Indian Statistical Institute

Junior Research Fellowship in Geology, Entrance Examination

2016

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**

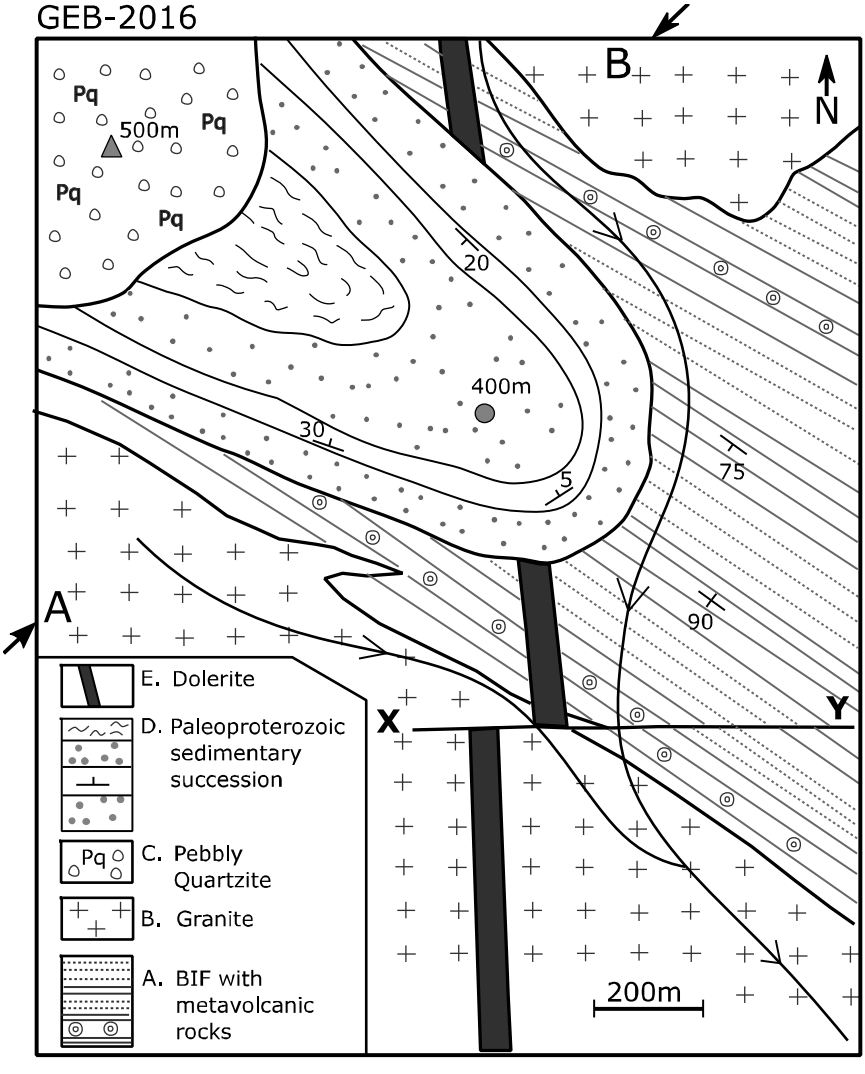
Give your answers in the answer booklet only.

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

GEB-2016



1. Read the accompanying geological map carefully and answer the following.

a) Interpret the contact relation between rock units 'A' and 'D', with suitable explanation.

b) Indicate the geometry of the fold within rock unit 'D' mentioning approximate orientations of fold axis, axial plane, and magnitude of inter limb angle.

c) Give two reasons why rock unit 'A' is to be considered as folded. State the nature of the fold giving approximate orientations of fold axis, axial plane, and magnitude of inter limb angle.

d) What is the nature of displacement along fault XY and what is its dip?

e) Draw a sketch cross section along line AB to depict the geological structure and relationship of different rock units.

f) Arrange the rock units in order of relative geological age. Briefly give reasons for your answer.

3+5+7+4+2+4

Part-II

(Five questions, eight marks each)

2. A metamorphic rock consists of muscovite-biotite-quartz-almandine.

a) To which Barrovian metamorphic zone the rock can be assigned to? Briefly explain your answer. Comment on the

geothermobarometric conditions under which the rock was metamorphosed.

b) Comment on the nature of the parent rock and metamorphic mineral transformations which led to present mineral assemblage.

2+2+4

3. a) Explain briefly the concept of P-T-t path. Draw a neat sketch of a clockwise P-T-t path on P-T space labelling the metamorphic evolutionary history.

b) A garnet-biotite mineral pair is often used for geothermometry. Explain why the same mineral pair cannot be utilized for geobarometry.

3+3+2

4. a) Describe with a neat sketch the major differences between a coset of trough and a coset of planar cross-strata when they are observed in a vertical profile cut parallel to the paleoflow directions.

b) What is Abundance Biozone or Acme Zone? Explain why this type of biozone is not always suitable for time-stratigraphic correlation.

4+1+3

5. Draw a schematic vertical log of a typical sedimentary succession deposited in a wave dominated shallow marine, siliciclastic setting where rate of net deposition is

greater than the rate of relative sea level rise. 8

6. Write the evolutionary significance of the ammonite heteromorphs. 8

Part-III

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

7. Which of the following will provide the most reliable age data for the sedimentary rock?

a) Radiometric dating of detrital zircon collected from a sedimentary rock
b) Radiometric dating of suitable minerals from a plutonic igneous rock that cuts across a sedimentary rock
c) Radiometric dating of suitable minerals from a plutonic igneous rock that lies unconformably beneath sedimentary rocks
d) Radiometric dating of a volcanic rock, which are interbedded with a sedimentary rock.

