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

Sample Question

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.

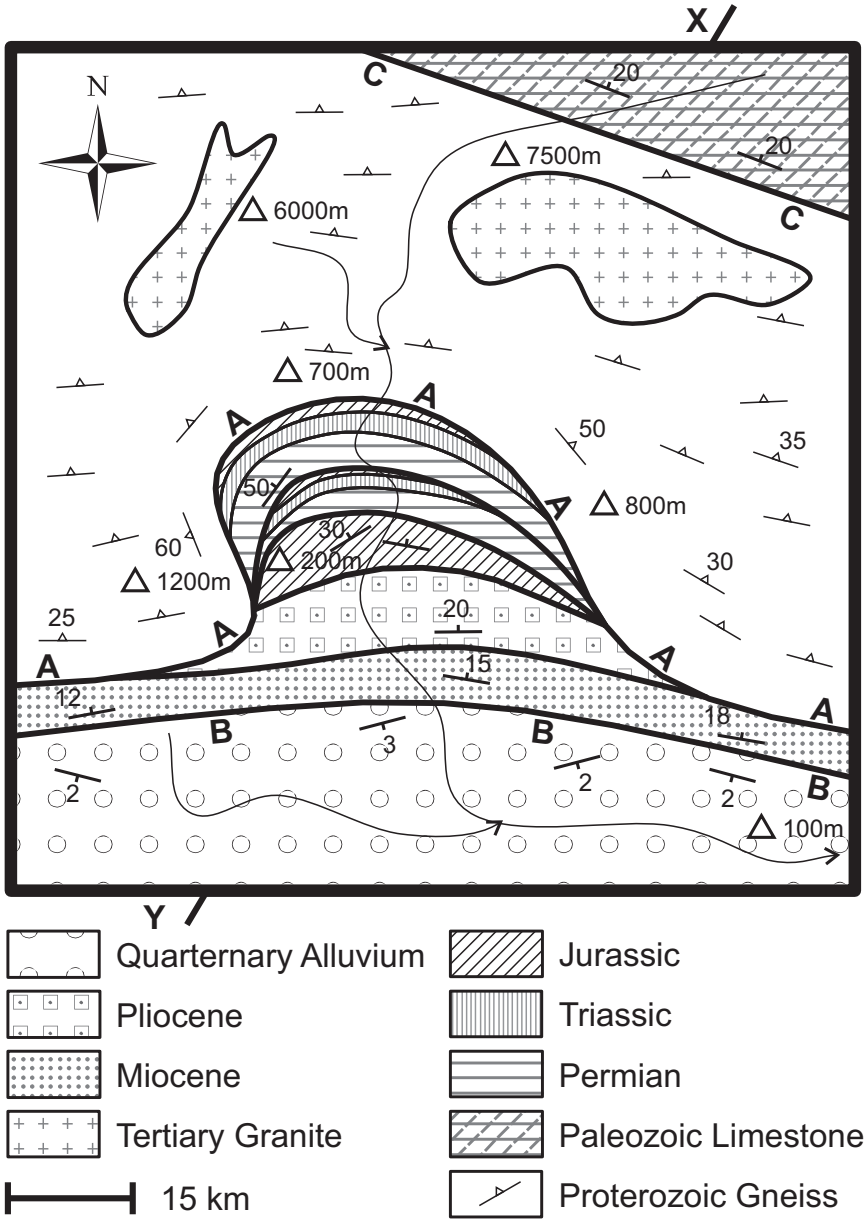
Write your Name, Registration Number, Test Centre, Test Code and the Number of this booklet in the appropriate places on the answer sheet.

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) Read the given geological map and interpret the nature of the contact, marked **A**, between the Proterozoic gneiss and the younger sedimentary successions, giving justification(s).

[5]

b) Explain the nature of repetition of Permian-Jurassic succession south of the contact marked **A**. What is the structural form of the contact marked **A**?

[5+2]

c) If the contact marked **B** is interpreted as a fault dipping north which rocks are on the footwall and the hanging-wall respectively?

[3]

d) What is the possible relation between Tertiary granite and the Proterozoic gneiss? Interpret the nature of the contact marked **C**.

[2+2]

e) Draw a sketch structure section along the line **XY**.

[6]

Part-II

(*Five questions, eight marks each*)

1. How can you recognize epsilon cross-strata in an ancient fluvial succession?

[8]

2. A regionally metamorphosed terrain shows Barrovian metamorphism. Name the index minerals in order of increasing metamorphic grade, which are expected to be encountered in outcrops of regionally extensive pelitic rocks.

Would you expect the same sequence of index minerals if the protolith is basalt? In the latter case, what is the expected mineral assemblage for granulite facies?

[4+2+2]

3. A granite consists of orthoclase, perthite, quartz and hornblende as essential minerals. Use the concept of Bowen's reaction series to explain the sequence of crystallisation of different minerals in the above granite. Name two common rock forming mineral groups which show exsolution textrure. How would you use the concept of a solvus in explaining exsolution?

