

Code No: E -22

Hall Ticket No: 

## ENTRANCE EXAMINATION 2023

Ph.D. - Earth, Ocean and Atmospheric Sciences

Date:

Duration:

Marks: 70

## Instructions:

1. All questions carry equal marks.
2. There is no negative marking.
3. Write your Hall Ticket Number in the OMR Answer Sheet given to you. Also write the Hall Ticket Number in the space provided above.
4. The questions are fully objective and the answers are to be marked on the OMR answer sheet following the instructions provided there upon.
5. At the end of the examination, hand over the OMR answer sheet to the invigilator.
6. No additional sheets will be provided. Rough work can be done in the question paper itself / space provided at the end of the booklet.
7. Non-programmable calculators are allowed.

**PART-A**

1. The following statements (i) to (iv) describe the objectives of research
  - i) To gain familiarity with a phenomenon or to achieve new insights into it.
  - ii) To portray accurately the characteristics of a particular individual, situation or group.
  - iii) To determine the frequency with which something occurs or the process through which it is associated with something else.
  - iv) To test a hypothesis of a causal relationship between variables.

Which of the following statements is correct?

- A. (iv) is the correct answer
  - B. (iv) is the correct answer and is correctly explained by only (i)
  - C. (iv) is the correct answer and is correctly explained by (i) and (iii)
  - D. (iv) is the correct answer and is correctly explained by only (ii)
2. Excluding the stoppages, the speed of a bus is 64 km/hr and including the stoppages, the speed of the bus is 48 km/hr. For how many minutes does the bus stop per hour?
    - A. 10
    - B. 15
    - C. 25
    - D. 35

3. Truth, belief and justification related to knowledge in research is contained in which term/terms below
- Metaphysics
  - Epistemology
  - Logic
  - Aesthetics

Which of the following options is correct?

- (i) and (iv) together
  - (ii) and (iv) together
  - (iii)
  - (ii)
4. In how many ways can the letters of the word 'FIGHT' be arranged?
- 100
  - 120
  - 98
  - 150
5. Which of the following statements best describes statistical significance?
- It indicates the practical importance or magnitude of an observed effect.
  - It suggests that the observed effect is unlikely to have arisen purely by random variation.
  - It definitively proves that the alternative hypothesis is true, and the null hypothesis is false.
  - It measures the strength and direction of the linear relationship between two variables.
6. A systematic step-by-step procedure following a logical process of reasoning is termed
- Experiment
  - Observation
  - Deduction
  - Scientific method

Which of the following statements is correct?

- (i), (ii) and (iv) explain the term satisfactorily
  - (ii) and (iv) explain the term satisfactorily
  - (iv) is correct
  - (ii) is correct
7. In data analysis, what does the term 'outlier' refer to?
- Data point that is significantly different from other data points
  - A missing value in a data set
  - The average value of a data set
  - A duplicate data point

8. If the standard deviation of a data set is small, it indicates that
- A. The data are close together
  - B. The mean of the data can never be zero
  - C. All of the data have the same value
  - D. The data are far apart
9. Which technique is used to group similar data points together?
- A. Classification
  - B. Regression
  - C. Clustering
  - D. Association
10. Which of the following is statement about linear correlation is FALSE?
- A. It measures the strength and direction (sign) of a linear relationship.
  - B. It can be significantly influenced by outliers.
  - C. It is unrelated to regression
  - D. Its values range from -1 to +1.
11. If a number '1005A4' is completely divisible by 8, then the smallest integer in place of 'A' will be
- A. 0
  - B. 1
  - C. 4
  - D. 2
12. Derivative of  $\sin x$  with respect to  $x^2$  is
- A.  $\cos x$
  - B.  $\cos x/2x$
  - C.  $\cos x/x$
  - D. Zero
13. Which of the following is true for the hypothetico-deductive method in research?
- i) It encourages the use of exploratory studies.
  - ii) It is the basis for testing statistical significance.
  - iii) It is a computer problem to help researchers to improve the quality of their hypotheses.
  - iv) It encourages the development of specific hypotheses based on empirically derived theories.

Which of the following statements is correct?

- A. (i), (ii) and (iii) explain the method in the true sense
- B. (ii) and (iv) explain the method in the true sense
- C. (iv) is correct
- D. (ii) is correct

14. The length of a rectangle is reduced by 20%, and the breadth is kept constant, and the new figure that is formed is a square.

