GATE 2014: General Instructions during Examination

1. Total duration of the GATE examination is **180** minutes.
2. The clock will be set at the server. The countdown timer at 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 need not terminate the examination or submit your paper.
3. Any useful data required for your paper can be viewed by clicking on the **Useful Common Data** button that appears on the screen.
4. Use the scribble pad provided to you for any rough work. Submit the scribble pad at the end of the examination.
5. You are allowed to use a non-programmable type calculator, however, sharing of calculators is not allowed.
6. 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, but marked for review, then the answer will be considered for evaluation unless the status is modified by the candidate.*

Navigating to a Question :

7. 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 by clicking on the bubble placed before the 4 choices, namely A, B, C and D. Use the virtual numeric keypad to enter a number as answer for a numerical type question.
    c. Click on **Save & Next** to save your answer for the current question and then go to the next question.
    d. Click on **Mark for Review & Next** to save your answer for the current question and also mark it for review, and then go to the next question.

Caution: Note that your answer for the current question will not be saved, if you navigate to another question directly by clicking on a question number without saving the answer to the previous question.

You can view all the questions by clicking on the **Question Paper** button. This feature is provided, so that if you want you can just see the entire question paper at a glance.

Answering a Question :

8. Procedure for answering a multiple choice (MCQ) type question:
   a. Choose one answer from the 4 options (A,B,C,D) given below the question, click on the bubble placed before the chosen option.
   b. To deselect your chosen answer, click on the bubble of the chosen option again or click on the **Clear Response** button.
   c. To change your chosen answer, click on the bubble of another option.
   d. To save your answer, you MUST click on the **Save & Next** button.

9. Procedure for answering a numerical answer type question:
   a. To enter a number as your answer, use the virtual numerical keypad.
   b. A fraction (e.g. -0.3 or -.3) can be entered as an answer with or without '0' before the decimal point. As many as four decimal points, e.g. 12.5435 or 0.003 or -932.6711 or 12.82 can be entered.
   c. To clear your answer, click on the **Clear Response** button.
   d. To save your answer, you MUST click on the **Save & Next** button

10. To mark a question for review, click on the **Mark for Review & Next** button. *If an answer is selected (for MCQ) or entered (for numerical answer type) for a question that is* **Marked for Review***, that answer will be considered in the evaluation unless the status is modified by the candidate.*

11. 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.

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

Choosing a Section :

13. 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 will be highlighted.

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

15. If the checkbox for an optional Section is not selected, the **Save & Next** button and the **Mark for Review & Next** button will NOT be enabled for that Section. You will

only be able to see questions in this Section, but you will not be able to answer questions in the Section.

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

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

Changing the Optional Section :

18. After answering the chosen optional Section, partially or completely, you can change the optional Section by selecting the 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 the Section and want to continue answering the previously chosen optional Section, then click on the **BACK** button.

19. 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.

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

GATE 2014 Examination

GG: Geology and Geophysics

Duration: **180 minutes**   *Maximum Marks*: **100**

Read the following instructions carefully.

1. To login, enter your Registration Number and password provided to you. Kindly go through the various symbols used in the test and understand their meaning before you start the examination.
2. Once you login and after the start of the examination, you can view all the questions in the question paper, by clicking on the **View All Questions** button in the screen.
3. This question paper consists of **3 parts** consisting of **4 sections**. The 3 parts are: the compulsory General Aptitude (GA) section for **15 marks**; Part-A, which is also a compulsory section and is for **25 marks;** and Part-B for **60 marks**.
   The Part-B consists of **2 sections**, namely, Section-1 for Geology students only and Section-2 for Geophysics students only.
   The GA section consists of **10** questions. Question numbers 1 to 5 are of 1-mark each, while question numbers 6 to 10 are of 2-mark each.
   Part-A consists of 25 questions each of 1-mark.
   Sections **1 and 2** of Part-B consist of 30 number of 2-mark questions.
4. Depending upon the GATE paper, there may be useful common data that may be required for answering the questions. If the paper has such useful data, the same can be viewed by clicking on the **Useful Common Data** button that appears at the top, right hand side of the screen.
5. The computer allotted to you at the examination center runs specialized software that permits only one answer to be selected for multiple-choice questions using a mouse and to enter a suitable number for the numerical answer type questions using the virtual keyboard and mouse.
6. Your answers shall be updated and saved on a server periodically and also at the end of the examination. The examination will **stop automatically** at the end of **180 minutes**.
7. In each paper a candidate can answer a total of 65 questions carrying 100 marks.
8. The question paper may consist of questions of **multiple choice type** (MCQ) and **numerical answer type**.
9. Multiple choice type questions will have four choices against A, B, C, D, out of which only **ONE** is the correct answer. The candidate has to choose the correct answer by clicking on the bubble (◯) placed before the choice.
10. For numerical answer type questions, each question will have a numerical answer and there will not be any choices**. For these questions, the answer should be entered**by using the virtual keyboard that appears on the monitor and the mouse.
11. All questions that are not attempted will result in zero marks. However, wrong answers for multiple choice type questions (MCQ) will result in **NEGATIVE** marks. For all MCQ questions a wrong answer will result in deduction of⅓ marks for a 1-mark question and ⅔ marks for a 2-mark question.
12. There is **NO NEGATIVE MARKING** for questions of **NUMERICAL ANSWER TYPE**.
13. Non-programmable type Calculator is allowed. Charts, graph sheets, and mathematical tables are **NOT** allowed in the Examination Hall. You must use the Scribble pad provided to you at the examination centre for all your rough work. The Scribble Pad has to be returned at the end of the examination.

