II –five questions	5 X 8 = 40
Part III –five questions	5 X 4 = 20
Part IV –fifteen questions	15 X 1 = 15
Total	100

Give your answers in the answer booklet only.

Write your Name, Registration Number, Test Centre, Test Code and the Number of this booklet in the appropriate places on the answer sheet.

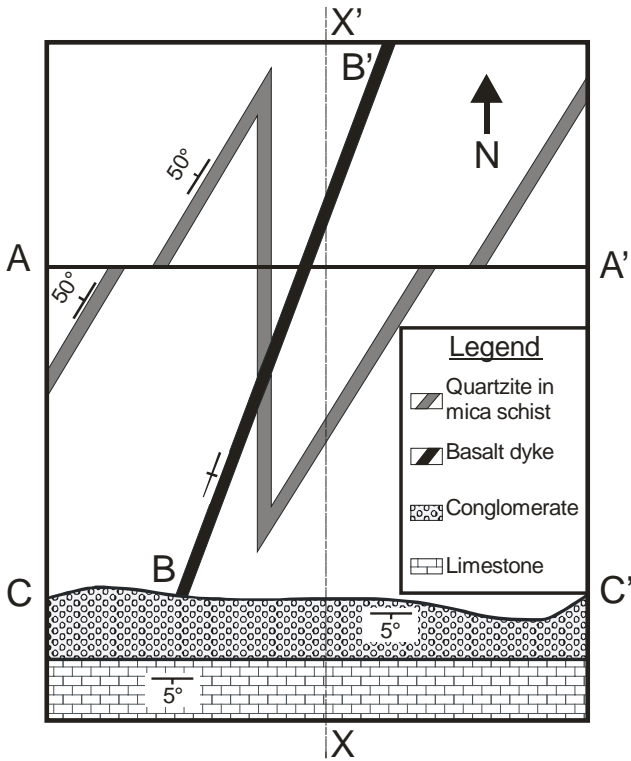
STAPLE/ATTACH QUESTION BOOKLET WITH THE ANSWER BOOKLET. ALL ROUGH WORK MUST BE DONE ON THE QUESTION BOOKLET AND / OR ON THE ANSWER BOOKLET.

WAIT FOR THE SIGNAL TO START WRITING

Part-I

(One question, twenty five marks)

1.



The given map pattern was observed on a flat topographic surface. AA' is a normal dip-slip fault and BB' is a vertical basalt dyke.

- 1) What is the approximate dip direction of the fold axial plane considering a cylindrical fold? [5]
- 2) Which block (i.e., northern or the southern) is upthrown by the fault AA'? [5]
- 3) What is the nature of the contact CC'? [5]
- 4) Draw a sketch geological cross-section along the line XX' and arrange the lithounits that are younger than the folded units according to their relative age. [10]

Part-II

(Five questions, eightmarks each)

2.

(i) What is 'Carbonate Compensation Depth' (CCD)?

(ii) How does it control the accumulation of pelagic carbonate in modern ocean basins?

(iii) How does CCD generally varies with latitude in the present day ocean basin?

(iv) Are CCD values for aragonite and calcite same in a modern ocean basin?

(v) Name two groups of microorganisms that occur in abundance in modern pelagic carbonates.

(vi) Explain how accumulation of siliceous ooze and pelagic claystone generally takes place below CCD in modern ocean basins.

(vii) Name two groups of microorganisms that you would expect in modern pelagic deposits of siliceous ooze.

2+1+1+ 1+ 1+1+1

3. What do you understand by the term "Unconformity"? Illustrate successive stages of development of an angular unconformity. Describe with sketches the other types of unconformities.

1+4+3

4. What kind of volcanic eruptions explains the eruption of pyroclastics? How would you recognize pyroclastics? State the difference between pyroclastics and volcanoclastics.

3+3+2

5. What is macroevolution? Why we do not get

i. Fossils of hominids from the Gondwana sediments of India?

ii. fossils of dinosaurs from the Siwalik deposits of India?

4+2+2

6. Draw sketches of different types of triple point junctions of plate boundaries.

8

7. Critically appraise the significance of *Glossopteris* flora in deciphering the geological history of the Gondwana deposits of India? What is the basis of the bipartite classification of Indian Gondwana deposits? Do you expect coal seams to be present in Early Triassic time?

4+3+1

Part-III

*(Choose the correct answer from the given alternatives and justify.
Five questions, four marks each)*

7. Which of the following is NOT a fossil

- a) Dinosaur track-way.
- b) *Hipparion* tooth.
- c) *Archaeopteryx*.
- d) Egyptian mummy.

8. Hummocky cross-stratification is generally interpreted to have formed

- a) Below mean storm wave base.
- b) Between mean fair weather wave base and mean storm wave base.
- c) Between mean high water and mean low water level
- d) Between mean fair weather wave base and mean low water level .

9. A sedimentary bed contains three fossils: A, B and C. Fossil A was formed from an organism that only existed in Cambrian and Ordovician Periods; Fossil B only existed in Ordovician; Fossil c is a long ranging one and spanned through Cambrian to the Triassic Period. Based on this fossil assemblage the age of the host rock is :

- a) Cambrian.
- b) Ordovician.
- c) Sometime between Cambrian and Triassic.
- a) Impossible to determine.