8. A horizontal ash bed is overlain by a 70 m thick succession of aeolian dune cross-stratified sandstone. All the major cross set bounding surfaces consistently make a positive angle of 1.5˚ with the ash bed. The small angle between the ash bed and the bounding surfaces of the dune cross strata are due to:

a) Tectonic tilt of the basin floor following the deposition of the ash bed

b) Tectonic tilt of the basin after the deposition of the sandstone unit

c) Climbing of the aeolian bedforms with respect to the paleo-horizontal

d) Soft sediment deformation within the aeolian sandstone.

9. Best way to estimate the age of deposition of a late Pleistocene fine-grained sand is:

a) Dating detrital zircons

b) Determine age from the length of Apatite fission tracks

c) K-Ar dates

d) OSL dates.

10. The igneous rock texture is said to be aphanitic if the sizes of the crystals are so small that they cannot be distinguished with a hand lens. The crystals are small due to

a) Large degrees of under-cooling, high nucleation rate and high growth rate.

b) Small degrees of under-cooling, high nucleation rate and slow growth rate.

c) Large degrees of under-cooling, slow nucleation rate and high growth rate.

d) Small degrees of under-cooling, slow nucleation rate and slow growth rate.

11. The basic structure of the phyllosilicate tetrahedron is :

a) $Si_2O_4(OH)^{-3}$

b) $Si_2O_6(OH)^{-3}$

c) $Si_2O_5(OH)^{-3}$

d) $Si_2O_5(OH)^{-2}$.

Part-IV

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

12. Ancient coral reefs may be used as indicators of paleoecological conditions because they were developed

a) In a fixed range of temperatures only
b) In fixed paleo-latitudinal positions only
c) in a fixed velocity range of ocean currents only
d) In a combination of fixed temperature range, fixed paleo-latitudinal conditions and fixed velocity range of ocean currents.

13. Palaeocurrent directions measured from the deposits formed in which of the following environments are likely to show more dispersion in the palaeocurrent vectors than others?

a) Sediment deposited in an alluvial plain by a system of braided streams
b) Sediment deposited in a deep marine setting by turbidity currents
c) Sediment deposited in a desert environment by Aeolian dune bedforms
d) Sediment deposited in a nearshore shallow marine environment.

14. Bimodal volcanics is typical of

a) Foreland basin setting

b) Mid-oceanic rift ridge system

c) Rift basin setting

d) Continent-continent collision belt.

15. In the field, the most significant indicator of glacial deposits is:

a) Bullet-shaped clasts in conglomerate

b) Dropstones within shales

c.) Striated pavements

d) Matrix supported conglomerate.

16. Aragonite and high-Mg calcite ooids are precipitated

a) when Pco_2 is low and Mg/Ca ratio is high

b) when Pco_2 is high and Mg/Ca ratio is high

c) when Pco_2 is low and Mg/Ca ratio is low

d) when Pco_2 is high and Mg/Ca ratio is low.

17.

Roche moutonnee (a)	Mass flow deposits (p)
Parasequence (b)	Flow drag over a fluidised sediment bed (q)
Overturned cross beds (c)	Small scale sea level fluctuation (r)
Massive conglomerate bed (d)	Glacial landforms (s)

Which of the following combinations provides correct matching of geological features listed in two columns above?

a) (a) - (p)
b) (b) - (p)
c) (c)- (q)
d) (d) - (s).

18. Devonian strata are noted

a) in peninsular and extra- peninsular India

b) in peninsular India only

c) in extra-peninsular India only

d) neither in peninsular or extra peninsular India.

19. Maleri Formation of Pranhita - Godavari valley is a

a) fluvial deposit

b) estuarine deposit

c) aeolian deposit

d) deep marine deposit.

20. Myrmekitic texture commonly found in granites is an intergrowth of

a) quartz and microcline that shows small wormlike bodies of quartz enclosed in microcline.

b) quartz and biotite that shows small wormlike bodies of quartz enclosed in biotite.

c) quartz and hornblende that shows small wormlike bodies of quartz enclosed in hornblende.

d) quartz and plagioclase that shows small wormlike bodies of quartz enclosed in plagioclase.

21. The First Law of Thermodynamics states that "the internal energy, E, of an isolated system is constant". It can be represented as (where, change in energy = ∂E, heat energy

gained or lost = ∂Q and work done at constant pressure by the system = ∂W)

a) ∂E = ∂Q - P∂V
b) ∂E = ∂Q + P∂V
c) ∂Q = ∂E - V∂P
d) P∂V = ∂Q + ∂E .

22. Which one of these statements is true?

a) S-wave propagation is related to pure shear with no volume change, whereas P-waves involve both a volume change and shearing (change in shape) in the material
b) S-wave propagation is related to pure shear with volume change, whereas P-waves involve both a volume change and shearing (change in shape) in the material
c) S-wave propagation is related to pure shear with no volume change, whereas P-waves involves only shearing (change in shape) in the material
d) S-wave propagation is related to simple shear with no volume change, whereas P-waves involve both a volume change and shearing (change in shape) in the material.

23. The most primitive/pristine meteorite is

a) Achondrites
b) Ordinary chondrites
c) Carbonaceous chondrites
d) Stony-iron meteorites.

24. The extinction of the dinosaurs is coeval with anomalous concentration of

a) Iron
b) Iridium
c) Manganese
d) Sodium.

25. In the Precambrian crustal evolution, Manganese (Mn) began to precipitate after Iron (Fe) due to

a) Higher solubility and oxidation state of Mn relative to Fe in water
b) Increasing Mn content in magma producing early crust
c) Progressive cooling of Precambrian crust
d) Release of Mn from crust- forming silicates.

26. Ornithischian and saurischian dinosaurs are mainly differentiated on the basis of their

a) Total food intake
b) Omnivorous and piscivorous habits respectively
c) Structure of their pelvic girdles
d) Structure of their pectoral girdles.