# GG : GEOLOGY AND GEOPHYSICS

*Duration* : Three Hours                                                                    *Maximum Marks* :100

Please read the following instructions carefully:

## General Instructions:

1.  Total duration of examination is 180 minutes (3 hours).

2.  The clock will be set at the server.  The countdown timer in the top right corner of screen will display the remaining time available for you to complete the examination. When the timer reaches zero, the examination will end by itself. You will not be required to end or submit your examination.

3.  The Question Palette displayed on the right side of screen will show the status of each question using one of the following symbols:

|  |  |
|---|---|
| **1** | You have not visited the question yet. |
| **3** | You have not answered the question. |
| **5** | You have answered the question. |
| **7** | You have NOT answered the question, but have marked the question for review. |
| **9** ✓ | You have answered the question, but marked it for review. |

The Marked for Review status for a question simply indicates that you would like to look at that question again. *If a question is answered and  Marked for Review, your answer for that question will be considered in the evaluation.*

## Navigating to a Question

4.  To answer a question, do the following:
    a.  Click on the question number in the Question Palette to go to that question directly.
    b.  Select an answer for a multiple choice type question. Use the virtual numeric keypad to enter a number as answer for a numerical type question.
    c.  Click on **Save and Next** to save your answer for the current question and then go to the next question.
    d.  Click on **Mark for Review and Next** to save your answer for the  current question, mark it for review, and then go to the next question.
    e.  **Caution: Note that your answer for the current question will not be saved, if you navigate to another question directly by clicking on its question number.**
5.  You can view all the questions by clicking on the **Question Paper** button. Note that the options for multiple choice type questions will not be shown.

## Answering a Question

6.  Procedure for answering a multiple choice type question:
    a.  To select your answer, click on the button of one of  the options
    b.  To deselect your chosen answer, click on the button of the chosen option again or click on the **Clear Response** button
    c.  To change your chosen answer, click on the button of  another option
    d.  To save your answer, you MUST click on the **Save and Next** button

    e. To mark the question for review, click on the **Mark for Review and Next** button**.** *If an answer is selected for a question that is Marked for Review, that answer will be considered in the evaluation.*

7. Procedure for answering a numerical answer type question:
   a. To enter a number as your answer, use the virtual numerical keypad
   b. A fraction (eg.,-0.3 or -.3) can be entered as an answer with or without '0' before the decimal point
   c. To clear your answer, click on the **Clear Response** button
   d. To save your answer, you MUST click on the **Save and Next** button
   e. To mark the question for review, click on the **Mark for Review and Next** button**.** *If an answer is entered for a question that is Marked for Review, that answer will be considered in the evaluation.*

8. To change your answer to a question that has already been answered, first select that question for answering and then follow the procedure for answering that type of question.

9. Note that ONLY Questions for which answers are saved or marked for review after answering will be considered for evaluation.

**Choosing an Optional Section**

10. Sections in this question paper are displayed on the top bar of the screen. Questions in a Section can be viewed by clicking on the name of that Section. The Section you are currently viewing is highlighted.

11. A checkbox is displayed for every optional Section in the Question Paper. To select an optional Section for answering, click on the checkbox for that Section.

12. If the checkbox for an optional Section is not selected, the **Save and Next** button and the **Mark for Review and Next** button will NOT be enabled for that Section.  You will be able to only see questions in the Section, but you will not be able to answer questions in the Section.

13. After clicking the **Save and Next** button for the last question in a Section, you will automatically be taken to the first question of the next Section in sequence.

14. You can move the mouse cursor over the name of a Section  to view the answering status for that Section.

**Changing the Optional Section**

15. After answering the chosen optional Sections, partially or completely, you can change an optional Section by selecting a checkbox for a new Section that you want to attempt. A warning message will appear along with a table showing the number of questions answered in each of the previously chosen optional Sections and a checkbox against each of these Sections. Click on a checkbox against a Section that you want to reset and then click on the **RESET** button. **Note that RESETTING a Section will DELETE all the answers for questions in that Section. Hence, if you think that you may want to select this Section again later, you will have to note down your answers for questions in that Section.** If you do not want to reset any Section and want to continue answering the previously chosen optional  Sections, then click on the **BACK** button.

16. If you deselect the checkbox for an optional Section in the top bar, the following warning message will appear: "Deselecting the checkbox will DELETE all the answers for questions in this Section. Do you want to deselect this Section?"  If you want to deselect, click on the **RESET** button. If you do not want to deselect, click on the **BACK** button.

17. You can shuffle between different Sections any number of times. You can change the optional Sections any number of times.