Consider the following statements

- i) The area of the square is 25% less than the area of the rectangle
- ii) The perimeter of the square is approximately 11% less than the perimeter of the rectangle
- iii) The diagonal of the square is approximately 12% less than the diagonal of the rectangle.

Which of the statements given above is/are correct?

- A. (i) only
  - B. (i) and (ii)
  - C. (ii) and (iii)
  - D. (i), (ii) and (iii)
15. What is the benefit of ensembles of experiments or ensembles of model simulations?
- A. It provides uncertainty estimates
  - B. It improves model resolution
  - C. It reduces computational costs
  - D. It simplifies model complexity

16. If two lines represented by  $a_1x + b_1y + c_1 = 0$  and  $a_2x + b_2y + c_2 = 0$  are parallel, then

- A.  $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$
- B.  $\frac{a_1}{a_2} \neq \frac{b_1}{b_2} = \frac{c_1}{c_2}$
- C.  $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$
- D.  $\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

17. Which of the following situations is best represented by a Gaussian distribution?

- A. The number of emails received by a server in a minute.
- B. The scores on a standardized IQ test for a large population.
- C. The number of times a specific word appears in a chapter of a book.
- D. The probability that a basketball player makes 7 out of 10 free throws.

18. What should come in place of 'A' in the following series: 110, 55, 55, 110, A, 3520

- A. 425
- B. 380
- C. 440
- D. None of the above

19. If A is the brother of B, C is the sister of B, and B is the father of D, how is D related to A?

- A. Nephew/Niece
- B. Niece
- C. Nephew
- D. Cousin

20. Hypothesis must have

- i) Applicability
- ii) Durability
- iii) Testability
- iv) Measurement

Which of the following statements is correct?

- A. (i) and (ii) only are correct
- B. (i) and (iv) only are correct
- C. (iii) is correct
- D. (iv) is correct

21. Which technique is commonly used to forecast future values based on past data?

- A. Time Series Analysis
- B. Regression Analysis
- C. Clustering
- D. Association

22. Which of the following statements is true regarding even and odd functions?

- A. An even function  $f(x)$  satisfies  $f(-x) = -f(x)$ , and its graph is symmetric about the x-axis.
- B. An odd function  $f(x)$  satisfies  $f(-x) = f(x)$ , and its graph is symmetric about the y-axis.
- C. The product of two odd functions is an odd function.
- D. The interval of an odd function over a symmetric interval  $[-t, t]$  is always zero.

23. The purpose of research is

- i) to extend the conceptual understanding of a topic.
- ii) that empirical work should be testing a theory.
- iii) primarily to get more data.
- iv) to produce work of publishable quality.

Which of the following statements is correct?

- A. (i) is correct
- B. (iii) and (iv) only serve the purpose of research
- C. (iv) is the correct answer and is correctly supported by (iii)
- D. (iv) is the correct answer and is correctly supported by only (i)

24. The value of  $5^{1/4} \times (125)^{0.25}$  is

- A. 0.5
- B. 25
- C.  $5\sqrt{5}$
- D. 5

25. Find  $\frac{dy}{dx}$ , if  $y = e^{-3 \log x}$

- A.  $\frac{-3}{x^4}$
- B.  $\frac{3}{x^4}$
- C.  $-3e^{-3 \log x}$
- D.  $3e^{-3 \log x}$

26. A hypothesis contributes to the development of:

- i) Theory
- ii) Generalization
- iii) Scientific evolution
- iv) Scientific concept

Which of the following statements is correct?

- A. (i) and (iv) only are correct
- B. (i) is correct
- C. (iii) is correct, but not (iv)
- D. (ii) is correct

27. A scientific method adopted in research comprises of

- i) Empirical evidence
- ii) Ethical neutrality
- iii) Probabilistic predictions
- iv) All of the above

Which of the following statements is correct?

- A. (i) and (ii) only are correct
- B. (iv) is correct
- C. (iii) is the correct answer, but not (iv)
- D. (ii) is correct

28. In a set of data, if all the data appears with the same frequency, then

- A. The standard deviation is always 0.
- B. The mean is always larger than the standard deviation.
- C. All of the data have the same value.
- D. The boxplot does not always look symmetrical.

