SUBJECT CODE	SUBJECT	PAPER
A-08-03	EARTH SCIENCE (EARTH, ATMOSPHERIC, OCEAN AND PLANETARY SCIENCE)	III

HALL TICKET NUMBER	QUESTION BOOKLET NUMBER

OMR SHEET NUMBER

DURATION	MAXIMUM MARKS	NUMBER OF PAGES	NUMBER OF QUESTIONS
2 HOUR 30 MINUTES	150	16	75

This is to certify that, the entries made in the above portion are correctly written and verified.

Candidates Signature **Name and Signature of Invigilator**

Instructions for the Candidates

1. Write your Hall Ticket Number in the space provided on the top of this page.
2. This paper consists of seventy five multiple-choice type of questions.
3. At the commencement of examination, the question booklet will be given to you. In the first 5 minutes, you are requested **to open the booklet and compulsorily examine it as below** :
   (i) To have access to the Question Booklet, tear off the paper seal on the edge of this cover page. Do not accept a booklet without sticker-seal and do not accept an open booklet.
   (ii) **Tally the number of pages and number of questions in the booklet with the information printed on the cover page. Faulty booklets due to pages/questions missing or duplicate or not in serial order or any other discrepancy should be got replaced immediately by a correct booklet from the invigilator within the period of 5 minutes. Afterwards, neither the Question Booklet will be replaced nor any extra time will be given.**
   (iii) After this verification is over, the Test Booklet Number should be entered in the OMR Sheet and the OMR Sheet Number should be entered on this Test Booklet.
4. Each item has four alternative responses marked (A), (B), (C) and (D). You have to darken the circle as indicated below on the correct response against each item.
   Example: (A) (B) ● (D)
   where (C) is the correct response.
5. Your responses to the items are to be indicated in the **OMR Answer Sheet given to you**. If you mark at any place other than in the circle in the Answer Sheet, it will not be evaluated.
6. Read instructions given inside carefully.
7. Rough Work is to be done in the end of this booklet.
8. If you write your name or put any mark on any part of the OMR Answer Sheet, except for the space allotted for the relevant entries, which may disclose your identity, you will render yourself liable to disqualification.
9. **The candidate must handover the OMR Answer Sheet to the invigilators at the end of the examination compulsorily** and must not carry it with you outside the Examination Hall. The candidate is allowed to take away the carbon copy of OMR Sheet and used Question paper booklet at the end of the examination.
10. **Use only Blue/Black Ball point pen.**
11. **Use of any calculator or log table etc., is prohibited.**
12. **There is no negative marks for incorrect answers.**

