

Set A

Clamphook CBT

2080

Full Marks: 140

Time: 2 hours

Pass Marks: 56

1. The resultant of two forces \vec{P} and \vec{Q} is perpendicular to \vec{P} and is equal to P . Then the magnitude of another force \vec{Q} is

- a. $\sqrt{3} P$
- b. $2P$
- c. P
- d. $\sqrt{2} P$

2. Two forces of magnitude F have a resultant of the same magnitude F . The angle between the two forces is

- a. 45°
- b. 120°
- c. 150°
- d. 180°

3. A large number of bullets are fired in all direction with speed ' u '. The maximum area on which these bullets will spread is:

- a. $\frac{\pi u^4}{g^2}$
- b. $\frac{\pi u^2}{g}$
- c. $\frac{\pi^2 u^4}{g^2}$
- d. $\frac{\pi^2 u^2}{g^2}$

4. The numerical ratio of displacement to distance for a moving object is [IOE 2074]

- a. equal to or less than 1
- b. always equal to 1
- c. always less than 1
- d. always more than 1

5. Which one of the following group of forces will not produce acceleration in a body acted by the forces ?

- a. 4 N, 7 N, 15 N
- b. 4 N, 7 N, 10 N
- c. 4 N, 7 N, 12 N
- d. 4 N, 7 N, 14 N

6. A body falls freely under the action of gravity. Its velocity is v when it has lost potential energy equal to U . The mass of body is

- a. $\frac{U^2}{v^2}$
- b. $2\frac{U^2}{v^2}$
- c. $\frac{2U}{v^2}$
- d. $\frac{U}{v^2}$

7. The time period of a satellite in circular orbit of radius R is T . What will be the time period if the radius of the orbit is $4R$.

- a. $2T$
- b. $4T$
- c. $8T$
- d. $16T$

8. A faulty thermometer has its fixed points marked 5° and 95° . This thermometer reads the temperature of body as 59° . Then the correct temperature on the Celsius scale is

- a. $48.6^\circ C$ b. $59^\circ C$
c. $60^\circ C$ d. $58^\circ C$

9. At constant T the graph of P Vs. $\frac{1}{V}$ is

- a. straight line b. parabola
c. ellipse d. circle

10. At same temperature, pressure and volume of two gases, with which of the following quantities is constant ?

- a. Total number of molecules. b. Root mean square velocity.
c. Average kinetic energy d. Mean free path

11. Optical fiber is based on phenomenon

- a. Total Internal reflection b. Interference
c. Diffraction d. Polarization

12. Two mirrors are at 60° , the number of image formed is

- a. 5 b. 6
c. 7 d. 8

13. The difference between angle of minimum deviation for violet and red rays in the spectrum of white light from a prism is 2° . If the angle of minimum deviation of the mean ray is 48° . The dispersive power of the material of the prism is :

- a. 24° b. 48°

- c. 0.0416 d. 0.0832

14. Capacity of an isolated sphere is increased n times when it is enclosed by an earthed concentric sphere . The ratio of their radii is

- a. $\frac{n^2}{n-1}$ b. $\frac{n}{n-1}$
c. $\frac{2n}{n+1}$ d. $\frac{2n+1}{n+1}$

15. The resistance of a conductor is 5 Ohm at $50^\circ C$ and 6 Ohm at $100^\circ C$ what is the resistance at $0^\circ C$?

- a. 1Ω b. 2Ω
c. 3Ω d. 4Ω

16. A wire has resistance of ' R '. When its diameter is made ($\frac{1}{5})^{th}$ of initial while stretching in resistance becomes [IOE 2076]

- a. $25R$ b. $\frac{R}{25}$
c. $625R$ d. $\frac{R}{625}$

17. The binding energies per nucleon of Li^7 and He^4 are 5.6 MeV and 7.06 MeV respectively, then the energy of the reaction $p + _3Li^7 \rightarrow 2_2He^4$

- a. 17.28 MeV b. 34.56 MeV
c. 39.2 MeV d. 8.64 MeV

18. If $aN = \{ax : x \in N\}$, then the set $3N \cap 7N$ is

a. $21N$

b. $10N$

c. $4N$

d. $11N$

19. The domain of function $\frac{1}{\sqrt{(1-x)(x-2)}}$ is

a. $(1,2)$

b. $[1,2]$

c. \mathbb{R}

d. $(1,2]$

20. The rational number for the sum of the infinite series

$0.45 + 0.0045 + 0.000045 + \dots$

$+ \infty$ is:

a. $\frac{46}{100}$

b. $\frac{4545}{1000}$

c. $\frac{45}{100}$

d. $\frac{5}{11}$

21. If A is a non-singular matrix, then $\det(A^{-1})$ is equal to:

a. $\frac{1}{\det(A^2)}$

b. $\frac{1}{\det(A)}$

c. $\det\left(\frac{1}{A^2}\right)$

d. $\det\left(\frac{1}{A}\right)$

22. The square root of i are [IOE 2075]

a. $\pm \frac{1}{\sqrt{2}} (1+i)$

b. $\pm \frac{1}{\sqrt{2}} (1-i)$

c. $\pm (1+i)$

d. Doesn't Exist

23. In a triangle ABC, $r.r_1.r_2.r_3$ is equal to :

a. 2Δ

b. Δ^2

c. $\frac{abc}{4R}$

d. $\frac{abc}{\Delta}$

24. The equation of perpendicular bisector of the line joining $(0, 2)$ and $(2, 4)$ is [IOE 2077]

a. $x - y = -2$

b. $x + y = 4$

c. $2x + y = 5$

d. $x + y = 5$

25. The pair straight lines represented by $8x^2 + 8xy + 2y^2 + 26x + 13y + 5 = 0$ are [IOE 2074]

a. Perpendicular

b. Parallel

c. Intersecting at 60°

d. Intersecting at 30°

26. The equation of the curve $x = 3 \cos \theta$, $y = 3 \sin \theta$ in Cartesian form is :

a. $x^2 - y^2 = 9$

b. $x^2 - y^2 = -9$

c. $x^2 + y^2 = 9$

d. $x^2 + y^2 = -9$

27. The angle made by a double the ordinate of length 16a at the vertex of the parabola $y^2 = 8ax$ is :

a. 30°

b. 45°

c. 60°

d. 90°

28. The points $(1, 0, 0)$, $(0, 1, 0)$ and $(0, 0, 1)$ are : [IOE 2074]

a. linearly dependent

b. linearly independent

c. right angled triangle vertices

d. none of these

29. $(\vec{a} \times \vec{b})^2 =$ [IOE 2075]