Declaration by the candidate:

"I have read and understood all the above instructions. I have also read and understood clearly the instructions given on the admit card and shall follow the same. I also understand that in case I am found to violate any of these instructions, my candidature is liable to be cancelled. I also confirm that at the start of the examination all the computer hardware allotted to me is in proper working condition".

Q. 1 – Q. 5 carry one mark each.

Q.1   Choose the most appropriate word from the options given below to complete the following sentence.

A person suffering from Alzheimer's disease _____ short-term memory loss.

(A) experienced   (B) has experienced
(C) is experiencing   (D) experiences

Q.2   Choose the most appropriate word from the options given below to complete the following sentence.

_____ is the key to their happiness; they are satisfied with what they have.

(A) Contentment   (B) Ambition   (C) Perseverance   (D) Hunger

Q.3   Which of the following options is the closest in meaning to the sentence below?

"As a woman, I have no country."

(A) Women have no country.
(B) Women are not citizens of any country.
(C) Women's solidarity knows no national boundaries.
(D) Women of all countries have equal legal rights.

Q.4   In any given year, the probability of an earthquake greater than Magnitude 6 occurring in the Garhwal Himalayas is 0.04. The average time between successive occurrences of such earthquakes is ____ years.

Q.5   The population of a new city is 5 million and is growing at 20% annually. How many years would it take to double at this growth rate?

(A) 3-4 years   (B) 4-5 years   (C) 5-6 years   (D) 6-7 years

Q. 6 – Q. 10 carry two marks each.

Q.6   In a group of four children, Som is younger to Riaz. Shiv is elder to Ansu. Ansu is youngest in the group. Which of the following statements is/are required to find the eldest child in the group?
**Statements**
　　　　1.   Shiv is younger to Riaz.
　　　　2.   Shiv is elder to Som.

(A) Statement 1by itself determines the eldest child.
(B) Statement 2 by itself determines the eldest child.
(C) Statements 1 and 2 are both required to determine the eldest child.
(D) Statements 1 and 2 are not sufficient to determine the eldest child.

Q.7   Moving into a world of big data will require us to change our thinking about the merits of exactitude. To apply the conventional mindset of measurement to the digital, connected world of the twenty-first century is to miss a crucial point. As mentioned earlier, the obsession with exactness is an artefact of the information-deprived analog era. When data was sparse, every data point was critical, and thus great care was taken to avoid letting any point bias the analysis.
From "BIG DATA" Viktor Mayer-Schonberger and Kenneth Cukier

The <u>main</u> point of the paragraph is:

(A) The twenty-first century is a digital world
(B) Big data is obsessed with exactness
(C) Exactitude is not critical in dealing with big data
(D) Sparse data leads to a bias in the analysis

Q.8   The total exports and revenues from the exports of a country are given in the two pie charts below. The pie chart for exports shows the quantity of each item as a percentage of the total quantity of exports. The pie chart for the revenues shows the percentage of the total revenue generated through export of each item. The total quantity of exports of all the items is 5 lakh tonnes and the total revenues are 250 crore rupees. What is the ratio of the revenue generated through export of Item 1 per kilogram to the revenue generated through export of Item 4 per kilogram?

Exports

Revenues
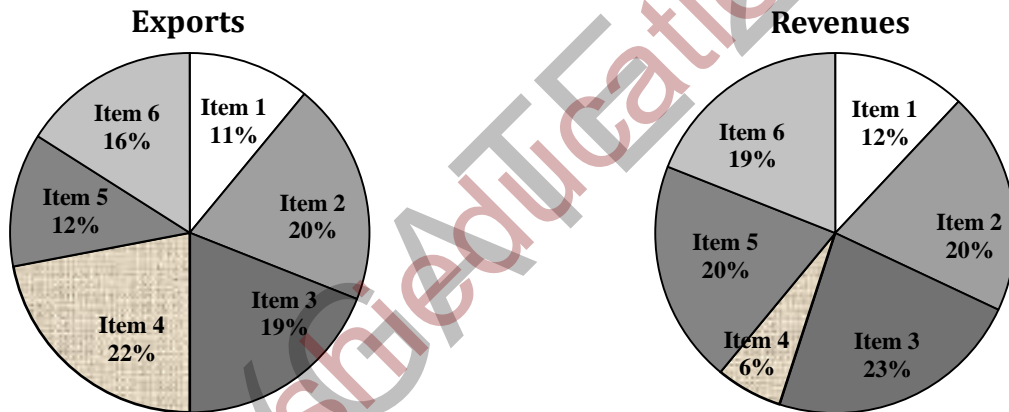
(A) 1:2   (B) 2:1   (C) 1:4   (D) 4:1

Q.9   X is 1 km northeast of Y. Y is 1 km southeast of Z. W is 1 km west of Z. P is 1 km south of W. Q is 1 km east of P. What is the distance between X and Q in km?

