ENTRANCE EXAMINATION, 2020

QUESTION PAPER BOOKLET

M.Sc. (OCEAN & ATMOSPHERIC SCIENCES)

Marks : 75
Time : 2:00 hrs.

Hall Ticket No.: [ ]

Read carefully the following instructions

i) Please enter your Hall Ticket Number on the OMR Answer Sheet given to you and the space provided above.

ii) This Question paper has two parts: **Part - A** and **Part - B**

iii) **Part - A** consists of 25 objective type questions and **Part - B** consists of 50 objective type questions. Each question carries one mark.

iv) **There is negative marking. Each wrong answer carries -0.33 marks.**

v) Answers are to be marked on the OMR answer sheet following the instructions provided there upon. An example is show here

75. Ⓐ Ⓑ Ⓒ ●

vi) Hand over the OMR answer sheet at the end of the examination to the Invigilator.

vii) No additional sheets will be provided. Rough work can be done in the question paper itself / space provided at the end of the booklet.

viii) Only scientific non-programmable calculators are permitted. Mobile phone based calculators are not permitted. Logarithmic tables are not allowed.

ix) This question paper booklet contains 14 pages.

PART - A

1. A force of 12.5 N acts on a particle along a direction making an angle of 37° with the vertical. Find the component of the force in the vertical direction

    A. 0.1

    B. 1.0

    C. 10.0

    D. 12.5

2. The oxidation number of cobalt in $K[Co(CO)_4]$ is
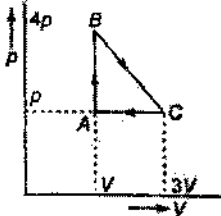
    A. +1

    B. -1

    C. +3

    D. -3

3. If a, b and c are unit coplanar vectors, then the value of [2a-b 2b-c 2c-a] is

    A. -1

    B. 0

    C. 1

    D. 2

4. Which of the following ions forms most stable complex compound?

    A. Fe^{3+}

    B. Cu^{2+}

    C. Mn^{2+}

    D. Ni^{2+}

5. An ideal gas is taken around the cycle ABCA as shown in the p-V diagram

The total work done by the gas during the cycle is

    A. pV

    B. 2pV

    C. 3pV

    D. 4pV

6. For $x \geq 3$, the solution set of $\{f(x) + |x-2|\} f(x) \leq 0$ lies in

    A. $(4, \infty)$

    B. $(-\infty, 3)$

    C. $(3, 4)$

    D. None of these

7. A 0.023 g of sodium metal is reacted with 100 cm^3 of water. The pH of the resulting solution is?
      A. 12
      B. 11
      C. 10
      D. 9

8. Statement I: In Young's double slit experiments; the two slits are at distance d apart. Interference pattern is observed on a screen at distance D from the slits. At a point on the screen when it is directly opposite to one of the slits, a dark fringe is observed. Then the wavelength of wave is proportional to square of distance of two slits.
Statement II: For a dark fringe intensity is zero
      A. Statement I is true, Statement II is also true and Statement II is the correct explanation of Statement I
      B. Statement I is true, Statement II is also true and Statement II is not the correct explanation of Statement I
      C. Statement I is true, Statement II is false
      D. Statement I is false, Statement II is true

9. If the adjoint of a 3×3 matrix P is, $\begin{bmatrix} 1 & 4 & 4 \\ 2 & 1 & 7 \\ 1 & 1 & 3 \end{bmatrix}$, then the possible value(s) of the determinant of P are
      A. ±1
      B. ±2
      C. ±3
      D. ±4

10. If a student drops a stone from a cliff of height 30 m and the time it takes to reach the ground is 2.6 s, then the acceleration due to gravity is
      A. 4.8 m/s^2
      B. 8.8 m/s^2
      C. 9.8 m/s^2
      D. 10.8 m/s^2

11. What is the chemical name of baking soda?
      A. Sodium carbonate
      B. Sodium bicarbonate
      C. Sodium nitrate
      D. Sodium nitrite

12. What is the 31st term of the sequence: 1, 4, 7, 10, ... ?
      A. 90
      B. 91
      C. 92
      D. 93

13. According to Newton's 2nd law the object's acceleration and centripetal force are
        A. at right angles to each other
        B. anti-parallel to each other
        C. make acute angle with each other
        D. in same direction