a. $ab + (\vec{a} \cdot \vec{b})$

b. $\sqrt{a^2 b^2 - (\vec{a} \cdot \vec{b})^2}$

c. $\sqrt{a^2 b^2 - (\vec{a} \times \vec{b})^2}$

d. $\sqrt{a^2 b^2 + (\vec{a} \cdot \vec{b})^2}$

30. Evaluate $\lim_{x \rightarrow 0} \frac{1 - \cos x}{1 - \cos 2x}$ [IOE 2078]

a. $\frac{1}{4}$

b. $\frac{1}{2}$

c. 1

d. 2

31. What is the derivative of \sqrt{x} with respect to x ?

a. $\frac{1}{x}$

b. $\frac{1}{2\sqrt{x}}$

c. $\frac{1}{\sqrt{x}}$

d. $-\frac{1}{2\sqrt{x}}$

32. What is the derivative of $\sqrt{\sin x}$ with respect to x ?

a. $\frac{\sin x}{2\sqrt{\sin x}}$

b. $\frac{\cos x}{2\sqrt{\cos x}}$

c. $-\frac{\sin x}{2\sqrt{\sin x}}$

d. $\frac{\cos x}{2\sqrt{\sin x}}$

33. In case of strictly decreasing functions, the derivative is [IOE 2075]

a. zero

b. positive or zero

c. negative

d. positive

34. $\int \frac{dx}{(x+2)\sqrt{x+1}} =$

a. $\tan^{-1}(\sqrt{x+1}) + c$

b. $2\sin^{-1}(\sqrt{x+1}) + c$

c. $\sin^{-1}(\sqrt{x+1}) + c$

d. $2\tan^{-1}(\sqrt{x+1}) + c$

35. The area bounded by the curve $y = x(1-x)^2$ and x -axis is:

a. $\frac{1}{14}$

b. $\frac{1}{12}$

c. $\frac{1}{13}$

d. $\frac{1}{2}$

36. $\frac{d}{dx}(\sin^{-1} x + \cos^{-1} x)$

a. 0

b. 1

c. -1

d. x

37. The 3rd term of G.P is 4. Then the product of the first 5 terms is: []

a. 4^3

b. 4^4

c. 4^5

d. 4^6

38. Total number of atoms in 22g of CO_2 is

a. 6.02×10^{23}

b. 6.02×10^{24}

c. 9.03×10^{23}

d. 18.06×10^{23}

39. Which of the ions has 18 electrons in its outermost shell

a. 7

b. 5

c. 3

d. 1

40. The number of unpaired electrons in an oxygen molecule is [IOE 2075]

41. Among the elements given below, the one with highest electropositivity is

- a. Cu
 - b. Cs
 - c. Cr
 - d. Ba

42. Addition of zinc powder to $CuSO_4$ solution precipitates copper due to

- a. reduction of Cu^{++}
 - b. reduction of SO_4^{2-}
 - c. hydrolysis of $CuSO_4$
 - d. ionization of $CuSO_4$

43. In 0.02 M solution of perchloric acid (HClO_4) at 298 K, the sum of pH and pOH is equal to

- a. 14
 - b. 7
 - c. Between 6 and 7
 - d. Can not be predicted

44 A mineral is called ore if

- | | |
|---|---|
| a. The metal present in the mineral is costly. | b. A metal can be extracted from it. |
| c. A metal can be extracted profitably from it. | d. A metal cannot be extracted from it. |

45. Complex ion is shown by

- a. Ag
 - b. Au
 - c. Cu
 - d. All of the above

46. Rusting of iron is a chemical reaction. The reaction is

47. Fractional crystallization method is applicable to separate substances having differences in

- a. densities
 - b. volatility
 - c. solubility
 - d. shape of crystals

48. Methane is formed when

- a. iodomethane is reduced
 - b. aluminium carbide reacts with water
 - c. sodium acetate is heated with soda lime
 - d. all

49. Ram said to her, " You are beautiful." Its indirect speech is:

- a. Ram told her that she was beautiful.
 - b. Ram said to her that she is beautiful.
 - c. Ram told her beautiful.
 - d. Ram told her that she were beautiful.

50. Collective noun: A of Flamingos

- a. Congregation
 - b. Standing
 - c. Convocation
 - d. Covert

51. He was admitted to college for a bachelor's course.

- a. on
 - b. at
 - c. with
 - d. to

52. The twins were set apart at birth. The underlined word means

53. Locate the word with /ə/ sound.

- a. bucks
 - b. duck
 - c. lurks
 - d. china

54. In the word “forgive” the stress falls on the syllable.

- a. First
 - b. Second
 - c. Third
 - d. Fourth

55. We if you explained it more slowly.

- a. understood
 - b. had understood
 - c. could understand
 - d. understand

56. Antonym of 'pique' is:

- a. value
 - b. gully
 - c. smooth
 - d. soothe

57. He postponed the manager.

- a. to meet
 - b. met
 - c. to meeting
 - d. meeting

58. The passive form of 'They let us go.' is [IOE 2077]

59. Wherever you go, you can always find beauty.

- a. Simple Sentence b. Compound Sentence

60. He got too tired over work.

- a. because of
 - b. because off
 - c. on
 - d. for

61. Assuming that about 200Mev. energy is released per fission of $^{92}U^{235}$ nuclei. What would be the mass of U^{235} consumed per fission reactor of power 1 Mw approximately

