Set D

Clamphook CBT

2080

Full Marks: 140 **Time:** 2 hours **Pass Marks:** 56

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1. $[ML^2T^{-3}A^{-1}]$ **is dimension of**

a. Resistivity
b. Potential difference
c. Electric field
d. Capacitance

2. A gramophone is revolving at angular speed ω with a coin placed on its surface at a distance r from the centre of record and coefficient of friction is μ for the coin and the surface . The coin will revolve with record without sliding if :

a. $\mu \geq \dfrac{\omega^2 r}{g}$
b. $\mu = \dfrac{gr}{\omega^2}$

c. $\mu < \dfrac{\omega^2}{gr}$
d. $\mu = 0$

3. A body is projected vertically upwards from the surface of a planet of radius R with a velocity equal to half the escape velocity for that planet. The maximum height attained by the body is

a. R/2
b. R/3
c. R/4
d. R/5

4. A uniform metallic disc of moment of inertia I_0 about its own axis is melted and a uniform ring of equal radius is then casted from it .Then , M.I of the ring about its diameter will be

a. $2I_0$
b. I_0

c. $\dfrac{1}{2}I_0$
d. $\dfrac{1}{4}I_0$

5. A film of water is formed between two parallel wires each 10 cm long and at separation 0.5 cm . The work required to increase the distance between them by 1 mm will be (surface tension of water = 72 dyne/cm)

a. 1.44 erg
b. 14.4 erg
c. 144 erg
d. 1440 erg

6. In a pressure cooker the cooking is fast because

a. the boiling point of water is raised by the increase pressure inside the cooker.
b. the boiling point of water is lowered by the increase pressure inside
c. More steam is available to cook the food at $100°c$
d. None of above

7. If two metallic rods of same material have same area of cross – section and length be connected in series , what will be the conductivity at the combination when the conductivity of the rod is K ?

a. $\dfrac{K}{2}$
b. K
c. 2K
d. 4K

8. Two mirrors A and B are inclined at angle θ. A ray of light incident in mirror B is deviated to $62°$ and the angle of

emergence is $20°$, then find the angle of inclination

a. $20°$ b. $30°$

c. $40°$ d. $50°$

a. $\dfrac{100}{\pi}$ MHz   b. $\dfrac{100}{\pi}$ kHz

c. $\dfrac{100}{\pi}$ Hz   d. $\dfrac{100}{\pi}$ mHz

9. . A ray of light travelling inside a rectangular glass block of refractive index $\sqrt{2}$ is incident on the glass – air surface at an angle of incidence of $45°$. The refractive index of air is 1. Under these conditions the ray

a. will emerge into the air without any deviation

b. will be reflected back into the glass will be absorbed .

c. will be absorbed

d. will emerge into the air with an angle of refraction equal to $90°$.

14. Sound quality of a portable radio is improved by adjusting the orientation of the aerial . Which statement is a correct explanation of the improvement ? [KU 2013 , 2012]

a. The radio waves from the transmitter are polarized

b. The radio waves from the transmitter are unpolarized .

c. The radio waves becomes polarized as a result of adjusting the aerial .

d. The radio waves become un polarized as a result of adjusting the aerial .

10. A capacitor connected to a 10 V battery collects a charge of 40 μ C with air as dielectric and 100 μ C with a given oil as dielectric . The dielectric constant of the oil is :

a. 1.5   b. 2.0

c. 2.5   d. 3.0

15. Two tuning forks have frequencies 450 Hz and 454 Hz. On sounding these forks together, the time interval between successive maximum intensities will be

a. $\dfrac{1}{2}$ sec   b. $\dfrac{1}{2}$ sec

c. 1 sec   d. 4 sec

11. Two bulb 500 W and 200 W are connected to same supply of 220 V source . The ratio of their resistance is [IOE 2074]

a. 1 : 1   b. 5 : 2

c. 2 : 5   d. 4 : 2

16. Penetrating power in order is

a. γ > β > α   b. γ > α > β

c. α > β > γ   d. β > α > γ

17. When a pure semiconductor is heated , its resistance :

a. goes down   b. goes up

c. remains same   d. change randomly

12. Horizontal component of earth's field at a height of $1m$ from the surface of earth is H . Its value at a height of $10m$ from the surface of earth is

a. $\dfrac{H}{10}$ b. $\dfrac{H}{9}$

c. $\dfrac{H}{100}$ d. H

18. On the graph of the function $y = 7\sin x + 24\cos x$, the distance of highest point from x-axis is

a. 24 units   b. 31 units

c. 25 units   d. 7 units

13. An AC circuit consists of a capacitor of capacitance $5\mu F$. that has a reactance of 0.001Ω . The frequency of AC mains is :

19. If $\begin{bmatrix} m & n \end{bmatrix} \begin{bmatrix} m \\ n \end{bmatrix} = [25]$ and $m < n$, then $(m, n) =$

a. $(3, 4)$

b. $(4, 5)$

c. $(4, 3)$

d. $(1, 2)$

20. If ω is a cube root of unity then
$\sin \left\{ \left(\omega^{13} + \omega^{20} \right) \pi + \dfrac{\pi}{4} \right\}$ is equal to:

a. $-\sqrt{2}$

b. $-\dfrac{1}{\sqrt{2}}$

c. $\dfrac{1}{\sqrt{2}}$

d. $\sqrt{2}$

21. If a_1, a_2, a_3 are in A.P., and a_p, a_q, a_r, are in A.P., then p, q, r are in:

a. GP

b. None

c. AP

d. HP

22. If $\sin \left(\dfrac{1}{2} \cos^{-1} x \right) = 1$ then x is:

a. 0

b. 1

c. -1

d. No solution

23. If $\sin^{-1} x + \sin^{-1} y = \dfrac{2\pi}{3}$ and $\cos^{-1} y = \dfrac{\pi}{3}$ then (x,y) is equal to:

a. $(1, 1)$

b. $\left(\dfrac{1}{2}, 1 \right)$

c. $\left(1, \dfrac{1}{2} \right)$

d. $\left(\dfrac{1}{3}, \dfrac{1}{3} \right)$

24. In any triangle ABC , $(b + c) \cos A + (c + a) \cos B + (a + b) \cos C$ is :

a. 0

b. $a + b + c$

c. $2(a + b + c)$

d. $a^2 + b^2 + c^2$

25. The unit vector perpendicular to each of the vectors $2\vec{i} - \vec{j} + \vec{k}$ and $3\vec{i} + 4\vec{j}$ is

a. $\dfrac{1}{\sqrt{46}}(-4\vec{i} + 3\vec{j} + 11\vec{k})$

b. $\dfrac{1}{\sqrt{146}}(-4\vec{i} + 3\vec{j} + 11\vec{k})$

c. $\dfrac{1}{\sqrt{246}}(-4\vec{i} + 3\vec{j} + 11\vec{k})$

d. None

26. A straight lines such that the portion of it intercepts between the coordinate axes is bisected at point (h, k). Then its equation is

a. $\dfrac{x}{h} + \dfrac{y}{k} = 2$

b. $\dfrac{x}{k} + \dfrac{y}{h} = 0$

c. $\dfrac{x}{h} - \dfrac{y}{k} = 2$

d. $\dfrac{x}{k} - \dfrac{y}{h} = 2$

27. The area of the circle centered at $(1, 2)$ and passing through the point $(4, 6)$ is :

a. 5 π sq .unit

b. 10 π sq .unit

c. 25 π sq .unit

d. 50 π sq .unit

28. Eccentricity of conic $x^2 - y^2 = -a^2$ is [IOE 2076]

a. 2

b. $\sqrt{2}$

c. $\dfrac{1}{\sqrt{2}}$

d. $\sqrt{3}$

29. If the equation $b^2 x^2 + a^2 y^2 = a^2 b^2$ represent a vertical ellipse then

a. $a > b > 0$

b. $b > a > 0$

c. $a \neq b$

d. $a = 2b$

30. If the points $(1, 1), (a, 0)$ and $(0, b)$ are collinear then these must satisfy [IOE 2077]

a. a – b + ab = 0

b. a – b – ab = 0

c. a + b + ab = 0   d. a + b-ab=0

31. The value of

$$\lim_{x \to \infty} \frac{(x+1)^{10} + (x+2)^{10} + \dots + (x+100)^{10}}{(x^{10} + 10^{10})} \text{ is}$$

a. 0   b. 1

c. 10   d. 100

32. The differential coefficient of e^{x^x} w.r.to x is:

a. $e^{x^x}(1 - \log x)$ b. $e^{x^x}(1 + \log x)$

c. $e^{x^x} x^x(1 + \log x)$ d. $e^x(1 - \log x)$

33. Derivative of $\tan^{-1}(e^x)$ is [IOE 2075]

a. $\dfrac{1}{e^x + e^{-x}}$ b. $e^x + e^{-x}$

c. $e^x - e^{-x}$ d. $\dfrac{1}{e^x - e^{-x}}$

34. The stationary point of x^x is

a. $x = \sqrt{e}$ b. $x = \dfrac{1}{e}$

c. $x = e$ d. $x = 1$

35. The minimum value of $|x|$ is

a. -1 b. x

c. 0   d. 1

36. $\displaystyle\int \dfrac{\sin x \cos x}{2 \cos^2 x} dx =$ **[IOE 2076]**

a. $\log(\cos x) + c$ b. $\log(\sqrt{\cos x}) + c$

c. $\log(\sec x) + c$ d. $\log(\sqrt{\sec x}) + c$

37. The area between the curve $y = \tan x$ and $y = \cot x$ and in the interval $[0, \pi/2]$ is:

a. e^2 b. e

c. $2 \log 2$ d. $\log 2$

38. Markovnikov's rule is not applicable to [IOE 2075]

a. 2-pentane   b. 2-butene

c. 1-butane   d. 2-butane

39. In stable organic compound, carbon will always form

a. 2 bonds   b. 4 bonds

c. 3 bonds   d. 5 bonds

40. The formula of fuming sulphuric acid is

a. H_2SO_4 b. H_2SO_3

c. H_2SO_5 d. $H_2S_2O_7$

41. Which of the following halogen is only obtained by anodic oxidation? [IOE 2077]

a. F   b. Cl
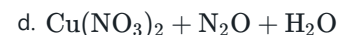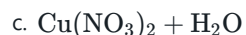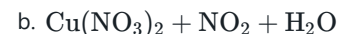
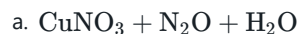c. I   d. Br

42. Sodium is extracted by using

a. Brime   b. Fused sodium chloride

c. Fused sodium chloride with $CaCl_2$ or KF d. Fused sodium chloride with sulphate of Mg

