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CSIR-UGC National Eligibility Test (NET) for Junior Research Fellowship & Lecturer-ship

SECTION-I

EARTH, ATMOSPHERIC, OCEAN & PLANETARY SCIENCES

NUMBER OF QUESTIONS ASKED IN CSIR - UGC (NET) - EARTH SCIENCES (2014 TO 2025)

SECTION-I		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023		2024		2025
PART-B		**JUNE**	**DEC**	**JUNE**	**DEC**	**JUNE**	**DEC**	**JUNE**	**DEC**	**JUNE**	**DEC**	**JUNE**	**DEC**	**JUNE**	**NOV**	**JUNE**	**DEC**	**SEP**	**DEC**	**JUNE**	**DEC**	**JULY**	**DEC**	**FEB**
1	Earth & Solar System	-	1	1	5	-	-	-	4	-	2	1	2	-	4	3	-	1	-	4	3	9	-	22
2	Earth Materials, Surface Features & Processes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	3	-	14
3	Interior of the Earth, Deformation & Tectonics	-	-	-	-	-	-	-	-	3	2	1	1	-	-	7	-	-	-	-	3	-	-	2
4	Oceans & Atmosphere	-	12	16	4	19	14	13	11	6	9	16	15	-	6	16	-	14	-	17	37	5	-	29
5	Environmental Earth Sciences	-	1	-	12	3	-	-	1	-	-	-	1	-	9	5	-	1	-	1	2	-	-	-
PART-C		**JUNE**	**DEC**	**JUNE**	**DEC**	**JUNE**	**DEC**	**JUNE**	**DEC**	**JUNE**	**DEC**	**JUNE**	**DEC**	**JUNE**	**NOV**	**JUNE**	**DEC**	**SEP**	**DEC**	**JUNE**	**DEC**	**JULY**	**DEC**	**FEB**
1	Earth & Solar System	-	-	1	-	-	-	1	1	1	-	-	3	-	1	-	-	-	-	-	-	-	-	-
2	Earth Materials, Surface Features & Processes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Interior of the Earth, Deformation & Tectonics	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
4	Oceans & Atmosphere	-	23	8	18	24	17	24	22	22	19	12	18	-	11	15	-	15	-	8	-	13	-	-
5	Environmental Earth Sciences	-	-	8	17	-	-	-	5	-	2	5	15	-	5	2	-	5	-	-	2	-	-	23

1 CHAPTER

EARTH & SOLAR SYSTEM

PREVIOUS YEAR EXAM QUESTIONS

Topic Cover: *Milky Way and the solar system, Modern theories on the origin of the Earth and other planetary bodies, Earth's orbital parameters, Kepler's laws of planetary motion, Geological Time Scale; Space and time scales of processes in the solid Earth, atmosphere and oceans, Radioactive isotopes and their applications, Meteorites Chemical composition and the Primary differentiation of the earth, Basic principles of stratigraphy, Theories about the origin of life and the nature of fossil record, Earth's gravity and magnetic fields and its thermal structure, Concept of Geoid and spheroid, Isostasy*

PART-B

(DEC 2014)

1. Which of the following sequences is the correct order of appearance in the geological history of the Earth?
(1) Fishes. Dinosaurs, Flowering plants, Whales
(2) Flowering plants, Whales, Dinosaurs, Fishes
(3) Fishes. Flowering plants. Whales, Dinosaurs
(4) Dinosaurs. Fishes. Flowering plants. Whales

(JUNE 2015)

2. Which one of the following is situated at one of the foci of the orbit of Mars?
(1) Sun (2) Venus
(3) Mercury (4) Jupiter

(DEC 2015)

3. A star which is burning/fusing mostly Hydrogen is called:
(1) Red giant (2) Main sequence
(3) White dwarf (4) Super giant

(DEC 2015)

4. The estimated age of the universe is;
(1) 4.56 billion years
(2) 13.5 billion years
(3) 10.1 billion years
(4) 25.7 billion years

(DEC 2015)

5. The relationship between the period of revolution of the planets around the Sun and their distance from the Sun is given by;
(1) Bode's Law (2) Kepler's Law
(3) Newton's Law (4) Hubble's Law

(DEC 2015)

6. Which of the following planets has a compo sition very different from that of the other three?
(1) Mars (2) Venus
(3) Earth (4) Jupiter

(DEC 2015)

7. Two planets A and B of masses M and 4M orbit around their central star at distances d and 4d respectively. Compared to A, the planet B orbits around the star;
(1) twice slower. (2) four times slower.
(3) eight times slower. (4) sixteen times slower.

(DEC 2017)

8. Kepler's third law does not apply to the;
(1) Motion of planets around the Sun
(2) Motion of moons around the planets
(3) Motion of artificial satellites around the Earth
(4) Comets which do not re-appear

(DEC 2017)

9. The oldest rock reported from India dates approximately;
(1) 3500 Ma (2) 8000 Ma
(3) 4500 Ma (4) 2500 Ma

(DEC 2017)

10. Compared to the Earth, Jupiter orbits around the Sun much slower because of its;
(1) Lower density
(2) Higher mass
(3) Larger distance from the Sun
(4) Slower rotation about its axis

(DEC 2017)

11. Which one of the following rocks approximates the average bulk composition of the continental crust?
(1) Rhyolite (2) Granodiorite
(3) Basalt (4) Pyroxenite

(DEC 2018)

12. The Moon's surface receives cosmic rays and solar wind everywhere unlike the Earth's surface. This is because the;

(1) Moon is closer to the Sun
(2) Moon lies at the center of the galaxy
(3) Moon's gravity is one-sixth of that of the Earth
(4) Moon does not have a significant magnetic field

(DEC 2018)

13. What is the age of the Sun?
(1) Twice the age of the Earth
(2) Same as the age of the Earth
(3) Same as the age of the Universe
(4) Same as the age of the Milky Way galaxy

(JUNE 2019)

14. The correct sequence of planets in order of increasing surface temperature is:
(1) Saturn, Earth, Mars, Mercury
(2) Neptune, Earth, Mercury, Venus
(3) Mars, Earth. Venus, Mercury
(4) Uranus, Mars, Jupiter. Earth

(DEC 2019)

15. Which one of the following astronomical objects is more massive than the Earth?
(1) Neptune (2) Pluto
(3) Venus (4) Mars

(DEC 2019)

16. Which one of the following statements is NOT true for Chondrites?
(1) contain olivine, pyroxene and metallic iron
(2) composed of three main components: Chondrules, CAIS, Metric
(3) subdivided into carbonaceous (C), Ordinary (O), and Enstatite (E)
(4) come from a parent body which has been fractionated since its aggregation early in the history of the solar system

(NOV 2020)

17. Compared to the Earth, Neptune is approximately 30 times farther away from the Sun. Its period of revolution around the Sun (in Neptune years) would be;
(1) 1 (2) 30
(3) 165 (4) 423

(NOV 2020)

18. The Earth is shaped like a/an;
(1) Oblate spheroid (2) Oblate geoid
(3) Prolate spheroid (4) Everest spheroid

(NOV 2020)

19. Which one of the following is the fastest spreading ridge on Earth?
(1) Mid-Atlantic ridge
(2) Southwest Indian ridge
(3) East Pacific ridge
(4) Carlsbad ridge

(NOV 2020)

20. The duration of the Cretaceous Normal Superchron (CNS) is about;
(1) 25 Ma (2) 30 Ma
(3) 40 Ma (4) 50 Ma

(JUNE 2021)

21. If the moon were farther away from the number of full –moon days in a year would be:
(1) fewer with a darker Moon.
(2) Larger with a brighter Moon.
(3) the same as the present, but with a brighter Moon.
(4) the same as the present, but with a darker Moon.

(JUNE 2021)

22. Which planet has the fastest rotation about its axis?
(1) Earth (2) Mars
(3) Jupiter (4) Saturn

(JUNE 2021)

23. Which one of the following coal deposits is from the Paleozoic age?
(1) Singareni (2) Akli
(3) Vastan (4) Gurha

(SEP 2022)

24. Which one of the following periods is known as the "Age of fishes"?
(1) Cambrian (2) Ordovician
(3) Devonian (4) Silurian

(JUNE 2023)

25. If the positions of Earth and Mars were to be interchanged in the solar system, then compared to their present velocities:
(1) both will orbit around the Sun without any change in their velocities
(2) both will orbit around the Sun with lower velocities
(3) Earth orbits around the Sun with a higher velocity, while Mars orbits with a lower velocity
(4) Earth orbits around the Sun with a lower velocity, while Mars orbits with a higher velocity

(JUNE 2023)

26. The inclination of the Earth's magnetic field is the least at which one of the following locations?
(1) Trivandrum (2) Visakhapatnam
(3) Shillong (4) Mumbai

(JUNE 2023)

27. For which one of the following pairs of stations the difference in their normal gravity fields is the least?
(1) New Delhi and Chennai
(2) Ahmedabad and Kolkata
(3) Hyderabad and Nagpur
(4) Panaji and Mumbai

(JUNE 2023)

28. Meghalayan stage is associated with;
(1) Late Pleistocene (2) Early Holocene
(3) Mid Holocene (4) Late Holocene

(**DEC 2023**)

29. Which of the following have/has more than 99% of the mass of the solar system?
(1) The Outer Planets
(2) The Inner Planets
(3) The Comets and Kuiper belt objects
(4) The Sun

(**DEC 2023**)

30. If the Earth were to be 20% farther from the Sun, then its gravity field would be;
(1) same as the present (2) 14.14% smaller
(3) 20% smaller (4) 28.3% smaller

(**DEC 2023**)

31. Which one of the following epochs was the warmest?
(1) Pliocene (2) Eocene
(3) Oligocene (4) Miocene

(JULY 2024)

32. Which one of the following meteorite types is NOT derived from differentiated planetary bodies?
(1) Iron meteorite
(2) Shergottite
(3) Eucrite
(4) Carbonaceous chondrite

(JULY 2024)

33. Which one of the following sequences shows the correct order of their first appearance in the geological record since Precambrian?
(1) Land plants- Amphibians- Ediacaran biota
(2) Ediacaran biota- Land plants- Amphibians
(3) Land plants- Ediacaran biota- Amphibians
(4) Ediacaran biota- Amphibians- Land plants

(JULY 2024)

34. The acceleration due to gravity, g, at sea level
(1) decreases with increasing latitude
(2) increases with increasing latitude
(3) remains constant at all latitudes
(4) varies with longitude for a given latitude

(JULY 2024)

35. Activity of 14 mg of $14\ C$ ($\lambda = 3.84\ x\ 10^{-12}\ S^{-1}$) in decays/second is approximately;
(1) 6.023×1020 (2) 2.31×109
(3) 2.31×1012 (4) 3.84×1011

(JULY 2024)

36. Moving towards the Sun from outer space, the correct order of appearance of the following celestial objects/ fields is;
(1) Heliopause, Oort cloud, Kuiper Belt, Asteroid Belt
(2) Oort Cloud, Kuiper Belt, Heliopause, Asteroid Belt
(3) Oort Cloud, Heliopause, Kuiper Belt, Asteroid Belt
(4) Kuiper Belt, Oort Cloud, Asteroid Belt, Heliopause

(JULY 2024)

37. If the Earth were to orbit around the Sun at twice its present distance, without any change in its rotational velocity, then a year on it would have;
(1) 365 days (2) 365√2 days
(3) 730 days (4) 730√2 days

(**JULY 2024**)

38. If the Earth were to be twice its present radius but with its density reduced to half its original value, then;
(1) its mass and gravity field would remain the same
(2) its mass would increase 4 times, but its gravity field would remain the same
(3) its mass and gravity field would increase by 4 times
(4) its mass would remain the same, but the gravity field would increase 4 times

(**JULY 2024**)

39. If the Earth starts rotating in opposite direction on its axis with the same period of rotation, then how will the length of day and night be affected at a particular place on the Earth's surface (say Delhi)?
(1) Length of the day becomes longer but night shorter
(2) Length of the night becomes longer but day shorter
(3) There will be no significant change in the length of day and night
(4) Lengths of the day and night both become shorter significantly

(**JULY 2024**)

40. At a depth of 900 mm in a sedimentary core the ^{14}C activity is $1/16th$ of the surface activity. What is the average sedimentation rate (given ^{14}C half-life = 6000 years)?
(1) 0.05 mm/year (2) 0.01875 mm/year.
(3) 0.0035 mm/year (4) 0.0375 mm/year

(FEB 2025)

41. Kamaitc and Taenite are dominant constituents of which group of meteorites?
(1) Iron meteorite
(2) Achondrite
(3) SNC meteorite
(4) Carbonaceous chondrite

(FEB 2025)

42. The Earth's gravity field from surface to the centre,
(1) decreases uniformly
(2) increases in the mantle and decreases uniformly in the outer & inner core
(3) increases in the mantle and decreases gently in the outer core and sharply in the inner core
(4) decreases sharply in the mantle and gently in outer and inner core

(FEB 2025)

43. Which one of the following combinations of radioisotopes produces the bulk of the heat generated within the Earth's continental crust?