[4+2+2]

4. State the functional significance of septa of a cephalopod. Describe (with labelled diagrams) the change in sutural pattern of cephalopods through the Mesozoic Era.

[2+6]

5. What is unconformity? Describe with labelled sketches the different types of unconformities.

[2+6]

Part-III

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

1. The thinnest crust on earth is found in which of the following tectonic zones?

a) Subduction zone
b) Transform faults
c) Mid oceanic ridge zone
d) Continental rifts

2. Bipolar paleocurrent pattern is common in:

a) Fluvial deposits
b) Shallow marine deposits
c) Aeolian deposits
d) Lacustrine deposits

3. High angle of intersection between bed and foliation indicates:

a) limb of a recumbent fold
b) limb of a tight fold
c) hinge of a fold
d) limb of an open fold

4. Which of the following is trace fossil?

a) Traces left by dragging of dead ammonite shell in a marine rock.
b) Impression of a leaf in Permian carbonaceous shale.
c) Excavation made by a crab in a Quaternary sedimentary rock.
d) Clutches of dinosaur eggs in continental Jurassic rocks.

5. Tectonic plates comprise:

a) crust and parts of upper mantle
b) only crust
c) crust and the whole of mantle
d) upper mantle

Part-IV

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

1. Which of the following is associated with prolific occurrence of body fossils?

a) Gondwana Supergroup
b) Iron Ore Group
c) Vindhyan Supergroup
d) Cuddapah Supergroup

2. Which extinction event is marked by the extinction of the ammonoid?

a) Permian - Triassic extinction
b) Triassic - Jurassic extinction
c) Cretaceous - Tertiary extinction
d) Devonian-Carboniferous extinction

3. Which of the following has superficial similarities with rudist bivalves like *Hippurites* :

a) corals
b) gastropods
c) ammonids
d) echinoids

4. Which of the following clay minerals is most commonly associated with most intense chemical weathering?

a) Chlorite
b) Montmorillonite
c) Kaolinite
d) Illite

5. The initial composition of a melt in the Forsterite (Fo) - Fayalite (Fa) system is given as Fo_{50} Fa_{50}. With cooling the first crystal to form is likely to have an initial composition of

a) Fo_{20} Fa_{80}
b) $Fo_{80}Fa_{20}$
c) Fo_{50} Fa_{50}
d) $Fo_{55}Fa_{45}$

6. "WGS-84" is the name of a:

a) Spheroid
b) Vertical Datum
c) Both a & b
d) Map Projection

7. Which of the following sole marks can be used as paleocurrent indicator?

a) Groove cast
b) Gutter cast
c) Flute cast
d) Load Cast

8. Symmetric boudinage is usually produced by extension of a competent layer embedded in an incompetent matrix. *Chocolate tablet structure* is the result of a deformation where the bulk finite strain ellipsoid shape (k-value) is given by:

a) $k = 1$
b) $k < 1$
c) $k > 1$
d) $k = \infty$

9. Which of the following is likely to give the lowest initial $^{87}Rb/^{86}Sr$ ratio calculated from Rb-Sr isochron?

a) Tertiary granite batholith
b) Deccan Trap

c) Lamprophyres in the Barakar Formation
d) Basaltic sills within the Vempalle Formation

10. Which of the following minerals show straight extinction with respect to cleavage trace?

a) Calcite
b) Clinohypersthene
c) Oligoclase
d) Biotite

11. Which of the following represents a set of ranks of stratigraphic units in correct ascending order? (Hint: member is a lesser ranking unit than a formation.)

a) bed, member, formation, group
b) formation, group, supergroup, bed
c) supergroup, group, formation, member
d) member, group, bed, formation

12. Which of the following gives the correct minimum requirement of symmetry elements for a mineral crystal to belong to the Orthorhombic system?

a) A two-fold axis of symmetry perpendicular to a mirror plane of symmetry
b) Three mutually perpendicular two-fold axes of symmetry
c) Three mutually perpendicular mirror planes of symmetry and three two-fold axes each perpendicular to a mirror plane
d) A four-fold axis of symmetry perpendicular to a mirror plane

13. The deflection of oceanic currents in the northern and southern hemispheres is due to

a) Thermohaline circulation
b) Coriolis effect

c) El Nino effect
d) Monsoon effect

14. Which one of the following statements is correct?

a) The oceanic crust contains the oldest rocks on Earth.
b) The oldest rock in existing oceans is less than 200 million years old.
c) The oceanic crust is oldest at the mid-ocean ridges.
d) Oceanic crust is of same age everywhere.

15. Biogenic silica in marine environment is precipitated as

a) Opal CT
b) Amorphous opal
c) Microcrystalline quartz
d) Chalcedony