43. When copper is heated with hot and conc. Nitric acid, the product formed are

a. $CuNO_3 + N_2O + H_2O$ b. $Cu(NO_3)_2 + NO_2 + H_2O$

c. $Cu(NO_3)_2 + H_2O$ d. $Cu(NO_3)_2 + N_2O + H_2O$

44. In manufacture of iron from haematite, limestone acts as

a. Slag
b. gangue

c. Flux
d. reductant

45. Neutralization of an acid with a base invariably results in the production of

a. H_3O^+
b. H_2O

c. H^+ and OH^-
d. OH^+

46. Degree of ionization if $1\,M\,HCOOH$ is decreased to maximum extent in presence of

a. 1 M HCHO
b. 1 M NaOH

c. 1 M HCOONa
d. Equal in all

47. If $Rutherford's$ atomic model be correct picture of an atom, there would be

a. 4
b. 3

c. 2
d. 1

48. The electronic configuration of copper

a. 2
b. 8

c. 12
d. 14

49. Between you and .... he is better in studies.

a. he
b. him

c. she
d. I

50. The man, along with his family and friends,...............

a. has arrived
b. have arrived

c. are arriving
d. were arriving

51. I went home _____ Dashain.

a. at
b. in

c. during
d. on

52. "They look happy." The sentence structure is [IOE 2077]

a. S + V + 0
b. S + V + C

c. S + V + Adverb
d. none

53. The test ....at 10 O' clock tomorrow. [IOE 2075]

a. begin
b. begins

c. will be began
d. will be beginning

54. They are repairing the bridge

a. The bridge is being repaired
b. The bridge is repaired by them.

c. The bridge are being repaired
d. The bridge was being repaired

55. The underlined letter in the word "drink' represents soun(d)

a. /ŋ /
b. /n/

c. both
d. none

56. I don't care how expensive it is . This is [IOE 2075]

a. Simple sentence
b. Compound Sentence

c. Complex sentence
d. None

57. She breathed her last. It means

a. she breather slowly
b. she is still breathing

c. she passed away
d. she was hungry

58. Synonym of generic

a. general
b. cheap

c. fresh
d. elderly

59. If today were sunny, he .... for a drive.

a. would be going
b. would go

c. would have gone

d. would be go

---

60. The train ____ as fast as the bus.

a. went

b. moving

c. moves

d. going

---

61. A car can travel half of the distance with a constant velocity of 30 km/hr and another half with a constant velocity of 40 km /hr. The average velocity of a car in km/hr is:

a. 35

b. 34.3

c. 0

d. $\sqrt{30}$

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62. If g is acceleration due to gravity on the surface of earth, the gain in potential energy of an object of mass m raised to a height equal to radius of earth R from surface of earth is

a. $\dfrac{mgR}{2}$

b. $2mgR$

c. mgR

d. $\dfrac{mgR}{4}$

---

63. A particle of mass 50 g executes SHM with period 0.1 sec. The amplitude of vibration is 10 cm then maximum force on a particle is:

a. 10 N

b. 20 N

c. 30 N

d. 35 N

---

64. A large block of ice 10m thick has a vertical hole drilled through it and it is floating in the middle of a lake . What is the minimum length of a rope required to scoop up a bucket full of water through the hole (density of ice = 0.9gm/cc ?)

a. 10 m

b. 9m

c. 1m

d. 0.5 m

---

65. In an isothermal process $100J$ of work is done on the gas. The change in internal energy of the gas is :

a. 0

b. $100J$

c. $-100J$

d. $50J$

---

66. A rectangular tank of depth 8 meter is full of water $(\mu = \dfrac{4}{3})$, the bottom is seen at the depth [ ]

a. 6 m

b. 8/3 m

c. 8 m

d. 10 m

---

67. Can a metal be used as a medium for dielectric

a. Yes

b. No

c. Depends in shape

d. Depends in dielectric

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68. An electron charge (e) is revolving in a circular orbit of radius r around a nucleus of charge e with speed v. The equivalent current is:

a. $\dfrac{ev}{2\pi r}$

b. $\dfrac{ev}{r}$

c. $e \cdot \dfrac{2\pi r}{v}$

d. zero

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69. The magnetic field at the center of a circular coil of radius 10 cm having 500 turns of the coil and carrying current 18 A is ($\mu_0 = 4\pi \times 10^{-7} Hm^{-1}$) [IOE 2076]

a. 5.65×10^{-5} T

b. 5.65×10^{-4} T

c. 5.65×10^{-3} T

d. 5.65×10^{-2} T

---

70. A coil of mean area 500 cm^3 and having 1000 turns is held perpendicular to a uniform field if 0.4 gauss. The coil is turned $180°$ in $\dfrac{1}{10}$second,, the induced emf is:

a. 4 V

b. 0.4 V

c. 0.04 V

d. 0.0004 V

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71. If mercury is used in place of water in resonance tube the frequency gets [IOE 2078]

a. increases   b. decreases

c. remains same   d. cannot say

72. A source and observer are moving with same velocity in same direction such that frequency of source is 'f' then apparent frequency 'fo' is: [IOE 2077]

a. fo≥f   b. fo≤f

c. fo=f   d. fo≠f

73. An X-rays tube work at p.d. of 8000 volt the comesponding wavelength of X-rays photon produced after rescattering through the target is 20.15 mm

a. 0.15 nm   b. 15 Å

c. 1500 Pm   d. none

74. Calculate the weight in gm of one curie of Pb^{214} from its half life 26 min. (N= 6.02×10^{23} /gm-mole).

a. $1.82 \times 10^{-8} gm$ b. $2.82 \times 10^{-8} gm$

c. $3.05 \times 10^{-8} gm$ d. $4.82 \times 10^{-8} gm$

75. Let $f = \{(1,5),(2,6),(3,4)\}, g = \{(4,7),(5,8),(6,9)\}$ then gof is

a. $\{(4,7),(5,8),(6,9),(1,5),(2,6),(3,4)(5,8),(1,5)\}$

c. $\{(1,8),(2,9),(3,7)\}$ d. None

76. $A = \begin{bmatrix} 1 & 2 \\ -3 & 0 \end{bmatrix}$ **and** $B = \begin{bmatrix} -1 & 0 \\ 2 & 3 \end{bmatrix}$ **then**