(1) ^{235}U, ^{14}C , and ^{137}Cs (2) ^{238}U, ^{147}C , and ^{240}Cs

(3) ^{238}U, ^{232}C , and ^{40}Cs (4) ^{235}U, ^{40}C , and ^{234}Cs

(FEB 2025)

44. If F, V, and H are the Earth's magnetic field and its vertical and horizontal components, respectively at Colombo, then,

(1) F > H > V (2) F > V > H

(3) V > F > H (4) H > V > F

(FEB 2025)

45. The declination of the Natural Remanent Magnetism (NRM) of a rock unit is a measure of

(1) the latitude of the formation of the rock

(2) its longitudinal movement

(3) its latitudinal movement

(4) the amount of rotation about a vertical axis

(FEB 2025)

46. The magnitude measured on a Richter scale _____.

(1) is valid for all epicentral distances

(2) does not saturate

(3) cannot be negative

(4) underestimates the magnitude of great earthquakes

(FEB 2025)

47. The orbital period of Mars is 687 Earth days. Then, the distance of Mars from the Sun in AU is _____.

[1 AU = distance of the Earth from the Sun]

(1) 1.5 (2) 1.8

(3) 2.2 (4) 2.6

(FEB 2025)

48. Choose the INCORRECT statement from the following:

(1) The geoid is an equipotential surface

(2) The reference spheroid is an equipotential surface

(3) The geoid is an undulating surface

(4) The reference spheroid and geoid refer to the same surface

(FEB 2025)

49. The S-wave velocity for a material with Poisson's ratio of 0.5 is _____.

(1) half of the P-wave velocity

(2) equal to the P-wave velocity

(3) twice the P-wave velocity

(4) zero

(FEB 2025)

50. Continent-continent collision zone is characterized by _____.

(1) shallow focus earthquakes

(2) intermediate and deep focus earthquakes

(3) shallow, intermediate, and deep focus earthquakes

(4) deep focus earthquakes

(FEB 2025)

51. The seismic phase which reveals that the inner core of the Earth is solid is _____.

(1) PKP (2) SKIKP

(3) SKJKS (4) PKIKP

(FEB 2025)

52. Match the regions with the impact structures:

Region		Impact Structure	
A	Bundelkhand	L	Shiva
B	Kota Plateau	M	Luna
C	Arabian Sea shelf	N	Ramgarh
D	Buldhana	O	Dhala
		P	Lonar

Code

	A	B	C	D
(1)	O	N	L	P
(2)	O	P	N	P
(3)	N	M	O	O
(4)	P	L	M	L

(FEB 2025)

53. A and B are two stars of equal size and equidistant from the Earth. The peak wavelengths coming from A and B are 965 nm and 482 nm, respectively. How many times brighter (in terms of energy) is star B than star A?

(1) 2 (2) 4

(3) 8 (4) 16

(FEB 2025)

54. Match Column I (DEM Product) with Column II (Satellite):

Column I (DEM Product)		Column II (Satellite)	
A	ALOS	P	Endeavor
B	SRTM	Q	Terra
C	ASTER	R	TanDEM X
D	Copernicus	S	Daichi
		T	Cartosat 3

Code

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

(FEB 2025)

55. Consider the following statements regarding the Geoid, an equipotential surface:

Statement A: The gravity field denotes the rate of change of gravity potential.

Statement B: The gravity field on the geoid is zero everywhere.

Choose the correct option.

(1) Both A and B are valid, and B can be explained by A.
(2) Both A and B are valid, but B cannot be explained by A.
(3) A is inaccurate, but B is valid.
(4) A is inaccurate and B is invalid.

(FEB 2025)

56. A magnetic anomaly profile across a dyke-like body records a maximum anomaly of $+640$ gammas and a minimum anomaly of -320 gammas. The anomaly (in gammas) at a point above the position of the dyke is expected to be:

(1) 480 (2) 320
(3) 0 (4) -160

(FEB 2025)

57. (F_A, g_A) and (F_B, g_B) are the Free Air and Bouguer anomalies due to two isostatically compensated elevated masses of thicknesses $1.0\ \boldsymbol{km}$ and $2.0\ \boldsymbol{km}$, respectively. Then:

(1) $F_B = F_A, g_B = g_A$ (2) $F_B = F_A, g_B = 2g_A$
(3) $F_B = 2F_A, g_B = 2g_A$ (4) $F_B = 2F_A, g_B = g_A$

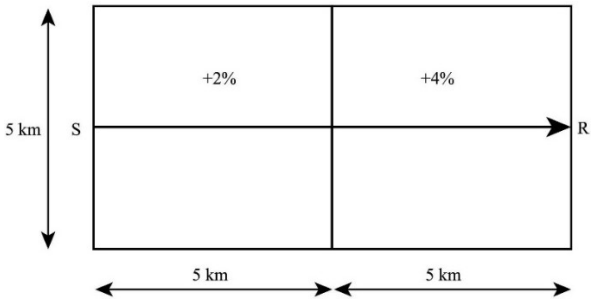
(FEB 2025)

58. From the position of the maximum anomaly, the gravity anomaly of a horizontal circular cylindrical body, at depth z, is reduced to one-third its maximum value at a distance of:

(1) z (2) $\sqrt{3}\ z/2$
(3) $\sqrt{2}\ z$ (4) $\sqrt{3}\ z$

(FEB 2025)

59. A seismic wave propagates through a medium with velocity perturbations (%) with respect to a reference velocity of $5\ \boldsymbol{km/sec}$ as shown in the figure. The travel time residual (%) at the receiver R is:



(1) -0.5 (2) -0.9
(3) -1.9 (4) -2.9

(FEB 2025)

60. A near-surface earthquake of magnitude 4.0 is recorded by broadband stations A, B, and C which are located at local, regional, and teleseismic distances, respectively. Assuming the recorded event duration at the stations A, B, and C to be denoted as E_A, E_B, and E_C, respectively, then:

(1) $E_A > E_B > E_C$ (2) $E_A = E_B = E_C$
(3) $E_A < E_B > E_C$ (4) $E_A < E_B < E_C$

(FEB 2025)

61. The P-wave time data corresponding to an earthquake are fit with two line segments having slopes $p_1 = 0.5\ \boldsymbol{s/km}$ and $p_2 = 0.33\ \boldsymbol{s/km}$, and intercepts (delay times) $t_1 = 0\ \boldsymbol{s}$ and $t_2 = 1.5\ \boldsymbol{s}$, respectively, leading to a two-layered crust. Then, the thickness of the top layer is:

(1) $0.5\ km$ (2) $1\ km$
(3) $1.5\ km$ (4) $2\ km$

(FEB 2025)

62. The angle between the effective gravity force and the Newtonian gravitational force is maximum over:

(1) Equator (2) North pole
(3) South pole (4) $45°$ latitude

ANSWER KEY									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
(1)	(1)	(2)	(2)	(2)	(4)	(1)	(4)	(1)	(3)
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
(2)	(4)	(1)	(2)	(1)	(4)	(1)	(1)	(3)	(3)
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
(1)	(3)	(1)	(3)	(4)	(1)	(3)	(4)	(4)	(1)
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
(2)	(4)	(2)	(2)	(2)	(3)	(4)	(2)	(3)	(4)
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
(1)	(2)	(3)	(1)	(4)	(4)	(1)	(4)	(4)	(1)
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
(3)	(1)	(4)	(4)	(4)	(2)	(2)	(3)	(4)	(4)
61	**62**								
(4)	(4)								

EXPLANATIONS:

1. Correct Answer is (1):
Fishes: First appeared in the Cambrian-Ordovician period (~500 million years ago).
Dinosaurs: Dominated during the Mesozoic Era (~230 million years ago).
Flowering Plants: Evolved in the late Jurassic to early Cretaceous (~160-120 million years ago).
Whales: Evolved from terrestrial mammals during the Eocene (~50 million years ago).

2. Correct Answer is (1): According to Kepler's First Law of Planetary Motion, the Sun is located at one of the foci of the elliptical orbit of every planet, including Mars.

3. Correct Answer is (2): A star that is burning or fusing mostly ***hydrogen*** in its core is in the ***main sequence*** phase of its life cycle. This is the longest and most stable phase for stars, during which they fuse hydrogen into helium in their cores. The Sun, for example, is currently a main sequence star. This is the longest and

most stable phase for stars, during which they fuse hydrogen into helium in their cores.

4. **Correct Answer is (2):** The ***estimated age of the universe*** is around ***13.8 billion years,*** based on measurements from observations such as the cosmic microwave background (CMB) radiation and the expansion rate of the universe (Hubble constant). These findings help scientists estimate the time elapsed since the Big Bang, which marks the beginning of the universe.

5. **Correct Answer is (2):** Kepler's Third Law of Planetary Motion relates the period of revolution of a planet (the time it takes to complete one orbit around the Sun) to its average distance from the Sun. The law states that the square of the orbital period (T) is directly proportional to the cube of the semi-major axis of the orbit (r): $T^2 \propto r^3$. This means that planets farther from the Sun have longer orbital periods.

6. **Correct Answer is (4):** Jupiter is a gas giant, while Mars, Venus, and Earth are rocky planets (terrestrial planets). Jupiter is primarily composed of hydrogen and helium, with a small rocky core, whereas the other three planets have solid surfaces made of rocks and metals. This makes Jupiter's composition very different from the other three.

7. **Correct Answer is (1):** We can use Kepler's third law of planetary motion to relate the orbital periods of two planets. Kepler's third law states that the square of the orbital period (T) is directly proportional to the cube of the semi-major axis (r) of the orbit: **T2 r3,** For the two planets A and B:
   The distance of planet A from the star is d, so its orbital period is TA.
   The distance of planet B from the star is 4d, so its orbital period is TB.
   TBTA2=4dd3=64
   TBTA=64=8
   The orbital speed v of a planet is related to its orbital period T and orbital radius r by: v=2πr/T. Since planet B has a larger orbital radius (4d) and an orbital period 8 times longer, it moves **slower** in its orbit. Therefore, planet B orbits **twice as slowly** as planet A.

8. **Correct Answer is (4):** Comets which do not re-appear. Kepler's third law applies to objects in bound (elliptical) orbits, such as planets, moons, and artificial satellites. These follow a specific relationship between orbital period (T_2) and semi-major axis (a_2). Comets that do not reappear have hyperbolic or parabolic trajectories, meaning they are not gravitationally bound, so Kepler's law does not apply.

9. **Correct Answer is (1):** The oldest rock reported from India is the Singhbhum Craton in eastern India, which has been dated to approximately 3500 Ma (million years ago). These rocks belong to the Archean Eon and provide important information about the early crustal evolution of the Earth.

10. **Correct Answer is (3):** Compared to Earth, Jupiter orbits around the Sun much slower because of its larger distance from the Sun. According to Kepler's third law, the farther a planet is from the Sun, the longer it takes to complete an orbit. Jupiter's orbit is much larger than Earth's, resulting in a longer orbital period.

11. **Correct Answer is (2):** The rock that approximates the average bulk composition of the continental crust is granodiorite. The continental crust is rich in silica and aluminum, and granodiorite is an intermediate intrusive igneous rock that closely represents this composition.

12. **Correct Answer is (4):** The Moon lacks a significant magnetic field, leaving its surface exposed to cosmic rays and solar wind. Unlike Earth, which is protected by a strong magnetic field that deflects charged particles, the Moon's surface faces constant bombardment, making its environment harsher.

13. **Correct Answer is (1):** The Sun and the Earth formed together from the same protoplanetary disk of gas and dust around 4.6 billion years ago. This is roughly the age of the Solar System itself.
   Sun's Age: The Sun is about 4.6 billion years old. It began its life as a part of a molecular cloud and eventually formed through gravitational collapse. The Sun is currently in its "main sequence" phase, where it fuses hydrogen into helium in its core, and it has been in this phase for about 4.6 billion years.
   Earth's Age: The Earth also formed around the same time as the Sun, around 4.6 billion years ago, making their ages essentially the same.

14. **Correct Answer is (2):** The planets in order of increasing surface temperature***: Neptune < Earth < Mercury < Venus.*** The surface temperature of planets in our solar system is primarily determined by their distance from the Sun and atmospheric composition.

Here's the order based on average surface temperatures:

Neptune: This planet is far from the Sun and very cold, with temperatures around -214°C (-353°F).