- a. $10^{-2}gm$ b. $1gm$
c. $100gm$ d. $10kg$

62. The number of electrons contained in one Coulomb of charge is:

- a. 1.67×10^{31} b. 9.31×10^{31}
c. 6.25×10^{18} d. 6.25×10^{20}

63. A ray of light passes from vacuum into a medium of refractive index , the angle of incidence is found to be twice the angle of refraction . The angle of incidence is :

- a. $\cos^{-1}\left(\frac{\mu}{2}\right)$

b. $2\cos^{-1}\left(\frac{\mu}{2}\right)$

c. $2\sin^{-1}(\mu)$

d. $2\sin^{-1}\left(\frac{\mu}{2}\right)$

64. Two rods of length l and $2l$ of thermal conductivity $2k$ and k are connected end to end. The cross sectional area is same then equivalent conductivity will be:

- a. $\frac{5}{6}k$ b. $1.5k$

c. $1.2k$

d. $8.9k$

65. A block of metal of specific heat capacity $0.1 \text{ cal/g}^\circ\text{C}$ fall from a height of $100m$. If 60% of energy of fall is converted into heat then rise in temperature is:

a. 1.43°C

b. 1.53°C

c. 1.62°C

d. 0.95°C

66. The length of wire increased by 1% on the application of 400 N force. Energy stored per unit volume of wire is (

$$Y = 2 \times 10^{10} \frac{N}{m^2}$$

a. $2 \times 10^6 \text{ J}$

b. 10^6 J

c. $5 \times 10^5 \text{ J}$

d. $6 \times 10^5 \text{ J}$

67. g_p is the acceleration due to gravity at pole and g_e is that at equator then [IOE 2078]

a. $g_p > g_e$

b. $g_p < g_e$

c. $g_p = g_e$

d. Cannot say

68. A thin uniform rod of length ' l ' is hinged at the lower end to the level floor and stands vertically. If the rod is allowed to fall its upper end will strike the floor with the velocity

a. \sqrt{gl}

b. $\sqrt{2gl}$

c. $\sqrt{3gl}$

d. $\sqrt{5gl}$

69. The bob of a simple pendulum (mass m and length l) dropped from a horizontal position strikes a block of the same mass elastically placed on a horizontal frictionless table. The K.E. of the block will be

a. $2 mgl$

b. $mgl/2$

c. mgl

d. 0

70. A man weighing 80 kg is standing on a trolley weighing 320 kg . The trolley is resting on frictionless horizontal rails. If the man starts walking on the trolley along the rails at a speed of 1 m/s . Then after 4 second , his displacement relative to trolley will be:

a. 3 m

b. 3.2 m

c. 4.8 m

d. 5 m

71. Two particles A and B are projected with same speeds so that ratio of their maximum heights reached is $3:1$. If the speed of A is doubled without altering other parameters, the ratio of horizontal ranges attained by A and B is: [IOE 2078]

a. $1:1$

b. $2:1$

c. $4:1$

d. $3:2$

72. The momentum of a body is increased by 50% , its associated kinetic energy [IOE 2076]

a. increases by 100%

b. increases by 125%

c. increases by 50%

d. decreases by 100%

$$73. \int \frac{\sin x \cos x}{2 - \cos^2 x} dx = [\text{IOE 2077}]$$

a. $\log(1 + \sin^2 x) + c$

b. $\log(1 + \cos^2 x) + c$

c. $\log \sqrt{1 + \sin^2 x} + c$

d. $\log \sqrt{1 + \cos^2 x} + c$

$$74. \int \tan \sin^{-1} x dx = [\text{IOE 2075}]$$

a. $\sqrt{1-x} + c$

b. $(1-x^2) + c$

c. $-(1-x^2) + c$

d. $-\sqrt{1-x^2} + c$

75. $\frac{d}{dx}\left(\frac{e^{ix} - e^{-ix}}{2i}\right)$ [IOE 2078]

a. $\sin x$

b. $\cos x$

c. $-\sin x$

d. $-\cos x$

76. The differential coefficient of $f(g(x^3))$ is [IOE 2075]

a. $f(g(x^3)) \times g'(x^3)$

b. $3f(g(x^3)) \times g'(x^3) \times x^3$

c. $f(g(x^3)) \times g'(x^3) \times x^3$

d. $f(g(x^3))$

77. The values of A, B such that the function given by

$$f(x) = \begin{cases} -2 \sin x, & x \leq -\frac{\pi}{2} \\ A \sin x + B, & x > -\frac{\pi}{2} \end{cases}$$

is continuous at $x = 0$

.

a. $A = 0, B = 1$

b. $A = 1, B = 1$

c. $A = -1, B = 1$

d. $A = -1, B = 0$

78. The value of $\lim_{x \rightarrow 0} \left(\frac{1 + \tan x}{1 + \sin x} \right)^{\cosec x}$ is equal to

a. e

b. 1

c. e^2

d. 0

79. The line $x \cos \theta - y \sin \theta = a$ cuts the circle $x^2 + y^2 = a^2$ at

a. Two distinct points

b. Two coincident points

c. No point

d. Depends on value of a

80. The equation of pair of tangents drawn from the point $(3, 5)$ to the parabola $y^2 = 8x$ is :

a. $16x^2 - 40xy + 24y^2 - 104x - 120y + 144 = 0$

b. $16x^2 + 40xy + 24y^2 + 104x - 120y + 144 = 0$

c. $16x^2 - 40xy + 24y^2 + 104x - 120y + 144 = 0$

d. $16x^2 - 40xy + 24y^2 + 104x + 120y + 144 = 0$

81. The equation $xy + a^2 = a(x + y)$ represents :

a. A parabola

b. Two perpendicular lines

c. An ellipse

d. Two parallel lines

82. If the equation $6x^2 + 11xy - 10y^2 + x + 31y + k = 0$ represent a pair of lines then the value of K is :

a. -15

b. 6

c. -10

d. -4

83. In triangle ABC, $b(c \cos A - a \cos C)$ is [IOE 2078]

a. 0

b. $b^2 - c^2$

c. $c^2 - a^2$

d. $a^2 - c^2$

84. in a right angled triangle ABC $\sin^2 A + \sin^2 B + \sin^2 C =$ [IOE 2078]

a. 0

b. 1

c. -1

d. 2

85. If $a^x = b^y = c^z$ and x, y, z are in H.P. then a, b, c are in

a. AP

b. GP

c. HP

d. None

c. Formaldehyde

d. Acetaldehyde

86. The equation $|z - 4i| + |z + 4i| = 10$ represents:

- a. a circle
- b. an ellipse
- c. a st. line
- d. pair of lines

87. Which is true about matrix multiplication

- a. It is commutative
- b. It is associative
- c. Both (a) and (b)
- d. None of these