14. Based on the first law of thermodynamics, which one of the following is correct?
        A. For an isothermal processes, $q = +w$
        B. For an isochoric process, $\Delta U = -w$
        C. For a cyclic process, $q = -w$
        D. For an adiabatic process, $\Delta U = -w$

15. If the order of a matrix A is $m \times p$. And the order of B is $p \times n$. Then the order of matrix AB is?
        A. $n \times m$
        B. $n \times p$
        C. $m \times n$
        D. $m \times p$

16. Statement: All mangoes are golden in colour. No golden-coloured things are cheap.
Conclusions:
I. All mangoes are cheap
II. Golden-coloured mangoes are not cheap.
        A. Only conclusion I follows
        B. Only conclusion II follows
        C. Either I or II follows
        D. Neither I nor II follows

17. Current in a 60 W light bulb when it is connected to a 230 V power supply is
        A. 2.6 A
        B. 0.26 A
        C. 0.026 A
        D. 22.6 A

18. For the reversible reactions, $A_{(s)} + B_{(g)} \rightleftharpoons C_{(g)} + D_{(g)}$ $\Delta G^\circ = -350$ kJ,
Which one of the following statements is true?
        A. The entropy change is negative
        B. The reaction is thermodynamically not feasible
        C. Equilibrium constant is greater than one
        D. The reaction should be instantaneous

19. The number that least fits this set: (324, 187, 97 and 64) is
        A. 324
        B. 187
        C. 97
        D. 64

20. Which of the following pairs represent units of the same physical quantity?
    - A. Kelvin and Joule
    - B. Joule and Calorie
    - C. Calorie and Kelvin
    - D. Calorie and Newton

21. The water pollution in river is measured by the dissolved amount of
    - A. chlorine
    - B. ozone
    - C. nitrogen
    - D. oxygen

22. Most stable isotope in nature is of
    - A. Fe^{56}
    - B. C^{12}
    - C. U^{235}
    - D. U^{238}

23. Metalloids are:
    - A. elements having some properties of both metals and non-metals
    - B. colloids of metals
    - C. alloys of alkali metals with other metals
    - D. metals heavier than lead

24. The solution of $\int_0^1 \frac{1}{1+x^2} dx$ is
    - A. $\frac{\pi}{2}$
    - B. $\frac{\pi}{4}$
    - C. 0
    - D. 1

25. According to Avogadro's hypothesis:
1. The molecular weights of the perfect gases occupy the same volume under same conditions of temperature and pressure.
2. Product of the gas constant and the molecular weight of an ideal gas is constant.
3. Gases have two values of specific heat.
3. All systems can be regarded as closed systems.
Which of the statements given above is/are correct?
    - A. 1 only
    - B. 2 only
    - C. Both 1 and 2
    - D. Neither 1 nor 2

PART - B

26. Match the following:

1. Homogeneous solution.	a. Distilled water
2. Heterogeneous solution	b. Milk
3. Colloidal solution	c. Orange juice with bulb

Select the correct answer using the codes given below:

     A. 1-a, 2-b, 3-c
     B. 1-b, 2-c, 3-a
     C. 1-c, 2-b, 3-a
     D. 1-a, 2-c, 3-b

27. If $A = \begin{bmatrix} 2 & 3 \\ 5 & -2 \end{bmatrix}$, then A^{-1} is

     A. $\frac{-1}{19}A$

     B. $\frac{1}{19}A$

     C. $\frac{1}{17}A$

     D. $\frac{-1}{17}A$

28. Match the following:

Type of Electromagnetic radiation	Wavelength (m)
A. Infrared radiation	1. 10^{-12}
B. X-rays	2. 10^{-5}
C. UV radiation	3. 10^{-10}
D. Gamma rays	4. 10^{-8}

Select the correct answer using the codes given below:

     A. a-2, b-3, c-4, d-1
     B. a-1, b-4, c-3, d-2
     C. a-1, b-3, c-4, d-2
     D. a-2, b-4, c-3, d-1

29. What is the value of x-y+z from the following equation

$$\begin{bmatrix} x + y + z \\ x + z \\ y + z \end{bmatrix} = \begin{bmatrix} 9 \\ 5 \\ 7 \end{bmatrix}$$

     A. 21
     B. 5
     C. 17
     D. 1

30. Match the following:

Element	Source of Symbol
a. Sodium	1. Argentum
b. Iron	2. Wolfram
c. Tungsten	3. Ferrum
d. Silver	4. Natrium