అభ్యర్థులకు సూచనలు

1. ఈ పుట పై భాగంలో ఇవ్వబడిన స్థలంలో మీ హాల్ టికెట్ నంబరు రాయండి.
2. ఈ ప్రశ్న పత్రము డెభైనదు బహుళైచ్ఛిక ప్రశ్నలను కలిగి ఉంది.
3. పరీక్ష ప్రారంభమున ఈ ప్రశ్నాపత్రము మీకు ఇవ్వబడుతుంది. మొదటి ఐదు నిమిషములలో **ఈ ప్రశ్నాపత్రమును తెరిచి కింద తెలిపిన అంశాలను తప్పనిసరిగా సరిచూసుకోండి.**
   (i) ఈ ప్రశ్న పత్రమును చూడడానికి కవర్‌పేజి అంచున ఉన్న కాగితపు సీలును చించండి. స్టిక్కర్ సీలులేని మరియు ఇదివరకే తెరిచి ఉన్న ప్రశ్నాపత్రమును మీరు అంగీకరించవద్దు.
   (ii) **కవరు పేజి పై ముద్రించిన సమాచారం ప్రకారం ఈ ప్రశ్నపత్రములోని పేజీల సంఖ్యను మరియు ప్రశ్నల సంఖ్యను సరిచూసుకోండి. పేజీల సంఖ్యకు సంబంధించి గానీ లేదా సూచించిన సంఖ్యలో ప్రశ్నలు లేకపోవుట లేదా నిజప్రతి కాకపోవుట లేదా ప్రశ్నలు క్రమపద్ధతిలో లేకపోవుట లేదా ఏవైనా తేడాలుండుట వంటి దోషపూరితమైన ప్రశ్న పత్రాన్ని వెంటనే మొదటి ఐదు నిమిషాల్లో పరీక్షా పర్యవేక్షకునికి తిరిగి ఇచ్చివేసి దానికి బదులుగా సరిగ్గా ఉన్న ప్రశ్నపత్రాన్ని తీసుకోండి. తదనంతరం ప్రశ్నపత్రము మార్చబడదు అదనపు సమయం ఇవ్వబడదు.**
   (iii) పై విధంగా సరిచూసుకొన్న తర్వాత ప్రశ్నాపత్రం సంఖ్యను OMR పత్రము పై అదేవిధంగా OMR పత్రము సంఖ్యను ఈ ప్రశ్నాపత్రము పై నిర్దిష్టస్థలంలో రాయవలెను.
4. ప్రతి ప్రశ్నకు నాలుగు ప్రత్యామ్నాయ ప్రతిస్పందనలు (A), (B), (C) మరియు (D) లుగా ఇవ్వబడ్డాయి. ప్రతిప్రశ్నకు సరైన ప్రతిస్పందనను ఎన్నుకొని కింద తెలిపిన విధంగా OMR పత్రములో ప్రతి ప్రశ్నా సంఖ్యకు ఇవ్వబడిన నాలుగు వృత్తాల్లో సరైన ప్రతిస్పందనను సూచించే వృత్తాన్ని బాల్ పాయింట్ పెన్‌తో కింద తెలిపిన విధంగా పూరించాలి.
   ఉదాహరణ : (A) (B) ● (D)
   (C) సరైన ప్రతిస్పందన అయితే
5. ప్రశ్నలకు ప్రతిస్పందనలను ఈ ప్రశ్నపత్రముతో ఇవ్వబడిన OMR పత్రము పైన ఇవ్వబడిన వృత్తాల్లోనే పూరించి గుర్తించాలి. అలాకాక సమాధాన పత్రంపై వేరొక చోట గుర్తిస్తే మీ ప్రతిస్పందన మూల్యాంకనం చేయబడదు.
6. ప్రశ్న పత్రము లోపల ఇచ్చిన సూచనలను జాగ్రత్తగా చదవండి.
7. చిత్తుపనిని ప్రశ్నపత్రము చివర ఇచ్చిన ఖాళీస్థలములో చేయాలి.
8. OMR పత్రము పై నిర్ణీత స్థలంలో సూచించవలసిన వివరాలు తప్పించి ఇతర స్థలంలో మీ గుర్తింపును తెలిపే విధంగా మీ పేరు రాయడం గానీ లేదా ఇతర చిహ్నాలను పెట్టడం గానీ చేసినట్లయితే మీ అనర్హతకు మీరే బాధ్యులవుతారు.
9. **పరీక్ష పూర్తయిన తర్వాత మీ OMR పత్రాన్ని తప్పనిసరిగా పరీక్ష పర్యవేక్షకుడికి ఇవ్వాలి.** వాటిని పరీక్ష గది బయటకు తీసుకువెళ్లకూడదు. పరీక్ష పూర్తయిన తరువాత అభ్యర్థులు ప్రశ్న పత్రాన్ని, OMR పత్రం యొక్క కార్బన్ కాపీని తీసుకువెళ్లవచ్చు.
10. **నీలి/నల్ల రంగు బాల్ పాయింట్ పెన్ మాత్రమే ఉపయోగించాలి.**
11. **లాగరిథమ్ టేబుల్స్, కాలిక్యులేటర్‌లు, ఎలక్ట్రానిక్ పరికరాలు మొదలగునవి పరీక్షగదిలో ఉపయోగించడం నిషేధం.**
12. **తప్పు సమాధానాలకు మార్కుల తగ్గింపు లేదు.**

EARTH SCIENCE
(Earth, Atmospheric, Ocean and Planetary Science)
Paper – III

1. In Scanning Electron Microscopy (SEM), what is mode of operation or procedure that is used to differentiate minerals of contrasting composition and different zones within a mineral having difference in composition ?

(A) Secondary Electrons

(B) Auger Electrons

(C) Back Scattered Electrons

(D) X-rays

2. Alkali pyriboles are

(A) Acmite, Riebeckite

(B) Nepheline, Leucite

(C) Biotite, Illite

(D) Albite, Anorthite

3. If the boudins, resulted by the stretching of the competent bed parallel to the fold axis, the boudin lines will be naturally _____ to the fold axis.