88. If a matrix A is such that $3A^3 + 2A^2 + 5A + I = O$, then its inverse is

- a. $-(3A^2 + 2A + 5I)$
- b. $3A^2 + 2A + 5I$
- c. $3A^2 - 2A - 5I$
- d. None of these

89. If $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$, $A = \{5, 6, 7, 8\}$, $B = \{6, 7, 8, 9\}$, then $(A' \cup B') - (A \cap B)'$ [IOE 2078]

- a. \emptyset
- b. $\{1, 2, 3\}$
- c. $\{5, 6, 7, 8\}$
- d. None

90. If $f(1) = 3$, $f(2) = 5$ and $f(3) = 7$ and g is the inverse of function of then $g(3)$, $g(5)$ and $g(7)$ are [IOE 2074]

- a. 1, 2, 3
- b. 13, 15, 17
- c. 11, 12, 13
- d. 3, 5, 7

91. Which of the following compounds gives methane and ethane by suitable one step reaction? [IOE 2077]

- a. Ethyl iodide
- b. Methyl iodide

92. In the metallurgy of zinc, the zinc dust obtained from roasting and reduction of zinc sulphide contains some ZnO. How is this removed

- a. Absorbance of ultraviolet light and re-emission of white light is employed
- b. Shock cooling by contact with a shower of molten lead is done
- c. X-ray method is used
- d. Smelting is employed

93. In Solvay process of manufacture of Na_2CO_3 the by-products are

- a. CaO , Na_2CO_3
- b. CaCl_2
- c. NH_4Cl , CaO
- d. Na_2CO_3 , CO_2

94. At 80°C distilled water (H_3O^+) concentration is equal to 10^{-6} moles/litre. At the same temperature the value of K_w is

- a. 1×10^{-3}
- b. 1×10^{-6}
- c. 1×10^{-9}
- d. 1×10^{-12}

95. How many moles of KI are required to produce 0.4 moles of K_2HgI_4 ?

- a. 0.4
- b. 0.8
- c. 3.2
- d. 1.6

96. When an electron jumps from lower to higher orbit, the energy

- a. Increases
- b. Decreases
- c. Remain the same
- d. Not definite

Read the following passage carefully and answer the questions below in the context of the passage.
(Questions from 97 to 100)

I believe that only one person in a thousand knows the trick of really living in the present. Most of us spend 59 minutes an hour living in the past, with regret for lost joys, or shame for things badly done (both utterly useless and weakening) or in a future which we either long for or dread. Yet the past is gone beyond repair, and every minute you spend in the vain effort to anticipate the future is a moment lost. There is only one world, the world pressing against you at this minute. There is only one minute in which you are alive, this miracle here and now. The only way to live is by accepting every minute as an unrepeatable miracle. Which is exactly what it is a miracle and unrepeatable.

97. People live either in the past or in the future

- a. because they are in the habit of b. because they are a prey to chewing the cud imaginary fears
- c. because they are chained to d. None of these memory and desire

98. What is an unrepeatable miracle?

- a. Every moment that we live and b. To repair the past spend
- c. To crave for what is not d. None of these

99. The attitude of the author is

- a. romantic
- b. political
- c. classical
- d. pragmatic

100. The most suitable title for the passage will be

- a. past is dynamic
- b. the art of living
- c. importance of the present
- d. none of these

Answer Key

1.d	2.b	3.a	4.a	5.b	6.c	7.c	8.c
9.a	10.a	11.a	12.a	13.c	14.b	15.d	16.c
17.a	18.a	19.a	20.d	21.b	22.a	23.b	24.b
25.b	26.c	27.d	28.b	29.b	30.a	31.b	32.d
33.c	34.d	35.b	36.a	37.c	38.c	39.b	40.c
41.b	42.a	43.a	44.c	45.d	46.c	47.c	48.d
49.a	50.b	51.d	52.b	53.c	54.b	55.c	56.d
57.d	58.d	59.c	60.a	61.b	62.c	63.b	64.c
65.a	66.b	67.a	68.c	69.c	70.d	71.c	72.b
73.c	74.d	75.b	76.b	77.c	78.b	79.b	80.c
81.b	82.a	83.c	84.d	85.b	86.b	87.b	88.a
89.a	90.a	91.a	92.d	93.b	94.d	95.b	96.a

97.c 98.a 99.d 100.b

$$F^2 = \sqrt{F^2 + F^2 + 2F^2 \cos \theta}$$

$$\text{or, } \cos \theta = -\frac{1}{2}$$

$$\text{or, } \theta = 120^\circ$$

Solutions

1. d

$$P^2 + 2PQ \cos \theta + Q^2 = P^2$$

$$\text{Also } \tan 90^\circ = \frac{Q \sin \theta}{P + Q \cos \theta}$$

$$\text{or, } P + Q \cos \theta = 0$$

$$P = -Q \cos \theta \dots \dots \dots \dots \dots \quad (\text{ii})$$

Dividing equation (i) by (ii)

$$\frac{Q}{P} = \frac{2P}{Q}$$

$$Q = \sqrt{2} P$$

2. b

Resultant of two vectors

$$R = \sqrt{P^2 + Q^2 + 2PQ \cos \theta}$$

In given condition,

3. a

$$\text{Range}(R_{max}) = \frac{u^2}{q}$$

$$\text{Maximum area } (A) = \pi R_{max}^2 = \frac{\pi u^4}{q^2}$$

4. a

Displacement \leq Distance

Distance is the scalar quantity. It is the measure of distance traveled by any object. It depends on the path taken by the object.