a. $A^2 = A$ b. $B^2 = B$

c. $AB = BA$ d. $AB \neq BA$

77. If $\left|\dfrac{(z-2)}{(z-4)}\right| = 1$ then $Re(z) =$

a. 1   b. 3

c. 2   d. 5

78. The sum of 2 numbers is 100 and ratio of their AM and GM is 5:4 then numbers are [IOE 2078]

a. 20, 80   b. 40, 60

c. 50, 50   d. 10, 90

79. $\dfrac{1}{1.2} + \dfrac{1}{2.2^2} + \dfrac{1}{3.2^3} + \dots + \infty =$

a. $\log_e 2$ b. $\log_e\left(\dfrac{1}{2}\right)$

c. $1 - \log_e 2$ d. $1 + \log_2 2$

80. If $\cos^{-1} x + \cos^{-1} y + \cos^{-1} z = 3$ then $xy + yz + xz =$? [IOE 2078]

a. 0   b. 1

c. 2   d. 3

81. In triangle ABC, a = 3, b = 4 and c = 5. The value of 'R' is [IOE 2075]

a. 0.5   b. 1

c. 2   d. 2.5

82. If $\overrightarrow{D}$ is the midpoint of line $\overrightarrow{BC}$ in ΔABC, then which of the following is true? [IOE 2078]

a. $2\overrightarrow{AD} = \overrightarrow{AB} + \overrightarrow{AC}$ b. $2\overrightarrow{AD} = \overrightarrow{AB} - \overrightarrow{AC}$

c. $2\overrightarrow{AB} = \overrightarrow{AD} - \overrightarrow{AC}$ d. $2\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{AD}$

83. The product of the lengths of the perpendiculars from (x_1, y_1) on the lines represented by $ax^2 + 2hxy + by^2 = 0$ is [IOE 2075]

a. $\dfrac{ax_1^2 + 2hx_1y_1 + by_1^2}{\sqrt{(a-b)^2 + 4h^2}}$ b. $\dfrac{ax_1^2 + 2hx_1y_1 + by_1^2}{\sqrt{(a-b)^2 - 4h^2}}$

c. $\dfrac{ax_1^2 + 2hx_1y_1 + by_1^2}{\sqrt{(a+b)^2 + 4h^2}}$

d. $\dfrac{ax_1^2 + 2hx_1y_1 + by_1^2}{\sqrt{(a+b)^2 + 2h^2}}$

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84. The centre of the circle $x^2 + y^2 + 8x + 5y + 1 = 0$ lies in .....quadrant. [IOE 2077]

a. 1st

b. 2nd

c. 3rd

d. 4th

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85. The number of tangents drawn from (1,2) to parabola $y^2 = 4x$ is [IOE 2078]

a. 1

b. 2

c. 3

d. 4

---

86. The equation of the plane passing through origin and perpendicular to the line joining (2,3 , 1) and (-5, -4, -2) is [IOE 2076]

a. 7x – 7y – 3z = 0

b. 7x – 7y + 3z = 0

c. 7x + 7y – 3z = 0

d. 7x + 7y + 3z = 0

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87. $\displaystyle \lim_{x \to 0} \dfrac{\sin x^\circ}{x}$ [IOE 2078]

a. 0

b. $\dfrac{\pi}{180}$

c. $\dfrac{180}{\pi}$

d. 1

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88. If $y = \ln(\ln x)$ then $e^y \dfrac{dy}{dx}$ = [IOE 2075]

a. 1/x

b. x

c. 1

d. -1

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89. $\int e^x (\tan x + \sec^2 x)$ [IOE 2078]

a. $e^x \tan x + c$

b. $e^x \sec x + c$

c. $e^x \sec^2 x + c$

d. $e^x \tan^2 x + c$

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90. The IUPAC name compound

$$CH_3 - CH = CH - CH_2 - COOH$$
$$\overset{|}{OH}$$
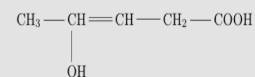
a. 4 – hydroxyl – 4 – pentenoic acid

b. 4 – hydroxy– 3 – pentenoic acid

c. hydroxyl pentenoic acid

d. 4 – hydroxyl – 4 – methyl – 3 – ene – pentanoic acid

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91. Tincture of iodine is

a. I_2, KI and rectified sprit

b. I_2 and rectified sprit

c. KI and rectified sprit

d. I_2 and water

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92. During the detection of organic compound sodium extract is prepared to

a. Dissolve it in water

b. To convert it into ionic form

c. Make it more reactive

d. Make the reaction slow

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93. 2.76 g of silver carbonate (at mass of Ag =108) on being heated strongly yield a residue weighing

a. 23.2 g

b. 12.3 g

c. 2.16g

d. 0.23 g

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94. 25 ml of 1 N solution of acid was diluted to 250 ml. 10 ml of the solution was titrated with 0.05 N alkali solution. The volume of alkali solution required for complete neutralization would be

a. 100 ml

b. 20 ml

c. 5 ml

d. 10 ml

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95. HA is a weak acid. The pH of 0.1 M HA solution is 2. The degree of dissociation of HA is

a. 0.1

b. 0.2

c. 0.3   d. 0.4

96. The quantity of electricity required to liberate 0.01g equivalent of element at electrode is

a. 96500 C

b. 9650 C

c. 965 C

d. 96.5 C

Read the following passage and answer the questions below: *(Questions from 97 to 100)*

Until very recently, it was universally believed that men are congenitally more intelligent than women, even so enlightened a man as Spinoza decided against votes of women on this ground. Among white men, it is held that white men are by nature superior to men of other colors and is the best colour. In Haiti, when they make statues of Christ and Satan, so innately superior to barbarians that slavery was justified so long as the master was Green and the slave a barbarian.