(A) Parallel

(B) Stretched

(C) Deformed

(D) Perpendicular

4. Diapiric movements are generally related to _____

(A) Plate Tectonics

(B) Salt Domes

(C) Batholiths

(D) Diagenesis

5. Match the items in List – **I** with that in List – **II**, and select the correct answers, using the code given below :

List – I	List – II
I. Zaphrentis	1. Brachiopoda
II. Cidaris	2. Anthozoa
III. Terebratula	3. Trilobita
IV. Olenellus	4. Echinoidea

Codes :

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

6. The chronostratigraphic unit, ranking above 'stage' and below 'system' is _____

(A) Substage

(B) Series

(C) Superstage

(D) Period

7. Pentlandite is an ore mineral of _____

(A) Copper

(B) Iron

(C) Nickel

(D) Chromium

8. Which of the following contain workable deposits of coal in India, as per the codes ?

(A) Tertiary

(B) Permocraboniferous

(C) Proterozoic

(D) Archaean

9. The Quaternary period covers stratigraphic columns covering last _____ years.

(A) One million

(B) Three million

(C) Two million

(D) Four million

10. Substitution of Nb by Ta and Zr by Hf is termed as _____

(A) Capturing

(B) Diadochy

(C) Admittance

(D) None of the above

11. **Assertion, A :** K, Rb, Ba, Li ad Cs are geochemically termed as 'incompatible' elements.

Reasons, R : In silicate melts, these elements are partitioned into liquid phase (melt) and enriched into the continental crust.

In the context of the above two statements, which one is correct, as per the following code ?

(A) Both A and R are true, and R is the correct explanation for A

(B) Both A and R are true, and R is not the correct explanation for A

(C) A is true, but R is false

(D) A is false, but R is true

12. In the geochemical cycle, which one of the following is not the correct statement ?

(A) Magmas are generated in the mantle

(B) Crystallization and melting take place in the surficial environment

(C) Sedimentation and diagenesis take place in the surficial environment

(D) High-grade metamorphic rocks form in the lower crust of the Earth

13. In India, workable graphite deposits are associated with _____

(A) Khonadalites

(B) Charnockites

(C) Shales

(D) Sandstones

14. Some of the following raw materials are used for manufacturing of cement

I. Limestone II. Dolomite

III. Gypsum IV. Coal

The materials used in the manufacturing of cement are

(A) I, II, IV

(B) I, III, IV

(C) I, II, III

(D) II, III, IV

15. Arrange the following igneous rocks with increasing 'colour index', using the code below :

I. Gabbro II. Diorite

III. Peridotite IV. Syenite

Code :

(A) I, II, III, IV

(B) IV, II, I, III

(C) II, III, IV, I

(D) III, IV, I, II

16. The reflectance and emittance of a feature over a variety of wavelengths is referred to _____

(A) Spatial resolution

(B) Spectral resolution

(C) Temporal resolution

(D) Radiometric resolution

17. Salinity of groundwater can be estimated using _____

(A) Seismic Survey

(B) Magnetic Survey

(C) Gravity Survey

(D) Electrical Resistivity Survey

18. Arrange the following isotopes in their increasing order of half-life (t), using the code given below :

I. $_{90}Th^{232}$

II. $_{92}U^{235}$

III. $_{92}U^{238}$

IV. $_{88}Ra^{226}$

Code :

(A) I, II, III, IV

(B) II, III, IV, I

(C) III, IV, I, II

(D) IV, II, III, I

19. Which of the following marks the boundary between the Archaean and Proterozoic formations in India ?

(A) Erinpura Granite

(B) Untala Granite

(C) Idar Granite

(D) Berach Granite

20. Kaladgis are said to be equivalent of ____

(A) Kurnools

(B) Cuddapahs

(C) Dharwars

(D) Gondwanas

21. If the function is shifted in the time-domain by two seconds, then the amplitude spectrum

(A) is doubled

(B) is reduced to half

(C) remains unchanged

(D) is increased to four times

22. The Nyquist frequency is _____ the sampling frequency.

(A) Double

(B) Same

(C) Half

(D) Not related to

23. Match the physical laws (List – **I**) with their mathematical expressions (List – **II**) :

List – I		List – II	
E	Ohm's Law	1	$\Delta \times E = -dB/dt$
F	Faraday's Law	2	$\Delta \times H = J + dD/dt$
G	Coulomb's Law	3	$J = \sigma E$
H	Ampere's Law	4	$\nabla B = 0$

(A) E-2, F-3, G-1, H-4

(B) E-3, F-1, G-4, H-2

(C) E-3, F-4, G-1, H-2

(D) E-4, F-1, G-2, H-3

24. In the general formula of numerical integration derived from Newton's forward difference polynomial, for what values of 'n', Simplon's 1/3 rule can be obtained

(A) n = 0

(B) n = 1

(C) n = 2

(D) n = 3

25. The method of least squares consists in minimizing

(A) Sum of the squares of the errors

(B) Sum of the squares of measured values

(C) Sum of squares of theoretical values

(D) Difference of squares of errors

26. According to Airy-Heiskanen System of isostatic compensation, the root thickness below a topographic high of 1.0 km will be _____ (with the assumed densities of 2.9 g/cc and 3.3 g/ cc to the lower crust and upper mantle, respectively).

