

Junior Research Fellowship in Geology

Test Code: RG (Short answer + Objective type) 2010

The candidates for Junior Research Fellowship in Geology will have to take two tests- Test GM in the forenoon session and Test RG in the afternoon session.

Syllabus

1. *Structural Geology*
Concepts of stress and strain, plastic and viscous flow; theory of brittle fracture. Folding and faulting – their 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. Interpretation of geological maps.
2. *Mineralogy*
General principles of mineral optics and modern methods of mineral identification.
3. *Petrology*
Phase equilibria studies of various silicate systems with reference to petrogenesis. Concept of magma; magmatic differentiation and assimilation. Petrogenetic study of important igneous or groups of igneous rocks – granites, alkaline rocks, andesite, basalt, ophiolites. 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.
4. *Geochemistry*
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.
5. *Sedimentology*
Classification of sedimentary rocks. Transport of sediments by fluids. Texture of sedimentary rocks. Sedimentary structures. 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.

6. *Economic geology*
Principles of classification of mineral deposits. Textures and structures of economic minerals. Processes of formation of economic mineral deposits.
Strategic, critical and essential minerals of India.
7. *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.
8. *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.
9. *GIS and Remote Sensing*

Remote sensing—definition, concept, scope, history of development with special reference to India. Geographic Information Systems and Global Positioning system; Geoinformatics- Scope and applications. Photographic systems – terrestrial and aerial photographs, Stereovision, stereo photography and stereoscopy. Satellite images—platforms, sensors, energy sources and data products. Image interpretation – visual and digital techniques. Some applications of GIS-RS techniques in geological problems

Sample Questions

PART-I

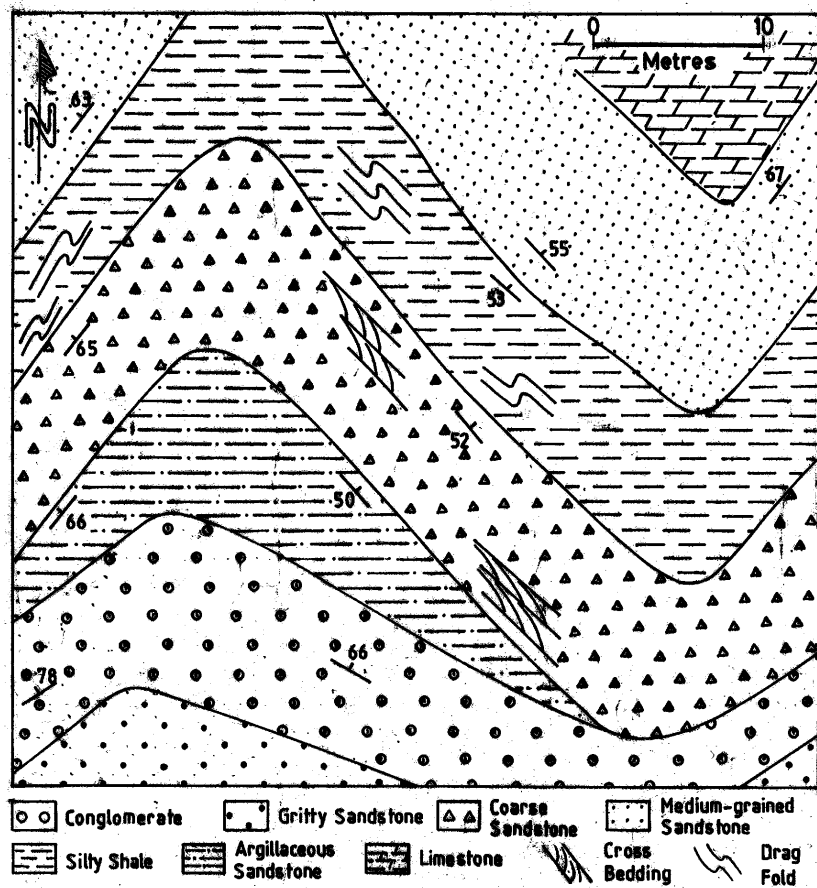


Figure 1

1. Work out the following from the geological map (ISI-GEOL-2K, Figure 1) given on page 1. Scale of the map is approximately 10 cm = 750m. Spot height in feet.
 - (a) Describe the relation between rock sequences A-B-C-D and E-F-H.
 - (b) Describe the relation between rock unit G and the other rock sequences in the area.