Earth: Earth has a moderate temperature due to its atmosphere, averaging around 15°C (59°F).

Mercury: Despite being closer to the Sun, Mercury has no atmosphere to retain heat, leading to a wide range of temperatures. The surface temperature averages around 167°C (333°F).

Venus: Venus has an extremely thick atmosphere composed mostly of carbon dioxide, which traps heat through a runaway greenhouse effect. Its surface temperature is the hottest among the planets, averaging around 465°C (869°F).

15. **Correct Answer is (1):** ***Neptune*** because it is significantly more massive than Earth. Here's breakdown of why Neptune is the most massive object among the options provided: ***Neptune*** is a gas giant and one of the outer planets in our solar system. It has a mass approximately 17 times that of Earth. This makes it one of the most massive planets in our solar system, only surpassed by Jupiter, Saturn, and Uranus.

16. **Correct Answer is (4):** ***Chondrites*** are primitive meteorites that have not undergone melting or differentiation. They come from undifferentiated parent bodies, preserving the original composition of the early solar nebula. As chondrites have not been fractionated into layers (core, mantle, crust) since their formation. They retain a mix of minerals like olivine, pyroxene, and metallic iron, reflecting the primordial solar system material.

17. **Correct Answer is (1):** Using Kepler's Third Law, the orbital period (T) is proportional to the 3/2power of the distance from the Sun (R):T∝R, 3/2 For Neptune, R=30 times Earth's distance: T=303≈165years.

18. **Correct Answer is (1):** ***Oblate spheroid:*** The Earth is not a perfect sphere; it is slightly flattened at the poles and bulges at the equator due to its rotation. This shape is known as an oblate spheroid, where the equatorial diameter is slightly larger than the polar diameter. This means the Earth's shape resembles a sphere that has been slightly compressed along its axis, making it oblate rather than perfectly round.

19. **Correct Answer is (3):** ***East Pacific Ridge:*** The East Pacific Ridge is the fastest-spreading mid-ocean ridge on Earth. It is located in the Pacific Ocean and has an exceptionally high spreading rate, reaching up to about 15–18 cm per year in some sections. This rapid spreading rate is due to the high rate of magma supply in this area, resulting in faster formation of new oceanic crust.

20. **Correct Answer is (3):** ***Cretaceous Normal Superchron (CNS),*** also known as the Cretaceous Quiet Zone, is a period in Earth's geologic history when the magnetic field remained in a normal polarity state without reversing. This period is notable because it lasted an unusually long time compared to typical geomagnetic reversal intervals. The duration of the CNS is approximately 40 million years (Ma), spanning from around 120 million years ago to about 80 million years ago during the Cretaceous period.

21. **Correct Answer is (1):** ***If the Moon were farther away from Earth: Fewer Full-Moon Days:*** The Moon's orbit would lengthen, increasing the time it takes to complete one cycle (from one full moon to the next). This would result in fewer full-moon days in a year. ***Darker Moon:*** The Moon's apparent brightness would decrease as its distance from Earth increases, following the inverse square law of brightness. This means the Moon would appear darker to observers on Earth.

22. **Correct Answer is (3):** Jupiter has the fastest rotation rate of all the planets in our solar system. It completes a full rotation about its axis in approximately 9 hours and 55 minutes. Despite being the largest planet, its rapid rotation creates a strong centrifugal force, leading to its noticeable oblate shape (bulging at the equator). Here's how Jupiter's rotation compares to the other options:

Earth: Takes 24 hours to complete one rotation.

Mars: Takes about 24.6 hours to complete one rotation.

Saturn: Has a fast rotation as well, taking about 10.7 hours to complete one rotation, but it is slower than Jupiter.

23. **Correct Answer is (1):** Coal deposits formed in the ***Paleozoic era*** (approximately 541 to 252 million years ago) are usually older and are often associated with the ***Gondwana coal*** formations in India. The Singareni coal deposits are part of the Gondwana coal and are from the Paleozoic age, specifically from the Permian period within the Gondwana sequence. ***Singareni:*** Located in Telangana, Singareni coalfields are part of the Gondwana coal deposits, which formed during the Permian period of the Paleozoic era. These deposits are known for their high age and geological significance.

24. **Correct Answer is (3):** The ***Devonian Period*** (419–359 million years ago) is known as ***the "Age of Fishes"*** due to the vast diversification and dominance of fish. Key fish groups included ***placoderms*** (armored fish), cartilaginous fish (early sharks and rays), ***ray-finned fish,*** and ***lobe-finned fish,*** the latter leading to the evolution of the first ***tetrapo,*** which eventually moved onto land. The period also saw the emergence of the first land plants and forests. It ended with a mass extinction that severely impacted marine life, particularly fish.

25. **Correct Answer is (4):** The Sun formed 4.6 billion years ago from the collapsing solar nebula, a spinning cloud of gas and dust. Most of the nebula's material gathered at the center, creating the Sun, which holds about 99.8% of the solar system's mass. Its immense gravity keeps planets, comets, and other bodies in orbit.

26. **Correct Answer is (1):** A vertical fold occurs when the axial plane of the fold is oriented vertically. In such folds, the profile plane (a plane that is perpendicular to the hinge line of the fold) will have a dip of 90°, meaning it is also oriented vertically. Dip refers to the angle that a plane makes with a horizontal surface. In the case of a vertical fold, the limbs of the fold are steep or upright, and the profile plane itself is vertical, resulting in a 90° dip.

27. **Correct Answer is (3):** The normal gravity difference is smallest between locations with similar latitude, altitude, and close proximity, as gravity varies with Earth's shape, altitude, and geological factors. Hyderabad and Nagpur are relatively close to each other, both at around 17°N latitude, leading to a smaller gravity difference due to their proximity and minimal geological variation.

28. **Correct Answer is (4):** The ***Meghalayan Stage*** is the latest division of the Holocene Epoch, and it began around 4,200 years ago. This stage is notable for the global climatic events, particularly a major drought that affected many ancient civilizations, including those in Mesopotamia, the Indus Valley, and Egypt.
    The Holocene is divided into three stages:
    Greenlandian (Early Holocene) - started around 11,700 years ago.
    Northgrippian (Mid Holocene) - began around 8,200 years ago.
    Meghalayan (Late Holocene) - began around 4,200 years ago and continues to the present.
    The Meghalayan Stage marks the most recent part of the Holocene and is officially recognized by the International Commission on Stratigraphy.

29. **Correct Answer is (4):** The ***Sun formed*** 4.6 billion years ago from the collapsing solar nebula, a spinning cloud of gas and dust. Most of the nebula's material gathered at the center, creating the Sun, which holds about 99.8% of the solar system's mass. Its immense gravity keeps planets, comets, and other bodies in orbit.

30. **Correct Answer is (1):** The gravitational field strength mentioned in the question is referring to Earth's own gravity field, which depends on its mass and radius, not its distance from the Sun.
    The gravitational field at Earth's surface is determined by: ***g = G MEarthREarth2***
    where: G is the gravitational constant, **M** Earth is the mass of the Earth, **R** Earth is the radius of the Earth. Distance from the Sun affects the Earth's orbit and the gravitational force between the Earth and the Sun, but it does not change the gravity field on Earth's surface, which depends solely on the Earth's mass and radius.

31. **Correct Answer is (2):** The ***Eocene Epoch*** (56–33.9 million years ago) was one of Earth's warmest periods, with little to no polar ice. The Early Eocene Climatic Optimum (EECO), around 52–50 million years ago, marked the peak of these warm conditions. High atmospheric CO_2 levels created a greenhouse climate, allowing temperate forests to grow in areas like Antarctica and the Arctic.

32. **Correct Answer is (4):** ***Iron meteorites,*** Shergottites, and Eucrites originate from differentiated planetary bodies: ***Iron meteorites*** form from the cores of such bodies, Shergottites are Martian meteorites from Mars' crust, and Eucrites come from the crust of asteroids like Vesta. ***Carbonaceous*** chondrites are primitive meteorites that have not experienced differentiation, preserving the early solar system's original composition.

33. **Correct Answer is (2):** The correct sequence of first appearances in the geological record since the Precambrian is: Ediacaran biota → Land plants → Amphibians.
    Ediacaran biota: These are the earliest known multicellular organisms, appearing in the late Precambrian (~600–541 Ma).
    Land plants: They first appeared in the Silurian period (~470–420 Ma) and began to colonize terrestrial environments.

Amphibians: These evolved later in the Devonian period (~375 Ma) as the first vertebrates to transition from water to land.

34. Correct Answer is (2): The acceleration due to ***gravity (g)*** increases with latitude because:
Centrifugal Force: At the equator, Earth's rotation causes maximum centrifugal force, reducing gravity. This force decreases toward the poles, increasing effective gravity.
Earth's Shape: The Earth's oblate shape means a smaller radius at the poles, and since gravity increases with a smaller radius, g is higher at the poles.

35. Correct Answer is (2): The activity (A) of ^{14}C is calculated using $A = \lambda N$, where $N = \frac{\text{mass}}{\text{molar mass}} \times N_A$.
Mass = 14 mg $= 14 \times 10^{-3}$ g,
Molar mass = 14 g/mol,
$N_A = 6.023 \times 10^{23}$ atoms/mol,
Decay constant (λ) = 3.84×10^{-12} s^{-1}.
$N = \frac{14 \times 10^{-3}}{14} \times 6.023 \times 10^{23} = 6.023 \times 10^{20}$ atoms.
$A = \lambda N = (3.84 \times 10^{-12}) \times (6.023 \times 10^{20}) 2.31 \times 10^{9}$ decays/second.

36. Correct Answer is (3): Moving toward the Sun, the sequence is ***Oort Cloud → Heliopause → Kuiper Belt → Asteroid Belt.***
Oort Cloud: The farthest region of the solar system, a spherical shell of icy bodies surrounding the Sun (~50,000 AU from the Sun).
Heliopause: The boundary where the solar wind pressure balances with the interstellar medium, marking the edge of the Sun's influence (~120 AU).
Kuiper Belt: A disc-shaped region of icy bodies and dwarf planets (like Pluto) beyond Neptune (~30–50 AU).
Asteroid Belt: Located between Mars and Jupiter (~2–3 AU), consisting mainly of rocky bodies.

37. Correct Answer is (4): ***Kepler's third law*** of planetary motion states that the square of the orbital period (T) is directly proportional to the cube of the semi-major axis (r) of the orbit: $T^2 \propto r^3$. If the Earth were to orbit at twice its present distance from the Sun (i.e., $r' = 2r$), we can use this relationship to determine the new orbital period: $T'^2 = (2r)^3 = 8r^3$. Thus, the new period T' would be: $T' = \sqrt{8} \times T = \sqrt{2} \times T$ So, the year would become longer by a factor of $\sqrt{2}$, making the new orbital period $T' = 365 \times \sqrt{2}$ days. Since the Earth's rotation period (day) does not change, the new year length would be $730 \times \sqrt{2}$ days.

38. Correct Answer is (2): ***Mass:*** If the radius is doubled and density is halved, mass increases by a factor of 4 (due to $M \propto r^3$). ***Gravity:*** Gravitational field at the surface depends on both mass and radius. Since mass increases by 4 times and radius increases by 2 times, the gravity field remains unchanged ($g \propto \frac{M}{r^2}$).

39. Correct Answer is (3): If the ***Earth*** starts rotating in the opposite direction but with the same period of rotation, the length of day and night at a particular location (like Delhi) would not be significantly affected. The ***Earth's rotation period (i.e., 24 hours)*** remains the same, meaning the time it takes for the Earth to complete one full rotation is unchanged. Consequently, the length of day and night will still be approximately ***12 hours*** each, just like before, with the only difference being the direction of the Earth's rotation.

40. Correct Answer is (4): The activity at ***900 mm*** depth is $\frac{1}{16}$ of the surface activity, which corresponds to 4 half-lives (since $\frac{1}{16} = \left(\frac{1}{2}\right)^4$). Given the half-life is 6000 years, the total time for 900 mm of sediment is $4 \times 6000 = 24{,}000$ years. The sedimentation rate is $\frac{900 \text{ mm}}{24{,}000 \text{ years}} = 0.0375$ mm/year.

41. Correct Answer is (1): Kamacite (low-nickel) and Taenite (high-nickel) are nickel-iron alloys dominant in iron meteorites. They form Widmanstätten patterns, a key texture seen when meteorites are cut and etched.
Other Option
Achondrite: Stony meteorites that lack chondrules and have silicate compositions, not iron-nickel alloys. **SNC meteorite**: A subgroup of achondrites, believed to be from Mars, mainly composed of silicates. **Carbonaceous chondrite**: Rich in carbon and silicates, contain chondrules, and sometimes water-bearing minerals, not dominated by metallic alloys.