(A) 0.67m (B) 67 km

(C) 6.7 km (D) 0.67 km

27. If 'a' is equatorial radius and 'c' is the polar radius, then the geometrical flattening of the earth is

(A) (a-c)/a

(B) (c-a)/a

(C) (a+c)/a

(D) (a-c)/c

28. The Rodrigues Triple Junction is a _____

(A) Ridge-Trench-Ridge

(B) Trench-Ridge-Ridge

(C) Ridge-Ridge-Ridge

(D) Trench-Trench-Trench

29. The following ocean is the youngest of all

(A) Pacific

(B) Indian

(C) Atlantic

(D) Antarctic

30. The seismic ray path PKP is

(A) P wave while passed down through the mantle and the outer core and then up through the mantle

(B) P wave which travelled down through the mantle and inner core

(C) P wave which travelled down through the inner and outer cores

(D) P wave which travelled through upper and lower crusts

31. The time difference between S wave and P wave travel

(A) Inversely proportional to epicentral distance

(B) Directly proportional to epicentral distance

(C) Decays exponentially with epicentral distance

(D) Decays logarithmically with epicentral distance

32. Match the following

M	μGAL	1	10^{-2} m s^{-2}
N	gu	2	10^{-5} m s^{+2}
O	mgal	3	10^{-8} m s^{-2}
P	gal	4	10^{-6} m s^{-2}

(A) M-3, N-4, O-1, P-2

(B) M-3, N-4, O-2, P-1

(C) M-4, N-3, O-2, P-1

(D) M-2, N-3, O-1, P-4

33. What will be the gravity field at mean sea level, if the gravity field measured at an elevation of 100 m is 979.85 ?

(A) Nearly 979810 mgals

(B) Nearly 979180 mgals

(C) Nearly 979108 mgals

(D) Nearly 979018 mgals

34. The sequence of resistivity contrasts between three layers in the 'Q' Type curve are

(A) $\rho_1 > \rho_2 < \rho_3$

(B) $\rho_1 > \rho_2 > \rho_3$

(C) $\rho_1 < \rho_2 > \rho_3$

(D) $\rho_1 < \rho_2 < \rho_3$

35. The longitudinal conductance of a layer with resistivity of 50 Ohm m and a thickness of 100 m is

(A) 5000 Ohm m

(B) 0.50 mhos

(C) 50 Ohm m

(D) 5 mhos

36. If we have 'n' vibroseis generated records on which signal shape is essentially constant and the noise is random, then S/N after stacking varies as

(A) $n^{1/2}$

(B) n^2

(C) n

(D) 1/n

37. The NMO (Δt_{NMO}) for a geophone offset from the source by 600 m is 9.1 ms, then what is the value of the (Δt_{NMO}) for a geophone offset by 3600 m from the source

(A) 36 ms

(B) 3280 ms

(C) 360 ms

(D) 328 ms

38. Noise generated in Marine seismic survey by ship vessel ranges between

(A) 10 and 200 Mz

(B) 10-200 Kz

(C) 200-1000 Gz

(D) 10-20 Hz

39. Bulk Volume Water (BVW) is the product of

(A) Porosity and residual oil saturation

(B) Porosity and residual water saturation

(C) Permeability and water saturation

(D) Porosity and water saturation

40. The transit time recorded by sonic log in salt water mud filtrate is _____ fresh water.

(A) greater than

(B) less than

(C) equal to

(D) twice that of

41. In a horizontal motion the coriolis force acts to the _____ of the wind direction in the Northern Hemisphere.

(A) Left

(B) Right

(C) North

(D) South

42. Streamlines exhibit points of _____ in the atmosphere.

(A) Inflow

(B) Outflow

(C) Neutral

(D) All

43. Intensity of Tropical cyclone is estimated, based on Current Intensity (C.I) number. C.I number 7.5 represents maximum wind speed of _____ Kts.