97. Congenitally means.

a. Certainly

b. innately

c. fantastically

d. falsely

98. Spinoza decided against votes for women because according to him

a. they were less educated than men

b. they were generally unintelligent.

c. they were naturally less gifted with intelligence

d. they did not deserve to have votes

99. I Haiti, Christ's statue is black and Satan white because the people there believe that

a. Christ was evil.

b. Satan was good.

c. black was good

d. All white was good

100. Aristotle and Plato supported slavery because the thought

a. the Greek to be superior to barbarians

b. the barbarians to be superior to Greeks

c. slaves to be inferior

d. that the barbarian belonged to Greece

Answer Key							
1.b	2.a	3.b	4.b	5.c	6.a	7.b	8.d
9.d	10.c	11.c	12.d	13.a	14.c	15.a	16.a
17.a	18.c	19.a	20.b	21.c	22.c	23.b	24.b
25.b	26.a	27.c	28.b	29.b	30.d	31.d	32.c
33.a	34.b	35.c	36.d	37.d	38.b	39.b	40.d
41.a	42.c	43.b	44.c	45.b	46.c	47.c	48.c
49.b	50.a	51.a	52.b	53.d	54.a	55.a	56.c
57.c	58.a	59.b	60.c	61.b	62.a	63.b	64.d
65.a	66.a	67.b	68.a	69.d	70.c	71.c	72.c
73.a	74.c	75.c	76.d	77.b	78.a	79.a	80.d
81.d	82.a	83.a	84.c	85.a	86.d	87.b	88.a
89.a	90.b	91.a	92.b	93.c	94.b	95.a	96.c
97.b	98.c	99.d	100.a				

Solutions

1. b

$$V = \frac{W}{q} = [ML^2T^{-3}A^{-1}]$$

2. a

For the coin to revolve without slipping . Frictional force $\geq$ Centripetal force

$$\mu mg \geq \frac{m\omega^2}{g}$$

3. b

$$v = \frac{v_e}{2} \ i.e \ \frac{v_e}{n}$$

$$h = \frac{R}{n^2 - 1} = \frac{R}{2^2 - 1} = \frac{R}{3}$$

4. b

For disc M.I about its own axis through C.G,

$$I_0 = \frac{MR^2}{2}$$

M.I of ring about its diameter,

$$I_0 = \frac{MR^2}{2}$$

5. c

Increase in area of soap film $= A_2 - A_1 = 2(10 \times 0.6 - 10 \times 0.5) \times 10^{-4} = 2cm^2$

Work done $= T \times \Delta A = 72 dyne/cm \times 2cm^2 = 144 erg$

6. a

7. b

$$K_{eq} = \frac{2K_1K_2}{K_1 + K_2} = K$$

8. d

Since angle of emergence is 20°, angle of incidence on mirror A is 20°.
Since angle of deviation on B is 62°, angle of reflection (and angle of incidence) on B is 31°
Hence,
Angle of inclination $= 180°-(20° + 31°) = 129°$

This is the angle between reflecting surfaces of the mirror. Actual angle of inclination of $180° - 129° = 51° \approx 50°$

9. d

From Snell's law, $\dfrac{\sin i}{\sin r} = \dfrac{\mu_2}{\mu_1}$

$$\frac{\sin 45°}{\sin r} = \frac{1}{\sqrt{2}} \rightarrow \sin r = 1 \rightarrow r = 90°$$

That is , the ray emerges at an angle 90° in air

10. c

Q = CV ,
As V is constant (battery connected) , therefore Q α C

Hence C becomes $\dfrac{100}{40} = 2.5$ times

$$K = 2.5$$

11. c

$$P = \frac{V^2}{R}$$

For same supply voltage, $P \propto \dfrac{1}{R}$

$$\therefore \frac{R_1}{R_2} = \frac{P_2}{P_1} = \frac{200}{500} = 2 : 5$$

12. d

The value of H is fairly uniform.

13. a

14. c

$$= -\sin\frac{3\pi}{4} = -\frac{1}{\sqrt{2}}$$

15. a

$$T = \frac{1}{n_2 - n_1} = \frac{1}{454\text{–}450} = \frac{1}{4}\ \text{sec}$$

16. a

Order of penetrating power = γ > β > α

17. a

When a pure semiconductor is heated, its resistance decreases. When the temperature is raised, some covalent bonds in the semiconductor break due to the thermal energy supplied.

18. c

Highest point from x-axis = Max. value of $y = 7\sin x + 24\cos x$

$= \sqrt{7^2 + 24^2} = 25$

19. a

$m^2 + n^2 = 25$

(a) $1^2 + 2^2 = 5 \neq 25$

(b) $3^2 + 4^2 = 25 = 25$ and $3 < 4$

Hence, $(m, n) = (3, 4)$

20. b

$$\sin\left\{\left(\omega^{13} + \omega^{20}\right)\pi + \frac{\pi}{4}\right\}$$

$$= \sin\left\{\left(\omega^{12}\cdot\omega + \omega^{18}\cdot\omega^2\right)\pi + \frac{\pi}{4}\right\}$$

$$= \sin\left\{\left(\omega + \omega^2\right)\pi + \frac{\pi}{4}\right\} = \sin\left(-\pi + \frac{\pi}{4}\right)$$