**Paper specific instructions:**

1. There are a total of 65 questions carrying 100 marks. Questions are of multiple choice type or numerical answer type. A multiple choice type question will have four choices for the answer with only **one** correct choice. For numerical answer type questions, the answer is a number and no choices will be given. **A number as the answer should be entered** using the virtual keyboard on the monitor.

2. Part-A is a compulsory section that contains 25 questions carrying 1 mark each. Part-B contains two optional sections: Section 1 (Geology) and Section 2 (Geophysics). Each of these sections contains 30 questions carrying 2 marks each. The 2 marks questions include two pairs of common data questions and two pairs of linked answer questions. The answer to the second question of the linked answer questions depends on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is not attempted, then the answer to the second question in the pair will not be evaluated.

3. Questions Q.56 – Q.65 belong to General Aptitude (GA) section and carry a total of 15 marks. Questions Q.56 – Q.60 carry 1mark each, and questions Q.61 – Q.65 carry 2marks each.

4. Questions not attempted will result in zero mark. Wrong answers for multiple choice type questions will result in **NEGATIVE** marks. For all 1 mark questions, ⅓ mark will be deducted for each wrong answer. For all 2 marks questions, ⅔ mark will be deducted for each wrong answer. However, in the case of the linked answer question pair, there will be negative marks only for wrong answer to the first question and no negative marks for wrong answer to the second question. There is no negative marking for questions of numerical answer type.

5. Calculator is allowed. Charts, graph sheets or tables are **NOT** allowed in the examination hall.

6. Do the rough work in the Scribble Pad provided.

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

### Q. 1 – Q. 25 carry one mark each.

Q.1     The number of hydrous minerals in the Moh's scale of hardness is _____.

Q.2     It takes approximately _____ minutes for sunlight to reach the Earth.

Q.3     In a remotely sensed data of a planet, the presence of hydrous species can be inferred using _____region of the electromagnetic spectrum?

(A) Radiowave          (B) Gamma          (C) Infrared          (D) Visible

Q.4     Amongst the following, which one will have the highest P-wave velocity?

(A) Granite          (B) Diamond          (C) Shale          (D) Talc

Q.5     Assuming the Earth to be a perfect sphere, its equatorial velocity is approximately _____ km/hr

Q.6     Both strength and plasticity of a rock increase with the

(A) increase in temperature
(B) decrease in strain rate
(C) increase in confining pressure
(D) increase in pore fluid pressure

Q.7     Amongst the following options, the acceptable value of the Poisson's ratio of a rock is

(A) 0.55          (B) 1.00          (C) 0.25          (D) -1.00

Q.8     The acceleration due to gravity, '*g*' is maximum at

(A) equator          (B) poles          (C) mid-latitudes          (D) sub-tropical regions

Q.9     The most abundant mineral in the Earth's crust is

(A) quartz          (B) K-feldspar          (C) biotite          (D) garnet

Q.10    Acoustic impedance is the _____ of density and velocity.

(A) sum          (B) difference          (C) product          (D) ratio

Q.11    Choose the diamagnetic mineral from the following.

(A) Calcite          (B) Enstatite          (C) Pyrite          (D) Ilmenite

Q.12    Two bodies made up of same material with different dimensions have

(A) same resistances and resistivities
(B) same resistivities but different resistances
(C) same resistances but different resistivities
(D) different resistances and resistivities

Q.13    The type of wave that arrives first at a station from an earthquake hypocenter is

(A) P-wave          (B) S-wave          (C) Rayleigh wave          (D) Love wave

Q.14    Which one of the following is the correct statement?

(A) Accretionary wedge is part of the foreland basin
(B) Spreading ridge is a major zone of metamorphism
(C) Dehydration of subducting slab induces mantle melting
(D) Back arc basin represent a convergent regime

Q.15    Match the following items of **Group I** with those of **Group II**.

| Group I | Group II |
| --- | --- |
| P) Electrical Method | 1) Density |
| Q) Magnetic Method | 2) Velocity |
| R) Gravity Method | 3) Resistivity |
| S) Seismic Method | 4) Susceptibility |
| | 5) Dielectric Permittivity |

(A) P – 3 ; Q – 2 ; R – 5 ; S – 1
(B) P – 3 ; Q – 4 ; R – 1 ; S – 2
(C) P – 3 ; Q – 4 ; R – 2 ; S – 1
(D) P – 5 ; Q – 4 ; R – 3 ; S – 2

Q.16    If a radioactive isotope has a decay constant of $1.55 \times 10^{-10}$ year$^{-1}$, its half-life (in years) would be

(A) $4.57 \times 10^{9}$         (B) $4.47 \times 10^{9}$         (C) $4.57 \times 10^{10}$         (D) $4.47 \times 10^{10}$

Q.17    Which of the following physical properties of rocks has the widest range of variation?

