

Entrance Examinations – 2017
M.Sc. Ocean and Atmospheric Sciences

Time : 2 hours

Max. Marks : 100

INSTRUCTIONS

1. Write your Hall Ticket Number in the OMR Answer Sheet given to you. Also write the Hall Ticket Number in the space provided above on the question paper booklet.
2. The question paper consists of 100 objective type questions of one mark each. There is **negative marking of 0.33** for **each wrong answer**.
3. The question paper consists of Part 'A' and Part 'B'.
4. Answers are to be marked on the **OMR answer sheet** following the instructions provided there upon.
5. Hand over the OMR answer sheet at the end of the examination 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. A particle moves on a straight line with a uniform velocity. Its angular momentum
 - A) is always zero.
 - B) is zero about a point on the straight line.
 - C) is not zero about a point on the straight line.
 - D) about any given point remains constant.
2. Most of the UV radiation coming towards earth from the Sun is absorbed
 - A) by the ozone in the upper stratosphere
 - B) by the ozone in the mesosphere
 - C) by the ozone in the lower troposphere
 - D) by the greenhouse gases in the lower troposphere
3. Which of the following functions of x is an even function?
 - A) $\sin(x)$
 - B) x
 - C) $\cos(x)$
 - D) $4x^3$

4. The outer electronic structure of chromium ($Z=24$) is:

- A) $4s^1 3d^5$
- B) $4s^2 3d^4$
- C) $4s^0 3d^6$
- D) $4s^2 3d^5$

5. $\frac{e^x + e^{-x}}{2}$ is the expression for

- A) $\operatorname{sech} x$
- B) $\operatorname{coth} x$
- C) $\operatorname{cosh} x$
- D) $\operatorname{Sinh} x$

6. Two containers, at the same temperature, are separately filled with argon gas and helium gas. Which molecule has higher rms speed?

- A) argon
- B) helium
- C) they have the same speed
- D) there is no such specific relation

7. The temperature at which the saturation vapour pressure is equal to the present vapour pressure is called

- A) melting point
- B) minimum temperature
- C) dew point
- D) triple point

8. The sum of the relative frequencies for all classes in a frequency distribution table will always equal to

- A) the sample size
- B) the number of classes
- C) One
- D) 100

9. The measure of location which is the most likely to be influenced by extreme values in the data set is the

- A) range
- B) median
- C) mode
- D) mean

10. Intermolecular hydrogen bonding is not possible in
- A) carboxylic acids
 - B) alcohols
 - C) water
 - D) ethers
11. Soap helps in cleaning clothes because
- A) chemicals of soap change
 - B) it increases surface tension of the solution
 - C) it lowers the surface tension of the solution
 - D) it absorbs dirt
12. Which of the following can pass through 20 cm thickness of steel?
- A) β -rays
 - B) γ -rays
 - C) α -rays
 - D) None of the above
13. The measure of dispersion that is influenced most by extreme values is
- A) the variance
 - B) the standard deviation
 - C) the range
 - D) the interquartile range
14. The energy generation in stars is due to
- A) Fusion of light nuclei
 - B) Fusion of heavy nuclei
 - C) Chemical reactions
 - D) Fission of heavy nuclei
15. The half life period of Radium is 1600 years. Its average life time will be
- A) 3200 years
 - B) 800 years
 - C) 2309 years
 - D) 4217 years
16. A sealed glass bottle at 27°C contains air at atmospheric pressure (1 atm) and has a volume of 30 cm^3 . If the temperature of the air is increased up to 200°C without any volume changes of the bottle, the pressure inside the bottle will be
- A) 1 atm
 - B) 1.6 atm
 - C) 0.625 atm
 - D) 7.4 atm

