

**GG : GEOLOGY AND GEOPHYSICS**

Duration : Three Hours

Maximum marks : 100

Read the following instructions carefully :

1. This question paper contains **24** printed pages including pages for rough work. Please check all pages and report discrepancy, if any.
2. Write your registration number, your name and name of the examination centre at the specified locations on the right half of the **Optical Response Sheet (ORS)**
3. Using HB pencil, darken the appropriate bubble under each digit of your registration number and the letters corresponding to your paper code.
4. All questions in this paper are of objective type.
5. Questions must be answered on **Optical Response Sheet (ORS)** by darkening the appropriate bubble (marked A, B, C, D) using HB pencil against the question number on the left hand side of the ORS. **Each question has only one correct answer.** In case you wish to change an answer, erase the old answer completely. More than one answer bubbled against a question will be treated as an incorrect response.
6. The paper consists of two parts: Part A and Part B. Part A is common to both Geology and Geophysics candidates. Part B contains two sections: Section 1 (Geology) and Section 2 (Geophysics). Geology candidates will attempt questions in Section 1 only. Geophysics candidates will attempt questions in Section 2 only. Correctly darken the bubble (in the ORS) corresponding to the section attempted by you.
7. There are a total of 60 questions carrying 100 marks. Part A consists of 20 questions; all are 1-mark questions. Each of the sections (Section 1 & Section 2) in Part B consists of 40 questions; all are 2-mark questions.
8. Questions 51 through 56 (3 pairs) are common data questions and question pairs (57, 58) and (59, 60) are linked answer questions. The answer to the second question of the above 2 pairs depends on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is un-attempted, then the answer to the second question in the pair will not be evaluated.
9. Un-attempted questions will carry zero marks.
10. Wrong answers will carry **NEGATIVE** marks. For Q.1 to Q.20,  $\frac{1}{3}$  mark will be deducted for each wrong answer. For Q. 21 to Q. 56,  $\frac{2}{3}$  mark will be deducted for each wrong answer. The question pairs (Q.57, Q.58), and (Q.59, Q.60) are questions with linked answers. There will be negative marks only for wrong answer to the first question of the linked answer question pair i.e. for Q.57 and Q.59,  $\frac{2}{3}$  mark will be deducted for each wrong answer. There is no negative marking for Q.58 and Q.60.
11. Calculator (without data connectivity) is allowed in the examination hall.
12. Charts, graph sheets or tables are **NOT** allowed in the examination hall.
13. Rough work can be done on the question paper itself. Additionally, blank pages are given at the end of the question paper for rough work.

## PART A: COMMON TO BOTH GEOLOGY AND GEOPHYSICS QUESTIONS

Q. 1 – Q. 20 carry one mark each.

Q.1 The Gutenberg discontinuity is located at a depth of around

- (A) 35 km
- (B) 150 km
- (C) 2900 km
- (D) 5000 km

Q.2 What is the age of the "Barail Series" ?

- (A) Jurassic
- (B) Paleocene
- (C) Oligocene
- (D) Miocene

Q.3 Thermohaline circulation in the oceans is driven by

- (A) only salinity gradients
- (B) both temperature and salinity gradients
- (C) only temperature gradients
- (D) only density difference

Q.4 Which one of the following minerals cannot be used as an abrasive ?

- (A) Garnet
- (B) Corundum
- (C) Quartz
- (D) Gypsum

Q.5 Which one of the following lakes is interpreted to be of meteoritic impact origin ?

- (A) Lonar Lake
- (B) Chilka Lake
- (C) Kolleru Lake
- (D) Pulicat Lake

Q.6 Which of the following geomorphic features is **not** related to desert environments ?

- (A) yardang
- (B) bajada
- (C) hamada
- (D) esker

Q.7 Which of the following is located closest to the Ninety-East Ridge ?