(A) 150

(B) 75

(C) 250

(D) All

44. The Geostrophic wind is generally a good approximation to the actual wind in _____ synoptic scale disturbances.

(A) Tropics

(B) Middle latitudes

(C) Polar latitudes

(D) Globe

45. The maximum eddy length scale is limited by the boundary layer depth to be about _____ meters.

(A) 10^3

(B) 10^5

(C) 10^7

(D) 10^9

46. Individual hot towers would need to visit simultaneously around the globe to account for the required vertical heat transport of the ITCZ

(A) 500 – 1,400

(B) 1,500 – 5,000

(C) 5,000 – 7,000

(D) 8,000 – 10,000

47. Zonally Symme Easterly and Westerly wind regions alternate requlary with periods varying from about _____ months.

(A) 5 – 10

(B) 10 – 15

(C) 15 – 20

(D) 24 – 30

48. Combined Albedo for the Earth and Atmosphere is _____ %

(A) 4

(B) 10

(C) 30

(D) 60

49. The Heat Engine released when water vapour changes to a liquid is called ___

(A) Latent heat of evaporation

(B) Latent heat of fusion

(C) Latent heat of condensation

(D) Latent heat of sublimation

50. The IPCC estimated that Aviation also causes _____% of global warming.

(A) 4.2

(B) 2

(C) 3.5

(D) 5

51. The following is not the artificial cloud seeding agent to enhance rainfall

(A) Calcium Chloride

(B) Silver Iodide

(C) Sodium Chloride

(D) Rubber

52. In Satellite meteorology, water vapour imagery is derived for the radiance at the atmospheric window region _____ μ m

(A) 5 – 6

(B) 1 – 2

(C) 8 – 10

(D) All

53. Clausius- Claperon equation deals with _____

(A) Saturated vapour pressure on temperature

(B) Vapour pressure on temperature

(C) Super saturated vapour pressure on temperature

(D) All

54. The value of Dry Adiabatic Lapse rate is _____

(A) 1°C per 100 met

(B) 3° C per 100 met

(C) 4° C per 100 met

(D) None

55. The seasonal shift of ITCZ is larger over _____

(A) SE Asia and Australia

(B) Atlantic ocean

(C) Pacific ocean

(D) West – African region

56. Blaton's relation deals with the relationship between _____

(A) Stream lines and Trajections

(B) Stream lines and Isobars

(C) Stream lines and Isotherms

(D) Stream lines and Isotach

57. Rossby number is a ratio between _____

(A) Vorticity and coriolis force

(B) Velocity and coriolis force

(C) Acceleration and coriolis force

(D) None

58. The Omega equation arises due to the contribution of vorticity and ____ equation.

(A) Static

(B) Thermodynamic

(C) Quasi Thermodynamic

(D) All

59. The following one is not General circulation model

(A) NCAR _ CCSM3

(B) CCSK _ mdrs

(C) GFDL _ CM2.1

(D) MM5

60. Land and sea breezes are explained by the _____ term in the circulation theorm.

(A) Solenoidal

(B) Coriolis

(C) Frictional

(D) All

61. SARAL Satellite is dedicated for _____

(A) Altimetry Mission for ocean observation

(B) Altimetry Mission for land observation

(C) Altimetry Mission for atmospheric observation

(D) All the above

62. When a wind- driven surface current moves away from a land mass, it results in _____

(A) Upwelling

(B) Convergence

(C) Eddy

(D) Gyte

63. The thermohaline circulation transports roughly _____ of the total heat transport of the ocean/atmospheric circulation system.

(A) $1/2$

(B) $1/3$

(C) $1/4$

(D) $1/8$

64. Indian rivers contribute about _____% of the global annual discharge.

(A) 6

(B) 10

(C) 25

(D) 4

65. The monsoon currents are shallow with most of the variation being restricted to the upper _____ mm.

(A) 200

(B) 150

(C) 175

(D) None

66. Sharp decrease of temperature with depths is called _____

(A) Halocline

(B) Pycnocline

(C) Surface layer

(D) Thermocline

67. The albedo of ocean surface is _____ %.

(A) 30 (B) 22

(C) 6 (D) 0

68. Deep water is often rich in _____

(A) Dissolved gases

(B) Plant life

(C) Nutrients

(D) A and C

69. The density of sea water increases with _____

(A) Increase of salinity

(B) Increase of temperature

(C) Decrease in Temperature

(D) A and B

70. Annual mean heat flux into the Arabian sea is associated with abrupt _____

(A) Cooling

(B) Heating

(C) Buoyancy

(D) None

71. In the Indian ocean, the equatorial counter current is located several hundred miles _____ of the equator.

(A) North (B) East

(C) South (D) West

72. The Leeuwin current is about ____ meters deep.

(A) 500

(B) 100

(C) 250

(D) 300

73. _____ is a sound channel near the surface.

(A) Shadow zone

(B) SOFAR

(C) Deep scatter layer

(D) Surface duct

74. South equatorial current flow is stronger during the _____ monsoon season.

(A) Summer

(B) Winter

(C) Pre

(D) None

75. Temperature sensor in XBT is _____

(A) Thermistor

(B) Semiconductor

(C) Electrode

(D) None

Space for Rough Work

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