17. Which one of the following compounds is the most acidic?
- A) CH_3COOH
 - B) $\text{CH}_3\text{CH}_2\text{OH}$
 - C) CH_2ClCOOH
 - D) CCl_3COOH
18. Faraday constant
- A) depends on the amount of the electrolyte
 - B) depends on the current of the electrolyte
 - C) depends on the amount of charge passed through the electrolyte
 - D) is a universal constant
19. A liquid can easily change its shape but a solid cannot, because
- A) the atoms combine to form bigger molecules in a solid.
 - B) the density of the liquid is smaller than that of a solid.
 - C) the force between the molecules is stronger in solids than in liquids.
 - D) the average separation between the molecules is larger in solids.
20. A researcher says that he measured the acceleration of a particle to be non-zero while no force was acting on the particle.
- A) It is not a true statement.
 - B) He might have used a non-inertial frame.
 - C) his clock may have run slow.
 - D) His meter scale might have been longer than the standard.
21. For water system when three phases are under equilibrium the system is:
- A) univariant
 - B) bivariant
 - C) zero variant
 - D) unvariant
22. Which of the following compounds has a definite dipole moment?
- A) CS_2
 - B) H_2O
 - C) HgCl_2
 - D) C_2H_2
23. The number of significant digits in the number 204.020050 is
- A) 5
 - B) 6
 - C) 8
 - D) 9

24. A "periodic function" is given by a function which
- A) has a period $T=2\pi$
 - B) satisfies $f(t + T) = f(T)$
 - C) has a period $T=2\pi$
 - D) satisfies $f(t + T) = -f(T)$
25. The law which states that amount of gas dissolved is proportional to its partial pressure is
- A) Boyle's law
 - B) Henry's law
 - C) Graham's law
 - D) Charle's law

PART – B

26. A function y and its first derivative at $x=2$ are given as $y(2)=1$, and $y'(2)=3$. The first-order Taylor polynomial is generated by y at $x=2$ is
- A) $1+3x$
 - B) $-5+3x$
 - C) $-5-3x$
 - D) $1-3x$
27. The first law of thermodynamics is a statement of conservation of
- A) work
 - B) heat
 - C) energy
 - D) momentum
28. Consider the following two statements:
- (i) *Line spectra contain information about atoms*
 - (ii) *Band spectra contain information about molecules*
- A) Both (i) and (ii) are correct.
 - B) Both (i) and (ii) are wrong.
 - C) Only (i) is correct.
 - D) Only (ii) is correct.
29. The time period of an earth-satellite in circular orbit is independent of
- A) the mass of the satellite
 - B) radius of the orbit.
 - C) neither (A) nor (B)
 - D) both (A) and (B).

30. The engine of a train sounds a whistle at a frequency α . The frequency heard by the driver of the engine is
- A) $> \alpha$
 - B) $< \alpha$
 - C) $=\alpha$
 - D) $\frac{1}{\alpha}$
31. Newton's law of cooling is a special case of
- A) Wein's displacement law
 - B) Stefan's law
 - C) Plank's law
 - D) Kirchoff's low
32. For a function $z = x^2 - y^2$ the point (0,0) is
- A) a critical point, but not a local extremum
 - B) a critical point, and a local maximum
 - C) not a critical point
 - D) a critical point, and a local minimum
33. The primary precursor of tropospheric ozone formation are
- A) VOCs and NO_x
 - B) CO₂ and NO_x
 - C) NO and NO₂
 - D) SO_x and VOCs
34. If $f(x) = \frac{4x}{x-3}$, then the following line is the vertical asymptote
- A) $x = 12$
 - B) $x = 3$
 - C) $x = 1$
 - D) $x = 4$
35. A normal eye is not able to see the objects closer than 25 cm because
- A) the eye is not able to decrease the distance between the eye-lens and retina beyond a limit.
 - B) the focal length of the eye is 25 cm
 - C) the eye is not able to decrease the focal length beyond a limit.
 - D) the distance of the retina from the eye-lens is 25 cm.

36. $\int_{-1}^1 2^x dx$ is

- A) 0
- B) 2
- C) 4.328
- D) 2.164

37. The strength of photo-electric current depends on

- A) Frequency of incident radiation
- B) Intensity of incident radiation
- C) Angle of incidence of radiation
- D) Distance between anode and cathode

38. The iron present in haemoglobin is in

- A) ferrous state
- B) ferric state
- C) metallic state
- D) none of the above

39. The cofactors of 9 and 7 in the matrix $A = \begin{bmatrix} 3 & 2 & 7 \\ 9 & 1 & 0 \\ 3 & -1 & 2 \end{bmatrix}$ are

- A) -11 & -12
- B) -12 & 11
- C) 11 & -12
- D) 11 & 12

40. A vertical wire carries a current in upward direction. An electron beam sent horizontally towards the wire will be deflected

