Junior Research Fellowship in Geology, 2014

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, seismisity 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 assembalges 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

2015

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.

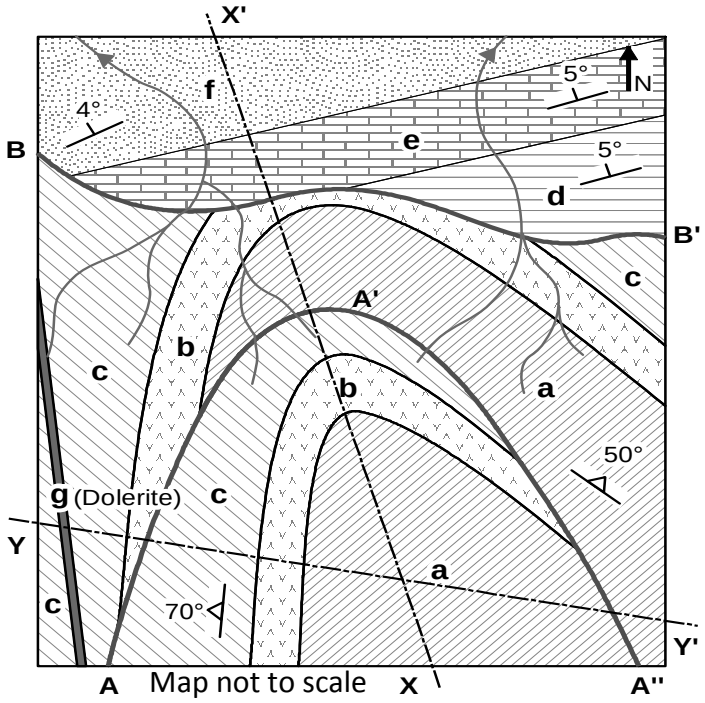
STAPLE/ATTACH QUESTION BOOKLET WITH THE ANSWER BOOKLET. ALL ROUGH WORK MUST BE DONE ON THE QUESTION BOOKLET AND / OR ON THE ANSWER BOOKLET.

WAIT FOR THE SIGNAL TO START WRITING

Part-I

(*One question, twenty five marks*)

1.



a) Interpret the nature of the boundaries AA´A´´ and BB´. State the relative timing of their formation in relation to the stratigraphic successions given by different lithologic units.

b) Explain the contact relation between unit marked 'g' and the surrounding units.

c) How would you explain the curved outcrop pattern of unit ´b´?

d) Suggest a possible stratigraphic succession (oldest to youngest) taking into account all the lithologic units in the map. Is any alternative interpretation about the ordering of lithologic units possible?

e) Draw two sketches depicting the geological cross-sections along the lines XX´ and YY´.6+3+5+6+5

Part-II

(*Five questions, eight marks each*)

2. During down-current migration, ripples must climb over one another to produce cross stratified beds. Explain with suitable sketches. 8

3. Why are the trilobites so named? Critically appraise the phenomena related to the vision of the trilobites. Is there any record of 'blind' trilobites? 8

4a. Briefly discuss the stratigraphic significance of the "*Gangamopteris beds"* of Kashmir area. Is there any *Gangamopteris* flora present in co-eval horizons of Spiti?

3

4b.What is chronostratigraphic unit? Why biostratigraphic correlation is inadequate for correlation of Precambrian sequences, despite the fact that life on earth started earlier than 600Ma? State the principles for correlating the Proterozoic sequences in the Vindhyan and Cuddapah basins.
1+2+2

5. What is an asymmetric rift basin? Draw suitable sketches to illustrate the generalised tectonic mechanism of forming a rift basin. Give one example of a modern rift basin. Give an example of possible ancient rift basin from the Indian craton.
2+4+1+1

6. What is partial melting? Partial melting producing granite melts can occur in association with upper amphibolite facies rocks as well as with granulite facies rocks. Explain how granitic melts are generated in either of the two cases?

2+6

Part-III

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

7. Buckling depends upon
   a) Thickness and relative viscosity of layers.
   b) Relative thickness of layers and P-T condition.
   c) Relative viscosity of layers.
   d) Thickness of layers and P-T condition.

8. Triassic, non-marine vertebrate fauna of India are
   a) non-endemic (not restricted to India only) and found all over the Pangaea.
   b) non-endemic and found only in India and other Gondwana countries.
   c) non-endemic but found only in India and America.
   d) non-endemic and comparable to only the coeval Australian fauna.

9. A region in Czechoslovakia has many sinkholes and boasts karst topography. What combinations of rock type and climate would best explain the topography?
   a) Granite and humid climate.
   b) Limestone and humid climate.
   c) Granite and arid climate.
   a) Limestone and arid climate.

10. If a GIS overlay operation is performed between a polygon feature and a line feature then the result will be
   a) a mixture of polygon and lines.
   b) lines only.
   c) polygons only.
   d) point features only.

11. Which of the following minerals is not suitable for Rb-Sr method of dating?
   a) K-feldspar

b) Biotite
c) Hornblende
d) Muscovite

Part-IV

(*Choose the correct answer from the given alternatives.* ***No*** *Justification is required. Fifteen questions, one mark 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.

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

a) 456 million years ago.
b) 4.56 million years ago.
c) 4.56 billion years ago.
d) 45.6 billion years ago.

19. The property of a mineral to resist scratching is referred to as

a) streak.
b) density.
c) hardness.
d) tenacity.

20. Index fossils have

a) short stratigraphic range and wide geographic distribution.
b) wide stratigraphic range and restricted geographic distribution.
c) do not have marked distinguishing characters.
d) 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?

a) It cooled very slowly at temperatures between 600°C and 800°C.
b) It cooled very rapidly at temperatures between 600°C and 800°C.
c) It cooled very slowly at temperatures between 1100°C and 1200°C.
d) 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 great circle passing through the centre, then fold axis will be plotted as

a) a point at the centre of the stereogram.
b) two points where the great circle intersects the perimeter.
c) two points on the perimeter, representing lines 180 degrees apart.
d) a point on the great circle, midway between the centre and the perimeter.

23. Stream power of a river is dependent on the

a) discharge and slope of the river.
b) amount of sediment entrained by the river.
c) specific gravity of the fluid transported.
d) ability of the river to erode its bed.

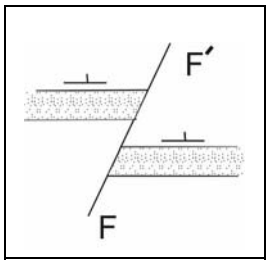
24. Parasequence is a

a) sequence of strata bounded by erosional unconformities.
b) a succession of facies bounded by sequence boundaries.
c) ashallowing 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