42. Correct Answer is (2): Gravity inside Earth increases from the surface to the mantle due to increasing mass and density. However, in the outer and inner core, gravity decreases uniformly because less mass is enclosed as you approach the center. This is consistent with Earth's seismological and geophysical models.

43. Correct Answer is (3): The primary sources of heat in the Earth's continental crust are the radioactive decay of **Uranium-238 (238U)**, **Thorium-232 (232Th)**, and **Potassium-40 (40K)**. **238U** and **232Th** generate most of the heat through their decay chains, while **40K** contributes a smaller but still significant amount. These isotopes are the main contributors to Earth's radiogenic heat.

44. Correct Answer is (1): The Earth's magnetic field has three components: total magnetic field (F), horizontal component (H), and vertical component (V). Since F is the resultant of H and V, it is always greater than or equal to both. Near the equator, H is larger than V, so the relation **F > H > V** holds.

45. Correct Answer is (4): The **declination of the Natural Remanent Magnetism (NRM)** in a rock unit measures the angle between the magnetic north (true north) and the direction of the magnetic field recorded in the rock. This declination is caused by the **rotation of the rock** relative to the Earth's magnetic field, often reflecting the **amount of rotation about a vertical axis**. It does not directly measure latitude, longitude, or latitudinal movement.

46. Correct Answer is (4): The **Richter scale** is used to measure the magnitude of an earthquake, but it tends to **underestimate the magnitude** of large, distant earthquakes. For great earthquakes, the scale doesn't accurately capture the energy released, especially for magnitudes above 7.5, which is why other scales, like the moment magnitude scale (Mw), are often used for larger events.

47. Correct Answer is (1): To find the distance of Mars from the Sun in AU, we can use **Kepler's Third Law**, which states that the square of the orbital period (T) is proportional to the cube of the semi-major axis (r), where T is in Earth years and r is the distance in AU.

For Mars: $\frac{T^2}{r^3} = \frac{1}{1}$ (since Earth is 1 AU from the Sun).

Given Mars' orbital period is **687 Earth days** (which is approximately **1.88 Earth years**), we can solve for rrr (the distance in AU):

$T^2 = r^3 \Rightarrow (1.88)^2 = r^3 \Rightarrow r = (1.88)^2 \approx 1.5$

Thus, the distance of Mars from the Sun is approximately **1.5 AU**.

48. Correct Answer is (4): The **geoid** is an undulating, equipotential surface that represents Earth's gravity and mean sea level, affected by variations in Earth's mass. The **reference spheroid** is a smooth, idealized mathematical model of Earth's shape, assuming uniform gravity. They are not the same surface.

49. Correct Answer is (4): For a material with a **Poisson's ratio of 0.5**, the S-wave (shear wave) velocity is **zero**. This is because, at a Poisson's ratio of 0.5, the material behaves as if it is incompressible, meaning it cannot support shear waves. Shear waves require the material to deform under shear stress, which does not occur in a material with a Poisson's ratio of 0.5, leading to a **zero S-wave velocity**.

50. Correct Answer is (1): In **continent-continent collision zones**, such as the Himalayas, the collision of two continental plates causes intense compression, leading to **shallow focus earthquakes**. These earthquakes occur near the Earth's surface due to the direct collision and buckling of the continental crust, with little subduction, unlike oceanic plate collisions that produce deeper earthquakes.

51. Correct Answer is (3): The seismic phase **SKJKS** is associated with the **solid inner core of the Earth**. This phase refers to shear waves (S-waves) that travel through the Earth's outer core and reflect off the solid inner core. Since S-waves cannot travel through liquids, the fact that **SKJKS** is observed indicates that the inner core is solid.

52. Correct Answer is (1): To match the regions with their corresponding impact structures, we need to understand the geographical locations and the specific impact craters or structures associated with each region. Impact structures are formed by the collision of celestial bodies like asteroids or meteoroids with the Earth's surface.

Bundelkhand: The Bundelkhand region is located in central India and is known for its Dhala impact crater, which is one of the prominent impact structures.

Kota Plateau: The Kota Plateau is in Rajasthan, and it is associated with the Lonar impact crater, which is a unique hyper-velocity impact crater created by a meteorite, located in Maharashtra.

Arabian Sea Shelf: The Arabian Sea Shelf is associated with the Luna impact structure, which is situated in the ocean region close to the Indian subcontinent.

Buldhana: The Buldhana district is located in Maharashtra, and it is known for the Shiva impact structure, which is a large impact crater.

53. Correct Answer is (4):

1. Wien's Displacement Law states that the temperature of a black body is inversely related to its peak wavelength of emission: $\lambda_{peak} \propto \frac{1}{T}$
   Where:
- λ_{peak} is the peak wavelength.
- is the temperature of the star.

2. T The ratio of the temperatures of the two stars can be derived from the inverse relationship between temperature and peak wavelength:
   Substituting the values for the wavelengths:
$$\frac{T_B}{T_A} = \frac{965}{482} = 2$$
   So, star B is 2 times hotter than star A.
3. The Stefan-Boltzmann Law gives the energy radiated by a black body: $E \propto T^4$
   Hence, the ratio of the energy radiated by star B to star A is: $\frac{E_B}{E_A} = \left(\frac{T_B}{T_A}\right) 4 = 2^4 = 16$
   Thus, star B radiates 16 times more energy (and is 16 times brighter) than star A.

54. Correct Answer is (4): The question asks us to match the Digital Elevation Model (DEM) products with the satellites that produced them. Let's break down each DEM product and the corresponding satellite:

A. ALOS: The **ALPS (Advanced Land Observing Satellite)** is associated with **Daichi**, which was Japan's Earth observation satellite. **Daichi** was used to acquire global elevation data.

B. SRTM: The **SRTM (Shuttle Radar Topography Mission)** is associated with the **Endeavor** space shuttle, which carried the radar system used to create the SRTM DEM.

C. ASTER: The **ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer)** is an instrument aboard the **Terra** satellite. ASTER is used for creating DEMs based on optical and infrared data.

D. Copernicus: The **Copernicus program** is part of the European Space Agency's Earth observation initiative, which uses various satellites, including **Cartosat 3** for high-resolution imagery.

55. Correct Answer is (4):

Statement A: The **gravity field** is related to the **rate of change of the gravitational potential**, which is correct. The gravity field represents the spatial variation of the gravitational potential, and this rate of change is the gradient of the potential.

Statement B: The gravity field **on the geoid** is **not zero** everywhere. The geoid is an equipotential surface, meaning the gravitational potential is constant along it, but the gravity field itself is not zero. The gravitational force on the geoid can still vary due to local variations in the Earth's mass distribution, like mountains or ocean trenches.

56. Correct Answer is (2): The magnetic anomaly profile shows a **maximum anomaly of +640 gammas** and a **minimum anomaly of -320 gammas** across a dyke-like body. The anomaly at a point directly above the position of the dyke is typically the **average** of the maximum and minimum anomalies.

To find the expected anomaly:

$$Expected\ anomaly = \frac{+640 + (-320)}{2} = \frac{640 - 320}{2}$$
$$= \frac{320}{2} = 320\ gammas$$

Thus, the anomaly at a point above the dyke is expected to be **320 gammas**.

57. Correct Answer is (2):

Free Air Anomaly (F_A): Depends on the height/thickness of the body. For a body with 2.0 km thickness, the Free Air anomaly is twice as large, so **F_B = 2F_A**.

Bouguer Anomaly (g_A and g_B): Considers the gravitational effect of the material. With a thicker body (2.0 km), the gravitational anomaly is also doubled, so **g_B = 2g_A**.

58. Correct Answer is (3): The gravity anomaly of a horizontal circular cylindrical body decreases with distance from its center. The anomaly reduces to one-third of its maximum value at a distance of $\sqrt{3}\,z$ from the position of the maximum anomaly.

59. Correct Answer is (4): The travel time residual is the difference between the observed and calculated travel times for a seismic wave. The velocity perturbations (%) affect the seismic wave's travel time. A decrease in velocity increases travel time, and a higher velocity decreases travel time. In this case, the residual is -2.9%, indicating that the observed travel time is longer than expected due to the perturbation in the velocity.

60. Correct Answer is (4): As the distance from the earthquake increases, seismic waves have more time to travel, causing the event duration to be longer at greater distances.

1. **Station A (local distance)**: Shortest event duration **E_A**.
2. **Station B (regional distance)**: Longer event duration **E_B**.
3. **Station C (teleseismic distance)**: Longest event duration **E_C**.

61. Correct Answer is (4): The explanation provided describes the process of calculating the thickness of the top layer of earth based on seismic wave travel time data fitted to two-line segments. Here's a summary of the key points:

- The slope of each line segment represents the P-wave velocity for that layer.
- The intercepts (delay times) are denoted as t_1 and t_2 for the top and second layers, respectively.
- The time for the top layer is calculated using:$t_1 + p_1 \times thickness\ of\ top\ layer$
- The boundary between the top and bottom layers is determined using the time for the second layer (t_2) and the relation:$t_2 = t_1 + p_1 \times thickness\ of\ top\ layer$
- Given Values: $p_1 = 0.5\ s/km,\ p_2 = 0.33\ s/km,\ t_1 = 0\ s,$ and $t_2 = 1.5\ s$.
- Calculation of top layer thickness: $thickness\ of\ top\ layer = \frac{1.5\ s}{0.5\ s/km} = 3\ km$
- The final conclusion: the thickness of the top layer is **3 km**, and the correct answer is **2 km** for the overall thickness (possibly considering additional information or context).

62. Correct Answer is (4): The **effective gravity force** includes both the **centrifugal force** (due to Earth's rotation) and the **Newtonian gravitational force**. **Centrifugal force** is strongest at the **equator** and zero at the **poles**. At **45° latitude**, the centrifugal force has a significant horizontal component, creating the **maximum angle** between the effective gravity force and the Newtonian gravitational force.

CSIR-UGC National Eligibility Test (NET) for Junior Research Fellowship & Lecturer-ship

SECTION-II

GEOLOGY

NUMBER OF QUESTIONS ASKED IN CSIR - UGC (NET) - EARTH SCIENCES (2014 TO 2025)

SECTION-II		2014		2015		2016		2017		2018		2019		2020			2021		2022			2023			2024		2025
	PART-B	J	D	J	D	J	D	J	D	J	D	J	D	J	N	D	J	D	J	S	D	J	S	D	J	JULY	F
1	MINERALOGY AND PETROLOGY	-	1	-	-	-	4	1	-	5	4	5	4	-	7	-	2	-	-	1	-	6	-	2	-	3	2
2	STRUCTURAL GEOLOGY & GEOTECTONICS	-	-	3	7	1	3	-	-	2	1	2	2	-	2	-	1	-	-	3	-	1	-	2	-	1	-
3	PALEONTOLOGY AND ITS APPLICATIONS	-	-	2	2	2	-	1	-	3	-	1	-	-	-	-	-	-	-	5	-	-	-	1	-	-	-
4	SEDIMENTOLOGY & STRATIGRAPHY	-	-	3	-	3	-	1	-	-	1	-	-	-	-	-	1	-	-	3	-	2	-	2	-	1	-
5	MARINE GEOLOGY & PALEOCEANOGRAPHY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
6	GEOCHEMISTRY	-	5	2	12	1	2	5	8	-	1	2	2	-	1	-	-	-	-	-	-	3	1	1	2	-	-
7	ECONOMIC GEOLOGY	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-		-	-	1	-
8	QUATERNARY GEOLOGY	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	APPLIED GEOLOGY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Section 1: Remote Sensing & GIS	-	-	-	-	1	1	1	1	-	-	1	-	-	-	-	1	-	-	1	-	1	-	1	-	1	-
	Section 2: Engineering Geology	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Section 3: Hyderogeology	-	-	-	-	-	2	5	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
10	PHYSICAL GEOGRAPHY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Section 1: Geomorphology	-	8	6	3	3	5	7	2	12	1	5	7	-	3	-	4	-	-	3	-	3	-	9	-	13	-
	Section 2: Climatology	-	10	9	-	1	9	4	7	7	9	8	6	-	10	-	3	-	-	2	-	9	-	3	-	24	-
	Section 3: Environmental Geography	-	-	-	-	-	-	-	6	-	9	3	4	-	-	-	-	-	-	3	-	-	-	-	-	1	-
	Section 4: Geography of India	-	1	2	-	-	2	2	2	3	4	-	2	-	-	-	1	-	-	1	-	2	-	1	-	-	-
11	GEOPHYSICS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Section 1: Mastering Signal Processing, Field Theory, And Numerical Inversion	-	-	3	2	3	1	5	-	1	5	1	-	-	4	-	-	-	-	1	-	-	-	-	-	-	-
	Section 2: Exploring Earth's Gravity, Magnetism, And Plate Tectonics Via Seismology	-	6	3	4	13	7	1	1	4	-	5	2	-	4	-	3	-	-	9	-	2	-	2	-	4	-
	Section 3: Geophysical Techniques	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
12	METEOROLOGY	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-		-	5		4	-		-
	Section 1: Atmospheric Electricity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Section 2: Cloud Physics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Section 3: Dynamic Meteorology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	4	-	-	-