Displacement is a vector quantity. It is the minimum distance between the initial and final position of the object. It is path-independent and depends only on the initial and final position.

The distance traveled by any object is always greater than or equal to the displacement of the body during any motion. That is,

Distance > Displacement.

Thus when we take the ratio of displacement with the distance, It always comes to be less than or equal to one.

Thus, the ratio of displacement to distance is less than or equal to one.

5. b

For, acceleration to be zero , the resultant sum of forces must be zero , since , in option (b , 4 N , 7 N , 10 N) sum of 4 N + 7 N = 11 N is greater than 10 N which obey the criteria for forming a triangle so, the resultant of forces could be zero in this case . So out of the given group it (b) will not produce zero acceleration in a body acted by the forces.

6. c

$$U = \frac{1}{2}mv^2$$

$$\text{or, } m = \frac{2U}{v^2}$$

7. c

$$T^2 \propto R^3$$

$$\left(\frac{T_1}{T_2}\right) = \left(\frac{R}{4R}\right)^{3/2}$$

$$\left(\frac{T_1}{T_2}\right) = \left(\frac{1}{2}\right)^3$$

$$T_2 = 8T_1 = 8T$$

8. c

Let θ be the correct temp. in Celsius scale corresponding to 59° on faulty scale.

$$\frac{\theta - 0}{100 - 0} = \frac{59 - 5}{95 - 5} = \frac{54}{90}$$

$$\theta = 60^\circ C$$

9. a

We have,

$$PV = K [\text{From Boyle's Law}]$$

$$P = \frac{K}{V} = K \times \frac{1}{V} \dots\dots(1)$$

Here, eqn (1) is in form of $y = mx$ which represent a straight line passing through origin.

- Similarly, at constant Pressure graph of Volume Vs Temp is also a straight line.

10. a

$$PV = nRT$$

Here, $P, V, T = \text{constant}$ and R is universal gas constant due to which total number of molecules is constant.

11. a

- Diameter of optical fiber is approximately 10^{-4} cm.
- Optical fiber is used as light pipe on medical and optical examination as endoscopy , in telephone and other transmitting cables .

12. a

$$\text{Number of image formed} = \frac{360^\circ}{\theta}$$

$$\text{for n even} = \frac{360^\circ}{\theta} - 1$$

$$\text{for n odd} = \frac{360^\circ}{\theta} = 6 \text{ (even)}$$

$$so, n = 6 - 1 = 5$$

13. c

$$\omega' = \frac{\delta_y - \delta_r}{\delta_y} = \frac{2}{48^\circ} = \frac{1}{24} = 0.0416$$

14. b

$$: C_1 = 4\pi\epsilon_o R_1 \\ C_2 = 4\pi \left(\frac{R_1 R_2}{R_2 - R_1} \right)$$

15. d

$$\Delta R = R_0 \alpha \Delta \theta$$

$$\text{So, } 5 - R_0 \alpha (50 - 0) \dots \dots \dots (i)$$

$$6 - R_0 = R_0 \alpha (100 - 0) \dots \dots \dots (ii)$$

Dividing (i) by (ii), we get,

$$\frac{5 - R_0}{6 - R_0} = \frac{50}{100} - \frac{1}{2}$$

$$\text{Or, } 6 - R_0 = 10 - 2R_0$$

$$\dots R_0 = 4\Omega$$

16. c

$$\text{While stretching, } R \propto \frac{1}{d^4}$$

$$\frac{R_2}{R_1} = \left(\frac{5d}{d}\right)^4 = 625$$

$$R_2 = 625R$$

17. a



Thus, proton energy = BE of He atom – BE of Li of atom.

$$\text{or } E_p = (2 \times 4 \times 7.06) - (7 \times 5.60) = 17.28 \text{ MeV}$$

where 4 is the no of nucleon of He and 7 is the no of nucleon of Li.

18. a

According to the given notation,

$$3N = \{3x : x \in R\} = \{3, 6, 9, 12, \dots\}$$

and

$$7N = \{7x : x \in R\} = \{7, 14, 21, 28, 35, 42, \dots\}$$

$$\text{Hence } 3N \cap 7N = \{21, 42, 63, \dots\} = \{21x : x \in N\} = 21N$$

19. a

For function to be defined:

$$(1 - x)(x - 2) > 0$$

$$\text{or, } (x - 1)(x - 2) < 0$$

The equality solution is $x=1$ and $x=2$

so, dividing in ranges $(-\infty, 1)$, $(1, 2)$ and $(2, -\infty)$

Using testing point 0, $(x - 1)(x - 2) < 0$, $(0 - 1)(0 - 2) < 0$, $2 < 0$ which is not valid.

Using testing point 1.5, $(x - 1)(x - 2) < 0$, $(1.5 - 1)(1.5 - 2) < 0$, $-0.25 < 0$ which is valid.

Using testing point 3, $(x - 1)(x - 2) < 0$, $(3 - 1)(3 - 2) < 0$, $2 < 0$ which is valid.

(1,2) is the solution.

20. d

$$a = 0.45, r = 0.01$$

$$S_{\infty} = \frac{a}{1 - r} = \frac{0.45}{1 - 0.01} = \frac{0.45}{0.99} = \frac{5}{11}$$

21. b

$$\det(A^{-1}) = [\det(A)]^{-1} = \frac{1}{\det(A)}$$

22. a

Square the options

23. b

$$r.r_1.r_2.r_3 = \frac{\Delta}{s} \frac{\Delta}{s-a} \frac{\Delta}{s-b} \frac{\Delta}{s-c} = \frac{\Delta^4}{\Delta^2} = \Delta^2$$

24. b

$$\begin{aligned} \text{Slope of bisector line} &= -\frac{1}{\text{slope of line}} \\ &= -\frac{1}{\frac{4-2}{2-0}} = -1 \end{aligned}$$

