ClampHook CBT Mock Test, 24th June, Shift 3

Tribhuvan University

2080

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

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1. Velocity of a particle is given by $v = a + \dfrac{b}{t} + ct^2$. The unit of b will be:

a. ms^{-2} b. ms^{-1}

c. ms^2 d. m

2. A chain has coefficient of friction 0.25 with the table surface. The maximum fraction of length of chain that can be hung over the table is [IOE 2078]

a. 20% b. 25%

c. 30% d. 35%

3. The cause of day and night is due to

a. Rotation of earth around it axis.
b. Revolution of earth around the sun.

c. Effect of gravity of moon on earth.
d. Effect of gravity of moon on earth.

4. The bob of a simple pendulum of length L is released at time t = 0 from a position of small angulardisplacement. Its linear displacement at time t is given by

a. $y = a \sin\ 2\pi\sqrt{\dfrac{L}{g}} \times t$

b. $y = a \cos\ 2\pi\sqrt{\dfrac{g}{L}} \times t$

c. $y = a \sin \sqrt{\dfrac{g}{L}} \times t$

d. $y = a \cos \sqrt{\dfrac{g}{L}} \times t$

5. A metallic sphere with a cavity weigh 200g in air and it weighs 120g when immersed in water. If

a. $80cm^3$ b. $120cm^3$

c. $40cm^3$ d. $20cm^3$

6. The common mercury thermometer can be used to measure temperature between.

a. $-30°$ to $100°C$ b. $0°$ to $200°C$

c. $-30°$ to $200°C$ d. $-30°$ C to $357°C$

7. Kirchoff's law states that

a. A good absorber of radiation is good reflector.
b. A poor absorber of radiation is poor reflector.

c. A good absorber of radiation is poor reflector.
d. A poor absorber of radiation is good reflector.

8. A transparent cube of a 12 cm edge contains a small air bubble. Its apparent depth when viewed through one face of the cube is 6 cm and when viewed through the opposite face is 2 cm. What is the actual distance of the bubble from the first face?

a. 6 cm   b. 2 cm

c. 8 cm

d. 9 cm

a. 10 mA

b. 15 mA

c. 20 mA

d. 18 mA

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9. A beam of monochromic blue light of wavelength 420 nm in air travels in water of refractive index is 1.33. Its wavelength in nm in water will be

a. 560 nm

b. 400 nm

c. 315 nm

d. 280 nm

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10. A capacitor of capacity C_1 is charged by connecting it across a battery of e.m.f V_o . The battery if then removed and he capacitor is connected in parallel with an uncharged capacitor C_2 . the potential difference across this combination is :

a. $\dfrac{C_2}{C_1 + C_2} V_o$

b. $\dfrac{C_1}{C_1 + C_2} V_o$

c. $\dfrac{C_1 + C_2}{C_2} V_o$

d. $\dfrac{C_1 + C_2}{C_1} V_o$

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11. If E_1 and E_2 be the Thermo emf of Bi- Sb and Cu – Fe thermocouple respectively for the given temperature difference between the two junctions , which of the followings is true ?

a. $E_1 = E_2$

b. $E_1 < E_2$

c. $E_1 > E_2$

d. None of the above

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12. A proton moving in a perpendicular magnetic field increases to $4B$ and the particle is constrained to move in the path of same radius, the kinetic energy of proton must be

a. Increased to 4 times

b. Increased to 16 times

c. Reduced to half

d. Unchanged

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13. An AC voltage $V = 200\sqrt{2}\sin(100t)$ volts is connected to a $1\mu F$. capacitor through an ac ammeter. The reading on the ammeter is _____.

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14. In an interference pattern produced by the identical coherent source of monochromatic light, the intensity at the spot of central maxima is I. The new intensity of central maxima, when one of the slits is closed, is :

a. I

b. $\dfrac{I}{2}$

c. $\dfrac{I}{4}$

d. $2I$

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15. A string of Length L is stretched between two points and harmonic waves are set up in the string. The wavelength of the second harmonic is :

a. L

b. $2L$

c. $3L$

d. $4L$

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16. an electron and a proton are projected in an magnetic field at right angles to the field with the same velocity. Then which of the following is true

a. trajectory of electron greater than proton

b. trajectory of electron less than proton

c. trajectory of electron equals than proton

d. cannot be determined

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17. In the half wave rectifier circuit operating from 50 Hz, mains frequency, the fundamental frequency inn the ripple would be:

a. 25 Hz

b. 50 Hz

c. 75 Hz

d. 100 Hz

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18. If 'm' is the no. of elements of a set then no of all the possible subsets are [IOE 2078]

a. m

b. 2^m

---

c. $2^m - 1$ d. 2m

a. -2   b. -1

c. 1   d. 0

19. $\begin{bmatrix} 1 & 3 \\ 3 & 10 \end{bmatrix}^{-1}$ **is:**

a. $\begin{bmatrix} -1 & -3 \\ -3 & -10 \end{bmatrix}$ b. $\begin{bmatrix} 1 & -3 \\ 3 & -10 \end{bmatrix}$

c. $\begin{bmatrix} 10 & 3 \\ 3 & 1 \end{bmatrix}$ d. $\begin{bmatrix} 10 & -3 \\ -3 & 1 \end{bmatrix}$

20. The total number of positive roots of the polynomial $x^3 - 2x^2 - x + 2 = 0$ **is**

a. 0   b. 3

c. 2   d. 1

21. If a, b, c **are in AP** b, c, d **are in GP** c, d, e **are in H.P., then** a, c, e **are in**

a. HP   b. GP

c. AP   d. None

22. If $\tan^{-1}(2x) + \tan^{-1}(3x) = n\pi + \dfrac{3\pi}{4}, n \in I$; **then x is equal to:**

a. $1, -\dfrac{1}{6}$ b. $\dfrac{1}{2}, \dfrac{1}{3}$

c. $4, 5$ d. $-3, \dfrac{1}{6}$

23. $\tan^{-1}(\tan 5)$ **is:**

a. 5   b. $\dfrac{1}{5}$

c. $2\pi - 5$ d. $5 - 2\pi$

24. In any triangle ABC , $\angle A$ **is right angled triangle . Then the value of** $\cos^2 B + \cos^2 C$ **is :**

25. If D is the midpoint of BC in $\triangle ABC$, **then which of the following is true ? [IOE 2076]**

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

c. $\overrightarrow{AD} = \dfrac{\overrightarrow{AB} + \overrightarrow{AC}}{3}$ d. None

26. If the slope of the line is zero then the line is

a. Only x-axis   b. Only y-axis

c. Parallel to x-axis   d. Parallel to y-axis

27. The equation of the common chord of the circle $x^2 + y^2 - 8x - 2y + 9 = 0$ **and** $x^2 + y^2 - 4x + 10y + 8 = 0$ **is :**

a. $4x - 12y - 1 = 0$ b. $4x - 12y + 1 = 0$

c. $4x + 12y - 1 = 0$ d. $4x + 12y + 1 = 0$

28. The equation of normal to the parabola $y^2 = 8x$ **having slope 1 is :**

a. x + y + 6 = 0   b. x−y−6 = 0

c. x − y + 6 = 0   d. x + y − 6 = 0

29. The locus of the point of the intersection of lines $x = \sec t + \tan t$ **and** $y = \sec t - \tan t$ **is**

a. Circle   b. Ellipse

c. Parabola   d. Hyperbola

30. Equation of the plane through the origin which contains the line $\dfrac{x-a}{l} = \dfrac{y-b}{m} = \dfrac{z-c}{n}$ **is**

a. $x(bn - cm) + y(cl - an) + z(am - bl) = 0$

b. $(x - a)l + (y - b)m + (z - c)n = 0$

c. $(x - l)a + (y - m)b + (z - n)c = 0$

d. $x(al - bm) + y(bm - cn) + z(cn - al) = 0$

31. The value of $\lim_{x \to 0} \left(\frac{1}{x} \tan^{-1} \left(\frac{3x - x^3}{1 - 3x^2} \right) \right)$ is equal to

a. 0

b. 1

c. 2

d. 3

32. What is the derivative of $\frac{1}{x}$ with respect to x?

a. $-\frac{1}{x^2}$

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

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

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

33. If $x \sin(a + y) = \sin y$ then $\frac{dy}{dx} =$

a. $\frac{\sin(a + y)}{\sin a}$

b. $\frac{\sin^2(a + y)}{\sin^2 a}$

c. $\frac{\sin^2(a + y)}{\sin a}$

d. $\frac{\sin(a + y)}{\sin^2 a}$

34. The maximum value of the function $y = x(x - 1)^2, 0 \leq x \leq 2$ is

a. 0

b. None

c. $\frac{4}{27}$

d. -4

35. The maximum value of $\sin x \cos x$ is

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

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

c. -1

d. 2

36. $\int \frac{1}{\sqrt{1 - x^2} \sin^{-1} x} dx =$ [IOE 2076]

a. $\log(\cos^{-1} x) + c$

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

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

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

37. Smaller area enclosed by the circle $x^2 + y^2 = 4$ and the line $x + y = 2$ is:

a. $(\pi - 2)$ sq. units.