(A) 1   (B) $\sqrt{2}$ (C) $\sqrt{3}$ (D) 2

Q.10 10% of the population in a town is HIV$^+$. A new diagnostic kit for HIV detection is available; this kit correctly identifies HIV$^+$ individuals 95% of the time, and HIV$^-$ individuals 89% of the time. A particular patient is tested using this kit and is found to be positive. The probability that the individual is actually positive is _____

END OF THE QUESTION PAPER

Q. 1 – Q. 25 carry one mark each.

Q.1   Which one of the following planets has the highest bulk density?

(A) Jupiter   (B) Venus   (C) Saturn   (D) Mars

Q.2   Mid-Oceanic ridges mark _____ plate margins and can be traced by belts of _____ focus earthquakes.

(A) constructive, shallow   (B) destructive, shallow
(C) constructive, deep   (D) destructive, deep

Q.3   From the surface to the Earth's interior, the velocity of P-wave decreases and the material density increases at the boundary between

(A) Outer core and inner core
(B) Mantle and outer core
(C) Crust and mantle
(D) Upper crust and lower crust

Q.4   The following gamma ray (GR) log data are recorded in a borehole:

GR log value against a formation = 30 API units,
Maximum GR log value = 45 API units,
Minimum GR log value = 20 API units.

What is the fraction of shale in the formation?

(A) 0.33   (B) 0.40   (C) 0.66   (D) 0.75

Q.5   Cirques are formed by

(A) glaciers   (B) rivers   (C) lakes   (D) oceans

Q.6   During which of the following geological eras did birds and mammals first appear on the Earth?

(A) Cenozoic   (B) Mesozoic   (C) Paleozoic   (D) Proterozoic

Q.7   Select the copper ore minerals from the following:

(P) Chalcopyrite
(Q) Pyrite
(R) Pyrrhotite
(S) Bornite
(T) Sphalerite
(U) Chalcocite

(A) P, S, U
(B) P, Q, R
(C) S, T, U
(D) Q, R, U

Q.8   The reflection coefficient at the interface between two layers of resistivities 9 Ωm and 1 Ωm respectively is

(A) 0.6   (B) 0.7
(C) 0.8   (D) 0.9

Q.9   In electromagnetic (EM) sounding, the depth of investigation _____ with increasing frequency.

(A) increases   (B) decreases
(C) remains unchanged   (D) varies randomly

Q.10   The International Gravity Formula predicts the theoretical gravity value at a given point assuming a

(A) non-rotating homogeneous spherical earth model
(B) rotating inhomogeneous spherical earth model
(C) rotating homogeneous oblate spheroidal earth model
(D) rotating inhomogeneous oblate spheroidal earth model

Q.11   The diurnal variation of geomagnetic elements is due to a system of electric currents flowing in the

(A) ionosphere
(B) Earth's outer core
(C) inter-planetary medium
(D) oceans

Q.12   Match the mineral deposits (listed in Group I) with the most appropriate geophysical exploration methods (listed in Group II)

Group I	**Group II**
(P) Mineralized conductive veins	(1) Gravity
(Q) Disseminated sulphides	(2) Magnetic
(R) Massive barytes	(3) Induced Polarization
(S) Kimberlite pipes	(4) Resistivity profiling
	(5) Low frequency Magnetotellurics

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

Q.13   In seismic refraction surveys, the critical distance

(A) is always less than the crossover distance
(B) is always more than the crossover distance
(C) is always equal to the crossover distance
(D) cannot be compared with the crossover distance

Q.14   As compared to large earthquakes, small earthquakes are

(A) more frequent and caused by short fault slip and long rupture lengths
(B) more frequent and caused by long fault slip and short rupture lengths
(C) less frequent and caused by short fault slip and short rupture lengths
(D) more frequent and caused by short fault slip and short rupture lengths

Q.15 Match the type of well logs (listed in Group I) with the characteristics of measurement (listed in Group II).

	Group I		**Group II**
	(P) Dipmeter	(1)	Hydrogen concentration in pores
	(Q) Neutron	(2)	Velocity of compressional waves
	(R) SP	(3)	Correlation of resistivity changes
	(S) Sonic	(4)	Natural radioactivity
		(5)	Natural electric potential

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

Q.16 For earthquakes of magnitudes 6 and 7, the seismic wave amplitudes are A_6 and A_7 and the radiated energies are E_6 and E_7 respectively.

Which one of the following is true?

(A) $A_7 \approx (7/6) A_6$ and $E_7 \approx 10 E_6$
(B) $A_7 \approx 10 A_6$ and $E_7 \approx 100 E_6$
(C) $A_7 \approx 10 A_6$ and $E_7 \approx (7/6) E_6$
(D) $A_7 \approx 10 A_6$ and $E_7 \approx 32 E_6$

Q.17 Structure contours of a bedding plane at 100 m interval are spaced in such a manner that the horizontal equivalent is also 100m. The dip of the bedding plane is

(A) 30°   (B) 45°   (C) 60°   (D) 90°

Q.18 Horizontal slickensides are observed on the surface of a vertical fault. What is the type of fault?