Select the correct answer using the codes given below:

A. a-2, b-3, c-4, d-1
B. a-4, b-2, c-1, d-3
C. a-4, b-3, c-2, d-1
D. a-2, b-4, c-1, d-3

31. An ideal diatomic gas is enclosed in an insulated cylindrical chamber at temperature 300K. The chamber is closed by a freely movable mass-less piston, whose initial height from the base is 1m. Now the gas is heated such that its temperature becomes 400K at constant pressure. The new height (in m) of the piston from base is:

A. $\frac{4}{3}$

B. $\frac{1}{3}$

C. $\frac{2}{3}$

D. $\frac{3}{4}$

32. Two litres of an ideal gas at a pressure of 10 atm expands isothermally against a constant external pressure of 1 atm until its total volume is 10 litres. How much heat is absorbed in the expansion?

A. 10 litre-atm
B. 8 litre-atm
C. 12 litre-atm
D. 6 litre-atm

33. The solution of the integral $\int \frac{(1+\log x)^2}{x} dx$ is ...., (Z is a constant)

A. $\frac{1}{3}(1 + logx)^3 + Z$

B. $\frac{1}{5}(1 + logx)^3 + Z$

C. $\frac{1}{3}(1 + logx)^5 + Z$

D. $\frac{1}{5}(1 + logx)^5 + Z$

34. The pair NH_3 and BH_3 is isoelectric with which of the following compounds mentioned below:

A. B_2H_6
B. C_2H_6
C. C_2H_4
D. CO_2

35. A spherical ball of radius R, is floating in a liquid with half of its volume submerged in the liquid. Now the ball is displaced vertically by small distance inside the liquid. The frequency of oscillation (f) of ball is

A. $\frac{1}{2\pi}\sqrt{\frac{2g}{R}}$

B. $\frac{1}{2\pi}\sqrt{\frac{3g}{R}}$

C. $\frac{1}{2\pi}\sqrt{\frac{3g}{R}}$

D. $\frac{1}{2\pi}\sqrt{\frac{3g}{2R}}$

36. The position vector of the mid-point of the vector joining the points P(2, 3, 4) and Q(4, 1, -2)

A. $2\hat{\imath} + 3\hat{\jmath} + 4\hat{k}$
B. $3\hat{\imath} + 2\hat{\jmath} + \hat{k}$
C. $\hat{\imath} + 3\hat{\jmath} + 2\hat{k}$
D. $2\hat{\imath} + \hat{\jmath} + 3\hat{k}$

37. A point object is moving with velocity 0.01 m/s on principal axis towards a convex lens of focal length 30 cm. When object is at a distance of 40 cm from the lens, the rate of change of position of the image is
A. 0.09 m/s
B. 0.9 m/s
C. 0.01 m/s
D. 0.1 m/s

38. What will be the wavelength of a ball of mass 0.1 kg moving with a velocity of 10 m s^{-1}? (h = 6.626 x 10^{-34} Js)
A. 896.7 x 10^{-34} m
B. 044.8 x 10^{-34} m
C. 6.626 x 10^{-34} m
D. 100 m

39. The value of 'λ' when the projection of $\vec{a} = \lambda\hat{\imath} + \hat{\jmath} + 4\hat{k}$ on $\vec{b} = 2\hat{\imath} + 6\hat{\jmath} + 3\hat{k}$ is 4 units
A. 3
B. 5
C. 7
D. 8

40. Which of the following ions have the highest value of ionic radius?
A. Li^+
B. F^-
C. O^{2-}
D. B^{3+}

41. A large open tank has two holes in the wall. One is a square hole of side L at a depth y from the top and the other is a circular hole of radius R at a depth $4y$ from the top. When the tank is completely filled with water, the quantities of water flowing out per second from both holes are the same. Then, what is the value of R?