Point of passing of bisector = midpoint of two points

$$= \left(\frac{0+2}{2}, \frac{2+4}{2} \right) = (1, 3)$$

\therefore Equation of line : $y - y_1 = m(x - x_1)$

25. b

$a = 8, h = 4, b = 2, g = 13, f = 13/2$ and $c = 5$

$$\text{here, } h^2 = 4^2 = 16, af^2 = 8 \times \left(\frac{13}{2}\right)^2 = 2 \times 13^2$$

$$ab = 8 \times 2 = 16, bg^2 = 2 \times 13^2$$

i.e., $h^2 = ab$ and $af^2 = bg^2 \rightarrow$ parallel lines

26. c

$$x = 3 \cos \theta \rightarrow x^2 = 9 \cos^2 \theta$$

$$y = 3 \sin \theta \rightarrow y^2 = 9 \sin^2 \theta$$

Adding, we get

$$x^2 + y^2 = 9$$

27. d

Length of double ordinate = $4At = 16a$

$$8at = 16a \rightarrow t = 2$$

Hence end points of double ordinates are: $(4a, 4a)$ and $(4a, -4a)$

$$\text{slope of first line} = \frac{4a - 0}{4a - 0} = 1$$

$$\text{slope of second line} = \frac{-4a - 0}{4a - 0} = -1$$

The product is -1 . Hence the angle subtended is 90°

28. b

These are \vec{i} , \vec{j} and \vec{k}

$$\text{Now, } a\vec{i} + b\vec{j} + c\vec{k} = 0 \rightarrow a = b = c = 0$$

29. b

$$\begin{aligned} (\vec{a} \times \vec{b})^2 &= (ab \sin \theta)^2 = a^2 b^2 \sin^2 \theta \\ &= a^2 b^2, \text{ since } a^2 b^2 \cos^2 \theta \\ &= a^2 b^2, \text{ since } (\vec{a} \cdot \vec{b})^2 \end{aligned}$$

30. a

31. b

$$y = \sqrt{x}$$

$$y = x^{\frac{1}{2}}$$

$$\frac{dy}{dx} = \left(\frac{1}{2}\right)x^{\frac{1}{2}-1} = \frac{1}{2\sqrt{x}}$$

32. d

$$y = \sqrt{\sin x}$$

$$\frac{dy}{dx} = \frac{d}{d(\sin x)}(\sqrt{\sin x}) \frac{d}{dx}(\sin x) = \frac{\cos x}{2\sqrt{\sin x}}$$

33. c

Strictly Increasing: Positive

Neither increasing nor decreasing: 0

Strictly Decreasing: Negative

34. d

Solution:

$$\text{Put } \sqrt{x+1} = z \Rightarrow x+1 = z^2$$

$$\text{Then, } \frac{1}{2\sqrt{x+1}} dx = dz$$

Now,

$$I = \int \frac{dx}{\sqrt{x+1}} \cdot \frac{1}{x+2} = \int \frac{2dz}{(z^2 - 1 + 2)}$$

$$I = \int \frac{2dz}{z^2 + 1} = 2 \tan^{-1} z + C$$

$$= 2 \tan^{-1}(\sqrt{x+1}) + C$$

35. b

In X-axis $y = 0$

i.e,

$$x(1-x)^2 = 0$$

$$x = 0, 1$$

$$\text{Area bounded } (A) = \int_0^1 y dx = \int_0^1 x(x^2 - 2x + 1) dx = \\ \left[\frac{x^2}{4} - \frac{2x^3}{3} + \frac{x^2}{2} \right]_0^1 = \frac{1}{4} - \frac{2}{3} + \frac{1}{2} = \frac{1}{12}$$

36. a

37. c

38. c

44g of $\text{CO}_2=\text{N}_\text{A}$ molecule

22 g of $\text{CH}_4=0.5 \text{ N}_\text{A}$ molecule = $3 \times 0.5 \times 6.02 \times 10^{23}$ atom = 9.03×10^{23} atom

45. d

39. b

40. c

From the MO diagram of oxygen molecule number of electrons, the paired electron is 5 and unpaired electrons is 2.

41. b

Caesium (Cs) is most electropositive in character, as it has the highest tendency to lose an electron from its outermost shell to achieve a stable fully filled configuration.

42. a

When Zn is added to copper sulfate zinc is oxidised to zinc sulfate and copper ions get reduced to form copper.

43. a

For any solution at 298 K, $\text{pH} + \text{pOH} = 14$.

44. c

Ore:

→ The entire scientific and technological process used for isolation of the metal from its ores is known as metallurgy." Metals that occur naturally in the earth's crust are called minerals.

→ Out of many minerals in which a metal may be found, only a few are viable to be used as sources of that metal. Such minerals are known as ores.

→ A mineral is called an ore if a metal is profitably extracted from it

All are transition elements and hence form complex ion.

46. c

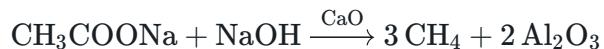
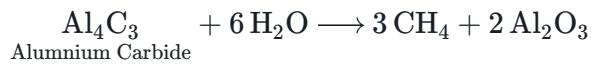
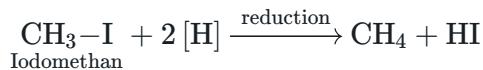
Rusting of iron is a combination reaction. It occurs as follows-



47. c

Fractional crystallization is a method of refining substances based on differences in solubility. It fractionates via differences in crystallization (forming of crystals).