(A) Normal fault   (B) Reverse fault   (C) Strike-slip fault   (D) Oblique fault

Q.19 Match the mineral habits (listed in Group I) with the minerals (listed in Group II)

	Group I		**Group II**
	(P) Acicular	(1)	Kyanite
	(Q) Fibrous	(2)	Beryl
	(R) Bladed	(3)	Sillimanite
	(S) Columnar	(4)	Chrysotile
		(5)	Olivine

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

Q.20 The correct chronological order (older to younger) of the following volcanic events is

(P) Rajmahal volcanism
(Q) Deccan volcanism
(R) Panjal volcanism
(S) Malani volcanism

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

Q.21   A clastic rock dominantly composed of feldspar grains is

       (A) shale   (B) arenite   (C) greywacke   (D) arkose

Q.22   A metamorphic rock consists of pyroxene, plagioclase and quartz, and exhibits hornfelsic texture.
       The rock has undergone _____ metamorphism.

       (A) regional   (B) contact   (C) cataclastic   (D) impact

Q.23   An igneous body with a flat top and a concave-upward base is known as a

       (A) laccolith   (B) lopolith   (C) sill   (D) stock

Q.24   The velocity discontinuity between the upper crust and the lower crust is known as
       _____ discontinuity.

       (A) Lehmann   (B) Gütenberg
       (C) Mohorovičić   (D) Conrad

Q.25   Match the items listed in **Group I** with those in **Group II**

       Group I   **Group II**
       (P) Isopachs   (1) Contours of equal slope
       (Q) Isotherms   (2) Contours of equal thickness
       (R) Isochrons   (3) Contours of equal temperature
       (S) Isotans   (4) Contours of equal core thickness
                                                         (5) Contours of equal age

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

PART B (SECTION 1): FOR GEOLOGY CANDIDATES ONLY

Q. 26 – Q. 55 carry two marks each.

Q.26 Match the items in **Group I** with those in **Group II**

<u>**Group I**</u>   <u>**Group II**</u>
(P) Interference colour   (1) Property of a single grain seen under microscope in
(Q)Twinkling   polarized light
(R) Pleochroism   (2) Property of a single grain seen under microscope under
(S) Play of colours   crossed nicols
                                             (3) Property seen when several grains are viewed
                                                 collectively under microscope in polarized light
   (4) Property of a mineral seen in hand specimen

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

Q.27 Which one of the following represents a closed crystallographic form?

(A) Hexagonal prism   (B) Hexagonal dipyramid
(C) Tetragonal pyramid   (D) Ditetragonal prism

Q.28 In the figure given below a, b and c are the crystallographic axes of a crystal. The Miller Index of
the crystal face PQR is:
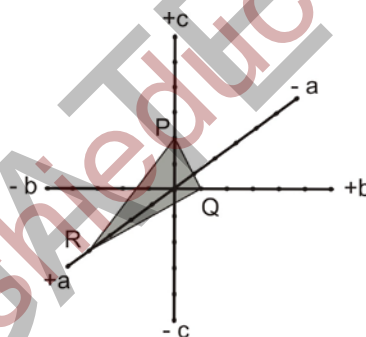
(A) (421)   (B) (124)   (C) (142)   (D) (214)

Q.29 Match the alkaline rocks listed in Group I with their characteristics listed in Group II

<u>**Group I**</u>   <u>**Group II**</u>
(P) Basanite   (1) Volcanic rock lacking feldspar
(Q) Nephelinite   (2) Ultrapotasic volcanic rock
(R) Shonshonite   (3) Feldspathoid-bearing basalt
(S) Lamproite   (4) K-rich basalt

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

Q.30 In a metamorphic terrain, crenulations at the hinge zone of a fold along with the development of
axial plane foliation is an evidence of

(A) one phase of deformation   (B) at least two phases of deformation
(C) no deformation   (D) extensional regime of the deformation

Q.31   A phase-diagram with a specified bulk-composition is known as

(A) isograd diagram   (B) AFM diagram   (C) pseudosection   (D) ACF diagram

Q.32   The uniaxial interference figure of a mineral given below shows the changes in the position of color bands when a mica plate is inserted in the accessory slot of the microscope as shown. The changes in the interference figure are due to
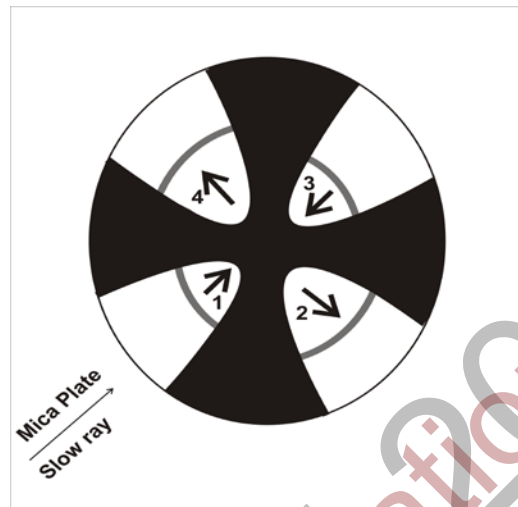
(A) increase in retardation along the quadrants 1 and 3
(B) increase in retardation along the quadrants 2 and 4
(C) decrease in retardation along the quadrants 1 and 3
(D) increase in retardation in all quadrants