- (A) Bombay High
- (B) Lakshwadweep Islands
- (C) Andaman and Nicobar Islands
- (D) Maldives

- Q.8 LPG (Liquefied Petroleum Gas) consists mainly of
- (A) propane and butane
  - (B) methane and ethane
  - (C) methane and butane
  - (D) ethane and propane
- Q.9 Who proposed the principle "the present is the key to the past" ?
- (A) Carl von Linnaeus
  - (B) James Hutton
  - (C) William Smith
  - (D) Alcide d'Orbigny
- Q.10 Of the following, which is an ore of nickel ?
- (A) Pentlandite
  - (B) Cinnabar
  - (C) Cassiterite
  - (D) Scheelite
- Q.11 Over a three layered earth, comprising of top dry soil followed by saturated weathered layer and hard rock basement, a resistivity sounding experiment is performed. The obtained VES curve is
- (A) K-type
  - (B) A-type
  - (C) H-type
  - (D) Q-type
- Q.12 The logging tool for direct determination of permeability is
- (A) induction
  - (B) litho-density
  - (C) sonic
  - (D) NMR
- Q.13 Which of the following parameters is uniquely resolved by residual gravity anomaly data ?
- (A) lateral density contrast
  - (B) excess/deficit mass
  - (C) absolute density
  - (D) geometric dimensions of geophysical model
- Q.14 Crude oil density, in degree API (American Petroleum Institute), is a measure of viscosity. The value of 10 API is of
- (A) water
  - (B) heavy crude
  - (C) average crude
  - (D) light crude

- Q.15 For perfectly conducting medium, skin depth (m) is
- (A)  $10^5$  (B) 100  
(C) 10 (D) 0
- Q.16 If a planet revolves around the Sun with a period of 8 years, then its distance from the Sun would be (in terms of distance between Earth and Sun)
- (A) two times (B) four times  
(C) six times (D) eight times
- Q.17 A vast majority of earthquake sources are often linked to
- (A) inner core  
(B) outer core  
(C) brittle part of the earth's crust  
(D) molten part of earth's mantle
- Q.18 In paleomagnetism, detrital magnetization is an important process for study of
- (A) sedimentary rocks  
(B) metamorphic rocks  
(C) basic igneous rocks  
(D) acidic igneous rocks
- Q.19 A Geiger-Muller counter is used for measuring
- (A) gamma radiation  
(B) alpha particles  
(C) beta particles  
(D) both alpha and beta particles
- Q.20 The presence of crustal root beneath a mountain chain can be best explained by
- (A) Pratt's model  
(B) Airy's model  
(C) Vening Meinesz model  
(D) Plume model

**END OF PART A**

# PART B (SECTION 1): FOR GEOLOGY CANDIDATES ONLY

Q. 21 to Q. 60 carry two marks each.

Q.21 Which one of the following is a typical Lower Gondwana plant assemblage ?

- (A) *Glossopteris*, *Ptilophyllum*, *Nilssonia*, *Bucklandia*
- (B) *Glossopteris*, *Gangamopteris*, *Schizoneura*, *Sphenophyllum*
- (C) *Gangamopteris*, *Lycopodites*, *Brachyphyllum*, *Nilssonia*
- (D) *Vertebraria*, *Alethopteris*, *Otozamites*, *Glossopteris*

Q.22 Which of the following is not correct for a Pelecypod shell ?

- (A) Pedicle is present.
- (B) Pallial sinus, if present, is on the posterior side.
- (C) Lunule is towards anterior.
- (D) Both the valves have teeth and sockets.

Q.23 Match the following:

## Group I

- P. Muschelkalk
- Q. Katrol Formation
- R. Uttatur Stage
- S. Baripada beds

(A) P-3, Q-6, R-5, S-1

(C) P-3, Q-6, R-4, S-2

## Group II

- 1. Cambrian
- 2. Miocene
- 3. Middle Triassic
- 4. Cretaceous
- 5. Pleistocene
- 6. Late Jurassic

(B) P-1, Q-2, R-3, S-4

(D) P-6, Q-3, R-1, S-2

Q.24 Match the following:

## Group I

- P. Pelagic
- Q. Pycnocline
- R. Psychrosphere
- S. Humboldt Current

(A) P-1, Q-4, R-3, S-6

(C) P-5, Q-6, R-1, S-3

## Group II

- 1. Open ocean
- 2. Cold sphere
- 3. North Atlantic
- 4. Density
- 5. Thermocline
- 6. East Pacific

(B) P-6, Q-2, R-1, S-5

(D) P-1, Q-4, R-2, S-6

Q.25 Match the following:

**Group I**

- P. *Globigerina bulloides*
- Q. *Olenellus*
- R. Ambulacrum
- S. Nema

**Group II**

- 1. Lower Cambrian
- 2. Echinodermata
- 3. Graptolites
- 4. Upwelling
- 5. Coelenterata
- 6. Silurian

- (A) P-1, Q-6, R-2, S-5
- (B) P-5, Q-6, R-2, S-3
- (C) P-4, Q-1, R-2, S-3
- (D) P-2, Q-4, R-5, S-6

Q.26 Dinosaurs can be distinguished from the other Mesozoic reptiles by

- (A) Large size
- (B) Carnivorous habit
- (C) Erect stance
- (D) Sprawling stance

Q.27 Which of the following is a polar planktic foraminifer ?