48. d



49. a

50. b

51. d

52. b

53. c

54. b

55. c

56. d

to pique means to excite or irritate; to soothe means to calm

57. d

58. d

59. c

60. a

61. b

62. c

$$q = ne$$

$$n = q/e$$

$$= \frac{1C}{1.6 \times 10^{-19} C}$$

$$= 6.25 \times 10^{18} \text{ electrons.}$$

63. b

$$\mu = \frac{\sin \sin i}{\sin \sin r} \text{ Given } i=2r$$

$$\dots \mu = \frac{\sin r}{2 \sin r \cos \cos r}$$

$$\text{or, } \mu = \frac{2 \sin r \cos \cos r}{\sin r}$$

$$\cos r = \frac{\mu}{2} \rightarrow r = \cos^{-1}\left(\frac{\mu}{2}\right)$$

$$\dots i=2r=2\cos^{-1}\left(\frac{\mu}{2}\right)$$

64. c

$$K_{eq} = l + \frac{2l}{\left(\frac{l}{2kA} + \frac{2l}{kA}\right) A} = 3l \times \frac{2k}{5l} = 1.2k$$

65. a

$$60\% \text{ of } mgh = mxsxd\theta$$

$$\text{or, } d\theta = 0.6 \times 10 \times 100 / 0.1 \times 4200 = 1.43^\circ C$$

66. b

$$\frac{E}{V} = \frac{1}{2} \text{ stress} \times \text{strain}$$

$$= \frac{1}{2} \times Y \times \text{Strain} \times \text{Strain}$$

$$= \frac{1}{2} Y \times (\text{Strain})^2$$

67. a

$$g_p - g_e = R\omega^2$$

68. c

$$\Delta PE = \Delta KE$$

$$\text{or, } \frac{mgl}{2} = \frac{1}{2}m\left(\frac{v}{2}\right)^2 + \frac{1}{2}ml^2 \cdot \frac{v^2}{12} \times l^2$$

$$\text{or, } gl = \frac{v^2}{4} + \frac{v^2}{12}$$

$$\text{or, } \frac{12gl}{4} = v^2$$

$$\text{or, } v = \sqrt{3gl}$$

69. c

P.E. of bob at point A = mgl This amount of energy will be converted into kinetic energy \ K.E. of bob at point B = mgl and as the collision between bob and block (of same mass) is elastic so after collision bob will come to rest and total Kinetic energy will be transferred to block. So kinetic energy of block = mgl



70. d

$$m_1 u_1 = m_2 u_2$$

$$\text{or, } 80 \times 1 = 320u_2$$

$$\text{or, } u_2 = \frac{1}{4} \text{ m/s}$$

For man

$$S_1 = u_1 \times t = 1 \times 4 = 4 \text{ m}$$

For trolley

$$\begin{aligned} S_2 &= u_2 t = \frac{1}{4} \times 4 = 1 \text{ m} \\ S &= S_1 + S_2 = 4 + 1 = 5 \text{ m} \end{aligned}$$

71. c

$$\frac{H_A}{H_B} = \frac{\sin^2 \theta_A}{\sin^2 \theta_B}$$

$$\frac{3}{1} = \frac{\sin^2 \theta_A}{\sin^2 \theta_B}$$

$$\frac{\sin \theta_A}{\sin \theta_B} = \frac{\sqrt{3}}{1}$$

$$\frac{\sin \theta_A}{\sin \theta_B} = \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}}$$

$$\frac{R_A}{R_B} = \frac{\frac{(2u)^2 \sin 2\theta_A}{2g}}{\frac{u^2 \sin 2\theta_B}{2g}} = \frac{4 \sin 120^\circ}{\sin 60^\circ} = \frac{4 \times \sin 60^\circ}{\sin 60^\circ} = 4$$

72. b

$$\frac{\Delta KE}{KE} = \left(\left[\frac{100 \pm x}{100} \right]^n - 1 \right) \times 100\% = \left(\left[\frac{100 + 50}{100} \right]^2 - 1 \right) \times 100\% = 125\%$$

73. c

$$\int \frac{\sin x \cos x}{2 - \cos^2 x} dx = \int \frac{\sin x \cos x dx}{1 + \sin^2 x}$$

$$\begin{aligned} \text{Put } y = \sin x &\implies dy = \cos x dx \\ &= \int \frac{y dy}{1+y^2} dy \end{aligned}$$

$$\frac{1}{2} \log(1+y^2) + c$$

$$\log \sqrt{(1+y^2)} + c$$

$$\log \sqrt{1+\sin^2 x} + c$$

74. d

$$\begin{aligned} &\int \tan(\sin^{-1} x) dx \\ &= \int \tan \tan^{-1} + \left(\frac{x}{\sqrt{1-x^2}} \right) dx = \int \frac{x}{\sqrt{1-x^2}} dx = \\ &\frac{1}{2} \int \frac{2x}{\sqrt{1-x^2}} dx \\ &- \sqrt{1-x^2} + c \end{aligned}$$

75. b

$$\begin{aligned} 76. b \\ \frac{df(g(x^3))}{dx} &= \frac{df(g(x^3))}{dg(x^3)} \times \frac{dg(x^3)}{dx^3} \times \frac{dx^3}{dx} \\ &= f(g(x^3)) \times g(x^3) \times 3x^2 = 3f(g(x^3)) \times g(x^3) \times x^2 \end{aligned}$$

77. c

$$\lim_{x \rightarrow -\frac{\pi}{2}^-} f(x) = \lim_{x \rightarrow -\frac{\pi}{2}^+} f(x)$$

$$\lim_{x \rightarrow -\frac{\pi}{2}^-} -2 \sin x = \lim_{x \rightarrow -\frac{\pi}{2}^+} A \sin x + B$$

$$2 = B - A$$

78. b

$$\lim_{x \rightarrow 0} \left(\frac{1 + \tan x}{1 + \sin x} \right)^{\operatorname{cosec} x}$$

$$\lim_{x \rightarrow 0} \left(\frac{1 + \tan x}{1 + \sin x} \right)^{\frac{1}{\sin x}}$$

$$\lim_{x \rightarrow 0} \frac{(1 + \tan x)^{\tan x} \frac{\sin x}{\tan x}}{(1 + \sin x)^{\frac{1}{\sin x}}}$$

$$\lim_{x \rightarrow 0} \frac{(1 + \tan x)^{\tan x \cos x}}{(1 + \sin x)^{\frac{1}{\sin x}}}$$

$$\frac{e^{\cos 0^\circ}}{e}$$

$$1$$

79. b

$$x \cos \theta - y \sin \theta = a$$

$$y = x \cot \theta - a \operatorname{cosec} \theta$$

$$x^2 + y^2 = a^2$$

$$x^2 + (x \cot \theta - a \operatorname{cosec} \theta)^2 = a^2$$

$$x^2 + x^2 \cot^2 \theta - 2xa \cot \theta \operatorname{cosec} \theta + a^2 \operatorname{cosec}^2 \theta = a^2$$