29. Consider a pouch containing 3 white and 2 black balls. If two balls are drawn sequentially without replacement, the probability that both drawn balls are black is

- A.  $\frac{1}{10}$
- B.  $\frac{2}{5}$
- C.  $\frac{3}{5}$
- D.  $\frac{3}{10}$

30. What does the term 'overfitting' in statistical optimization refer to?

- A. A model that performs well on test data but poorly on training data
- B. A model that performs well on both training and test data
- C. A model that performs poorly on both training and test data
- D. A model that performs well on training data but poorly on test data

31. What is the role of an independent variable in experimental research?

- A. To be manipulated by the researcher
- B. Depending on the outcome variable
- C. To measure the relationship between variables
- D. To be controlled for statistical analysis

32. In statistical analysis, a one-tailed test is also known as
- A. Non-directional test
  - B. Directional test
  - C. Confirmatory test
  - D. Randomized test
33. The list of all population units from which sample is selected is known as
- A. Sampling design
  - B. Population Frame
  - C. Sampling Frame
  - D. Sampling Unit
34. Which statistical test is used for assessing the associateship between two continuous variables?
- A. Chi-Square test
  - B. Mann-Whitney U test
  - C. Pearson's correlation coefficient
  - D. Independent samples t-test
35. What type of hypothesis states the absence of a relationship or effect?
- A. Null Hypothesis
  - B. Alternate Hypothesis
  - C. Research Hypothesis
  - D. Experimental Hypothesis

**PART-B**

36. The acceleration due to gravity of the earth attains its maximum
- A. on the surface
  - B. at the centre of the earth
  - C. in the atmosphere above the topography
  - D. at 520 m depth from the topography
37. In basic rocks, high-pressure granulites are characterized by the key mineral association of
- A. Garnet + Plagioclase + Quartz
  - B. Garnet + Orthopyroxene + Clinopyroxene + Quartz
  - C. Garnet + K-feldspar + Kyanite
  - D. Garnet + Clinopyroxene + Plagioclase + Quartz
38. Which of the following satellites is a Geostationary satellite?
- A. INSAT
  - B. CARTOSAT
  - C. OCEANSAT
  - D. RESOURCESAT
39. The key agency of meridional heat transport in the midlatitude is due to
- A. Baroclinic Eddies
  - B. Hadley Cell
  - C. ENSO
  - D. Land-sea temperature gradient

40. In kinetic isotope fractionation involving stable isotopes of Carbon and Oxygen,  $^{12}\text{C}^{16}\text{O}_2$  can diffuse ..... further than  $^{13}\text{C}^{16}\text{O}_2$  in a given amount of time.

Select the correct options given below

- A. 1.1%
  - B. At equal rates
  - C. 2%
  - D. None of the above
41. The vertical zone of the ocean, where rapid change in salinity takes place, is called
- A. SOFAR channel
  - B. Pycnocline
  - C. Halocline
  - D. Thermocline
42. The length of a copper wire is reduced by half and its cross-sectional area is increased by four times, then its resistivity
- A. increased by two times
  - B. decreased by two times
  - C. remains unchanged
  - D. increased by three times
43. Which of the following UV radiation may penetrate through the stratospheric ozone layer and cause skin cancer?
- A. UV-C
  - B. UV-A
  - C. UV-B
  - D. UV-A and UV-B
44. Most of the marine living organisms are found in \_\_\_\_\_ zone
- A. Hadal zone
  - B. Mixed layer zone
  - C. Aphotic zone
  - D. Euphotic zone
45. Among the following, the statement that **DOES NOT** apply to a cyclostrophic flow is
- A. It is a balance between pressure gradient force and Centrifugal force
  - B. It cannot be anticyclonic
  - C. Curvature of its radius is small
  - D. Dust devil is an example of it
46. Referring to the solar abundance of elements, consider the following statements
- i) Sawtooth Pattern of Elemental Distribution
  - ii) Big negative anomaly for Boron, Beryllium and Lithium
  - iii) Hydrogen is most abundant, Uranium is least abundant
  - iv) Moderate positive anomaly for Iron
- Which of the following statements is correct?
- A. (ii) is correct
  - B. All statements are correct
  - C. (iii) is correct
  - D. (iv) is the correct answer and is correctly explained by only (i)

- 47. Perthite texture is a result of which process?
  - A. Secondary reactions and replacement
  - B. Exsolution
  - C. Secondary twinning
  - D. Polymorphic transformation
  
- 48. Which of the following is the coldest point temperature in Earth's atmosphere
  - A. Tropical Tropopause
  - B. Stratopause
  - C. Mesopause
  - D. Zero-degree isotherm at 5 km
  
- 49. High magnetic field anomalies and low gravity anomalies are usually associated with
  - A. Volcanic tuff
  - B. Batholiths
  - C. Dolerite dykes
  - D. Sills
  