(A) Magnetic permeability              (B) Dielectric permittivity
(C) Seismic velocity                       (D) Electrical resistivity

Q.18    Which of the following is **NOT** an inverse square law?

(A) Newton's law of gravitation
(B) Coulomb's law of electrostatics
(C) Coulomb's law of magnetostatics
(D) Hooke's law

Q.19    A type of unconformity characterized by the occurrence of sedimentary rocks on igneous/metamorphic rocks is known as

(A) angular unconformity               (B) nonconformity
(C) paraconformity                          (D) disconformity

Q.20    For seismic S-wave velocity, $V$, the rigidity modulus, $\mu$, is proportional to

(A) $\sqrt{V}$              (B) $V$              (C) $V^{2}$              (D) $V^{3}$

Q.21    An active trench is present in the vicinity of

(A) Andaman & Nicobar Islands          (B) Gulf of Cambay
(C) Lakshadweep                                  (D) Krishna-Godavari delta

Q.22    In a homogeneous anisotropic medium, the physical property varies

(A) with position but not with direction
(B) with both position and direction
(C) with direction but not with position
(D) neither with position nor with direction

Q.23    Which one of the following stable isotopic ratios is used for estimation of palaeo-temperature of seawater?

(A) $^{13}C/^{12}C$                                      (B) $^{18}O/^{16}O$

(C) $^{87}S/^{86}Sr$                                     (D) $^{15}N/^{14}N$

Q.24    Match the items of **Group I** with those of **Group II**.

| **Group I** | **Group II** |
|---|---|
| P. Coal | 1. Gandhar |
| Q. Copper | 2. Singareni |
| R. Oil | 3. Khetri |
| S. Uranium | 4. Jadugoda |
| | 5. Degana |

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

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

Q.25    Which of the following logging techniques is best suited to estimate the shaliness of hydrocarbon reservoirs?

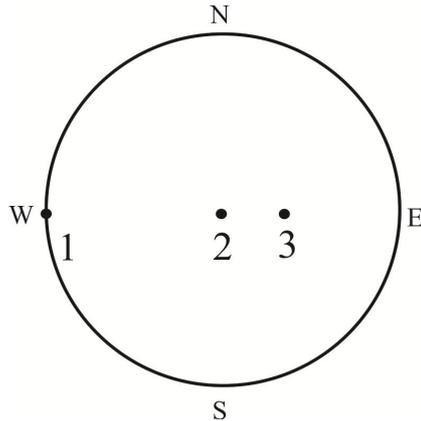(A)  Resistivity                                     (B)  Sonic

(C)  Induction                                       (D)  Gamma ray

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

## Q. 26 to Q. 55 carry two marks each.

Q.26    Which of the following statements is correct?

    (A) Eolian sands do not exhibit cross bedding.
    (B) Deep marine sands are well sorted.
    (C) Glacier deposit may contain faceted pebble.
    (D) Wave ripples do not form on shallow marine sands.

Q.27    The test of organic-walled foraminifera is termed as

    (A) Microgranular                   (B ) Hyaline
    (C) Porcellaneous                 (D) Tectinous

Q.28    The void ratio (in percentage) of sandstone is 25. Its porosity in percentage is _____.

Q.29    On a 1:10,000 scale map, the length of a fault trace on a horizontal plane is represented as 5 cm. The same on a 1:25,000 scale vertical aerial photograph is _____ cm.

Q.30    In high-grade metamorphism, biotite melting indicates

    (A) rock cooling                   (B) rock hydration
    (C) rock uplifting                  (D) rock dehydration

Q.31    Match the dentition type in **Group I** with the bivalves in **Group II**.

| Group I | Group II |
| --- | --- |
| P. Desmodont | 1. *Mytilus* |
| Q. Dysodont | 2. *Cerastoderma* |
| R. Isodont | 3. *Mya* |
| S. Heterodont | 4. *Spondylus* |
|  | 5. *Nucula* |
|  | 6. *Arca* |

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

Q.32    Which one of the following is the correct statement regarding hydrocarbon generation?

    (A) H/C content of organic matter increases as it matures.
    (B) O/C content of organic matter increases as it matures.
    (C) Lignite does not form any hydrocarbon during maturation.
    (D) Oil source rock is most abundant in Mesozoic.

Q.33    In the stereographic projection, 1, 2 and 3 represent poles of three planes. Choose the correct combination of statements from the following.



(A) The plane corresponding to 1 is horizontal and the plane corresponding to 2 is inclined.
(B) The plane corresponding to 1 is striking N-S and the plane corresponding to 2 is horizontal.
(C) The plane corresponding to 2 is vertical and the plane corresponding to 3 is striking E-W.
(D) The plane corresponding to 2 is striking E-W and the plane corresponding to 3 is inclined.