- (c) Which rock unit is the youngest in the area and what is its mode of occurrence? Justify your answer.
- (d) Is the NE trending fault a normal fault? Justify your answer.
- (e) Comment on the nature of displacement on the NNW trending fault.
- (f) Change in attitude of foliation shown in different parts of the mapped area indicates that the foliation is folded. Are all the folds shown on the map of comparable style? Cite orientations of fold axes and axial planes at locations 1 through 4 (circled spots) in support of your answer.

PART-II

Note : Write short answer to each of the following questions.

- 2. Describe briefly the history of differentiation of the earth.
- 3. "Granitic rocks have mineralogical compositions close to eutectics." – explain.
- 4. Give an account of the textural features suggestive of chemical equilibrium in metamorphic rocks.
- 5. Give an account of the climatic and tectonic significance of arkosic sandstones.
- 6. (a) Could *Archaeopteryx* fly? Justify your answer. (b) Why are fossil brachiopods mostly found with their valves closed?
- 7. How do you explain the origin of crustal stresses?
- 8. Give a detailed account of the important aerial photo-interpretation elements usually used for photo-geological mapping. Illustrate your answers with suitable examples and sketches
- 9. Name three spatial objects that are mainly used to represent the real world phenomena. Give examples of their usage with respect to geological mapping.

PART-III

Questions 9-12 are multiple choice type. Select the correct answer for each and justify it.

- 10. The primitive crust of the earth was
(a) granitic (b) basaltic (c) komatiitic (d) andesitic
- 11. The major source of heat in the primordial earth was
(a) decay of short-lived radioactive isotopes
(b) decay of long-lived radioactive isotopes
(c) impact of planetesimals
(d) all of the above
- 12. Bedforms with the crest trending roughly parallel to the net sediment transport direction are called
(a) linear dune (b) longitudinal dune (c) seif dune (d) parabolic dune

13. Transgression is caused by
- (a) rise in eustatic sea level
 - (b) rise in relative sea level
 - (c) increased rate of subsidence
 - (d) decreased rate of sedimentation
14. Boudins are products of
- (a) homogeneous deformation
 - (b) inhomogeneous, brittle deformation
 - (c) inhomogeneous, ductile deformation
 - (d) none of the above.

PART-IV

Select the correct answer from the multiple choices. No justification is needed.

15. Temperature at the crust-mantle boundary is of the order of
- (a) 600°C (b) 900°C (c) 1700°C (d) 1300°C
16. Diphyodonty does not take place in
- (a) incisors (b) pre-molars (c) molars (d) canines
17. Epsilon cross-stratification is common in
- (a) marine environment
 - (b) fluvial environment
 - (c) lacustrine environment
 - (d) aeolian environment
18. S- or Z-shaped inclusion trails in garnets indicate
- (a) Syn-tectonic crystallization
 - (b) Pre-tectonic crystallization
 - (c) Post-tectonic crystallization
 - (d) None of the above
19. Under high P-T conditions Al is favoured in a SiO₄ tetrahedra linkage in the
- (a) 4 co-ordinated position
 - (b) 6 co-ordinated position
 - (c) 8 co-ordinated position
 - (d) 10 co-ordinated position
20. *Barapasaurus tagorie*, a Jurassic dinosaur, was recovered from
- (a) Jabalpur Formation
 - (b) Ariyalur Formation
 - (c) Kota Formation

(d) Bhuj Formation

21. Paratype is formally designated when
- (a) used in the description of the species
 - (b) a new specimen is used due to the destruction of the type specimen
 - (c) it is not the part of the original type material
 - (d) several type specimens are used
22. Foreland basins are associated with
- (a) crustal extension
 - (b) strike slip faults
 - (c) thrust loading
 - (d) thermal contraction
23. Transform faults occur within
- (a) continental lithosphere
 - (b) oceanic lithosphere
 - (c) both continental and oceanic lithosphere
 - (d) none of the above
24. An area in isostatic equilibrium would show
- (a) no free air anomaly but may show Bouguer anomaly
 - (b) no free air and Bouguer anomaly
 - (c) free air anomaly but no Bouguer anomaly
 - (d) none of the above.