    A. $\frac{L}{\sqrt{2\pi}}$

    B. $\frac{L}{\sqrt{\pi}}$

    C. $\frac{L}{2}$

    D. $\frac{L}{4}$

42. The binary operation $*$: $R \times R \rightarrow R$ is defined as $a*b=2a+b$. The value of $(2*3)*4$ is

    A. 14
    B. 16
    C. 18
    D. 20

43. The current across the AC source is given as, $I = I_1 \cos \omega t + I_2 \sin \omega t$. The rms value of current is

    A. $\frac{I_1+I_2}{2}$

    B. $\frac{I_1^2+I_2^2}{2}$

    C. $\frac{(I_1+I_2)^2}{\sqrt{2}}$

    D. $\sqrt{\frac{I_1^2+I_2^2}{2}}$

44. Which of the following oxides is amphoteric in nature?

    A. CaO
    B. CO_2
    C. SiO_2
    D. SnO_2

45. Five numbers 10, 7, 5, 4 and 2 are to be arranged in a sequence from left to right following the direction given below:
1. No two odd or even numbers are next to each other
2. The second number from the left is exactly half of the left most number
3. The middle number is exactly twice the right most number
Which is the second number from the right?

    A. 2
    B. 4
    C. 7
    D. 10

46. The area bounded by the lines 3x+2y=14, 2x-3y=5 in the first quadrant is

    A. 15.25
    B. 14.50
    C. 15.75
    D. 14.35

47. The half-life of a radioisotope is four hours. If the initial mass of isotope was 200g, the mass of it remaining after 24 hours undecayed is?
  A. 1.042g
  B. 4.167g
  C. 3.125g
  D. 2.084g

48. An electromagnetic wave, going through vacuum is described by $E = E_0 \sin(kx \pm \omega t)$. Which of the following is independent of wavelength?
  A. k/ω
  B. $k\omega$
  C. both (a) and (b) are correct
  D. both (a) and (b) are wrong

49. An electric field of 300 V m^{-1} is confined to a circular area 10 cm in diameter. If the electric field is increasing at the rate of 20 V m^{-1}s^{-1}, the magnitude of magnetic field at a point 15 cm from the centre of the circle will be
  A. 1.85×10^{-15} T
  B. 3.70×10^{-16} T
  C. 1.85×10^{-18} T
  D. 0.85×10^{-17} T

50. For one molar aqueous solution of the following compounds which one will show the highest freezing point?
  A. $[Co(H_2O)_3Cl_3].3H_2O$
  B. $[Co(H_2O)_5Cl]Cl_2.H_2O$
  C. $[Co(H_2O)_6]Cl_3$
  D. $[Co(H_2O)_4Cl_2]Cl.2H_2O$

.51. If $\vec{p}$ is a unit vector and $(\vec{x} - \vec{p}).(\vec{x} + \vec{p}) = 80$, then $|\vec{x}|$ is
  A. 9
  B. 7
  C. 13
  D. 21

52. In the following equation, x, t and F represent displacement, time and force respectively.
$F = a + bt + \frac{1}{c+xd} + A \sin(\omega t + \varphi)$, The dimensional formula for A×d is
  A. $[M^0 L^0 T^{-1}]$
  B. $[M^0 L^{-1} T^0]$
  C. $[M^{-1} L^0 T^0]$
  D. $[M^1 L^{-1} T^1]$

53. A compound (60 g) on analysis gave C=24 g, H=4 g and O=32 g. Its empirical formula is
  A. C_2H_2O
  B. $C_2H_4O_2$
  C. CH_2O
  D. CH_2O_2

54. If $f(x) = \sqrt{\frac{\sec x - 1}{\sec x + 1}}$, then $f'\left(\frac{\pi}{2}\right)$ is

    A. $\frac{\pi}{2}$

    B. 1

    C. $\frac{\pi}{4}$

    D. 0

55. A uniform disc of radius R lies in x-y plane with its centre at origin. Its moment of inertia about the axis $x = 2R$ and $y = 0$ is equal to the moment of inertia about the axis $y = d$ and $z = 0$, where d is equal to

    A. $\frac{4}{3}R$

    B. $3R$

    C. $\frac{\sqrt{17}}{2}R$

    D. $\frac{\sqrt{15}}{2}R$

56. The correct order of increasing basic nature for the bases NH_3, CH_3NH_2, $(CH_3)_2NH$ is

    A. $(CH_3)_2NH < NH_3 < CH_3NH_2$

    B. $NH_3 < CH_3NH_2 < (CH_3)_2NH$

    C. $CH_3NH_2 < (CH_3)_2NH < NH_3$

    D. $CH_3NH_2 < NH_3 < (CH_3)2NH$

57. The daily rainfall in Hyderabad during summer monsoon has a

    A. continuous distribution

    B. discrete distribution

    C. combination of both discrete and continuous distribution

    D. Constant zero

58. The mass of a hydrogen molecule is 3.32×10^{-27} kg. If 10^{23} molecules are colliding per second on a stationary wall of area 2 cm^2 at an angle of 45° to the normal to the wall and reflected elastically with a speed 10^3 m s^{-1}. Find the pressure exerted on the wall (in N m^{-2})