- (A) *Globigerinoides ruber*
- (B) *Neogloboquadrina pachyderma*
- (C) *Globorotalia menardii*
- (D) *Orbulina universa*

Q.28 Which one of the following mass-wasting processes is designated as a slow flowage type ?

- (A) Mudflow
- (B) Solifluction
- (C) Slump
- (D) Rockslide

Q.29 Which of the following accurately describes the rock 'phonolite' ?

- (A) Undersaturated ultramafic volcanic rock
- (B) Undersaturated mafic plutonic rock
- (C) Undersaturated ultrabasic volcanic rock
- (D) Intermediate alkaline plutonic rock

Q.30 Match the assemblages in Group I with the corresponding metamorphic facies in Group II

**Group I**

- P. Albite-jadeite-glaucophane-lawsonite
- Q. Garnet-orthopyroxene-clinopyroxene-plagioclase
- R. Garnet-muscovite-biotite-sillimanite-quartz
- S. Albite-chlorite-epidote-actinolite

**Group II**

- 1. Greenschist
- 2. Blueschist
- 3. Granulite
- 4. Amphibolite
- 5. Zeolite
- 6. Prehnite-pumpellyite

(A) P-1, Q-6, R-2, S-5

(B) P-5, Q-1, R-3, S-4

(C) P-2, Q-3, R-4, S-1

(D) P-3, Q-2, R-1, S-6

Q.31 When underplated by mafic magmas, and with no erosion, lower crustal rocks will experience \_\_\_\_\_ during metamorphism.

- (A) isobaric heating followed by isothermal decompression
- (B) isothermal compression followed by isobaric heating
- (C) isobaric heating followed by isothermal compression
- (D) isobaric heating-cooling trajectory

Q.32 Match the minerals in Group I with their characteristic optical properties in Group II :

**Group I**

- P. Biotite
- Q. Sodalite
- R. Nepheline
- S. Quartz

**Group II**

- 1. Uniaxial negative
- 2. Mottled extinction
- 3. Uniaxial positive
- 4. Isotropic, low relief
- 5. Isotropic, high relief
- 6. Biaxial negative

(A) P-5, Q-1, R-3, S-6

(B) P-6, Q-2, R-5, S-1

(C) P-3, Q-2, R-4, S-5

(D) P-2, Q-4, R-1, S-3

Q.33 A single slice of rock bound by thrust faults on all sides is called a

- (A) horse
- (B) pop-up structure
- (C) duplex
- (D) graben

Q.34 A strike-slip dip fault strikes  $30^\circ\text{N}$ , and dips  $45^\circ\text{SE}$ . The net slip of the fault plunges

- (A)  $30^\circ$  towards  $45^\circ\text{N}$
- (B)  $0^\circ$  towards  $30^\circ\text{N}$
- (C)  $45^\circ$  towards  $120^\circ\text{N}$
- (D)  $90^\circ$  towards  $30^\circ\text{N}$

- Q.35 The boundary between the Indian and Eurasian plates is the
- Main Central Thrust
  - Main Boundary Thrust
  - South Tibetan Detachment Zone
  - Indus-Tsangpo Suture Zone
- Q.36 Plagioclase feldspars belong to the \_\_\_\_\_ crystal system.
- Triclinic
  - Monoclinic
  - Orthorhombic
  - Rhombic
- Q.37 The plane by which twinned crystals are united is called the
- mirror plane
  - twin plane
  - glide plane
  - composition plane
- Q.38 In satellite remote-sensing, the spectral bands near 1.4  $\mu\text{m}$  and 1.9  $\mu\text{m}$  are avoided because of
- absorption due to  $\text{H}_2\text{O}$  and  $\text{CO}_2$  in the atmosphere
  - absorption due to ozone layer in the atmosphere
  - absorption due to nitrogen in the atmosphere
  - absorption by vegetation
- Q.39 Formation of chromitite from a basaltic magma can be explained by
- liquid immiscibility
  - assimilation
  - magma mixing
  - Soret effect
- Q.40 Match the following economic deposits in Group I with their places of occurrences in Group II :
- | Group I        | Group II      |
|----------------|---------------|
| P. Bauxite     | 1. Naliya     |
| Q. Phosphorite | 2. Maldeota   |
| R. Magnesite   | 3. Pahalgam   |
| S. Barite      | 4. Salem      |
|                | 5. Mangampeta |
|                | 6. Belgaum    |
- P-1, Q-2, R-4, S-5
  - P-2, Q-3, R-4, S-6
  - P-3, Q-1, R-6, S-5
  - P-6, Q-2, R-4, S-5