b. π sq. units.

c. $2\pi - 2$ sq. units.

d. $4\pi - 2$ sq. units.

38. Partial double bonds the character of carbon-carbon bonds of benzene is justified by a phenomenon called.

a. Inductive effect

b. Resonance

c. Electromeric effect

d. Hyper conjugation

39. An isomer of ethanol is

a. Methanol

b. Dimethyl ether

c. Diethyl ether

d. Ethylene glycol

40. Which of following turns lead acetate paper black

a. SO_2

b. SO_3

c. H_2SO_4

d. H_2S

41. The active species in aqua-regia is

a. Nascent hydrogen

b. Nascent oxygen

c. Nascent nitrogen

d. Nascent chlorine

42. When $NaCl$ is dissolved in water , Na^+ ion is [IOE 2075]

a. Hydrolysed

b. Oxidised

c. Reduced

d. Hydrated

43. The number water molecules directly bonded to Cu^{++} ion in $CuSO_4 \cdot 5H_2O$ is: [IOE 2078]

a. 2

b. 3

c. 4

d. 5

44. Cosmetic powders and zinc ointments contain

a. Pb

b. ZnO

c. $ZnCO_3$

d. $ZnSO_4$

45. NaH when dissolve in water produces

a. Neutral solution

b. Basic solution

c. Acidic solution

d. Can not be predicted

46. Conjugate acid of $S_2O_8^{2-}$ is

a. $H_2S_2O_8$

b. H_2SO_4

c. $HS_2O_8^-$

d. HSO_4^-

47. What is the maximum number of electrons, which can have following quantum numbers, n = 3, l = 1, m = -1?

a. 2

b. 4

c. 6

d. 10

48. Which of the following is correct?

a. Ionic radius is proportional to atomic number

b. Ionic radius is inversely proportional to atomic mass

c. Ionic radius is inversely proportional to effective nuclear charge

d. all

49. He really enjoyed …….. moment passed with us.

a. no one

b. neither

c. each

d. any

50. The socks……………torn.

a. is

b. was

c. are

d. has been

51. He prefer tea __ coffee. [IOE 2075]

a. for

b. to

c. of

d. at

52. The bird is flying'. The correct pattern for this sentence is [IOE 2077]

a. S + V + 0

b. S + V

c. S+V+Adj

d. S+V+C

53. The game _____ at 5 O'clock today.

a. began

b. will be beginning

c. begins

d. had began

54. Why do you waste time?

a. Why is time being wasted by you?

b. Why has time been wasted by you?

c. Why is time wasted by you?

d. Why is time been wasted by you?

55. The word 'Modality' gets its primary stress on its…….syllable. [IOE 2075]

a. 1st

b. 2nd

c. 3rd

d. 4th

56. When he handed in his homework he forgot the last page.

a. Simple Sentence

b. Compound Sentence

c. Complex Sentence   d. Compound-Complex Sentence

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57. She is a hot dancer.' hot' means:

a. valuable

b. sensual

c. tasty

d. simple

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58. Antonym of 'pit' is:

a. group

b. peak

c. select

d. marry

---

59. We'd be terribily offended if he ....

a. didn't come

b. Hadn't have come

c. wouldn't come

d. Wouldn't have come

---

60. Antonym of Terrible is

a. soothing

b. frightening

c. scaring

d. horrible

---

61. A stone is just released from the window of a train moving along a horizontal straight track. The stone will hit the ground following

a. Straight path

b. Circular path

c. Parabolic path

d. Hyperbolic path

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62. Two identical balls A and B are moving towards each other with velocity 5m/s and -3m/ s, undergoes head on collision . Their velocities after collision will be

a. $+5$ and -3

b. -3 and $+5$

c. $+3$ and -5

d. -5 and $+3$

---

63. In simple harmonic motion of pendulum, time period is independent of [IOE 2078]

a. length from CG of bob to point of suspension

b. acceleration due to gravity

c. mass of bob

d. effective g

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64. Equal volume of two immiscible liquids of densities ρ and 2ρ are filled in a vessel. Two small holes are punched at depth $\dfrac{h}{2}$ and $\dfrac{3h}{2}$ from the surface of lighter liquid If V_1 and V_2 are the velocities of efflux at these two holes, then $\dfrac{V_1}{V_2}$ is