SECTION-II		2014		2015		2016		2017		2018		2019		2020			2021		2022			2023			2024		2025
PART-C		J	D	J	D	J	D	J	D	J	D	J	D	J	N	D	J	D	J	S	D	J	S	D	J	JULY	F
1	MINERALOGY AND PETROLOGY	-	-	3	-	12	2	6	4	-	4	9	2	-	9	-	5	-	-	1	-	3	-	3	-		8
2	STRUCTURAL GEOLOGY & GEOTECTONICS	-	4	2	-	2	4	5	-	1	2	4	2	-	5	-	1	-	-	7	-	4	-	4	-	4	1
3	PALEONTOLOGY AND ITS APPLICATIONS	-	-	3	2	2	3	-	4	-	-	2	1	-	-	-	2	-	-	3	-	1	-	4	-	3	2
4	SEDIMENTOLOGY & STRATIGRAPHY	-	2	9	11	3	6	1	10	2	7	5	2	-	3	-	2	-	-	4	-	4	-	7	-	2	3
5	MARINE GEOLOGY & PALEOCEANOGRAPHY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
6	GEOCHEMISTRY	-	6	6	5	1	3	4	4	14	1	8	4	-	3	-	1	-	-	1	-	-	-	2	-	5	3
7	ECONOMIC GEOLOGY	-	1	-	1	1	1	1	-	-	-	-	1	-	1	-	-	-	-	-	-	-		3	-	1	1
8	QUATERNARY GEOLOGY	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	APPLIED GEOLOGY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-
	Section 1: Remote Sensing & GIS	-	-	2	1	-	-	-	1	3	3	1	1	-	-	-	1	-	-	-	-	5	-	4	-	-	1
	Section 2: Engineering Geology	-	-	-	-	4	16	3	9	4	-	1	-	4	-	-	-	-	-	-	-	-	-	-	-	3	3
	Section 3: Hyderogeology	-	4	-	-	4	3	4	-	2	-	1	-	-	-	-	3	-	-	3	-	2	-	-	-	3	-
10	PHYSICAL GEOGRAPHY final	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Section 1: Geomorphology	-	7	3	8	1	4	4	2	3	7	-	5	-	6	-	8	-	-	8	-	9	-	1	-	-	-
	Section 2: Climatology	-	3	4	-	5	17	9	8	12	11	18	4	-	13	-	14	-	-	18	-	12	-	5	-	-	5
	Section 3: Environmental Geography	-	-	5	-	1	1	-	1	6	3	-	-	-	2	-	1	-	-	1	-	7	-	-	-	2	-
	Section 4: Geography of India	1	-	3	-	3	1	-	3	1	6	2	3	-	7	-	1	-	-	-	-	4	-	3	-	1	-
11	GEOPHYSICS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Section 1: Mastering Signal Processing, Field Theory, And Numerical Inversion	-	3	11	15	1	-	5	2	1	7	3	4	-	10	-	5	-	-	3	-	1	-	3	-	1	1
	Section 2: Exploring Earth's Gravity, Magnetism, And Plate Tectonics Via Seismology	-	9	6	2	11	-	6	-	11	8	11	13	-	2	-	8	-	-	8	-	1	-	7	-	8	-
	Section 3: Geophysical Techniques	-	4	7	-	1	-	3	-	-	-	-	-	-	-	-	3	-	-	4	-	10	-	5	-	6	8
12	METEOROLOGY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Section 1: Atmospheric Electricity	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-
	Section 2: Cloud Physics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
	Section 3: Dynamic Meteorology	-	2	-	-	3	1	6	5	-	-	1	1	-	3	-	-	-	-	-	-	2	-	-	-	-	-

1 CHAPTER

MINERALOGY & PETROLOGY

PREVIOUS YEAR EXAM QUESTIONS

Topic Cover: *Concept of point group, space group, reciprocal lattice, diffraction and imaging, Concepts of crystal field theory and mineralogical spectroscopy, Lattice defects (point, line and planar). Electrical, magnetic and optical properties of minerals, Bonding and crystal structures of common oxides, sulphides, and silicates, Transformation of minerals, polymorphism, polytypism, and polysomatism, Solid solution and exsolution, Steady-state geotherms, Genesis, properties, emplacement and crystallization of magmas, Phase equilibrium studies of simple systems, effect of volatiles on melt equilibria, Magma -mixing, mingling and immiscibility, Metamorphic structures and textures; isograds and facies, Mineral reactions with condensed phases, solid solutions, mixed volatile equilibria and thermobarometry, Metamorphism of pelites, mafic -ultra mafic rocks and siliceous dolomites. Material transport during metamorphism. P-T-t path in regional, metamorphic terrains, plate tectonics and metamorphism, Petrogenetic aspects of important rock suites of India, such as the Deccan Traps, layered intrusive, complexes, anorthosites, carbonatites, charnockites, alkaline rocks, Kimberlites, ophiolites and granitoids.*

PART-B

(DEC 2014)

1. Magnetite, gold, chromite and tin ores occur together in river placer deposits. This association is due to their;
(1) geochemical affinity
(2) derivation from a single source rock
(3) densities being higher than those of other minerals
(4) similar magnetic properties

(DEC 2016)

2. The present-day Martian surface is not known to contain water either in liquid or solid form, however, ice has been reported from the polar regions of the planet. This ice is likely to be frozen;
(1) Oxygen (2) Sulphur dioxide
(3) Hydrogen (4) Carbon dioxide

(DEC 2016)

3. Out of following, which one can be considered as the best reference point in a stratigraphic section?
(1) A turbidity deposit
(2) A tsunami deposit
(3) A limestone deposit
(4) A tephra deposit

(DEC 2016)

4. Minerals in the Moh's scale of hardness are;
(1) silicates, phosphates, carbonates, oxides
(2) silicates, carbonates, chlorides, sulphides
(3) silicates, phosphates, oxides, chlorides
(4) silicates, carbonates, phosphates, sulphides

(DEC 2016)

5. Among marine crustaceans, the largest number of species are known from the order;
(1) Maxillipoda (2) Copepoda
(3) Branchiopoda (4) Ostracoda

(JUNE 2017)

6. Which of the following geological time intervals witnessed the first appearance of skeletal organisms in the Earth's history?
(1) Triassic (2) Cambrian
(3) Devonian (4) Cretaceous

(JUNE 2018)

7. Which one of the following SiO_2 polymorphs may form because of meteorite impact?
(1) Quartz (2) Tridymite
(3) Opal (4) Stishovite

(JUNE 2018)

8. Correctly match the mineral group and corresponding minerals that are used for dating geological events;

A	Phosphate	P	Galena
B	Silicate	Q	Monazite
C	Oxide	R	Zircon
D	Sulfide	S	Baddeleyite

Code

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

(JUNE 2018)

9. Correctly match the processes with the corresponding mineral concentrations;

Processes		Mineral Concentration	
(1)	Residual enrichment	**P**	Mn-oxide nodule
(2)	Chemical sedimentation	**Q**	Tale
(3)	Metamorphic	**R**	Chromite
(4)	Magmatic	**S**	Bauxite

Code

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

(JUNE 2018)

10. Which one of the mineral sequences, arranged in the order of increasing hardness (in Mohs scale) is correct?

(1) Tale, calcite, gypsum, apatite
(2) Orthoclase, topaz, quartz, diamond
(3) Calcite, apatite, orthoclase, quartz`
(4) Gypsum, tale, calcite, apatite

(JUNE 2018)

11. Electrically, sphalerite (ZnS) and cinnabar (HgS) are;

(1) Both good conductors
(2) Both bad conductors
(3) Good and bad conductors, respectively
(4) Bad and good conductors, respectively

(DEC 2018)

12. Which of the following minerais is likely to be altered to serpentine?

(1) Plagioclase (2) Garnet
(3) Olivine (4) Quartz

(DEC 2018)

13. Which one of the following fabrics is a characteristic feature at the center of a large pluton?

(1) Randomly oriented & interpenetrating large grains
(2) Preferred orientation of phyllosilicates
(3) Phenocrysts embedded in a fine grained groundmass
(4) Alternate bands of mafic and felsic minerals

(DEC 2018)

14. Some volcanoes are explosive whereas others are not. One of the reasons is related to;

(1) The larger heat content in the source of explosive volcanoes
(2) The larger content of volatiles in the melt producing explosive volcanoes
(3) The presence of network of faults in the crust overlying the source of explosive volcanoes
(4) The larger depth of the source of explosive volcanoes

(DEC 2018)

15. Compared to pyrite, galena and Sphalerite are;

(1) Both denser
(2) Denser and lighter, respectively
(3) Lighter and denser, respectively
(4) Both lighter

(JUNE 2019)

16. Which one of the following minerals does NOT show the phenomenon of double refraction?

(1) Quartz (2) Fluorite
(3) Calcite (4) Apatite

(JUNE 2019)

17. In the olivine group of minerals, which one of the following increases with increase in Fayalite content?

(1) Hardness (2) Unit cell volume
(3) Twinning (4) Melting point

(JUNE 2019)

18. Which one of the following minerals is a good conductor of electricity, besides being strongly magnetic?

(1) Pyrite (2) Pyrrhotite
(3) Cuprite (4) Sphalerite

(JUNE 2019)

19. During an equilibrium crystallization, the maximum number of minerals that can crystallize from 3-component system is:

(1) 2 (2) 3
(3) 4 (4) 5

(JUNE 2019)

20. Under anoxic conditions manganese is expected in water in the form of:

(1) Mn^{2+} (2) Mn^{3+}
(3) Mn^{4+} (4) Mn^{6+}

(DEC 2019)

21. Which one of the following minerals is characterized by a lack of cleavage?

(1) Calcite (2) Fluorite
(3) Quartz (4) Feldspar

(DEC 2019)

22. Which one of the following is the cause of magmatism in the collision zone?

(1) decompression
(2) accumulation of radioactive heat
(3) seismicity
(4) increased erosion

(DEC 2019)

23. Oxygenation of the Earth's atmosphere was caused by;

(1) mantle degassing
(2) the initial planetary accretion
(3) photosynthetic life
(4) weathering processes

(DEC 2019)

24. How old are the oldest fossils recorded on the Earth?

(1) <1 Ga (2) 1-2 Ga
(3) 2-3 Ga (4) >3 Ga

(NOV 2020)

25. Which one of the following minerals determines the strength of the Earth's continental crust?

(1) Feldspar (2) Mica
(3) Quartz (4) Amphibole

(NOV 2020)

26. In the Earth's interior, the increase of P-wave velocity at 670 km discontinuity is caused by phase transition from;

(1) olivine to spinel
(2) garnet to perovskite
(3) olivine to perovskite
(4) β-spinel to Y-spinel

(NOV 2020)

27. Which of the following minerals exhibit the maximum number of cleavage planes?

(1) Calcite (2) Galena
(3) Fluorite (4) Sphalerite

(NOV 2020)

28. Which one of the following clay minerals is devoid of iron?

(1) Chlorite (2) Glauconite
(3) Chamosite (4) Kaolinite

(NOV 2020)

29. Which of the following symmetry operations would give a result similar to an operation of a bar 6 symmetry axis?

(1) A 6-fold symmetry axis with a mirror plane perpendicular to it.
(2) A 6-fold symmetry axis with a mirror plane parallel to it.
(3) A 3-fold symmetry axis with a mirror plane perpendicular to it.
(4) A 3-fold symmetry axis with a mirror plane parallel to it.

(NOV 2020)

30. The texture in a graphic granite can represent which of the following stages of crystallization in the Albite-Silica binary system?

(1) At liquidus in the albite rich composition
(2) At liquidus in the silica rich composition
(3) At the eutectic point
(4) At the temperature below the eutectic point

(NOV 2020)

31. Which one of the following is NOT a cryptocrystalline form of quartz?

(1) Jasper (2) Agate
(3) Chalcedony (4) Amethyst

(JUNE 2021)

32. Which one of the following represents the CORRECT sequence of phase transformations with increasing depth in the mantle?

(1) Pyroxene→Garnet→Ilmenite →Perovskite
(2) Garnet→Perovskite→Pyroxene→Ilmenite
(3) Olivine→Ringwoodite→Perovskite→Wadsleyite
(4) Olivine→Pyroxene→Periclase→Ilmenite

(JUNE 2021)

33. Poisson's ratio is the ratio of;

(1) Axial strain to lateral strain.
(2) Lateral strain to axial strain
(3) Axial stress to axial strain.
(4) Transverse stress to lateral strain.