- A) towards right
- B) towards left
- C) upwards
- D) downwards

41. One of the following is not a greenhouse gas

- A) carbon dioxide
- B) methane
- C) Argon
- D) Ozone

42. In its standardized form, the normal distribution
- A) has a mean of 0 and a standard deviation of 1.
 - B) has a variance 0 and mean 1
 - C) area under the curve is 0.50
 - D) mean, median and mode are equal to one
43. The frequency of radio waves is
- A) between 500 kHz to about 1000 MHz
 - B) in Gigahertz range
 - C) between 10^{19} to 10^{23} Hz
 - D) between 10^{14} to 10^{15} Hz
44. A plane mirror produces a magnification of
- A) -1
 - B) Zero
 - C) Between 0 and $+\infty$
 - D) +1
45. The average value of the function $f(t)=t^2$ across [2,5] is
- A) 2
 - B) 5
 - C) 13
 - D) 3
46. Which of the following statements about ozone is true?
- A) Ozone is a major constituent of photochemical smog
 - B) Ozone is high reactive
 - C) Ozone protects us from the harmful UV radiation of sun
 - D) All of the above
47. One of the following sequences, considered from left to right, cannot form the cold junction of a thermocouple. Identify.
- A) constantan-bismuth
 - B) zinc-copper
 - C) gold-iron
 - D) aluminium-mercury
48. Which of the following is not a sugar?
- A) Cane sugar
 - B) Lactose
 - C) Starch
 - D) Fructose

49. If $z = \cos\alpha + j\sin\alpha$,

- A) $z + \frac{1}{z} = 2\cos\alpha$
- B) $z + \frac{1}{z} = \cos\alpha$
- C) $z + \frac{1}{z} = 2j\sin\alpha$
- D) $z + \frac{1}{z} = 2\sin\alpha$

50. When the rate of reaction, $r = k[A]^2[B]$, the reaction is said to

- A) first order with respect to B
- B) second order with respect to A
- C) third order overall
- D) all of the above are correct

51. The process in which heat is neither allowed to enter nor allowed to leave the system but in which temperature change is known as

- A) isothermal
- B) adiabatic
- C) exothermic
- D) isobaric

52. $\lim_{x \rightarrow 0} \frac{\cos x - 1}{x^2}$ equals to

- A) $\frac{-1}{2}$
- B) -1
- C) 0
- D) $\frac{1}{2}$

53. A uniform sphere of mass 200 g rolls without slipping on a plane surface so that its centre moves at a speed of 2 cm/s. Its kinetic energy will be

- A) 5.6×10^{-6} J
- B) 4.0×10^{-6} J
- C) 1.6×10^{-6} J
- D) None of the above

54. Which of the following is NOT an important property of the electric charges?

- A) Unlike charges attract one another.
- B) Electric charge is not always conserved.
- C) Charge is quantized.
- D) The force between the charged particles varies as the inverse square of their separation.

55. In an exothermic reaction, heat is

- A) absorbed
- B) converted to electric work
- C) evolved
- D) converted to mechanical work

56. Which of the following is a state function?

- A) Enthalpy
- B) Internal energy
- C) Radioactive energy
- D) Heat energy

57. The Mclaurin series for e^x is expressed as

- A) $\sum_{n=0}^{\infty} \frac{x^{2n}}{n!}$
- B) $\sum_{n=0}^{\infty} \frac{x^n}{n!}$
- C) $\sum_{n=0}^{\infty} \frac{(-1^n) x^n}{n!}$
- D) $\sum_{n=0}^{\infty} \frac{(-1^n) x^{n+1}}{n!}$

58. The amount of salt present in 1 kg of sea water is:

- A) 35 g
- B) 3.5 g
- C) 35 mg
- D) 3.5 mg

59. Most abundant constituent of dry air in terms of volume is:

- A) oxygen
- B) nitrogen
- C) carbon dioxide
- D) ozone

60. A circuit provides a current of 20 A at an operating voltage of 120 V. How many 75-W bulbs can operate with this voltage source?