- Q.41 What is the host rock for sulphide mineralization in Rampura-Agucha belt ?
- (A) Graphitic mica schist
  - (B) Garnetiferous mica schist
  - (C) Graphitic biotite-sillimanite gneiss
  - (D) Garnetiferous sillimanite-feldspar gneiss
- Q.42 Which of the following is the correct order of decreasing permeability ?
- (A) silty sandstone > siltstone > sandstone > pebbly sandstone
  - (B) siltstone > silty sandstone > sandstone > pebbly sandstone
  - (C) pebbly sandstone > sandstone > silty sandstone > siltstone
  - (D) pebbly sandstone > sandstone > siltstone > silty sandstone
- Q.43 Which of the following varieties of coal has the least H/C ratio ?
- (A) peat
  - (B) lignite
  - (C) bituminous
  - (D) anthracite
- Q.44 What is the age of the reservoir rock in the Cambay basin ?
- (A) Eocene
  - (B) Oligocene
  - (C) Miocene
  - (D) Paleocene
- Q.45 Which one of the following can be considered the best cap rock for oil and gas traps ?
- (A) chert
  - (B) evaporite
  - (C) sandstone
  - (D) shale
- Q.46 A negative Eu anomaly will develop in a fractionating magma following separation of
- (A) garnet
  - (B) olivine
  - (C) plagioclase
  - (D) orthopyroxene
- Q.47 In which of the following islands is the Mid-oceanic ridge exposed above sea-level ?
- (A) Japan
  - (B) Seychelles
  - (C) Hawaii
  - (D) Iceland

Q.48 \_\_\_\_\_ dams are constructed where the foundation rock is strong.

- (A) Gravity (B) Arch  
(C) Buttress (D) Earth

Q.49 Which type of cross-bedding is a definite indicator of tidal currents ?

- (A) epsilon cross-bedding (B) herring-bone cross-bedding  
(C) hummocky cross-bedding (D) trough cross-bedding

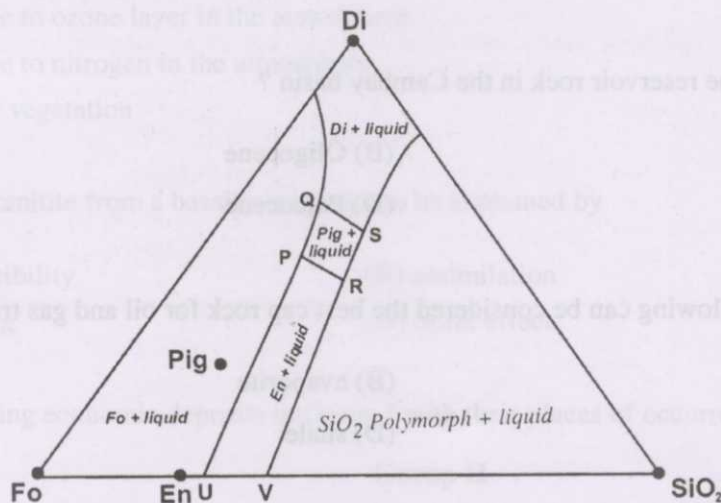
Q.50 Which type of sedimentary basin is formed close to continent-continent collisional settings ?

- (A) Fore-arc basin (B) Peripheral foreland basin  
(C) Back-arc basin (D) Retro-arc foreland basin

### Common Data Questions

#### Common Data for Questions 51 and 52 :

A rock contains 65% forsterite (Fo), 27% enstatite (En) and 8% pigeonite (Pig) and its melting relationships at 1 bar can be represented by the figure given below:



Q.51 The name of the rock is

- (A) Lherzolite (B) Harzburgite  
(C) Wehrlite (D) Dunite

Q.52 On partially melting this rock, the first melt will have the composition of point

- (A) P (B) Q  
(C) R (D) S

**Common Data for Questions 53 and 54:**

An unfossiliferous sedimentary succession is characterized by the following features –

- (i) sandstone-shale alternation, with sheet-like geometry of the sandstone beds; (ii) the sandstones exhibit graded bedding; (iii) erosional structures under the sandstone beds; (iv) convolute lamination, and (v) ripple marks on the sandstone beds.