    A. 3.32×10^{-24}

    B. 2.347×10^{-24}

    C. 2.347×10^3

    D. 3.32×10^3

59. A water sample has ppm level concentration of the following anions: $F^- = 10$; $SO_4^{2-} = 100$; $NO_3^- = 50$. The anions/anions that make/makes the water unsuitable for drinking is/are

    A. both SO_4^{2-} & NO_3^-

    B. only F^-

    C. only SO_4^{2-}

    D. only NO_3^-

60. In a scatter plot of X versus Y that has a negative correlation,

    A. As X decreases, Y decreases

    B. As X decreases, Y increases

    C. As X increases, Y increases

    D. For every unit increase of X, the Y increases by 2.73 times

61. Two point masses m_1 and m_2 are initially at rest and at infinite distance apart. They start moving towards one another under their mutual gravitational field. Their relative speed when they are at a distance d

    A. $\sqrt{2G(m_1 + m_2)}$

    B. $\sqrt{\dfrac{2G(m_1 + m_2)}{d}}$

    C. $\sqrt{\dfrac{2G(m_1 m_2)}{d}}$

    D. $\sqrt{\dfrac{2Gd}{(m_1 + m_2)}}$

62. Which of the following kinds of isomerism can nitroethane exhibit?

    A. Metamerism

    B. Functional isomerism

    C. Tautomerism

    D. Position isomerism

63. A ball is thrown in the air. Its height at any time t is, $h = 3 + 14t - 5t^2$. Its maximum height is

    A. 19.2 m

    B. 12.8 m

    C. There is no way to decide with the given information

    D. 5 m

64. The Poisson's ratio for a material is 0.1. If the longitudinal strain of a rod of this material is 1×10^{-3}, find the percentage change in the volume of the rod.

    A. 1.12%

    B. 11.2%

    C. 112%

    D. 0.12%

65. Which of the following is a soft base?

    A. NH_3

    B. R_2S

    C. Cu^+

    D. H_2O

66. The order of the following differential equation $-(d^2x/dx^2)^4 + (dy/dx) = 3$ is

    A. 3

    B. 1

    C. 2

    D. 4

67. The chemical formula for Sucrose is

    A. $C_{12}H_{22}O_{11}$

   B. $C_6H_{12}O_6$

    C. $C_5H_{10}O_5$

    D. $C_{12}H_{22}O_5$

68. A He^+ ions is at rest and is in ground state. A neutron with initial kinetic energy K collides head on with the He^+ ion. Find the minimum value of K so that there can be an inelastic collision between these two particles.

    A. 40 eV

    B. 48 eV

    C. 51 eV

    D. 54 eV

69. Which of the following is INCORRECT, as per Rutherford's scattering experiment?

    A. The atom is neutral

    B. There exists large space between the electrons and nucleus of the atom

    C. Electrons can change orbits when they emit energy

    D. The nucleus is positively charged

70. Consider the following reaction:

$C_2H_5OH + H_2SO_4 \rightarrow$ Product
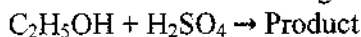
Among the following, which one cannot be formed as a product under any condition?

    A. Diethyl ether

    B. Ethyl hydrogen sulphate

    C. Ethylene

    D. Acetylene

71. For an arbitrary scalar A, $\nabla \times \nabla A =$

    A. 0

    B. ∇A

    C. $\nabla^2 A$

    D. None of the above

72. If for a real continuous function f(x), f(a)f(b) <0 , then in the range of [a, b] for f(x) = 0, there is

    A. only one root

    B. at least one root

    C. no root

    D. Given information is insufficient to conclude

73. Coriolis force deflects the direction of an air current the northern hemisphere

    A. to its left

    B. upwards

    C. to its right

    D. downwards

74. The triple point of water occurs at

    A. 273.16 K

    B. 0.01 K

    C. 32.018 K

    D. 273.16°C

75. A man is known to speak truth 3 out of 4 times. He throws a die and report that it is a 6. Find the probability that it is actually 6.

      A. 3/8

      B. 5/8

      C. 7/8

      D. 7/9