- A) 32
- B) 6
- C) 64
- D) 20

61. In a standing wave one of the following does not apply
- A) all particles between two successive nodes reach their extreme positions together.
 - B) different particles move with different amplitudes.
 - C) all particles do not cross their mean positions together.
 - D) energy of one region is confined in that region
62. CH_3CHCl_2 and $\text{CH}_2\text{Cl}\cdot\text{CH}_2\text{Cl}$ show which type of isomerism?
- A) Functional
 - B) Chain
 - C) Position
 - D) Metamerism
63. Let the matrices $A = \begin{bmatrix} 1 & -1 \\ 2 & 0 \\ 8 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 0 \\ 1 & -1 \end{bmatrix}$. Then
- A) AB is not defined
 - B) Both BA and AB are not defined.
 - C) Both AB and BA are defined, and are equal
 - D) BA is not defined.
64. When the data are skewed to the right, the measure of Skewness will be
- A) negative
 - B) zero
 - C) positive
 - D) Three
65. Which of the following is the chemical formula for calcite?
- A) CaCO_3
 - B) CaMgSO_4
 - C) FeCO_3
 - D) FeS_2
66. A parallel beam of monochromatic light of wavelength 450 nm passes through a long slit of 0.2 mm. The angular divergence through which the light is diffracted is
- A) 4.5×10^{-3} rad
 - B) 2.25×10^{-3} rad
 - C) 4.444×10^6 rad
 - D) 2.222×10^6 rad

67. A pendulum has a period of 3.0s in its inertial frame. Its period when measured by observer moving at speed of $0.95c$ with respect to the pendulum, where c is the speed of a light pulse is
- A) 3 s
 - B) 3.95 s
 - C) $(\frac{3}{9.8})s$
 - D) 9.6s
68. The value of a correlation is reported by a statistician to be $r = -0.6$. Which of the following statements is correct?
- A) The x-variable explains 36% of the variability in the y-variable.
 - B) The x-variable explains 60% of the variability in the y-variable.
 - C) The x-variable explains -60% of the variability in the y-variable.
 - D) The x-variable explains -6% of the variability in the y-variable.
69. $\log_2 14$ equals
- A) $\log_{10} 14$
 - B) $\log_{10} 2$
 - C) $\frac{\log_{10} 14}{\log_{10} 2}$
 - D) $\frac{\log_{10} 2}{\log_{10} 14}$
70. If the amplitude of a system moving in simple harmonic motion is doubled, which of the following does not change?
- A) total energy
 - B) period
 - C) maximum acceleration
 - D) maximum speed
71. The light from the Sun has maximum intensity near 470×10^{-9} m. Assuming that the surface of Sun emits as a blackbody, the temperature of the sun would be 6130 K following
- A) Stefan-Boltzmann Law
 - B) Faraday's Law
 - C) Kirchoff's Law
 - D) Wein's displacement Law
72. A steam engine in London has a boiler that operates at 500 K, converting water into steam. The temperature of the exhaust is that of the outside air, about 300 K. The maximum thermal efficiency of the engine is
- A) 40%
 - B) 4.8%
 - C) 100%
 - D) 138 %

73. One of the following statements is FALSE. Identify.
- A) Electromagnetic waves travel at the speed of light.
 - B) Electromagnetic waves are transverse waves.
 - C) Electromagnetic waves carry both energy and momentum.
 - D) The ratio of electric field to the magnetic field in an electromagnetic wave equals half-speed of light.
74. If $a=3i-2j+k$ and $b= -2i+j-5k$, then $b-a$ is
- A) $5i-3j+6k$
 - B) $\sqrt{70}$
 - C) $-5i+3j-6k$
 - D) $\sqrt{14}$
75. Jacobi's method is also known as
- A) Displacement method
 - B) Simultaneous displacement method
 - C) Simultaneous method
 - D) Diagonal method
76. Mathematically, what is a differential?
- A) Difference between two quantities.
 - B) A gear box on the back end of your car.
 - C) A method of directly relating how changes in an independent variable affect changes in a dependent variable.
 - E) A method of directly relating how changes in a dependent variable affect changes in an independent variable.
77. Does $f(c) = (c + 2)^3 - 2$ have an inflection point? If so, where is it located?
- A) Yes, at $(-2, -2)$
 - B) Yes, at $(2, -2)$
 - C) Yes, at $(8, -2)$
 - D) No
78. The 2nd derivative of a function at point P is 0, and concavity is positive for values to the right of P. What must the concavity be to the left of P for P to be an inflection point?
- A) The concavity must also be positive.
 - B) The concavity must be negative.
 - C) The concavity must be neutral (0).
 - D) The concavity must be imaginary.