Q.53 Which depositional environment is indicated for the above sedimentary succession ?

- (A) Fluvial (B) Eolian  
(C) Intertidal (D) Deep marine

Q.54 What type of paleocurrent pattern is expected from the erosional structures in the succession ?

- (A) Unimodal (B) Bimodal  
(C) Bimodal - bipolar (D) Polymodal

**Common Data for Questions 55 and 56:**

Examine the given geological section, which contains sedimentary successions interrupted by a dyke, and which contains no tectonic discontinuities.



Q.55 How many unconformities can be identified in the section ?

- (A) 3 (B) 4  
(C) 5 (D) 6

Q.56 Which of the following contacts is a nonconformity ?

- (A) Granite gneiss – Red Sandstone  
(B) Black Shale – Limestone  
(C) Limestone – Red Shale  
(D) Red Shale – Arkosic Sandstone

## Linked Answer Questions

### Statement for Linked Answer Questions 57 and 58:

Microfossils may have different test composition.

- Q.57 Which of the following is a siliceous microfossil group ?
- (A) Conodonts (B) Radiolaria  
(C) Dinoflagellates (D) Foraminifera
- Q.58 What is the preferred microhabitat of the microfossil group that is the correct answer in Q.57?
- (A) Benthic (B) Planktic  
(C) Nektic (D) Nektobenthic

### Statement for Linked Answer Questions 59 and 60:

Pb-Zn sulphide deposits can form in different types of host rocks.

- Q.59 Of the following, where do we get predominantly carbonate-hosted Pb-Zn sulphide deposits ?
- (A) Mochia – Zawar (B) Sargipalli  
(C) Pur – Banera (D) Sindesar-Khurd
- Q.60 What is the age of the host rock to the correct answer in Q.59 ?
- (A) Neoproterozoic (B) Mesoproterozoic  
(C) Paleoproterozoic (D) Archean

**END OF SECTION 1 OF PART B**

# PART B (SECTION 2): FOR GEOPHYSICS CANDIDATES ONE

Q. 21 to Q. 60 carry two marks each.

Q.21 Match the following functions in time-domain with their fourier spectra :

## Group I

P.  $\Pi(t) = \begin{cases} 1, -1/2 \leq t \leq 1/2 \\ 0, t < -1/2 \text{ and } t > 1/2 \end{cases}$

Q. Dirac delta function,  $\delta(t)$

R.  $x(t) = e^{-|t|}$

S.  $\Lambda(t) = \begin{cases} 1+t, -1 < t < 0 \\ 1-t, 0 < t < 1 \\ 0, \text{otherwise} \end{cases}$

## Group II

1. 1

2.  $\frac{\sin(\pi f)}{f}$ , where  $f$  is frequency

3.  $\frac{2}{1+4\pi^2 f^2}$ , where  $f$  is frequency

4.  $\frac{\sin^2(\pi f)}{f^2}$ , where  $f$  is frequency

(A) P-2, Q-3, R-1, S-4

(C) P-1, Q-4, R-2, S-3

(B) P-1, Q-3, R-2, S-4

(D) P-2, Q-1, R-3, S-4

Q.22 The teleseismic rays are those that arrive at a seismometer for a distance greater than

(A) 18°

(B) 28°

(C) 38°

(D) 48°

Q.23 Match the following seismic source generated noise type with its appearance on the seismogram :

## Group I

P. Reverberation

Q. Multiples

R. Guided waves

S. Diffractions

## Group II

1. Coherent hyperbolic events

2. Tails on reflected events

3. Events paralleling first breaks

4. Reflections at even time intervals after the primary reflections

(A) P-1, Q-3, R-2, S-4

(C) P-2, Q-4, R-3, S-1

(B) P-3, Q-4, R-2, S-1

(D) P-4, Q-1, R-3, S-2

Q.24 Which is the parameter for measuring the size of the earthquake that does not need an instrumental record ?