- 50. In the vorticity equation expressed in isobaric coordinates, the following contribution is negligible
  - A. Divergence term
  - B. Tipping term
  - C. Solenoidal term
  - D. None the above
  
- 51. The semi-diurnal tidal pattern has
  - A. One high-tide and one low-tide in a solar day
  - B. Two high-tides and two low-tides in a solar day
  - C. One high-tide and one low-tide in a lunar day
  - D. Two high tides and two low-tides in a lunar day
  
- 52. A recumbent fold is one where the axial plane of the fold is
  - A. Vertical
  - B. Inclined
  - C. Horizontal
  - D. Curved
  
- 53. Porphyry Cu-(Mo) type of ore deposits re associated with which rock type?
  - A. Basic
  - B. Felsic
  - C. Intermediate to felsic
  - D. Basic to intermediate
  
- 54. Given that the Sun's maximum emission wavelength is  $0.6 \mu\text{m}$  at a temperature of 6000 K, and assuming Earth radiates as a blackbody with a temperature of 255 K, the wavelength of Earth's peak thermal emission is
  - A.  $23 \mu\text{m}$
  - B.  $46 \mu\text{m}$
  - C.  $0.026 \mu\text{m}$
  - D.  $14 \mu\text{m}$

55. Which geophysical method is preferable to explore disseminated sulphides
- A. Gravity
  - B. Induced polarization
  - C. Magnetic
  - D. Seismic reflection
56. Identify the dominant process for Rip current generation
- A. ocean heating
  - B. waves
  - C. winds
  - D. long-shore currents
57. In the concept of a theoretical aqua-planet \_\_\_\_\_ is abundant (more)
- A. land is abundant
  - B. vegetation is abundant
  - C. water is abundant
  - D. radiation
58. The summer monsoon depressions in the Bay of Bengal rarely intensify into tropical cyclones owing to
- A. local SST intensity
  - B. a low latitude
  - C. strong vertical wind shear
  - D. associated heavy precipitation
59. The mineral formula of lawsonite is
- A.  $\text{CaAl}_2\text{Si}_2\text{O}_7(\text{OH})_2\text{H}_2\text{O}$
  - B.  $\text{Ca}_2(\text{Fe}^{3+}, \text{Al})_3(\text{SiO}_4)_3(\text{OH})$
  - C.  $\text{NaAlSi}_3\text{O}_8$
  - D.  $[\text{Na}_2][\text{Mg}_3\text{Al}_2]\text{Si}_8\text{O}_{22}(\text{OH})_2$
60. Identify the primary driver for ocean currents
- A. winds
  - B. gravitational forces
  - C. differences in ocean density
  - D. winds and differences in ocean density
61. Aulacogens are formed because of
- A. Igneous intrusions
  - B. Failed rift system
  - C. Listric faults
  - D. Strike-slip faults
62. Increasing global warming since 1950s **CANNOT** be attributed to
- A. increasing  $\text{CO}_2$  emissions
  - B. increasing methane
  - C. water vapor feedback
  - D. Sulphur dioxide

63. Identify the phenomena that highly influences marine productivity
- A. Ocean tides
  - B. Internal waves
  - C. Upwelling
  - D. Ocean mixing
64. Which ocean phenomenon is characterized by the warming of sea surface temperatures in the central and eastern Pacific Ocean?
- A. El Niño
  - B. La Niña
  - C. Tsunami
  - D. Monsoon
65. Arêtes are residual landforms produced by
- A. Fluvial processes
  - B. Marine processes
  - C. Aeolian processes
  - D. Glacial processes
66. Trilobites made their first appearance in the
- A. Devonian period
  - B. Cambrian period
  - C. Carboniferous period
  - D. Ordovician period
67. The process of fluidizing water-saturated soil during an earthquake is known as
- A. Gelatinization
  - B. Quicksand
  - C. Liquefaction
  - D. None of these.
68. Seismologists locate the epicenter of an earthquake by
- A. Measuring the amplitude of surface waves
  - B. Triangulating data from three or more seismograph stations
  - C. Measuring the intensity of ground shaking
  - D. Calculating the duration of the earthquake
69. In which of the following electromagnetic method, are the field strength ratio and relative phase difference measured between two receiver coils?
- A. Sundberg Compensator Method
  - B. TURAM Method
  - C. SLINGRAM Method
  - D. Fixed Vertical Loop Method
70. Which physical property of the medium governs the response of Ground Penetrating radar?
- A. Dielectric Permittivity
  - B. Electromagnetic Conductivity
  - C. Electrical Conductivity
  - D. Seismic wave velocity

00---000---00