Q.33   The relative enrichment factors (Δ values) of sulphur isotopes of two sulphide minerals A and B in equilibrium with H_2S at the same P-T-X conditions are +5.9 ‰ and −11.2 ‰ respectively. If A and B are in equilibrium under the same P-T-X conditions and $\delta^{34}S$ value of A is +6.8 ‰, then the $\delta^{34}S$ value of B is

(A) −10.3 ‰   (B) +10.3 ‰
(C) −9.3 ‰   (D) +9.3 ‰

Q.34   If $Fe^{2+} \longrightarrow Fe^{3+}+e$, $E^0 = +0.77$ volt, Eh = 0.6 volt, $K = \frac{[Fe^{3+}]}{[Fe^{2+}]}$ and the basic equation to be used is $Eh = E^0 + \frac{0.059}{n} \log K$, then the value of $\frac{Fe^{2+}}{Fe^{3+}}$ ratio in the solution is _____.

Q.35   In an ore mine exposing stratified sulfide ore with sulfide bands having thickness between 10 and 100 cm, which one of the following sampling methods is the most appropriate?

(A) Chip sampling   (B) Channel sampling
(C) Bulk sampling   (D) Grab sampling

Q.36   From the given Eh-pH diagram, which one of the following pairs can be inferred to be a disequilibrium assemblage
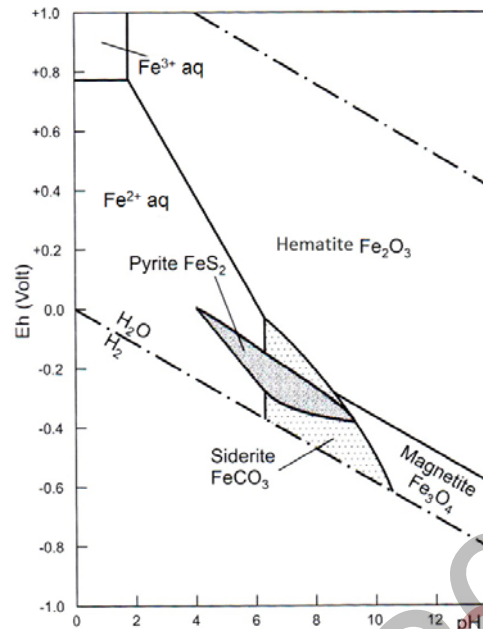
(A) Hematite-magnetite   (B) Magnetite-pyrite
(C) Pyrite-siderite   (D) Hematite-pyrite

Q.37   Metal content (in metric tonnes) of an ore having specific gravity and assay values of 2.86 and 1.49 % respectively in a mining block 40 m long, 30 m wide and with an average thickness of 2.13 m is _____.

Q.38   From the list of planktic foraminifera below, the pair having a supplementary sutural aperture is

(P) *Globigerina*
(Q) *Globorotalia*
(R) *Globigerinoides*
(S) *Orbulina*

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

Q.39   Match the morphological features (listed in Group I) with the corresponding fossils (listed in Group II)

Group I	Group II
(P) Callus	(1) Graptolite
(Q) Cusp	(2) Gastropod
(R) Sicula	(3) Conodont
(S) Calyx	(4) Foraminifer
	(5) Trilobite
	(6) Coral

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

Q.40   Which one of the following marine environments is indicated by the assemblage of benthic
       foraminifera *Quinqueloculina, Lenticulina, Ammonia, Elphidium*?

       (A) Abyssal   (B) Bathyal   (C) Shelf   (D) Hadal

Q.41   The correct chronological order (older to younger) of the following geological units is

       (P) Talchir Tillite
       (Q) Muth Quartzite
       (R) Umia Ammonites Bed
       (S) Umaria Marine Bed

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

Q.42   The best match of terms in **Group I** with those in **Group II** is

       Group I   **Group II**
       (P) Alkali reaction   (1) Tunnelling in hard rocks
       (Q) Arching   (2) Earth dam
       (R) Rip rap   (3) Concrete aggregate
       (S) Clay core   (4) Surface slope protection
                                                      (5) Concrete gravity dam

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

Q.43   Knick points indicate changes in the

       (A) attitude of beds
       (B) strike of a fault
       (C) attitude of joints
       (D) stream gradient

Q.44   A confined sandy aquifer has a thickness of 10 m and transmissivity of 0.75 m^2 per day. Its
       hydraulic conductivity is _____ m/day.

Q.45   A geological reconnaissance survey is being carried out using remote sensing multispectral data.
       Which set of the two band data of the following is most appropriate for mapping limonite bearing
       zones?

       (A) Near infrared band and Thermal infrared band image data
       (B) Blue band and Red band image data
       (C) Shortwave infrared band and Thermal infrared image data
       (D) Thermal infrared band and X-band radar image data

Q.46   The maximum amount of hydrogen (dry mineral matter free basis) in bituminous-anthracite is

       (A) less than 10%   (B) 10-15%
       (C) 15-20%   (D) 20-25%

Q.47   The standard free energy change (in kJ) at 25^OC of the dissolution of anhydrite at equilibrium in the
       equation $CaSO_4 \leftrightarrows Ca^{2+} + SO_4^{2-}$, given K=$3.4 \times 10^{-5}$ and R=8.314 J/mol/K, is

       (A) 43.7   (B) 37.4   (C) 30.2   (D) 25.5

Q.48

Drainage patterns observed in four areas are shown in black-and-white panchromatic images P, Q, R and S. Field work in these areas has indicated presence of the following lithology/geological unit.
1. Fractured quartzite
2. Shale
3. Limestone
4. Alluvial plain
The correct match of the drainage patterns with the lithology/geological unit is

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

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

Q.49

The given figure shows the grain size distribution of two soil samples S1 and S2. The uniformity coefficient is defined as d_{60}/d_{10}, where d_{60} and d_{10} represent particle sizes corresponding to 60 and 10 percent finer respectively. Determine the correctness or otherwise of the Assertion (**a**) and Reason (**r**).