(A) Richter Magnitude

(C) Moment

(B) Intensity

(D)  $M_w$

Q.25 The standard form of wave equation for propagation of cubical dilatation (6)

$$\rho \frac{\partial^2 \theta}{\partial t^2} = (\lambda + 2\mu) \nabla^2 \theta.$$

The compressional wave velocity is given by

(A)  $\sqrt{\frac{2\lambda + \mu}{\rho}}$

(B)  $\sqrt{\frac{\lambda + 2\mu}{2\rho}}$

(C)  $\sqrt{\frac{\lambda + \mu}{\rho}}$

(D)  $\sqrt{\frac{\lambda + 2\mu}{\rho}}$

Q.26 PKIKP is a seismic body wave which travels through

- (A) upper mantle
- (B) upper and lower mantle
- (C) mantle, outer core and inner core
- (D) mantle and outer core

Q.27 A seismic signal is recorded in a frequency band, 50-100 Hz. The sampling interval (ms) to avoid aliasing would be

- (A) 5
- (B) 10
- (C) 15
- (D) 20

Q.28 The minimum appreciable amplitude recorded by a seismometer is 0.2 mm and the maximum one is 20.0 cm, then the dynamic range in dB is

- (A) 80
- (B) 60
- (C) 40
- (D) 20

Q.29 Match the following:

**Group I**

**Group II**

- |                   |                                                              |
|-------------------|--------------------------------------------------------------|
| P. Primary wave   | 1. Propagate along surface of the medium                     |
| Q. Secondary wave | 2. Particle motion is orthogonal to direction of propagation |
| R. Rayleigh wave  | 3. Particle motion describes a retrograde ellipse            |
| S. Love wave      | 4. Particle motion in the direction of propagation           |

(A) P-3, Q-4, R-1, S-2

(B) P-1, Q-4, R-2, S-3

(C) P-1, Q-3, R-2, S-4

(D) P-4, Q-2, R-3, S-1

Q.30 Which of the following is a minimum-phase wavelet ? The first value in each case is at  $t = 0$

- (A)  $\{-2, 5, -2\}$  (B)  $\{-2, 5, 2\}$   
 (C)  $\{6, -1, -2\}$  (D)  $\{3, 4, -4\}$

Q.31 In a gas zone, true porosity  $\phi_t$ , neutron log  $\phi_n$  and density derived porosity  $\phi_d$  are related as

- (A)  $\phi_n < \phi_d > \phi_t$  (B)  $\phi_n > \phi_d > \phi_t$   
 (C)  $\phi_n > \phi_d = \phi_t$  (D)  $\phi_n < \phi_d = \phi_t$

Q.32 Identify the equation for formation water resistivity ( $R_{we}$ ) estimation from SP log, wherein  $SSP$ ,  $K(T)$  and  $R_{mfe}$  are respectively static SP, temperature dependent coefficient and mudfiltrate resistivity.

- (A)  $SSP = -R_{we} \log\left(\frac{K(T)}{R_{mfe}}\right)$   
 (B)  $SSP = -K(T) \log\left(\frac{R_{we}}{R_{mfe}}\right)$   
 (C)  $SSP = -R_{mfe} \log\left(\frac{K(T)}{R_{we}}\right)$   
 (D)  $SSP = -K(T) \log\left(\frac{R_{mfe}}{R_{we}}\right)$

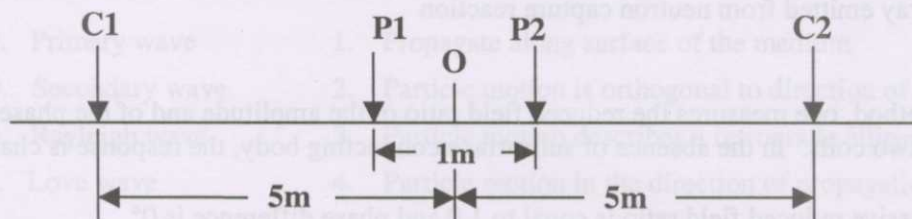
Q.33 Gamma ray detected in density log is

- (A) natural gamma present in the formation  
 (B) gamma ray from epithermal neutron source  
 (C) gamma ray scattered from the formation  
 (D) gamma ray emitted from neutron capture reaction

Q.34 In Turam method, one measures the reduced field ratio of the amplitude and of the phase difference between the two coils. In the absence of subsurface conducting body, the response is characterized as