(SEP 2022)

34. Which of the following is NOT an example of isomorphic mineral pairs?

(1) Pyrite and Marcasite
(2) Rutile and Pyrolusite
(3) Calcite and Siderite
(4) Barite and Anhydrite

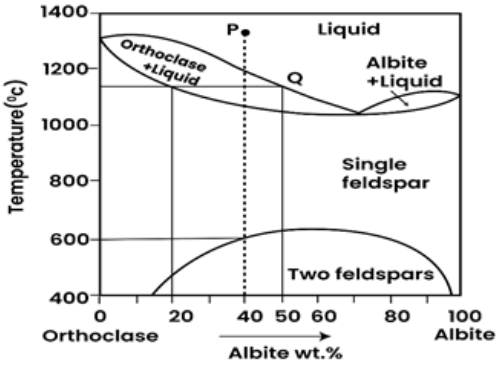
(JUNE 2023)

35. Which one of the following minerals contains potassium?

(1) Kaolinite (2) Chamosite
(3) Illite (4) Berthierine

(JUNE 2023)

36. The following diagram shows phase relations in the Orthoclase-Albite system at 1 bar pressure. If 'P' is the initial composition of liquid, which one of the following statements is INCORRECT regarding cooling and crystallization of liquid?



(1) The initial composition of liquid contains 40 wt.% albite and 60 wt.% orthoclase
(2) At point 'Q', the proportions (wt%) of crystal and liquid are 33.33 and 66.67, respectively
(3) On complete crystallization of liquid, the final composition of rock contains 60 wt.% perthite and 40 wt.% antiperthite
(4) On cooling of liquid, the first appearance of albite exsolution in orthoclase occurs at 600 °C

(JUNE 2023)

37. Which of the following minerals would replace hypersthene in the normative composition of silica undersaturated igneous rock?

(1) Leucite (2) Wollastonite
(3) Diopside (4) Olivine

(JUNE 2023)

38. Match the pelitic mineral assemblages in Group-I with the corresponding metamorphic facies in Group-II.

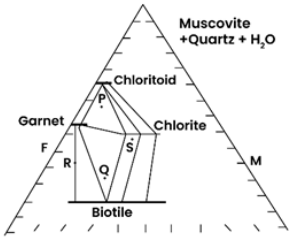
Group I		Group II	
P	Muscovite + chlorite + chloritoid + quartz	A	Amphibolite
Q	Biotite + muscovite garnet sillimanite + quartz	B	Eclogite
R	Biotite + garnet + cordierite + sillimanite + quartz	C	Green schist
S	Muscovite kyanite + garnet + biotite +quartz	D	Granulite

Code

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

(JUNE 2023)

39. The following AFM diagram shows the stability of minerals in the garnet zone where P, Q, R and S represent four pelitic assemblages. Identify garnet absent assemblage.



(1) R (2) Q
(3) P (4) S

(JUNE 2023)

40. Which of the following lithostratigraphic units are CORRECTLY paired?

(1) Ambaji Basin - South Delhi Terrane
(2) Berach Granite - Singhbhum Craton
(3) Ongole Domain - Southern Granulite Terrain
(4) Mahadek Formation - Cuddapah Basin

(DEC 2023)

41. Which one of the following rocks commonly hosts Platinum Group Elements (PGE) ore deposits?

(1) Felsic volcanic rock
(2) Greywacke
(3) Ultramafic igneous rocks
(4) Mafic igneous rocks

(DEC 2023)

42. A crystal that has two perpendicular and one oblique crystallographic axes belongs to which of the following crystal systems?

(1) tetragonal (2) orthorhombic
(3) monoclinic (4) triclinic

(JULY 2024)

43. In Augite, how many O-atoms of each [SiO_4] tetrahedron are shared with other tetrahedra?

(1) 0 (2) 2
(3) 1 (4) 4

(JULY 2024)

44. Which one of the following minerals is NOT a part of the Bowen's discontinuous reaction series?

(1) Olivine (2) Amphibole
(3) Enstatite (4) Andesine

(JULY 2024)

45. An imaginary line representing the first appearance of a particular metamorphic index mineral in the field is called an

(1) isopleth (2) index line
(3) isograd (4) iso-facies line

(FEB 2025)

46. If a body under a mean stress of 4 kbars requires a shear stress of 2.5 kbars for shear failure, the differential stress developed in the body is _____ kbars.

(1) 1.5 (2) 2.0
(3) 2.5 (4) 3.0

(FEB 2025)

47. Match the following:

Column-I (Wilson cycle stages)	Column-II (Examples)
A. Embryonic	P. Red Sea, Africa
B. Juvenile/young	Q. Arabian Sea
C. Mature	R. Mediterranean Sea
D. Terminal	S. Basin and Range Province, USA

Code

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

Answer Key									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
(3)	(4)	(4)	(1)	(2)	(2)	(4)	(2)	(4)	(3)
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
(2)	(3)	(1)	(2)	(2)	(2)	(2)	(2)	(4)	(1)
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
(3)	(1)	(3)	(4)	(3)	(2)	(4)	(4)	(3)	(3)
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
(4)	(1)	(2)	(1)	(3)	(3)	(4)	(3)	(4)	(1)
41	**42**	**43**	**44**	**45**	**46**	**47**			
(3)	(3)	(2)	(4)	(3)	(4)	(1)			

EXPLANATION:

1. **Correct Answer is (3):** Magnetite, gold, chromite, and tin ores are often found in placer deposits because they are heavy minerals with high densities. During transport in rivers, lighter minerals are carried away, while these dense minerals settle and concentrate together due to gravity. This process is independent of geochemical affinity or magnetic properties.

2. **Correct Answer is (4):** The ice reported on Mars, particularly in its polar regions, is primarily carbon dioxide ice (also known as dry ice), not water. While water ice exists in some places on Mars, carbon dioxide ice is more prominent in the planet's polar regions, especially during colder seasons.

3. **Correct Answer is (4):** A tephra deposit (volcanic ash layer) is often considered the best reference point in a stratigraphic section because it is widespread, can be dated accurately using radiometric techniques, and provides a precise marker horizon for correlating different geological sections across regions.

4. **Correct Answer is (1):** The Mohs scale of hardness is a qualitative scale used to measure the hardness of minerals, based on their ability to scratch softer materials. The minerals in the Mohs scale represent various types of compounds, including silicates, phosphates, carbonates, and oxides, which are some of the most common groups of minerals in Earth's crust.

5. **Correct Answer is (2):** ***Copepoda*** is the order with the largest number of marine crustacean species. They are small, planktonic organisms that form a crucial part of marine food webs.

6. **Correct Answer is (2):** The first appearance of skeletal organisms occurred during the Cambrian period, around 540 million years ago. This marks the beginning of the Cambrian Explosion, a time of rapid diversification in marine life, including the development of hard, mineralized skeletons in many organisms. The Triassic, Devonian, and Cretaceous periods all came after this significant evolutionary milestone.

7. **Correct Answer is (4):** ***Stishovite,*** a high-pressure polymorph of SiO_2, forms under the extreme pressures and temperatures generated by meteorite impacts. It is a denser and more compact form of silica, commonly associated with impact structures.

8. **Correct Answer is (2):** The correct matching is A-Q, B-R, C-S, D-P. ***Phosphate-Monazite:*** A phosphate mineral commonly used in U-Th-Pb dating. ***Silicate-Zircon:*** A silicate mineral widely used in U-Pb dating. ***Oxide-Baddeleyite:*** An oxide mineral used in U-Pb dating for mafic rocks. ***Sulfide-Galena:*** A sulfide mineral used in Pb-Pb dating.

9. **Correct Answer is (4):** The Correct matching is A-S, B-P, C-Q, D-R. ***Residual Enrichment-Bauxite:*** Forms through residual weathering of aluminum-rich rocks. ***Chemical sedimentation-Mn-oxide nodule:*** Forms by precipitation in ocean basins. ***Metamorphic-Talc:*** Forms during low-grade metamorphism. ***Magmatic-Chromite:*** Concentrated in mafic and ultramafic igneous intrusions.

10. **Correct Answer is (3):** ***Calcite, apatite, orthoclase, quartz*** correctly follows the Mohs scale in increasing order of hardness. The ***Mohs scale*** of mineral hardness is used to rank minerals based on their ability to scratch one another. It ranges ***from 1 (softest) to 10 (hardest).*** The hardness of the minerals mentioned in the options is as follows: Talc - Hardness: 1, Gypsum - Hardness: 2, Calcite - Hardness: 3, Fluorite - Hardness: 4 (not mentioned in the options), Apatite - Hardness: 5, Orthoclase (Feldspar) - Hardness: 6, Quartz - Hardness: 7, Topaz - Hardness: 8, Corundum - Hardness: 9 (not mentioned in the options), Diamond - Hardness: 10.

11. **Correct Answer is (2):** ***Sphalerite (ZnS)*** is a bad conductor of electricity because it is a sulfide mineral with a high resistance to electrical flow. On the other hand, ***cinnabar (HgS)*** is a good conductor of electricity, primarily because of the metallic nature of mercury, which contributes to better electrical conductivity.

12. **Correct Answer is (3):** ***Serpentine*** is a group of minerals that forms through the alteration of olivine and other magnesium-rich minerals under low-temperature, high-

pressure conditions typical of environments like oceanic crust and ultramafic rocks (such as peridotite). The alteration process, called serpentinization, occurs when water interacts with olivine, leading to the formation of serpentine minerals (including chrysotile, lizardite, and antigorite), which are characterized by their fibrous texture.

13. **Correct Answer is (1):** The slow cooling of magma deep within the Earth's crust allows large crystals to form, which interlock in a random arrangement. This results in a coarse-grained texture, characteristic of granite or granodiorite, common in the centers of large plutons. The absence of directed pressure or shear forces in the core of the pluton leads to the random orientation of the grains. This is in contrast to textures formed under high-pressure conditions, like those in metamorphic rocks, where minerals are often aligned or foliated.

14. **Correct Answer is (2):** Volatile content in magma is the primary factor determining whether a volcano is explosive or not. ***Explosive volcanoes*** have magma with high volatile content and high viscosity, which traps gas bubbles, leading to pressure build-up and violent eruptions. ***Non-explosive volcanoes*** (effusive eruptions) have magma with low viscosity, allowing gas to escape easily, resulting in steady lava flows instead of explosive events.

15. **Correct Answer is (2):** ***Here's the detailed explanation:*** Pyrite (FeS_2) has a density of around 5.0 g/cm³. Galena (PbS) has a density of around 7.4 g/cm³. Sphalerite (ZnS) has a density of around 3.9 g/cm³. ***Now, let's break down the comparison:*** Galena is denser than pyrite, since 7.4 g/cm³ (galena) > 5.0 g/cm³ (pyrite). Sphalerite is lighter than pyrite, since 3.9 g/cm³ (sphalerite) < 5.0 g/cm³ (pyrite).

16. **Correct Answer is (2):** ***Double refraction*** (also called birefringence) is a phenomenon where a mineral splits a light ray into two separate rays, each traveling at different speeds, causing a double image. This occurs in minerals that have an anisotropic crystal structure, meaning they have different optical properties in different directions.

17. **Correct Answer is (2):** ***Olivine*** is a mineral group that includes a solid solution between forsterite (Mg_2SiO_4) and fayalite (Fe_2SiO_4). As the fayalite content increases, the iron (Fe) content in the mineral also increases, replacing magnesium (Mg). ***Unit cell volume*** refers to the volume of the smallest repeating unit in a mineral's crystal structure. Since ***iron (Fe)*** atoms are larger than ***magnesium (Mg)*** atoms, the replacement of Mg by Fe in the crystal lattice increases the unit cell volume.

18. **Correct Answer is (2):** ***Pyrrhotite*** is known for being both strongly magnetic and a good conductor of electricity. It is an iron sulfide mineral with a variable composition, often containing iron deficiencies, which enhances its magnetic properties. Pyrrhotite's conductivity and magnetic properties make it distinctive among sulfide minerals.

19. **Correct Answer is (4):** In an ***equilibrium crystallization process,*** the number of minerals that can crystallize from a given system is constrained by the degrees of freedom in the system, which is related to the Gibbs phase rule. The Gibbs phase rule defines the number of independent variables (such as temperature, pressure, and composition) that can vary in a system while maintaining equilibrium. The Gibbs phase rule is given by: $= C - P + 2$. ***Where:*** F is the degrees of freedom (the number of independent variables), C is the number of components in the system, P is the number of phases present (e.g., solid, liquid, gas). For a 3-component system (where $C = 3$), the maximum number of phases (P) that can exist at equilibrium is determined by the degrees of freedom. In a 3-component system, the phase diagram allows for a maximum of 4 phases in equilibrium, which typically includes solid phases (minerals), liquid, and possibly a gas phase. However, when considering the crystallization of solid minerals, the maximum number of minerals (solid phases) that can crystallize is 4.