21. c

a_1, a_2, a_3 are in A.P

$a_1 + a_3 = 2a_2$

$a_p, a_q, a_r,$ are in A.P

$a_q - a_p = a_r - a_q$

$a + (q-1)d - [a + (p-1)d] = a + (r-1)d - [a + (q-1)d]$

$(q - 1 + p - 1)d = (r - 1 - q + 1)d$

$2q = p + r$

22. c

$$\sin\left(\frac{1}{2}\cos^{-1}x\right) = 1$$

$$\left(\frac{1}{2}\cos^{-1}x\right) = \sin^{-1}1 = \frac{\pi}{2}$$

$$\cos^{-1}x = \pi$$

$$x = \cos\pi = -1$$

23. b

$$\cos^{-1}y = \frac{\pi}{3}$$

$$y = \cos\frac{\pi}{3} = \frac{1}{2}$$

$$\sin^{-1} x + \sin^{-1} y = \frac{2\pi}{3}$$

$$\sin^{-1} x + \sin^{-1} \cos\frac{\pi}{3} = \frac{2\pi}{3}$$

$$\sin^{-1} x + \cos^{-1}(\cos(\frac{\pi}{2} - \frac{\pi}{3})) = \frac{2\pi}{3}$$

$$\sin^{-1} x + \frac{\pi}{6} = \frac{4\pi}{6}$$

$$\sin^{-1} x = \frac{\pi}{2} \rightarrow x = 1$$

24. b

$$(b + c)\cos A + (c + a)\cos B + (a + b)\cos C$$

$$b\cos A + c\cos A + c\cos B + a\cos B + a\cos C + b\cos C$$

$$(b\cos A + a\cos B) + (c\cos A + a\cos C) + (a\cos B + b\cos A)$$

$$c + b + a$$

25. b

Vector perpendicular to both is the cross product of two vectors:

$$(2\vec{i} - \vec{j} + \vec{k}) \times (3\vec{i} + 4\vec{j}) = -4\vec{i} + 3\vec{j} + 11\vec{k}$$

But we need unit vector, unit vector is vector divided by magnitude of vector.

$$\frac{-4\vec{i} + 3\vec{j} + 11\vec{k}}{(-4)^2 + 3^2 + 11^2}$$

$$\frac{1}{\sqrt{146}}(-4\vec{i} + 3\vec{j} + 11\vec{k})$$

26. a

The portion between the coordinate axes is bisected at (h, k)

$$(h, k) = \frac{a + 0}{2}, \frac{0 + b}{2} \rightarrow a = 2h, b = 2k$$

$$\frac{x}{a} + \frac{y}{b} = 1$$

$$\frac{x}{2h} + \frac{y}{2k} = 1$$

$$\frac{x}{h} + \frac{y}{k} = 2$$

27. c

Radius = $\sqrt{(4 - 1)^2 + (6 - 2)^2} = \sqrt{3^2 + 4^2} = 5$

Hence $A = \pi r^2 = \pi 5^2 = 25\pi$

28. b

The given conic is: $x^2 - y^2 = -a^2$ i.e., $\frac{x^2}{a^2} - \frac{y^2}{a^2} = -1$ as $a = b$ so, eccentricity (e) = $\sqrt{1 + \frac{a^2}{a^2}} = \sqrt{2}$

29. b

For vertical ellipse $b > a > 0$

30. d

Slope of line joining (1,1) and (a,0) = slope of line joining (a,0) and (0,b)

$or, \dfrac{0-1}{a-1} = \dfrac{b-0}{0-a} \implies \dfrac{1}{a-1} = \dfrac{b}{a} \implies a = ab - b \implies a + b - ab = 0$

31. d

$$\lim_{x\to\infty} \dfrac{(x+1)^{10} + (x+2)^{10} + \ldots\ldots + (x+100)^{10}}{(x^{10} + 10^{10})}$$

$$\lim_{x\to\infty} \dfrac{x^{10}[(1+\dfrac{1}{x})^{10} + (1+\dfrac{2}{x})^{10} + \ldots\ldots + (1+\dfrac{100}{x})^{10}}{x^{10}[(1+\dfrac{10^{10}}{x^{10}})}$$

$$\lim_{x\to\infty} \dfrac{[(1+\dfrac{1}{x})^{10} + (1+\dfrac{2}{x})^{10} + \ldots\ldots + (1+\dfrac{100}{x})^{10}}{(1+\dfrac{10^{10}}{x^{10}})}$$

$$\dfrac{1+1+1+\cdots+1}{1}(100 \text{ times addition})$$

100

32. c

$y = e^{x^x}$

$\therefore \log y = x^x \log e = x^x$

Again, $\log(\log y) = x \log x$

\text{Differentiating w.r.t x , we get}

$\dfrac{1}{\log y} \cdot \dfrac{1}{y}\dfrac{dy}{dx} = \left(x \cdot \dfrac{1}{x} + \log x\right)$

$\dfrac{dy}{dx} = y \log y(1 + \log x) = e^{x^x} x^x (1 + \log x)$

33. a

$$\dfrac{d}{dx} \tan^{-1}(e^x) = \dfrac{1}{1 + (e^x)^2} \times e^x = \dfrac{1}{e^{-x} + e^x}$$

34. b

$y = x^x$

$\dfrac{dy}{dx} = x^x(1 + \log x)$

$1 + \log x = 0$

$\log x = -1$

$x = e^{-1}$

$x = \dfrac{1}{e}$

35. c

$0 \le |x| < \infty$

36. d

$$\int \dfrac{\sin x \cos x}{2\cos^2 x}dx =$$

$$\dfrac{1}{2}\int \dfrac{\sin x}{\cos x}dx =$$

$-\dfrac{1}{2}\log \cos x + c$

$\dfrac{1}{2}\log \sec x + c$

$\log \sqrt{\sec x} + c$

37. d

Required area$(A) = \int_0^{\pi/4} \tan x\, dx + \int_{\pi/4}^{\pi/2} \cot x\, dx$

$= [\log \sec x]_0^{\pi/4} + [\log \sin x]_{\pi/4}^{\pi/2}$

$= (\log \sec \pi/4 - \log \sec 0) + (\log \sin \pi/2 - \log \sin \pi/4)$

$= \log \sqrt{2} - \log \dfrac{1}{\sqrt{2}}$

$= \log \sqrt{2} - \log 1 + \log \sqrt{2}$

$= 2 \log \sqrt{2}$

$= 2 \cdot 1/2 \log 2$

$= \log 2$

38. b

2-butene is symmetrical alkene, $CH_3-HC= CH-CH_3$ hence Markovnikov's rule is not applicable.