Assertion (**a**): S1 has a higher value of uniformity coefficient than S2.
Reason (**r**): S1 has less variation in grain-size than S2.

(A) Both (**a**) and (**r**) are true, and (**r**) is the correct reason for (**a**).
(B) Both (**a**) and (**r**) are false.
(C) (**a**) is false but (**r**) is true, (**r**) being not the correct reason for (**a**).
(D) (**a**) is true but (**r**) is false.

Q.50   The geological map given below shows beds in a normal stratigraphic order. Which one of the
        following statements is true in respect of features near locations P and Q?
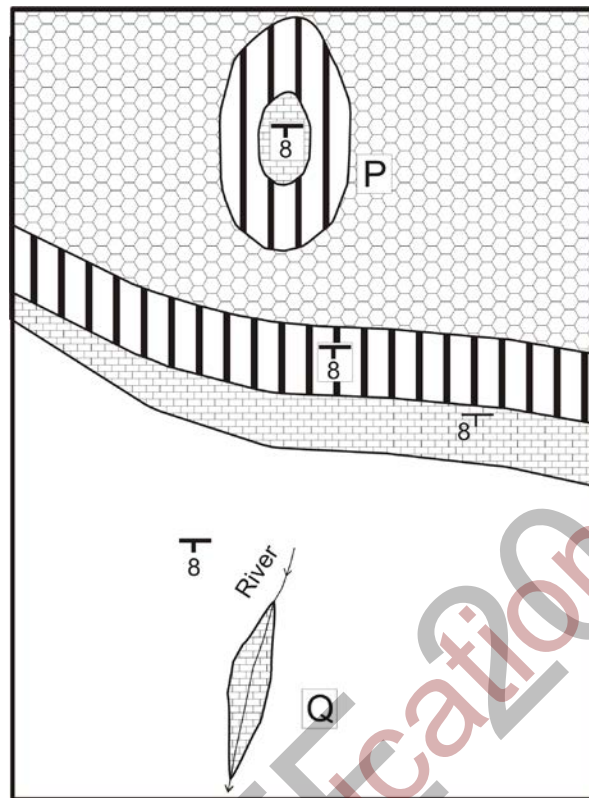
(A) P is an anticline and Q is a syncline
(B) Q is an anticline and P is a syncline
(C) P is an outlier and Q is an inlier
(D) Q is an outlier and P is an inlier

Q.51   Four aqueous-vapor fluid inclusions P, Q, R and S are petrographically identical at room
        temperature, and contain approximately 90 % liquid and 10 % vapor. The freezing temperatures of
        the fluid inclusions are: P = – 5.3 °C, Q = – 16.6 °C, R = – 21.2 °C, S = – 8.7 °C. With respect to P,
        Q, R and S, the correct statement is

(A) salinity of "P" is highest but density is lowest
(B) both salinity and density of "Q" are lowest
(C) both salinity and density of "R" are highest
(D) both salinity and density of "S" are lowest

Q.52   Which one of the following is the youngest marine formation in the Himalaya?

(A) Dagshahi Formation   (B) Subathu Formation
(C) Kasauli Formation   (D) Karewa Formation

Q.53   Which one of the following environments is represented by molasse facies?

(A) Atectonic   (B) Pre-tectonic
(C) Syn-tectonic   (D) Post-tectonic

Q.54   In the given ternary (Fo = forsterite; Di = diopside; An = anorthite) eutectic diagram, the point A represents the composition of magma. What will be the sequence of crystallization during cooling of this magma?
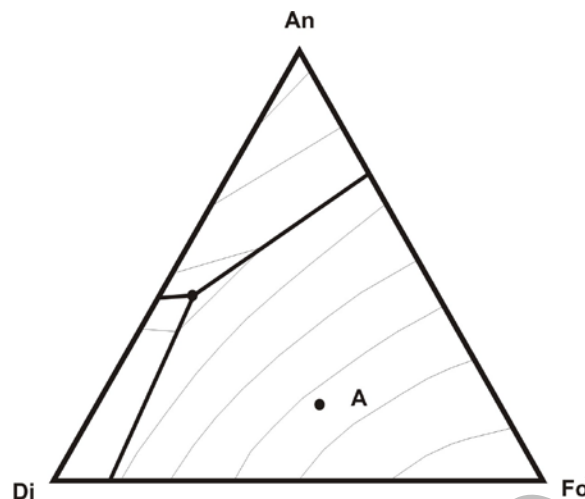
(A) olivine and olivine + plagioclase
(B) olivine and olivine + pyroxene
(C) olivine, olivine + plagioclase and olivine + plagioclase + pyroxene
(D) olivine, olivine + pyroxene and olivine + pyroxene + plagioclase

Q.55   Which one of the following is the best suited mining method for a low-dipping, tabular-shaped, hard and compact ore body with 2 to 2.5 m thickness sandwiched between hard and compact roof and floor rock?