Q.34    Match the minerals in **Group I** with its corresponding industrial application in **Group II**.

| **Group I** | **Group II** |
| --- | --- |
| P. Kaolinite | 1. Pigment |
| Q. Rutile | 2. Asbestos |
| R. Graphite | 3. Cement |
| S. Serpentine | 4. Lubricant |
|  | 5. Abrasive |

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

Q.35    Match the Hermann-Maugin symbol in **Group I** with its corresponding general form in **Group II**.

| **Group I** | **Group II** |
| --- | --- |
| P. 6/m | 1. Trigonal Dipyramid |
| Q. 3m | 2. Ditrigonal Dipyramid |
| R. $\bar{6}m2$ | 3. Dihexagonal Pyramid |
| S. $\bar{6}$ | 4. Ditrigonal Pyramid |
|  | 5. Hexagonal Dipyramid |

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

Q.36    Which of the following is a type of dam?

(A) Anchor          (B) Shotcrete          (C) Geogrid          (D) Buttress

Q.37    Match the items in **Group I** with those in **Group II**.

| Group I | Group II |
| --- | --- |
| P. Kersantite | 1. Hornblende-diopside-plagioclase lamprophyre |
| Q. Fenite | 2. Basaltic trachyandesite |
| R. Mugearite | 3. Volcanic nepheline syenite |
| S. Phonolite | 4. Biotite-plagioclase lamprophyre |
| | 5. Metasomatic rock associated with carbonatites |

(A) P – 1, Q – 2, R – 4, S – 3          (B) P – 4, Q – 5, R – 2, S – 3

(C) P – 3, Q –1, R – 2, S – 4          (D) P – 4, Q – 5, R – 3, S – 2

Q.38    A chondrite-normalized REE pattern of quartzo-feldspathic gneiss shows a sharp positive Eu anomaly. This indicates presence of

(A) plagioclase in the sample.

(B) quartz in the sample.

(C) clinopyroxene in the sample.

(D) sillimanite in the sample.

Q.39    Choose the correct expression from the following that explains the changing vertical position of a point on the land surface at any time (Surface Uplift – SU, Bedrock Uplift – BU, Deposition – D, Compaction – C, Erosion – E).

(A) SU = BU – D – C – E

(B) SU = BU – D + C – E

(C) SU = BU + D – C + E

(D) SU = BU + D – C – E

Q.40    Match the following stratigraphic units listed in **Group I** with the Precambrian basins in **Group II**.

| Group I | Group II |
| --- | --- |
| P. Badami Group | 1. Vindhyan |
| Q. Kheinjua Formation | 2. Chhatisgarh |
| R. Sullavai Group | 3. Kaladgi |
| S. Papaghni Group | 4. Cuddapah |
| | 5. Pranhita-Godavari |

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

(C) P – 1, Q – 2, R – 3, S – 5          (D) P – 3, Q – 2, R – 5, S – 4

Q.41    Mantle xenoliths are observed in

(A) Kimberlite

(B) Granite

(C) Pegmatite

(D) Granulite

Q.42    Dimension of hydraulic conductivity is

(A) $LT^{-2}$          (B) $L^3T^{-1}$          (C) $ML^{-3}$          (D) $LT^{-1}$

Q.43    Match the items in **Group I** with those in **Group II**.

**Group I**                                          **Group II**

P. Katrol Formation                                  1. Oligocene
Q. Barail Formation                                  2. Cretaceous
R. Ariyalur Formation                                3. Eocene
S. Sylhet Formation                                  4. Jurassic
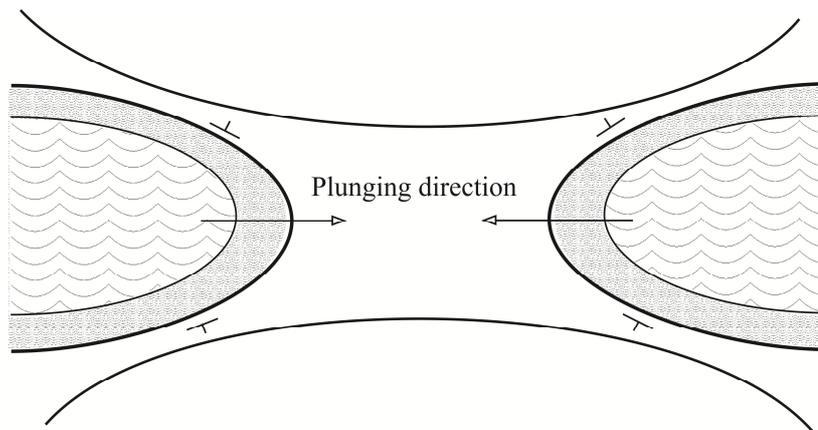                                                     5. Paleocene
                                                     6. Miocene

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

Q.44    The outcrop pattern of folded sedimentary strata on the map given below represents



Plunging direction

(A) culmination of antiform                          (B) culmination of synform
(C) depression of antiform                           (D) depression of synform

Q.45    Match the economic deposits in **Group I** with the host rocks in **Group II**.