10. Fractional crystallization of a mafic magma at depth leads to various rocks as the crystallization proceeds through different stages. Which of the following gives correct pairing of *rock type* and *stage of crystallization*? (Justification needed)

- a) Cambrian olivine gabbro late stage.
- b) Ordovician. norite early stage
- c) pegmatite very early stage
- d) anorthositic gabbro late stage.

11. A schist contains tremolite-actinolite as a metamorphic mineral. The best possible protolith set for the schist is given by

- a) Limestone, arkose, shale
- b) Limestone, rhyolite, shale
- c) Marl, greywacke, dacite K-feldspar
- d) Marl, mafic tuff, basalt.

Part-IV

(Choose the correct answer from the given alternatives. **No** Justification is required. Fifteen questions, onemark each)

12. *Lystrosaurus* is helpful in correlating

- a) Early Triassic deposits of India and Australia.
- b) Middle Triassic deposits of Belgium and India.
- c) Early Triassic deposits of India and South Africa.
- d) Late Triassic deposits of India and United States of America.

13. Which of the following sets of physical and/or optical properties would best help in distinguishing different species of feldspar?

- a) Lustre, cleavage, refractive index.
- b) Hardness, cleavage, extinction angle.
- c) Refractive index, extinction angle, twinning.
- d) Extinction angle, twinning, hardness.

14. Which of the following mineral pairs you would expect during early crystallization of a basaltic magma?

- a) Forsterite and augite.
- b) Olivine and bytownite.
- c) Fayalite and anorthite.
- d) Augite and albite.

All paleospecies are

- a) Morphospecies.
- b) Crown-group species.
- c) Stem-group species.
- d) Ichnospecies.

15. Gabbro is denser compared to granite. Although granitic rocks form the bulk of upper continental crust, one may get gabbros on continental outcrops because

- a) granitic plutons commonly have gabbroic xenoliths.
- b) a slice of the oceanic crust is accreted to the continental margin.
- c) unroofing of a layered complex.
- d) metamorphic transformation of granites to gabbros due to crustal thickening.

16. Which of the following sets represent correct increasing order of clast/grain sizes in rocks?

- a) siltstone, breccia, charnockite
- b) mudstone, boulder bed, granite
- c) breccia, mylonite, ultramylonite
- d) porcellanite, gritty sandstone, conglomerate

17. A hypothetical ion X has an electrical charge of negative 2. Which of the following statements best describes the relative number of electrons and protons in the atom?

- a) The X ion has 2 less electrons than protons.
- b) The X ion has 2 more electrons than protons.
- c) The X ion has 1 less electron than protons.
- d) The X ion has 1 more electron than protons.

18. The formation of the Earth and other planetary bodies through the processes of condensation and accretion was essentially complete in
- 456 million years ago.
 - 4.56 million years ago.
 - 4.56 billion years ago.
 - 45.6 billion years ago.
19. The property of a mineral to resist scratching is referred to as
- streak.
 - density.
 - hardness.
 - tenacity.
20. Index fossils have
- short stratigraphic range and wide geographic distribution.
 - wide stratigraphic range and restricted geographic distribution.
 - do not have marked distinguishing characters.
 - are always restricted in characters to a particular lithology.
21. An igneous rock contains olivine crystals of size about 1cm across. Which of the following statements about the igneous rock would be true?
- It cooled very slowly at temperatures between 600°C and 800°C.
 - It cooled very rapidly at temperatures between 600°C and 800°C.
 - It cooled very slowly at temperatures between 1100°C and 1200°C.
 - It cooled very rapidly at temperatures between 1100°C and 1200°C.
22. In a stereogram, if the bed-normals of a cylindrical fold fall on a greatcircle passing through the centre, then fold axis will be plotted as
- a point at the centre of the stereogram.
 - two points where the great circle intersects the perimeter.
 - two points on the perimeter, representing lines 180 degrees apart.
 - a point on the great circle, midway between the centre and the perimeter.
23. Stream power of a river is dependent on the
- discharge and slope of the river.
 - amount of sediment entrained by the river.
 - specific gravity of the fluid transported.

d) ability of the river to erode its bed.

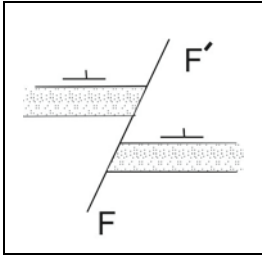
24. Parasequence is a

- a) sequence of strata bounded by erosional unconformities.
- b) a succession of facies bounded by sequence boundaries.
- c) a shallowing upward succession of strata bounded by marine flooding surfaces.
- d) a theoretical unit defined on the basis of lithology.

25. Following Dunham's classification, a limestone that contains more than 10% allochems (<2mm) and is lime mud (micrite)-supported is termed as

- e) mudstone.
- f) grainstone.
- g) wackestone.
- h) packstone.

26. Which of the following cannot be true (based on the sketch map given)



- a) F-F' is a normal fault and the right hand side is down thrown
- b) F-F' is a reverse fault and the right hand side is down thrown
- c) F-F' is a strike slip fault
- d) F-F' is a joint plane