(A) Cut and fill method   (B) Shrinkage stope method
(C) Open stope method   (D) Caving method

PART B (SECTION 2): FOR GEOPHYSICS CANDIDATES ONLY

Q. 26 – Q. 55 carry two marks each.

Q.26   A gaseous hydrocarbon-bearing zone can be best identified by a combined analysis of

 (A) Density and Self potential(SP) logs
 (B) Density and Neutron logs
 (C) Sonic and Neutron logs
 (D) Natural gamma ray (GR) and Neutron logs

Q.27   In general, geophysical inverse problems dealing with real data obtained from field measurements are

(A) grossly over determined   (B) even determined
(C) over determined   (D) grossly underdetermined

Q.28   In vector calculus, Stoke's theorem relates

(A) line-integral to volume integral   (B) surface integral to volume integral
(C) scalar product integral to norm   (D) line integral to surface integral

Q.29   The radial dependence of the solution of the Laplace equation in cylindrical coordinates is expressed in terms of

(A) Bessel function   (B) Legendre polynomial
(C) Exponential function   (D) Hermite polynomial

Q.30   For an electrostatic field, the Maxwell's equations reduce to

(A) Wave equation   (B) Diffusion equation
(C) Helmholtz equation   (D) Poisson equation

Q.31   Which one of the following functions is used as a source-term to obtain the Green's function of a boundary value problem?

(A) Heaviside unit step function   (B) Exponential function
(C) Rectangular function   (D) Dirac delta function

Q.32   The heat flow through a unit area of the Earth's surface is given by the product of

(A) vertical thermal gradient and thermal conductivity
(B) horizontal thermal gradient and thermal conductivity
(C) vertical thermal gradient and thermal diffusivity
(D) horizontal thermal gradient and thermal diffusivity

Q.33   The S-wave velocity of a medium having a Poisson's ratio and a P-wave velocity of 0.5 and 3 km/s respectively is _____km/s.

Q.34   The PKiKP phase denotes the passage of a seismic wave in the Earth as

(A) P in mantle, S in outer core, reflected as P from inner-outer core boundary, S in outer core, P in mantle and crust
(B) P in crust, P in mantle, reflected as P from core-mantle boundary, P in mantle, P in crust
(C) P in mantle, P in outer core, P in inner core, P in outer core, P in mantle and crust
(D) P in mantle, P in outer core, reflected as P from inner-outer core boundary, P in outer core, P in mantle and crust

Q.35   Match the items of **Group I** with those in **Group II**

Group I	**Group II**
(P) Proton precession magnetometer	(1) Induction in a pair of high permeable cores
(Q) Alkali-vapor magnetometer	(2) SQUID
(R) Fluxgate magnetometer	(3) Radio-spectroscopy
(S) Superconducting magnetometer	(4) Nuclear magnetic resonance

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

Q.36   Königsberger ratio refers to

(A) anisotropy of magnetic susceptibility
(B) ratio of remnant magnetization and induced magnetization
(C) ratio of longitudinal and transverse electrical resistivities
(D) ratio of P and S wave velocities

Q.37   The Poisson's relation linking the gravity and magnetic potentials assumes the same anomaly
         source with

         (A) inhomogeneous density and intensity of magnetization
         (B) uniform density contrast and inhomogeneous intensity of magnetization
         (C) uniform density contrast and homogeneous intensity of magnetization
         (D) inhomogeneous density and homogeneous intensity of magnetization

Q.38   Compute the coefficient of anisotropy from the following parameters estimated from a Vertical
         Electric Sounding (VES) survey.

         Resistivity of first layer, ρ_1= 15 Ω-m
         Resistivity of second layer, ρ_2= 4 Ω-m
         Resistivity of lower half-space, ρ_3= 50 Ω-m
         Thickness of first layer, h_1=3m
         Thickness of second layer, h_2=16m

         (A) 1.43   (B) 1.28   (C) 1.19   (D) 1.13

Q.39   The convolution of two finite length sequences x_n = [1, 0, -2] and y_n = [1, -1] is

         (A) [-1, 1, 2, -2]   (B) [1, -1, -2, 2]
         (C) [1, 0, -2, 2]   (D) [1, -2, -1, 2]

Q.40   Arrange the following electrode configurations in the ascending order of their depth of
         investigation

         (P) Dipole-Dipole
         (Q) Schlumberger
         (R) Wenner
         (S) Pole-Pole

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

Q.41   Which one of the following transforms relates the real and imaginary components of harmonic
         electromagnetic (EM) field?

         (A) Fourier transform   (B) Laplace transform
         (C) Hilbert transform   (D) Wavelet transform

Q.42   Which one of the following geophysical methods is most suitable for exploration of possible
         hydrocarbon-bearing sediments underlying the Deccan Traps?