39. b

A carbon atom forms four bonds in stable organic compounds such as ethane, ethene (ethylene), and ethyne (acetylene). Each carbon atom in ethane forms four single bonds, one to each of three hydrogen atoms and one to the neighboring carbon atom.

40. d

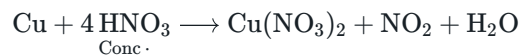$H_2S_2O_7 (H_2SO_4 + SO_3)$ - Fuming Sulphuric acid is also known as oleum.

41. a

Fluorine only shows -1 oxidation state due to the absence of a d-orbital.

42. c

Sodium is extracted by the electrolysis process of fused sodium chloride by a process called Down's process.

43. b

$Cu + 4\,HNO_3 \underset{Conc.}{\longrightarrow} Cu(NO_3)_2 + NO_2 + H_2O$

44. c

Lime stone in the manufacture of Hematite ore is called flux. It removes unwanted material combining with gangue.

45. b

Neutralization of an acid and base involves the combination of

$H^+ + OH^- \longrightarrow H_2O$

46. c

As $HCOONa$ is a salt of weak acid which on dissolving in water will produce counter anion. i.e $HCOO^-$ which suppress the dissociation of $HCOOH$ due to common ion effect, hence, the degree of ionisation will be decreased to maximum extent.

47. c

48. c

49. b

50. a

51. a

52. b

53. d

54. a

55. a

56. c

57. c

58. a

generic means having the characteristic of a whole group, or general

59. b

60. c

61. b

$$t_1 = \frac{s}{2} \times v_2 = \frac{s}{2} \times 30 = \frac{s}{60}$$

$$t_2 = \frac{s}{2} \times v_2 = \frac{s}{2} \times 40 = \frac{s}{80}$$

$$V_{av} = \frac{s}{t_1 + t_2} = \frac{s(80 \times 60)}{80 \times s + 60 \times s}$$

$$= s \times \frac{4800}{140s} = 34.3 \text{ km/ hr}$$

62. a

Gain in PE $= -\dfrac{GMm}{R_1} + R - (\dfrac{-GMm}{R_1})$

$= GMm(\dfrac{1}{R} - \dfrac{1}{2R}) = gR^2.m \times \dfrac{1}{2R} = \dfrac{mgR}{2}$

63. b

$$F_{max} = mr\omega^2 = 50 \times 10^{-3} \times 0.1 \times (\frac{2\pi}{T})^2$$

64. d

65. a

$dW = 100J$
$dU = 0$

66. a

$$\mu = \frac{h}{h'}$$

$$h' = \frac{8}{\frac{4}{3}} = 6m$$

67. b

68. a

$$i = \frac{q}{T} = \frac{e}{\frac{2\pi r}{v}} = \frac{ev}{2\pi r}$$

69. d

$$B = \frac{\mu_0 NI}{2r} = \frac{4\pi \times 10^{-7} \times 500 \times 18}{2 \times 10 \times 10^{-2}} = 0.0565T =$$
5.65×10^{-2} T

70. c

$$E = \frac{d\phi}{dt}$$

$$= \frac{-NBA(\cos 180° - \cos 0°)}{t}$$

$$\frac{-NBA(-1 - 1)}{t}$$

$$= \frac{2NBA}{t}$$

$$= \frac{2 \times 1000 \times 0.4 \times 10^{-4} \times 500 \times 100^{-4}}{\frac{1}{10}}$$

$$= 4 \times 10^{-2} = 0.04V$$

71. c

72. c

73. a

eV = hfmax

eV = hc / λmin

λmin = hc/ eV

74. c

Given, $T_{1/2} = 26.8\text{min} = 1608s$

∴ $\lambda = \dfrac{0.693}{T_{1/2}} = \dfrac{0.693}{1608}$

$= 0.431 \times 10^{-3} s^{-1}$

If N_c is the number of atoms in one curie,

$\dfrac{d}{dt}(N_c) = \lambda \cdot N_c$

According to the definition of Curie,

$\dfrac{d}{dt}(N_c) = 3.7 \times 10^{10}$

∴ $N_c = 8.585 \times 10^{13}$

Atomic weight of $Pb^{214} = 214$

Mass of one atom $= \dfrac{214}{\text{Avogadro.s number}}$

Mass of N_c atoms $= \dfrac{214}{6.023 \times 10^{23}} N_c g$ [from Eq. (i)]

$= 305.03 \times 10^{-10} g$

75. c

$f = \{(1,5),(2,6),(3,4)\}, g = \{(4,7),(5,8),(6,9)\}$

Range of $f = \{5,6,4\}$

Range of $g = \{3,1\}$

Now, $g_o f(1) = g(f(1)) = g(5) = 8$

$gof(2) = g(6) = 9$

$gof(3) = g(4) = 7$

∴ $g_o f = \{(1,8),(2,9),(3,7)\}$

76. d

$A^2 = \begin{bmatrix} 1 & 2 \\ -3 & 0 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ -3 & 0 \end{bmatrix} = \begin{bmatrix} -4 & 2 \\ -3 & -6 \end{bmatrix} \neq A$

$B^2 = \begin{bmatrix} -1 & 0 \\ 2 & 3 \end{bmatrix} \begin{bmatrix} -1 & 0 \\ 2 & 3 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 4 & 9 \end{bmatrix} \neq B$