20. **Correct Answer is (1):** In anoxic conditions, which are environments lacking oxygen (such as deep water bodies, sediments, or groundwater), the oxidation state of manganese (Mn) is typically in the +2-oxidation state as Mn^{2+}. This is because:
Manganese Behavior in Anoxic Conditions:
In the absence of oxygen, Mn^{2+} is the most stable form of manganese in water. Without oxygen to oxidize manganese, it remains in its reduced state, which is Mn^{2+}.
Under these conditions, manganese doesn't interact with oxygen or other strong oxidants that could push it into higher oxidation states, such as Mn^{3+} or Mn^{4+}.

21. **Correct Answer is (3):** ***Cleavage*** refers to the tendency of a mineral to break along specific planes of weakness in its crystal structure, producing smooth, flat surfaces.

Minerals that have cleavage will break along these planes when subjected to stress.

Quartz: It lacks cleavage, meaning it does not break along flat, predictable planes. Instead, quartz fractures in an irregular pattern known as conchoidal fracture, producing curved, shell-like surfaces. This is due to its strong and evenly bonded crystal structure, which does not have inherent planes of weakness.

22. Correct Answer is (1): ***Magmatism*** in a collision zone (where two tectonic plates collide) is primarily caused by the accumulation of heat, often due to radioactive decay within the thickened continental crust. Here's how this process works:

Crustal Thickening: In a collision zone, tectonic forces push the crustal material together, creating a thickened crust. This thickened crust leads to an increase in temperature due to the insulation effect, which traps heat within the deeper layers.

Radioactive Heat: As the crust thickens, radioactive elements (such as uranium, thorium, and potassium) present in the crust undergo radioactive decay, generating heat over time. This gradual buildup of radioactive heat within the thickened crust can lead to partial melting, which contributes to magmatism in the region.

Magma Formation: The accumulated heat, especially when combined with pressure, can cause the crust to partially melt, forming magma that may rise and lead to volcanic activity in the collision zone.

23. Correct Answer is (3): ***Great Oxidation Event (GOE)*** was caused by photosynthetic organisms like cyanobacteria, which began producing oxygen as a byproduct of photosynthesis around 2.4 to 2.1 billion years ago. Initially, this oxygen was absorbed by iron in the oceans, but as these materials became saturated, oxygen started accumulating in the atmosphere. This led to a major increase in atmospheric oxygen, enabling the formation of an ozone layer and supporting the evolution of aerobic life.

24. Correct Answer is (4): The ***oldest fossils on Earth*** are estimated to be over ***3 billion years old,*** specifically around 3.5 billion years. These fossils, found in formations like the Strelley Pool Chert and Warrawoona Group in Western Australia and South Africa, are primarily stromatolites and microfossils of ancient cyanobacteria. They represent microbial mats that indicate the presence of simple, unicellular life forms early in Earth's history. Fossils from this period are rare because geological processes have altered much of Earth's early crust, but these discoveries show that microbial life existed relatively soon after Earth's formation.

25. Correct Answer is (3): ***Quartz*** is one of the most abundant and durable minerals in Earth's continental crust, and it plays a significant role in determining the crust's strength. Due to its high hardness and resistance to weathering, quartz contributes to the structural integrity and long-term stability of the continental crust. It is also stable at a wide range of temperatures and pressures, which further reinforces the strength of the crust.

26. Correct Answer is (2): ***Garnet to Perovskite:*** At the 670 km discontinuity, garnet undergoes a phase transition to form perovskite (specifically, bridgmanite, a high-pressure form of magnesium silicate). This transition leads to an increase in density and seismic wave velocity, marking the boundary between the upper and lower mantle. This is the correct answer, as it matches the conditions at the 670 km depth.

27. Correct Answer is (4): ***Cleavage refers*** to the tendency of a mineral to break along specific planes of weakness in its crystal structure. The number of cleavage planes varies among minerals, and the arrangement of these planes is influenced by the internal atomic structure. ***Sphalerite*** has the maximum number of cleavage planes among the given options, with six cleavage planes. Sphalerite's crystal structure is such that it has multiple cleavage directions, forming dodecahedral cleavage (each cleavage plane intersecting at specific angles), which is highly prominent and characteristic of this mineral. This provides more cleavage planes compared to the cubic cleavage of galena or the rhombohedral cleavage of calcite.

28. Correct Answer is (4): ***Kaolinite*** is a clay mineral primarily composed of aluminum silicate and does not contain iron in its chemical structure. It has the formula $Al_2Si_2O_5(OH)_4$ and is commonly found in weathered rocks, soils, and sedimentary deposits. Kaolinite is often white or light-coloured due to the absence of iron.

29. Correct Answer is (3): A ***bar 6 (or 6) symmetry axis*** can be thought of as a combination of a 3-fold rotation with a perpendicular mirror plane, which results in a similar symmetry effect. ***3-fold*** symmetry with a perpendicular mirror plane creates alternating 120° rotations combined with reflections, which produces a pattern of symmetry similar to a bar 6. ***In contrast,*** a 6-fold axis

with perpendicular or parallel mirror planes doesn't replicate this exact symmetry, as the bar 6 operation involves both rotation and inversion across a perpendicular plane, not just rotation and reflection.

30. Correct Answer is (3): In the ***Albite-Silica binary system,*** a graphic granite texture forms at the eutectic point. At this temperature, both albite and quartz crystallize together from the melt, leading to the characteristic intergrowth pattern seen in graphic granite. ***Eutectic Point:*** This is the specific temperature in the albite-silica system where both minerals (albite and quartz) begin to crystallize simultaneously from the remaining melt. Because they crystallize together, they interlock in the distinctive ***"graphic"*** pattern.
Graphic Texture: This texture arises because of the simultaneous crystallization of albite and quartz at the eutectic point, where the composition and cooling conditions favor the development of this intergrowth.

31. Correct Answer is (4): ***Cryptocrystalline quartz*** consists of very fine crystals that are too small to be seen individually under a microscope. This form of quartz includes varieties like jasper, agate, and chalcedony.
Jasper, Agate, and Chalcedony: These are all cryptocrystalline forms of quartz. They consist of a microscopic crystal structure and have an opaque or translucent appearance. Jasper is typically opaque and colored by impurities, agate often shows banding patterns, and chalcedony is more translucent and can appear in various colors.
Amethyst: Amethyst is a macrocrystalline form of quartz, meaning its crystals are large enough to be seen with the naked eye. It has a purple color due to trace amounts of iron and is not classified as cryptocrystalline.

32. Correct Answer is (1): As we go deeper into the Earth's mantle, minerals undergo phase transformations due to increasing pressure and temperature. The following is the correct sequence of these transformations with increasing depth:
Pyroxene: In the upper mantle, pyroxenes are stable at shallower depths.
Garnet: With increasing depth, pyroxene transforms into garnet under higher pressure conditions.
Ilmenite: As we go deeper, garnet transforms into ilmenite, which is stable at even higher pressures.
Perovskite: In the lower mantle, at great depths, ilmenite eventually transforms into perovskite, which is one of the most stable forms of silicate minerals under extreme mantle conditions.

33. Correct Answer is (2): ***Poisson's ratio*** is a measure of how a material deforms in directions perpendicular to the direction of applied stress. When a material is stretched or compressed along one axis (axial direction), it will also tend to contract or expand in the perpendicular (lateral) direction.
Definition of Poisson's Ratio (ν) **:** $\boldsymbol{\nu = -\frac{\text{lateral strain}}{\text{axial strain}}}$
where:
Lateral strain is the strain (deformation) occurring perpendicular to the applied force direction.
Axial strain is the strain in the direction of the applied force.

34. Correct Answer is (1): ***Pyrite (FeS_2)*** and ***Marcasite (FeS_2)*** have the same chemical formula but different crystal structures, which means they are polymorphs, not isomorphic pairs. Polymorphs are minerals with the same chemical composition but different atomic arrangements and crystal structures. ***Pyrite crystallizes*** in the isometric (cubic) crystal system. ***Marcasite crystallizes*** in the orthorhombic crystal system. Since isomorphism refers to minerals that have similar crystal structures but different chemical compositions, Pyrite and Marcasite are not isomorphic but polymorphs.

35. Correct Answer is (3): ***Illite*** is a clay mineral that contains potassium (K) as part of its chemical structure. It is a ***mica-like*** mineral and has the chemical formula $\mathbf{K(H_3O)\ (Al,Mg,Fe)_2\ (Si,\ Al)_4O_{10}(OH)_2}$**.** Potassium is an essential component of the illite structure, and this mineral is commonly found in soils and sedimentary rocks.

36. Correct Answer is (3): ***Final Composition of the Rock:*** This statement claims that after complete crystallization, the rock will contain 60 wt.% perthite and 40 wt.% ant perthite. ***Perthite*** refers to orthoclase with exsolved albite. ***Ant perthite*** refers to albite with exsolved orthoclase. The final solid composition reflects the initial melt composition of 40 wt.% albite and 60 wt.% orthoclase. Perthite and ant perthite are textural features from slow cooling and exsolution, not fixed ratios like 60% perthite and 40% ant perthite. Their development depends on cooling rates, not the initial bulk composition.

37. Correct Answer is (4): In the normative composition of igneous rocks, ***hypersthene*** forms in ***silica-saturated*** or oversaturated conditions. In ***silica-undersaturated rocks,*** where there isn't enough silica to support the formation of pyroxenes like hypersthene, olivine takes its place. ***Olivine*** requires less silica to form and is

common in silica-undersaturated rocks, such as basalts, gabbros, and peridotites. As a result, when silica is insufficient for hypersthene formation, olivine becomes more stable and replaces it.

38. Correct Answer is (3): The correct matching is P-C, Q-A, R-D, S-B.

Muscovite + chlorite + chloritoid + quartz: **Greenschist facies:** This mineral assemblage is typical of low-grade metamorphism in the greenschist facies, where minerals like chlorite, chloritoid, and muscovite are stable.

Biotite + muscovite + garnet + sillimanite + quartz: ***Amphibolite facies:*** This assemblage corresponds to the amphibolite facies, which is a medium-grade metamorphism where biotite, garnet, and sillimanite are stable, indicating higher temperatures and pressures.

Biotite + garnet + cordierite + sillimanite + quartz: ***Granulite facies:*** This mineral assemblage is characteristic of high-grade metamorphism in the granulite facies, where cordierite and sillimanite are stable at higher temperatures and pressures. ***Muscovite + kyanite + garnet + biotite + quartz-Eclogite facies:*** This assemblage is typically associated with high-pressure metamorphism, as found in the eclogite facies, where kyanite is stable at high pressures.

39. Correct Answer is (4): In the AFM diagram, P, Q, and R are near the garnet stability field, indicating garnet presence. S is positioned away from the garnet field, suggesting it lacks garnet. Therefore, S represents a garnet-absent assemblage, likely containing minerals like chlorite or biotite instead.

40. Correct Answer is (1): ***Ambaji Basin,*** located in northwestern India (Gujarat), is part of the ***South Delhi Terrane*** within the Delhi Fold Belt. This region is significant for its mineral deposits and forms part of the larger Delhi Supergroup, which is divided into the North and South Delhi Terranes. The South Delhi Terrane hosts geological formations like the Ambaji Basin, characterized by Proterozoic rocks that have undergone metamorphism and deformation.

41. Correct Answer is (3): Platinum Group Elements (PGE) including platinum, palladium, and others are commonly found in ***ultramafic igneous rocks*** like peridotite, dunite, and komatiite. These rocks, rich in magnesium and iron with low silica, host PGE deposits in layered mafic-ultramafic intrusions such as the ***Bushveld Complex*** in South Africa and ***Stillwater Complex*** in the USA. PGEs accumulate in ***sulfide minerals*** during magma crystallization, as ultramafic rocks originate from ***metal-rich mantle*** melts that concentrate these elements in ***magmatic sulfide deposits***.

42. Correct Answer is (3): In the ***monoclinic crystal system,*** the crystal structure is defined by ***three unequal axes.*** Two of these axes are perpendicular to each other, while the third axis intersects obliquely, forming an ***oblique angle*** (not 90°) with the other two axes. **Characteristics of Monoclinic System:** ***Axes:*** b c. ***Angles:*** = 90°, 90°. One oblique angle (β) and two perpendicular angles.