- (A) the successive reduced field ratio is equal to 1.0 and phase difference is  $0^\circ$   
 (B) the successive reduced field ratio is equal to 1.0 and phase difference is  $45^\circ$   
 (C) the successive reduced field ratio is equal to 0.5 and phase difference is  $90^\circ$   
 (D) the successive reduced field ratio is equal to 0.5 and phase difference is  $60^\circ$

- Q.35 Electric field ( $\vec{E}$ ) through a polarizable dielectric medium with polarization vector  $\vec{P}$ , electric susceptibility ( $\chi_e$ ) and dielectric permittivity ( $\epsilon_0$ ). The electric displacement vector ( $\vec{D}$ ) for the medium can be written as
- (A)  $\vec{D} = \epsilon_0 (1 + \chi_e) \vec{E}$  (B)  $\vec{D} = \epsilon_0 \vec{E} - \vec{P}$   
 (C)  $\vec{D} = \epsilon_0 \vec{E} + \chi_e$  (D)  $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$
- Q.36 Using different electrodes configuration, maximum depth of investigation is achieved in
- (A) Schlumberger (B) dipole  
 (C) tri-electrodes (D) Wenner
- Q.37 Relevant differential equation to study low frequency electromagnetic prospecting for a conducting target can be written in the form of
- (A) Wave equation (B) Laplace's equation  
 (C) Helmholtz equation (D) Poisson's equation
- Q.38 In a layered medium, if the basement is perfectly conducting, magnetotelluric phase response asymptotically approaches to
- (A)  $0^\circ$  (B)  $45^\circ$   
 (C)  $60^\circ$  (D)  $90^\circ$
- Q.39 Magnetotelluric spectral impedance can be defined as
- (A) the ratio of the spatial spectrum from mutually orthogonal horizontal components of the electric and magnetic field  
 (B) the ratio of the spatial spectrum of the vertical component to the horizontal component of magnetic field  
 (C) the ratio of the spatial spectrum of the vertical component to the horizontal component of electric magnetic field  
 (D) the ratio of the spatial spectrum of the two horizontal components of electric field
- Q.40 Following four electrodes array: P1, P2 are measuring electrodes and C1, C2 are current electrodes used in resistivity measurement. Inter-electrode separation is also shown in figure.



The above electrode configuration is

- (A) radial dipole (B) parallel dipole  
 (C) Schlumberger (D) Wenner

- Q.41 In DC resistivity method, direct filter coefficients are used to compute
- (A) apparent resistivity data from resistivity transform
  - (B) resistivity transform from apparent resistivity data
  - (C) apparent resistivity from measured potential difference
  - (D) apparent resistivity from one electrode configuration to other electrode configuration
- Q.42 A counting rate of 15,100 counts per minute is recorded by a radiation counter having a dead time of 300  $\mu$ sec. The count rate (counts per minute) in the absence of dead time would be
- (A) 13,333                      (B) 14,333                      (C) 15,333                      (D) 16,333
- Q.43 The output of a linear and invariant system for a unit input is  $\{3, 1\}$ . Then what would be the output for an input  $\{-2, 1\}$  ?
- (A)  $\{-6, 1, 1\}$                       (B)  $\{-1, 1, 6\}$                       (C)  $\{-1, 6, 1\}$                       (D)  $\{1, -1, 6\}$
- Q.44 Geophysical inverse problems are described by
- (A) Fredholm's integral equation of first kind
  - (B) Fredholm's integral equation of second kind
  - (C) Volterra's equation of second kind
  - (D) Legendre equation
- Q.45 Spot the ANN method from the following :
- (A) Singular value decomposition
  - (B) Monte-Carlo technique
  - (C) Ridge regression procedure
  - (D) Back propagation technique
- Q.46 The concept of resolving kernel is used in
- (A) Tikhonov's regularization method
  - (B) Ridge regression method
  - (C) Backus-Gilbert method
  - (D) Simulated annealing method

- Q.47 For underwater gravity measurements, the following correction is needed :
- (A) Prey correction
  - (B) Free-air correction
  - (C) Bouguer correction
  - (D) Isostatic correction
- Q.48 The source of magnetic anomalies extend up to
- (A) upper mantle
  - (B) core-mantle boundary
  - (C) lower mantle
  - (D) Curie-point isotherm
- Q.49 In magnetic prospecting scalar magnetometers are used. Then, the prime assumption involved in magnetic data acquisition is
- (A) remnant magnetization is predominant
  - (B) both remnant and induced magnetization are responsible
  - (C) induced magnetization plays a dominant role
  - (D) only diamagnetic sources are responsible
- Q.50 Source of main geomagnetic field is best represented by
- (A) a system of electric currents at core-mantle boundary
  - (B) a system of dipoles, quadrupoles, octupoles and multipoles
  - (C) an inclined geomagnetic dipole at center of earth
  - (D) a system of currents in the ionosphere

### Common Data Questions

#### Common Data for Questions 51 and 52:

In a resistivity sounding experiment using Schlumberger configuration the apparent resistivity function asymptotically approaches a sloping straight line of slope  $45^\circ$  with abscissa.