**Group I**                                          **Group II**

P. Malanjkhand copper                                1. Granite
Q. Salem magnesite                                   2. Dolomite
R. Zawar Pb-Zn                                       3. Graphitic Schist
S. Rampura-Agucha                                    4. Ultramafics
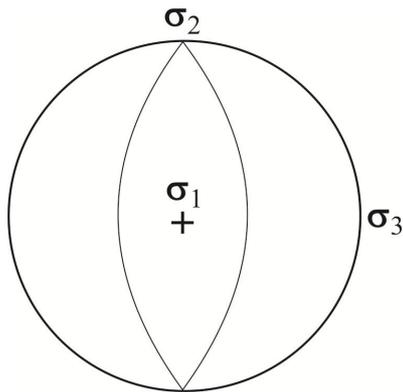                                                     5. Basalt
                                                     6. Rhyollite

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

Q.46 The stereographic projection below shows the principal stress axes and fault planes. The projection represents a
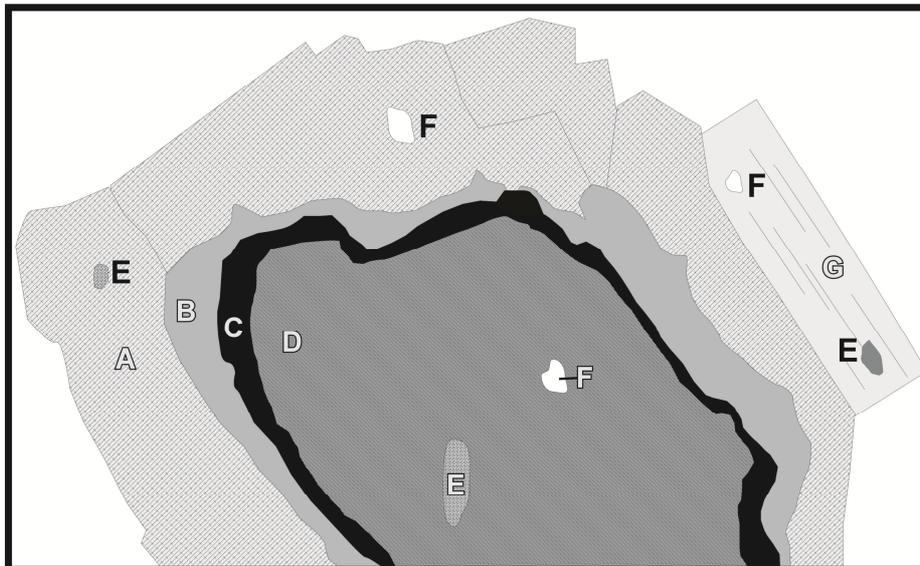


(A) normal fault       (B) reverse fault       (C) dextral fault       (D) sinistral fault

Q.47 Select the correct the statement from the following.

(A) Incised channels form an account of aeolin action.
(B) Mesa structures are observed only in steeply dipping beds.
(C) Crevasse splay is commonly associated with meandering river.
(D) Coral reefs are abundant in Gulf of Cambay.

## Common Data Questions

Common Data for Questions 48 and 49:
A, B, C, D, E, F and G are minerals in a sample of metamorphic rock. The micro-texture of the assemblage is given below. A, D and G are porphyroblasts, B and C are coronas, E and F are inclusions.



Q.48 Select the appropriate metamorphic reaction from the following options.

(A) A + B = C + D          (B) A + C = D + G
(C) A + D = B + C          (D) E + D = C + A

Q.49    Based on the micro-texture, select the oldest assemblage from the following.