43. Correct Answer is (2): Augite is a pyroxene mineral with a single-chain silicate structure ***($[SiO_3]^n$).*** In this structure, $[SiO_4]$ tetrahedra are linked by sharing 2 oxygen atoms with neighboring tetrahedra along the chain. The other 2 oxygen atoms in each tetrahedron remain unshared, contributing to the single-chain configuration.

44. Correct Answer is (4): ***Bowen's discontinuous*** reaction series includes mafic minerals like Olivine, Pyroxene (e.g., Enstatite), ***Amphibole,*** and Biotite, which crystallize at different temperatures with structural changes. Andesine, a plagioclase feldspar, is part of the continuous reaction series, involving compositional changes (Ca-rich to Na-rich) without structural changes, and is not part of the discontinuous series.

45. Correct Answer is (3): An ***isograd*** is an imaginary line on a geological map or in the field that marks the first appearance of a particular metamorphic index mineral in rocks of a specific composition. It represents a line of equal metamorphic grade, indicating a specific set of pressure-temperature conditions during metamorphism.

Other option

Isopleth: Represents equal values of a specific property, such as composition. ***Index line:*** A general term without specific geological significance. ***Iso-facies line:*** Represents boundaries between metamorphic facies, not individual minerals.

46. Correct Answer is (4): In this case, we need to calculate the **differential stress**, which is the difference between the maximum and minimum principal stresses. The

differential stress (σ_d) can be calculated using the following relationship: $\sigma_d = 2 \times \tau$

Where: σ_d = differential stress, τ = shear stress required for shear failure

Given: $\tau = 2.5\ kbars$

Now, we calculate the differential stress:

$$\sigma_d = 2 \times 2.5 = 5\ kbars$$

However, the mean stress (σ_m) is given as 4 kbars, and the differential stress (σ_d) represents the difference between the maximum and minimum principal stresses.

The formula for the principal stresses is:

$\sigma_1 = \sigma_m + \frac{\sigma_d}{2}$, $\sigma_3 = \sigma_m - \frac{\sigma_d}{2}$

The differential stress is the difference between σ_1 and σ_3, which we already calculated as 5 kbars.

47. Correct Answer is (1): The Wilson cycle is a model that explains the stages of ocean basin formation and closure. It describes how ocean basins evolve from rifting to spreading and then eventually close. **Embryonic**: This is the first stage of the Wilson cycle where a rift begins to form and continents start to separate. **Red Sea** is an example of an embryonic ocean, as it is a rift zone where Africa is splitting from the Arabian Peninsula.

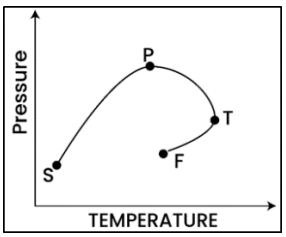
Juvenile/Young: This stage represents the early phase of ocean formation, where the ocean basin is still young and expanding. **Arabian Sea** is an example of a young ocean basin, formed as the Arabian plate began separating from the Indian plate.

Mature: In this stage, the ocean basin has fully formed, and the ocean is wide with an active mid-ocean ridge. **Mediterranean Sea** represents a mature stage where the sea is quite large, but its closure is also imminent due to tectonic interactions. **Terminal**: This is the final stage of the Wilson cycle when an ocean begins to close, and subduction takes place, causing the ocean to shrink. The **Basin and Range Province, USA**, is an example where continental rifting and extension lead to the formation of narrow valleys, representing a terminal stage where the region is undergoing crustal extension.

PART - C

(JUNE 2015)

1. Choose the INCORRECT statement based on the figure showing the P-T path (SPTF) for a body of rock undergoing metamorphism along a subduction zone.



(1) SPT depicts prograde metamorphic path
(2) The highest-grade mineral assemblage will be produced at P
(3) TF depicts retrograde metamorphic path
(4) The highest-grade mineral assemblage will be produced at T

(JUNE 2015)

2. Which one of the following mineral assemblages, found in mantle nodules, represents the greatest depth of derivation?
(1) Plagioclase + Clinopyroxene
(2) Clinopyroxene + Olivine
(3) Olivine + Spinel
(4) Olivine+ Garnet

(JUNE 2015)

3. The right sequence of sulfide ore minerals according to their increasing order of reflectance is;
(1) galena, pyrite, sphalerite, pyrrhotite
(2) sphalerite, galena, pyrrhotite, pyrite
(3) sphalerite, pyrrhotite, galena, pyrite
(4) pyrrhotite, sphalerite, pyrite, galena

(JUNE 2016)

4. Two cogenetic igneous rocks crystallized 1 billion years ago, yielded different present day $^{87}Sr\ ^{85}Sr$ ratios, this could be because these rocks;
(1) originated with different initial $^{87}Sr\ ^{85}Sr$ ratios
(2) crystallized with different Rb/Sr ratios
(3) have accommodated different amounts of ^{87}Sr compared to ^{86}Sr during crystallization
(4) have been emplaced at different levels in the crust

(JUNE 2016)

5. For a cubic mineral, the first few peaks in the XRD pattern have Miller indices 111, 200, 220, 222 and 311. From the systematic absences of peaks, the mineral may be inferred to have;
(1) a primitive unit cell
(2) a face-centred unit cell
(3) a body-centred unit cell
(4) an edge-centred unit cell

(JUNE 2016)

6. A mineral showing about $13wt\%$ volatiles in its chemical analysis is;
(1) chlorite (2) biotite
(3) pyroxene (4) amphibole

(JUNE 2016)

7. Which of the following " X_{Fes} value and mineral" pairs corresponds to the mineral with formula $Fe_7 S_8$?

(1) 46.7, pyrrhotite (2) 87.5, pyrrhotite
(3) 46.7, troilite (4) 87.5, troilite

(JUNE 2016)

8. Match the corresponding mineral with its optical properties.

Mineral		Optical property	
A	Epidote	P	High Relief & inclined extinction
B	Kyanite	Q	Carlsbad twinning
C	Nepheline	R	Patchy interference colour
D	Sanidine	S	Straight extinction

Code

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

(JUNE 2016)

9. Match the fossil events given in column X and geological time in column Y.

X		Y	
A	Extinction of Trilobites	P	Late Neo-Proterozoic
B	Extinction of Ammonites	Q	Base of Cambrian
C	Appearance of trace fossil Treptichnus pedum	R	End of Palaeozoic
D	Appearance of Ediacara fauna	S	End of Cretaceous

Code

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

(JUNE 2016)

10. Second boiling, which is important for certain types of ore deposits, refers to

(1) two consecutive boiling of water
(2) crystal fractionation resulting in exsolution of mineralizing fluid
(3) reduction of lithostatic pressure resulting in exsolution of mineralizing fluid
(4) boiling of formation water resulting in the release of mineralizing fluid

(JUNE 2016)

11. The Marwar Super group of Rajasthan is believed to have been formed between 750 Ma and 560 Ma. Which of the following global events is likely to have been recorded in these rocks?

(1) Marinoan glaciation
(2) Breakup of Gondwanaland
(3) Breakup of Rodinia
(4) Cambrian explosion of life

(JUNE 2016)

12. The simplest sequence of mineral zones that typically develops, in the order of increasing grades, during metamorphism of siliceous limestone in a contact aureole is?

(1) Talc – Tremolite – Diopside
(2) Talc – Wollastonite – Tremolite
(3) Tremolite – Enstatite – Forsterite
(4) Talc – Diopside – Enstatite

(JUNE 2016)

13. Match the feldspar mineralogy of sandstone with the most likely provenance.

I	Orthoclase	A	nepheline syenite
II	Ca-richplagioclase	B	pegmatites
III	Sanidine	C	rhyolite
IV	Na-rich plagioclase	D	basalt

Code

	I	II	III	IV
(1)	D	A	B	C
(2)	B	C	A	D
(3)	B	D	C	A
(4)	C	D	A	B

(JUNE 2016)

14. Which of the following sets best represents cartilaginous fishes?

(1) halfbeak, gar, mullet, pearl spot
(2) skate, electric ray, sawfish, dogfish
(3) oriental bonito, skipjack, yellowfin, seer
(4) sturgeon, wrass, pike, travelly

(JUNE 2016)

15. Identify the correct set of meroplankton

(1) Auriculata, Megalopa, Nauplius, Veliger
(2) Copepodid, Lucifer, Trochophore, Zoea
(3) Brachiolaria, Calanus, Copepodite, Ophiolites
(4) Auralia, Elver, Euphrasia, Leptocephalus

(DEC 2016)

16. Sheet silicates are considered as trioctahedral if they have

(1) Al in tetrahedral site
(2) only Si in tetrahedral site
(3) divalent ions in tetrahedral site
(4) divalent ions in octahedral site

(DEC 2016)

17. Suppose an ore of Cu contains 20% chalcopyrite by mass. What is the minimum tonnage of the ore desirable if at least 1000 tons of Cu needs to be extracted? (Atomic mass: Cu = 63.55, Fe = 55.85, S = 32.06)

(1) 2724 (2) 3301
(3) 11917 (4) 14439

(JUNE 2017)

18. The unit-cell parameters $\mathbf{a}, \mathbf{b}$ and $\mathbf{c}$ of a crystal are $10\dot{A}, 20\dot{A}$ and $30\dot{A}$, respectively. What will be the Miller indices for a face that intercepts the crystallographic axes X, Y and Z at $30\dot{A}$, $60\dot{A}$ and $60\dot{A}$? Assume that $\mathbf{X}, \mathbf{Y}$ and Z are respectively parallel to $\mathbf{a}, \mathbf{b}$ and c.

(1) 123 (2) 321
(3) 223 (4) 322

(JUNE 2017)

19. Which one of the following igneous textures is indicative of eutectic crystallization?

(1) Pathetic (2) Granophyre
(3) Porphyritic (4) Trachytic

(JUNE 2017)

20. Greisenisation associated with Sn-W mineralization involves the replacement of the original mineral assemblage by;

(1) Quartz + calcite (2) Muscovite + chlorite
(3) Quartz + chlorite (4) Quarts muscovite

(JUNE 2017)

21. The following two columns list marine microfossils and their paleoceanographic setting.

Column-I	Column-II
A. Globigerina bulloides	p. Shallow ocean floor
B. Elphidizm	Q. upwelling
C. Neogloboquadrina pachyderma	R. Ancient suture zone (plate boundary)
D. Radiolaria	S. Polar water mass

Which one of the following is the correct match?

Code

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

(JUNE 2017)

22. Which one of the following represents the composition of peridotite?

(1) Olivine (50%), Orthopyroxene (38%), Clinopyroxene (12%)
(2) Olivine (40%), Clinopyroxene (30%), Plagioclase (30%)
(3) Olivine (30%), Orthopyroxene (30%), Clinopyroxene (40%)
(4) Olivine (30%), Orthopyroxene (30%), Plagioclase (40%)

(JUNE 2017)

23. A function $f(x)$ has values $f(0) = 0$, $f(2) = 4$ and $f(4) = 16$. Using a suitable numerical method calculate $\int_0^4 f(x)dx$;

(1) 21.3 (2) 32
(3) 22 (4) 24.3

(DEC 2017)

24. The drilling fluid with viscosity (μ) used for drilling through a thick formation of anhydrite should be;

(1) saline and exhibit time dependent decrease in μ
(2) saline and exhibit time independent decrease in μ
(3) fresh water based and exhibit time dependent increase in μ
(4) oil based and exhibit time independent increase in μ

(DEC 2017)

25. A seismic survey is carried out over a region comprising of a sequence of alternating horizontal layers of shale and sandstone, each having a thickness of 0.5 km with the shale layer at the top of the sequence. The P wave velocities in shale and sandstone are 2 km/sec and 4 km/sec respectively. The stacking velocity for a reflection from the base of the 5th layer from the top is;

(1) $0.64\ km/h$ (2) $1.64\ km/h$
(3) $2.64\ km/h$ (4) $3.64\ km/h$

(DEC 2017)

26. In a mineralized zone, dip angle measurements were carried out along three E-W profiles at 100 m spacing at three frequencies f1, f2, f3 (f1>f2>f3). The profile length is 500 m. Zero cross over was observed for all the three profiles and for all the three frequencies at the same location. Statement I: Conductor extends at least up to the depth corresponding to frequency f3. Statement II: Minimum strike length is 200m and strike orientation is N – S. Which of the following is correct?

(1) Statement I is true but statement II is false
(2) Statement I is false but statement II is true
(3) Both statements I and II are true
(4) Both statements I and II are false

(DEC 2017)

27. Interpretation of a K type sounding curve suggests the following section:

Layer	Resistivity $(\Omega\mathbf{m})$	Thickness $(\mathbf{m})$
1	1	0.1
2	6	1.4
3	0.56	∞