         (A) Seismic   (B) Magnetotellurics
         (C) DC resistivity   (D) Airborne EM

Q.43   A collection of traces having a common mid-point is called a CMP gather. The number of traces in
         an **n-fold** survey in a CMP gather is

         (A) n – 1   (B) n + 1   (C) n   (D) n/2

Q.44   In seismic prospecting, migration is the process of moving data elements from

(A) midpoint locations to subsurface locations
(B) subsurface locations to midpoint locations
(C) midpoint locations to surface locations
(D) subsurface locations to surface locations

Q.45   An 80 Hz seismic signal is sampled at a rate of 100 samples/s. What will be its aliased period (in seconds) in the sampled signal?

(A) 30   (B) 10   (C) 0.1   (D) 0.05

Q.46   The Fourier transform and integral of the Dirac delta function respectively are

(A) 1 and 1   (B) 0 and 0
(C) 0 and 1   (D) 1 and ∞

Q.47   A signal $x_n = [2, 1]$ is input to a system whose impulse response is $h_n = [8, 4, 2, 1]$. The z-transform of the output is

(A) $16 + 16\,z^{-1} + 3\,z^{-2} + 4\,z^{-3} + z^{-4}$ (B) $10 + 5\,z^{-1} + 2\,z^{-2} + 4\,z^{-3} + z^{-4}$
(C) $16 + 16\,z^{-1} + 8\,z^{-2} + 4\,z^{-3} + z^{-4}$ (D) $16 + 16\,z^{-1} + 8\,z^{-2} + 2\,z^{-3} + z^{-4}$

Q.48   Calculate the formation water saturation, S_w from the following well log data:

Resistivity of completely saturated formation, $R_o = 1.8\ \Omega\text{-m}$
True resistivity of formation, $R_t = 25\ \Omega\text{-m}$

(A) 31%   (B) 29%   (C) 27%   (D) 25%

Q.49   Consider the four systems of algebraic equations (listed in Group I).

The systems (Q), (R) and (S) are obtained from (P) by restricting the accuracy of data or coefficients or both respectively, to two decimal places.

Match these systems to their characteristics (listed in Group II)

Group I	**Group II**
(P) $x + 1.0000y = 2.0000$ $x + 1.0001y = 2.0001$	(1) instability
(Q) $x + 1.0000y = 2.00$ $x + 1.0001y = 2.00$	(2) inconsistency
(R) $x + 1.00y = 2.0000$ $x + 1.00y = 2.0001$	(3) non-uniqueness
(S) $x + 1.00y = 2.00$ $x + 1.00y = 2.00$	(4) exact

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

Q.50 The eigenvalue (Λ) and eigenvector (U) matrices for singular value decomposition of the matrix

$\begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix}$ respectively are

(A) $\Lambda = \begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$ and $U = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 & -1 \\ 1 & 1 \end{pmatrix}$ 　　(B) $\Lambda = \begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$ and $U = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 & -1 \\ 1 & -1 \end{pmatrix}$

(C) $\Lambda = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$ and $U = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 & -1 \\ 1 & 1 \end{pmatrix}$ 　　(D) $\Lambda = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$ and $U = \frac{1}{\sqrt{2}}\begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}$

Q.51 The amplitude spectrum of a band pass filter, A_B, can be obtained by a combination of spectra of a low pass filter, A_L, and that of a high pass filter, A_H, as

(A) $A_B = A_L \times A_H$ 　　　　　　　　　(B) $A_B = A_L + A_H$
(C) $A_B = A_L - A_H$ 　　　　　　　　　　(D) $A_B = A_L / A_H$

Q.52 Compute the maximum value of gravity anomaly in μGal over a buried sphere from the following data:

Radius of a sphere = 5 m 　　　　　　Depth to centre of sphere = 11 m
Density contrast = 0.1 gm/cc 　　　　$G = 6.673 \times 10^{-8}$ dyne-cm^2/gm^2

(A) 2887.58 　　　(B) 288.76 　　　(C) 28.88 　　　(D) 2.89

Q.53 Given the potential field anomaly data at the datum level z=0, match the spatial frequency expressions (listed in Group I) with the corresponding operations (listed in Group II).
(k is wave number)

Group I
(P) $\exp(-zk)$
(Q) $k \exp(-zk)$
(R) k^2
(S) $k \exp(zk)$

Group II
(1) Second vertical derivative at the datum level
(2) Analytic continuation into upper half-space
(3) Analytic continuation into lower half-space
(4) First vertical derivative of upward continued values
(5) First vertical derivative of downward continued values

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

Q.54 **Assertion (a):** An efficient marine seismic survey should use an implosive source.

Reason (r): The performance of a marine seismic source is rated by high pulse-to-bubble ratio.

(A) Both **(a)** and **(r)** are true and **(r)** is the correct reason for **(a)**
(B) Both **(a)** and **(r)** are true but **(r)** is not the correct reason for **(a)**
(C) **(a)** is true but **(r)** is false
(D) **(a)** is false but **(r)** is true

Q.55   The electric field intensity vector (E) and the displacement vector (D) are given by
       $E = 2\,\hat{\imath} + 2\,\hat{\jmath} + 4\,\hat{k}$ and $D = \hat{\imath} + \hat{\jmath} + \hat{k}$. The energy of the field is

       (A) 2   (B) 4

       (C) 6   (D) 8

END OF THE QUESTION PAPER