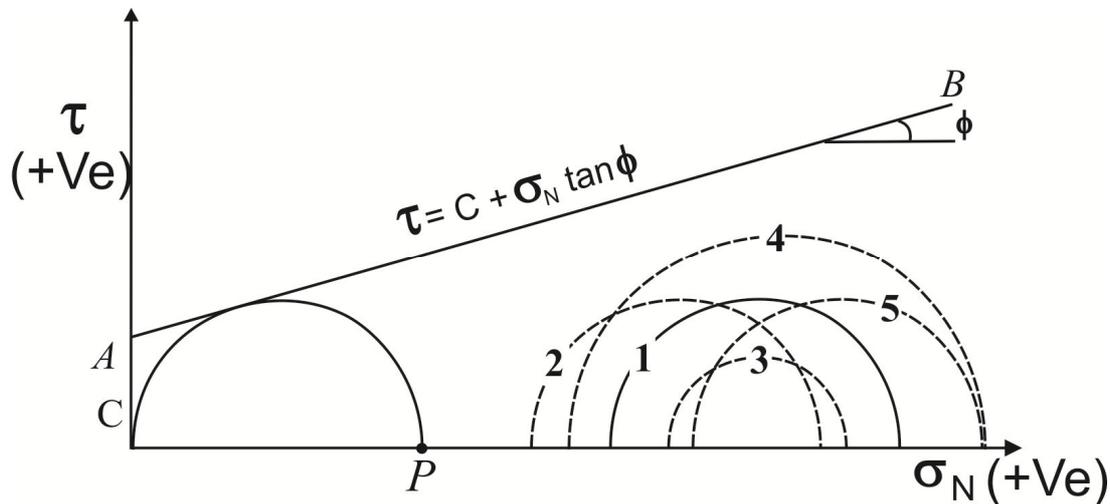        (A) A-D                 (B) E-F                 (C) B-C                 (E) A-G

Common Data for Questions 50 and 51:
The Mohr-Coulomb failure envelope (A-B) of a porous limestone is given below.



Q.50    The point P represents

        (A) uniaxial tensile strength.
        (B) uniaxial compressive strength.
        (C) indirect tensile strength.
        (D) shear strength.

Q.51    For a condition represented by the circle 1, if pore water pressure increases, the circle will change
        to

        (A) circle 2.           (B) circle 3.           (C)  circle 4.          (D)  circle 5.

# Linked Answer Questions

Statement for Linked Answer Questions 52 and 53:
Sedimentary structures are useful for determining the younging direction of a bed.

Q.52    Which one of the following sedimentary structure represents the bottom of a bed?

        (A) Current crescent                    (B) Desiccation crack
        (C) Rain print                          (D) Load cast

Q.53    Which sedimentary process is responsible for the generation of the structure identified above?

        (A) Wave reworking                      (B) Liquefaction of sediments
        (C) Drying and desiccation              (D) Erosion of cohesive substrate

Statement for Linked Answer Questions 54 and 55:
The table below represents recalculated cation compositions data of minerals.

|        | I      | II      | III   | IV     |
|--------|--------|---------|-------|--------|
| Si     | 3.000  | 3.000   | 1.910 | 2.000  |
| Ti     | 0.000  | 0.003   | 0.003 | 0.000  |
| Al     | 1.997  | 2.000   | 0.186 | 0.009  |
| Fe     | 1.400  | 6.000   | 0.160 | 1.405  |
| Mn     | 0.000  | 0.000   | 0.000 | 0.032  |
| Mg     | 1.038  | 0.510   | 0.877 | 0.998  |
| Ca     | 0.568  | 0.475   | 0.848 | 1.567  |
| Na     | 0.000  | 0.024   | 0.021 | 0.000  |
| **Total** | **8.003** | **12.012** | **4.005** | **6.011** |

Q.54 Select the correct garnet [$(Ca,Fe,Mg,Mn)_3Al_2Si_3O_{12}$] and clinopyroxene [$Ca(FeMg)Si_2O_6$] pair respectively.

(A) II and III      (B) II and IV      (C) I and IV      (D) I and III

Q.55 Calculate the distribution coefficient [$K_D$] for the Fe-Mg system.

(A) 0.504      (B) 0.620      (C) 1.420      (D) 1.535

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

## Q. 26 to Q. 55 carry two marks each.

Q.26    A P-wave is reflected as both P- and S- waves from an interface at angles $r_p$ and $r_s$ respectively. The relationship between $r_p$ and $r_s$ is

(A)  $r_p > r_s$              (B) $r_p = r_s$              (C)  $r_p < r_s$              (D)  $r_p = 2r_s$

Q.27    Which of the following ways of measuring the size of an earthquake does not require instrumental recording?

(A)  Richter magnitude                    (B) Moment
(C)  Mw                                   (D) Intensity

Q.28    In what circumstances, the migrated reflection seismic section will be same as the unmigrated one?

(A) Inclined interfaces                    (B) Undulating interfaces
(C) Horizontal interfaces                  (D) Vertical interfaces

Q.29    Which of the following methods is best suited to estimate the resistivity variations in the upper mantle?