$$x^2(1 + \cot^2 \theta) - 2xa \cot \theta \operatorname{cosec} \theta + a^2(\operatorname{cosec}^2 \theta - 1) = 0$$

$$x^2 \operatorname{cosec}^2 \theta - 2xa \cot \theta \operatorname{cosec} \theta + a^2 \cot^2 \theta = 0$$

$$(x \operatorname{cosec} \theta - a \cot \theta)^2 = 0$$

80. c

$$T^2 = SS_1$$

$$(yy_1 - 2a(x + x_1))^2 = (y^2 - 8x)(y_1^2 - 8x_1)$$

$$(5y - 4x - 12)^2 = (y^2 - 8x)(5^2 - 8 \times 3)$$

$$25y^2 + 16x^2 - 40xy - 120y + 96x + 144 = y^2 - 8x$$

$$16x^2 + 24y^2 - 40xy - 120y + 104x + 144 = 0$$

81. b

$$xy + a^2 = a(x + y)$$

$$xy + a^2 - ax - ay = 0$$

Comparing with $ax^2 + by^2 + 2hxy + 2gx + 2fy + c = 0$

$$a = 0, b = 0, h = 1, g = -\frac{a}{2}, f = -\frac{a}{2}, c = a^2$$

$$abc + 2fgh - af^2 - bg^2 - ch^2$$

$$(0)(0)(a^2) + 2(-\frac{a}{2})(-\frac{a}{2})(1) - (0)(-\frac{a}{2})^2 - 0(-\frac{a}{2})^2 - 1(a^2)^2 = 0$$

Also, $a + b = 0$ Hence lines are perpendicular.

82. a

$$6x^2 + 11xy - 10y^2 + x + 31y + k = 0$$

Comparing with $ax^2 + by^2 + 2hxy + 2gx + 2fy + c = 0$

$$a = 6, b = -10, h = 11/2, g = \frac{1}{2}, f = \frac{31}{2}, c = k$$

$$abc + 2fgh - af^2 - bg^2 - ch^2$$

$$-60k + \frac{341}{4} - 6 \times \frac{961}{4} - (-10)\frac{1}{4} - k\frac{121}{4} = 0$$

$$-240k + 341 - 5766 + 10 - 121k = 0$$

$$-361k = 5415$$

$$k = -15$$

83. c

84. d

85. b

$$a^x = b^y = c^z = k \text{ (let) Then, } a^x = k$$

$$\text{or, } x \log a = \log k, y \log b = \log k, z \log c = \log k$$

$$\text{or, } x = \frac{\log k}{\log a}, y = \frac{\log k}{\log b}, z = \frac{\log k}{\log c}$$

Since, x, y, z are in HP

$$y = \frac{2xz}{x+z}$$

$$\text{or, } \frac{\log k}{\log b} = \frac{2 \frac{\log k}{\log a} \cdot \frac{\log k}{\log c}}{\frac{\log k}{\log a} + \frac{\log k}{\log c}}$$

$$\text{or, } \frac{\log k}{\log b} = \frac{2 \frac{\log k}{\log a} \cdot \frac{\log k}{\log c}}{\frac{\log k \log c + \log k \log a}{\log a \log c}} = 2 \times \frac{\log k \log k}{\log k (\log ac)}$$

$$2 \log b = \log ac$$

$$\log b^2 = \log ac$$

$$b^2 = ac$$

Hence a, b, c are in GP.

86. b

$$|z - 4i| + |z + 4i| = 10$$

$$\sqrt{x^2 + (y-4)^2} + \sqrt{x^2 + (y+4)^2} = 10$$

$$\sqrt{x^2 + (y-4)^2} = 10 - \sqrt{x^2 + (y+4)^2}$$

$$x^2 + (y-4)^2 = 100 - 20\sqrt{x^2 + (y+4)^2} + x^2 + (y+4)^2$$

$$y^2 - 8y + 16 = 100 - 20\sqrt{x^2 + (y+4)^2} + y^2 + 8y + 16$$

$$-8y = 100 - 20\sqrt{x^2 + (y+4)^2} + 8y$$

$$20\sqrt{x^2 + (y+4)^2} = 100 + 16y$$

$$5\sqrt{x^2 + (y+4)^2} = 25 + 4y$$

Squaring both sides,

$$25(x^2 + y^2 + 8y + 16) = 16y^2 + 200y + 625$$

$$25x^2 + 9y^2 = 225$$

$$\frac{x^2}{9} + \frac{y^2}{25} = 1$$

87. b

$$AB \neq BA$$

$$(AB)C = A(BC)$$

88. a

$$3A^3 + 2A^2 + 5A + I = 0 \Rightarrow I = -3A^3 - 2A^2 - 5A$$

$$IA^{-1} = -3A^2 - 2A - 5I$$

$$A^{-1} = -(3A^2 + 2A + 5I)$$

89. a

$$(A' \cup B') - (A \cap B)'$$

Using De morgan's Law:

$$(A \cap B)' - (A \cap B)'$$

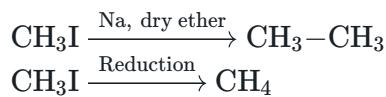
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90. a

If $f(x) = y$ and g is inverse if f then $g(y) = x$

$$g(3) = 1, g(5) = 2 \text{ and } g(7) = 3$$

91. a



92. d

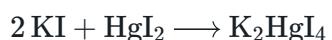
93. b

The ingredients of this process are readily available and inexpensive. These are salt brine (NaCl), ammonia (NH_3) and

limestone (CaCO_3). In this process, CaCl_2 is an important by-product obtained.

94. d

95. b



mole of KI required to produce 0.4 mole of
 $\text{K}_2\text{HgI}_4 = 2 \times 0.4 = 0.8$

96. a

When electron jumps from lower energy orbit to higher energy orbit, energy is absorbed and it increases.

97. c

98. a

99. d

100. b