$AB = \begin{bmatrix} 1 & 2 \\ -3 & 0 \end{bmatrix} \begin{bmatrix} -1 & 0 \\ 2 & 3 \end{bmatrix} = \begin{bmatrix} 3 & 6 \\ 3 & 0 \end{bmatrix}$

$BA = \begin{bmatrix} -1 & 0 \\ 2 & 3 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ -3 & 0 \end{bmatrix} = \begin{bmatrix} -1 & -2 \\ -7 & 4 \end{bmatrix}$

Hence $AB \neq BA$

77. b

$\left| \dfrac{(z-2)}{(z-4)} \right| = 1$

$\dfrac{|(z-2)|}{|(z-4)|} = 1$

$\dfrac{\sqrt{(x-2)^2 + y^2}}{\sqrt{(x-4)^2 + y^2}} = 1$

$(x-2)^2 = (x-4)^2$

$x^2 - 4x + 4 = x^2 - 8x + 16$

$4x = 12$

$x = 3$

78. a

79. a

$\dfrac{1}{12} + \dfrac{1}{2.2^2} + \dfrac{1}{3.2^3} + \ldots\ldots\infty$

$$= \frac{\left(\frac{1}{2}\right)}{1} + \frac{\left(\frac{1}{2}\right)^2}{2} + \frac{\left(\frac{1}{2}\right)^2}{3} + \ldots \ldots \infty$$

$$= -\log_e \left(1 - \frac{1}{2}\right)$$

$$= -\log_e \left(\frac{1}{2}\right) = \log_e 2$$

80. d

81. d

Here, $c^2 = a^2 + b^2 \rightarrow 5^2 = 3^2 + 4^2$

i.e., $\angle C = 90^o$

so, we have

$$\frac{c}{\sin C} = 2R$$

or, $\dfrac{5}{\sin 90^o} = 2R$

or, $R = 2.5$

82. a

83. a

Let $y - m_1 x = 0 \, \& \, y - m_2 x = 0$ be equation of line whose joint equation is $ax^2 + 2hxy + hy^2 = 0$

Then, $m_1 m_2 = \dfrac{a}{b} \ldots \ldots$ (i)

$$m_1 + m_2 = \frac{-2h}{b} \ldots \ldots$$
(ii)

Now, product of length of perpendiculars=
$$\frac{(y_1 - m_1 x_1)}{\sqrt{1 + m_1^2}} \frac{(y_1 - m_2 x_1)}{\sqrt{1 + m_2^2}}$$

$$= \frac{(y_1^2 - m_1 x_1 y_1 - m_2 x_1 y_1 + m_1 m_2 x_1^2)}{\sqrt{(1 + m_1^2)(1 + m_2^2)}}$$

$$= \frac{(y_1^2 - x_1 y_1 (m_1 + m_2) + m_1 m_2 x_1^2)}{\sqrt{(1 + m_1^2 + m_2^2 + m_1^2 m_2^2)}}$$

$$= \frac{\left(y_1^2 + x_1 y_1 \dfrac{2h}{b} + \dfrac{a}{b} x_1^2\right)}{\sqrt{(1 + (m_1 + m_2)^2 - 2m_1 m_2 + m_1^2 m_2^2)}}$$

$$= \frac{\left(y_1^2 + x_1 y_1 \dfrac{2h}{b} + \dfrac{a}{b} x_1^2\right)}{\sqrt{\left(1 + \left(-\dfrac{2h}{b}\right)^2 - 2\dfrac{a}{b} + \left(\dfrac{a}{b}\right)^2\right)}}$$

$$= \frac{(by_1^2 + 2h x_1 y_1 + a x_1^2)}{\sqrt{b^2 + 4h^2 - 2ab + a^2}}$$

$$\frac{ax_1^2 + 2h x_1 y_1 + by_1^2}{\sqrt{(a - b)^2 + 4h^2}}$$

84. c

85. a

86. d

Direction ratios of line $(a, b, c) = (-5 - 2, -4 - 3, -2 - 1) = (-7, -7, -3)$

So, equation of plane is: $a(x - x_1) + b(y - y_1) + c(z - z_1) = 0$

or, $(-7) \times (x - 0) + (-7) \times (y - 0) + (-3) \times (z - 0) = 0$

equation of plane is $7x + 7y + 3z = 0$

87. b

88. a

$y = \ln(\ln x) \Rightarrow e^y = \log_e x$

now, $e^y dy/dx = \log_e x \dfrac{d}{dx} \log_e(\log_e x)$
$= \log_e x * 1/\log_e x * 1/x$
$= 1/x$

89. a

90. b

91. a

Tincture of iodine is an solution of I_2 in aqueous KI. It is an antiseptic, it is also called weak iodine solution. It is usually 2-7% elemental iodine, along with potassium iodide, dissolved in a mixture of ethanol and water.

92. b

Sodium extract is prepared because the elements in the organic compounds are in the covalent form in which they cannot be detected but when the organic compound is fused with sodium metal, sodium salt are formed in which organic compound converted into ionic salt and hence elements can be easily detected.

93. c

$Ag_2CO_3 \longrightarrow 2\,Ag^+ + CO_3^{-2}$
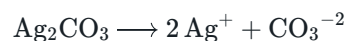
$276\,g = 216\,g$ of Ag

$2.76\,g = 2.16\,g$ of Ag

94. b

For dilution
$25 \times 1 = 250 \times N$

$N = 0.1N$

For reaction of acid with alkali

$10 \times 0.1 = 0.05 \times V$

$V = 20$ ml

95. a

$pH = 2 \rightarrow [H^+] = 10^{-2}$

$[H^+] = c\,\alpha$

$10^{-2} = 0.1 \times \alpha$

$\alpha = 0.1$

96. c

1 gm equivalent of substance required 96500 C

0.01 gm equivalent=965C

97. b

98. c

99. d