(A)  Deep electrical resistivity
(B)  Ground Penetrating Radar
(C)  Controlled Source Electromagnetics
(D)  Magnetotellurics

Q.30    Amongst the following 4-electrode configurations of the electrical resistivity method, which is best suited for archeological investigations?

(A) Schlumberger
(B) Pole-Pole
(C) Wenner
(D) Dipole-Dipole

Q.31    A singular value of an *m* x *n* matrix, *A*, is defined as

(A) positive square root of eigenvalue of $AA^T$
(B) modulus of eigenvalue of *A*
(C) eigenvalue of $A^TA$
(D) square of eigenvalue of *A*

Q.32    In an ill-posed geophysical inverse problem, stated as non-singular matrix equation, the magnitude of determinant of the coefficient matrix is

(A) large              (B) zero              (C) near zero              (D) very large

Q.33    In a 4-layer subsurface model, which combination of A-, H-, K- and Q- type electrical resistivity sounding curves is **NOT** possible?

(A) HA              (B) AK              (C) KQ              (D) HQ

Q.34    Which of the following characteristics of a Self Potential (SP) anomaly gives the approximate position of centre of the buried ore body?

(A) Position of maximum of the anomaly
(B) Position of minimum of the anomaly
(C) Position of zero crossing
(D) Position midpoint between maximum and minimum of the anomaly

Q.35    Given a scalar function, $f(x, y) = xy$. The curl of gradient of $f(x, y)$ is

(A) $2x\hat{i}$              (B) $-2y\hat{j}$              (C) $0\hat{i}$              (D) $x\hat{i} + y\hat{j}$

Q.36    Which of the following is **NOT** correct?

(A) In VLF-EM technique, the tilt-angle mode is best suited to locate conductive bodies
(B) Fraser filter is a difference filter
(C) Static shift affects MT impedance phase
(D) Tipper vector is derived from the three magnetic field components, Hx, Hy and Hz.

Q.37    If L, B, F and T respectively stand for Latitude correction, Bouguer correction, Free-air correction and Terrain correction, then the order in which they will have to be applied for gravity data analysis is

(A) LFBT              (B) LBTF              (C) FLBT              (D) TBLF

Q.38    Geomagnetic secular variations originate from the

(A) inner core          (B) outer core          (C) crust          (D) mantle

Q.39    Removal of regional component from magnetic data is similar to

(A) band-pass filtering
(B) low-pass filtering
(C) high-pass filtering
(D) band-reject filtering

Q.40    Which of the following is useful to estimate the depth to the centre of a spherical body from a gravity anomaly curve?

(A) Surface integration
(B) Volume integration
(C) Twice the absolute maximum
(D) Half-width of the anomaly

Q.41    Application of reduction-to-pole technique to a magnetic anomaly results in

(A) flattening the anomaly curve.
(B) transforming the asymmetry in the anomaly to symmetry.
(C) halving the amplitude.
(D) doubling the amplitude.

Q.42    The Fourier transform of a comb function is

(A) delta function      (B) comb function      (C) sync function      (D) rectangular function

Q.43    In Cartesian coordinate system, if the geological strike of a two-dimensional body is oriented along the x-direction, then the electromagnetic field components associated with TM mode of magnetotelluric method are

(A) Hx, Ey and Ez      (B) Ex, Hy and Ez      (C) Hx, Hy and Ez      (D) Ex, Hy and Hz

Q.44    A seismic signal is recorded in the frequency band 100-250 Hz. While digitizing the signal, the sampling interval one should choose to avoid aliasing is _____ ms.

Q.45   Wadati diagram is a plot of the difference in P- and S- wave arrival times against the arrival time of P-wave. It helps in estimating the

(A) velocity of P-wave.                         (B) velocity of S-wave.

(C) time of occurrence of earthquake.          (D) hypocenter of earthquake.

Q.46   Match the items of **Group I** with those of **Group II**

**Group I**                                     **Group II**

P) Caliper log                                  1) Permeability
Q) NMR log                                      2) Resistivity
R) Neutron log                                  3) Diameter
S) SP log                                       4) Velocity
                                                5) Porosity

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

Q.47   The most common hydrocarbon indicator is

(A) flat spot          (B) dim spot          (C) bright spot          (D) velocity sag

## Common Data Questions

Common Data for Questions 48 and 49:  A recursive filter $y_n$ is given by $y_n = 2x_n - 1.5x_{n-1} + y_{n-2}$.

Q.48   The order of $y_n$ is_____.