79. Newton forward interpolation formula is used for _____ intervals.
- A) open
 - B) unequal
 - C) equal
 - D) closed
80. If two equally likely events A and B are mutually exclusive, what is the probability that event A occurs?
- A) 0.50
 - B) 1.00
 - C) 0.0
 - D) 0.25
81. $\lim_{x \rightarrow 3} \frac{8x^2}{1+\sqrt{x}}$ is
- A) $\frac{72}{1+\sqrt{3}}$
 - B) $\frac{8}{1+\sqrt{3}}$
 - C) Does not exist
 - D) 0
82. Divergence of a the curl of a vector V is
- A) $(\nabla)^2 V$
 - B) 0
 - C) V^2
 - D) ∇V
83. The high reactivity of fluorine is due to
- A) its high electro negativity
 - B) small size of fluorine atom
 - C) availability of d-orbitals
 - D) strong F - F bond
84. The physical quantity that has no dimensions
- A) Angular Velocity
 - B) Angular momentum
 - C) Linear momentum
 - D) Strain
85. The mass of one Avogadro number of helium atom is
- A) 1.00 gr
 - B) 4.00 gr
 - C) 8.00 gm
 - D) $4 \times 6.02 \times 10^{23}$ gr

86. The points (-3,3), (0,0) and (5,5) represents the vertices of a triangle
- A) Equilateral
 - B) scalene
 - C) Right angled
 - D) Isosceles
87. The potential of a hydrogen electrode at pH = 10 is
- A) 0.59 V
 - B) 0.00V
 - C) -0.59 V
 - D) -0.059 V
88. Determinant of n x n unit matrix is
- A) 0
 - B) 1
 - C) 2
 - D) n
89. If $y = x \cdot \sin x$, then y' is
- A) $\sin x - \cos x$
 - B) $\sin x + \cos x$
 - C) $1 - \cos x$
 - D) $\frac{\sin x - x \cos x}{x^2}$
90. Which of the following molecules/ions does not contain unpaired electrons?
- A) O_2^{2-}
 - B) B_2
 - C) N_2^+
 - D) O_2
91. Keeping more extreme values in a distribution, the standard deviation will
- A) reduce
 - B) increase
 - C) no affect
 - D) none
92. There is no atmosphere on the moon because
- A) it is closer to the earth
 - B) it revolves round the earth
 - C) it gets light from the sun
 - D) the escape velocity of gas molecules is less than their root mean square velocity

93. A satellite is revolving around the sun in a circular orbit with uniform velocity v . If the gravitational force suddenly disappears, the velocity of the satellite will be
- A) zero
 - B) v
 - C) $2v$
 - D) infinity
94. The sum of the cubes of first 9 natural numbers is
- A) 45
 - B) 2025
 - C) 91125
 - D) 13125
95. A cylinder rolls without slipping down an inclined plane, the number of degrees of freedom it has, is
- A) 2 B) 5 C) 3 D) 1
96. Newton's first law of motion describes the following
- A) Energy
 - B) Inertia
 - C) Work
 - D) Moment of inertia
97. The magnetic moment of a circular coil carrying current is
- A) Directly proportional to the length of the wire in the coil
 - B) Directly proportional to the square of the length of the wire in the coil
 - C) Inversely proportional to the length of the wire in the coil
 - D) Inversely proportional to the square of the length of the wire in the coil
98. A separable solution for a partial differential equation for $f(x,t)$ is a solution which is
- A) a product of a function of x and a function of t
 - B) a sum of a function of x and a function of t
 - C) an infinite sum of products of functions of x and functions of t
 - D) either a function only of x or a function only of t
99. Select the pair whose dimensions are same
- A) Pressure and stress
 - B) Pressure and force
 - C) Stress and strain
 - D) Power and force
100. The convergence of which of the following method is sensitive to starting value?
- A) False position
 - B) Gauss seidal method
 - C) Newton-Raphson method
 - D) All of these