- Q.51 From the above data it can be inferred that the basement is
- (A) Perfectly conducting
  - (B) Relatively resistive
  - (C) Relatively conducting
  - (D) Perfectly resistive

Q.52 If the intercept at  $\rho_a = 1$  ohm-m is 5 and resistivity of top layer is 10 ohm-m, then the basement is

- (A) 50.0 m (B) 5.0 m  
(C) 2.0 m (D) 0.5 m

**Common Data for Questions 53 and 54:**

In a seismic refraction experiment involving a two-layered earth of P-wave velocities, 3 km/sec and 4.5 km/sec the delay time is found to be 49.69 m sec.

Q.53 From the above data, the depth to the interface is given by

- (A) 150 m (B) 120 m  
(C) 100 m (D) 50 m

Q.54 Using the above depth, the computed critical distance (m) would be

- (A) 151.20 (B) 178.88  
(C) 221.67 (D) 169.87

**Common Data for Questions 55 and 56:**

The peak gravity anomaly over a 2-D line mass of circular cross-section (horizontal cylinder) of density contrast  $500 \text{ kg/m}^3$  is 1.674 mgal. The anomaly decreases to 0.837 m gal at a distance of 500 m along a principal profile. The universal gravitation constant,  $G = 6.6667 \times 10^{-11} \text{ m}^3 \text{ sec}^{-2} \text{ kg}^{-1}$ .

Q.55 The depth (m) to center of line mass and radius (m) of the horizontal cylinder are

- (A) 500, 199.80 (B) 200, 150.93  
(C) 200, 100.33 (D) 100, 60.37

Q.56 Hence compute the excess mass per unit length (kg/m) of the line mass

- (A)  $11.0 \times 10^7$  (B)  $9.0 \times 10^7$   
(C)  $6.27 \times 10^7$  (D)  $3.67 \times 10^7$

## Linked Answer Questions

### Statement for Linked Answer Questions 57 and 58:

Resistivity log recorded using normal device with measuring electrode, M, is situated close to electrode, A, in logging device placed in borehole. A constant current,  $I$ , injected from current electrode formation.

Q.57 If the spacing between A and M is  $r$ , and the potential difference  $\Delta V$  is measured between measuring electrode, M and remotely placed surface electrode. Then the expression for the apparent resistivity can be written as

$$(A) \rho_a = \frac{2\pi r}{I} \Delta V$$

$$(B) \rho_a = \frac{4\pi r^2}{I} \Delta V$$

$$(C) \rho_a = \frac{2\pi r^2}{I} \Delta V$$

$$(D) \rho_a = \frac{4\pi r}{I} \Delta V$$

Q.58 If  $r = 0.40 \text{ m}$ ;  $I = 0.02 \text{ amp}$ ;  $\Delta V = 0.04 \text{ volt}$ , then the measured apparent resistivity will be

$$(A) 1 \Omega m$$

$$(B) 5 \Omega m$$

$$(C) 10 \Omega m$$

$$(D) 20 \Omega m$$

### Statement for Linked Answer Questions 59 and 60:

Given the wavelets,  $a = \{3, -2\}$  and  $b = \{1, -2\}$

Q.59 The cross-correlation,  $\phi_{ab}$ , is given by

$$(A) \{-6, 7, -2\}$$

$$(B) \{-6, 10, -12\}$$

$$(C) \{-4, -11, -6\}$$

$$(D) \{-6, 11, -4\}$$

Q.60 The inverse of wavelet 'a',  $W_a^{-1}$  is given by

$$(A) \{4/3, 16/9, 17/7, 64/81\}$$

$$(B) \{1/3, 2/9, 4/27, 8/81\}$$

$$(C) \{4/9, 1/3, 64/81, 16/27\}$$

$$(D) \{16/27, 64/81, 4/9, 1/3\}$$

**END OF THE QUESTION PAPER**