Q.49   The transfer function of $y_n$ in z-domain is

(A) $\dfrac{1 - 1.5z}{2 - z^2}$                 (B) $\dfrac{1 - z^2}{2 - 1.5z}$

(C) $\dfrac{2 + z^2}{1 + 1.5z}$                 (D) $\dfrac{2 - 1.5z}{1 - z^2}$

Common Data for Questions 50 and 51:  In a linear inverse problem, the coefficient matrix, $A = \begin{bmatrix} 2.00 & 2.01 \\ 2.01 & 2.00 \end{bmatrix}$.

Q.50   The eigenvalues of $A$ are

(A) (4.01, -0.01)      (B) (-4.01, -0.01)      (C) (4.01, 0.01)      (D) (-4.01, 0.01)

Q.51   If the elements of $A$ are expressed up to first decimal place only, then the number of possible solution(s) of the resulting inverse problem is

(A) 1                  (B) 2                  (C) 3                  (D) $\infty$

## Linked Answer Questions

Statement for Linked Answer Questions 52 and 53:  In an electrical resistivity sounding survey a current of 20 mA is passed through the current electrodes separated by a distance of 50 m and a voltage of 3 V is measured across the potential electrodes, separated by 10 m.

Q.52    The above electrode configuration is known as

(A) Schlumberger
(B) Wenner
(C) Pole-Dipole
(D) Pole-Pole

Q.53    The apparent resistivity (in Ω-m) for the above electrode configuration is close to

(A) 100            (B) 200            (C) 300            (D) 400

Statement for Linked Answer Questions 54 and 55:  An electromagnetic (EM) wave of frequency 25 Hz is impinging on a homogeneous half-space, having resistivity of 100 Ω-m.

Q.54    The skin-depth of the wave is about

(A) 1 km           (B) 1 m            (C) 500 km          (D) 500 m

Q.55    The velocity of the EM wave (in km/s) is close to

(A) 20π            (B) 30 π           (C) 40 π            (D) 50 π

## General Aptitude (GA) Questions

### Q. 56 – Q. 60 carry one mark each.

Q.56    A number is as much greater than 75 as it is smaller than 117. The number is:

(A) 91                    (B)  93                    (C)  89                    (D)  96

Q.57    The professor ordered to the students to go out of the class.
          I            II          III         IV
Which of the above underlined parts of the sentence is grammatically incorrect?

(A) I                    (B) II                    (C)  III                    (D)  IV

Q.58    Which of the following options is the closest in meaning to the word given below:

Primeval

(A) Modern                                    (B) Historic
(C) Primitive                                  (D) Antique

Q.59    Friendship, no matter how _____it is, has its limitations.

(A) cordial

(B) intimate

(C) secret

(D) pleasant

Q.60    Select the pair that best expresses a relationship similar to that expressed in the pair:
**Medicine: Health**

(A) Science: Experiment                        (B) Wealth: Peace
(C) Education: Knowledge                        (D) Money: Happiness

### Q. 61 to Q. 65 carry two marks each.

Q.61    X and Y are two positive real numbers such that $2X + Y \leq 6$ and $X + 2Y \leq 8$. For which of the following values of $(X, Y)$ the function $f(X, Y) = 3X + 6Y$ will give maximum value?

(A) (4/3, 10/3)

(B) (8/3, 20/3)

(C) (8/3, 10/3)

(D) (4/3, 20/3)

Q.62    If $|4X - 7| = 5$ then the values of $2\,|X| - |-X|$ is:

(A)  2, 1/3              (B)  1/2, 3              (C)  3/2, 9              (D)  2/3, 9

Q.63    Following table provides figures (in rupees) on annual expenditure of a firm for two years - 2010 and 2011.

| Category | 2010 | 2011 |
|---|---|---|
| **Raw material** | 5200 | 6240 |
| **Power & fuel** | 7000 | 9450 |
| **Salary & wages** | 9000 | 12600 |
| **Plant & machinery** | 20000 | 25000 |
| **Advertising** | 15000 | 19500 |
| **Research & Development** | 22000 | 26400 |

In 2011, which of the following two categories have registered increase by same percentage?

(A) Raw material and Salary & wages

(B) Salary & wages and Advertising

(C) Power & fuel and Advertising

(D) Raw material and Research & Development

Q.64    A firm is selling its product at Rs. 60 per unit. The total cost of production is Rs. 100 and firm is earning total profit of Rs. 500. Later, the total cost increased by 30%. By what percentage the price should be increased to maintained the same profit level.

(A) 5                    (B) 10                    (C) 15                    (D) 30

Q.65    Abhishek is elder to Savar.
Savar is younger to Anshul.

Which of the given conclusions is logically valid and is inferred from the above statements?

(A) Abhishek is elder to Anshul

(B) Anshul is elder to Abhishek

(C) Abhishek and Anshul are of the same age

(D) No conclusion follows

# END OF THE QUESTION PAPER