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

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

c. $\dfrac{1}{4}$

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

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65. A Carnot engine works between a source and sink maintained at constant temperatures T_1 and T_2. For efficiency to be the greatest [IOE 2073]

a. T1 and T2 should be high

b. T1 and T2 should be low

c. T1 should be low and T2 should be high

d. T1 should be high and T2 should be low

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66. An air bubble in a glass slab of refractive index $\dfrac{3}{2}$ appear 6 cm when viewed from one side and 4cm when viewed from one side and 4cm when viewed from opposite side . The thickness of the glass slab is :

a. 12 cm

b. 13 cm

c. 14 cm

d. 15 cm

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67. If a dielectric substance is introduced between the plates of a charged air-gap capacitor. The energy of the capacitor will [ ]

a. Increases

b. Decreases

c. Remain unchanged

d. First Increase and Decrease

68. A galvanometer has a resistance of 7 ohm gives a full scale deflection for 1 A. how can be converted into voltmeter of range 10 v? [IOE 2078]

a. 3 in series

b. 3 in parallel

c. 10 in series

d. 17 in parallel

69. A length of wire carrying current when bent to form a circle magnetic field is b. If the same length is bent to form n number of circular loops, then the magnetic field at centre is

a. $n^2 B$

b. nB

c. $\dfrac{B}{n}$

d. B

70. Transformer loses 30% energy in the form of heat. If input voltage is 220V and output voltage is 110V. Then, find the ratio of current in primary to secondary coil. [IOE 2078]

a. $\dfrac{5}{7}$

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

c. $\dfrac{7}{5}$

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

71. For identical open and closed pipes, the first overtone of the open organ pipe is 200 Hz more than first overtone of closed organ pipe . The length of pipes are (velocity of sound = $320ms^{-1}$) [IOE 2075]

a. 0.2 m

b. 0.4 m

c. 0.6 m

d. 0.8 m

72. A radio wave of frequency 840μ Hz is sent towards an aeroplane. The frequency of radio echo has a frequency 2.8 KHz more than original frequency. Then the Velocity of aeroplane is:

a. 3 km/s

b. 2 km/s

c. 4 km/s

d. 0.5 km/s

73. Energy of photon is 20 eV then its momentum is

a. 5.33×10^{-27} kg m/ sec

b. 10.66×10^{-25} kg m/ sec

c. 10.66×10^{-27} kg m/ sec

d. 5.33×10^{-30} kg m/ sec

74. The frequency of first line of Balmer series in hydrogen atom is f_0. The frequency of the first line of same series emitted by Li^{++} is [IOE 2074]

a. $2f_0$

b. $4f_0$

c. $9f_0$

d. $\dfrac{f_0}{9}$

75. A relation $f : [-1, 1] \to R$ is defined by $x^2 + y^2 = 1 \forall x \in [-1, 1]$, then f is :

a. One-to-one and into

b. One-to-one and onto

c. Many to one and into

d. Not a function

76. If $(a_{11} = 9, a_{12} = 4, a_{21} = 2, a_{22} = 1)$ then $A + A^{-1} =$ [IOE 2078]

a. $10I$

b. $-10I$

c. $-5I$

d. $5I$

77. If $\omega(\neq 1)$ is a cube root of unity, then
$$\begin{vmatrix} 1 & 1 + i + \omega^2 & \omega^2 \\ 1 - i & -1 & \omega^2 - 1 \\ -i & -i + \omega - 1 & -1 \end{vmatrix}$$ is equal to

a. 0

b. 1

c. ω

d. i

78. If $\log_3 2, \log_3(2^x - 5)$ and $\log_3 \left(2^x - \dfrac{7}{2} \right)$ are in A.P, then x is equal to:

a. $2, 3$

b. $-2, -3$

c. 2 only

d. 3 only

79. A middle term in the expansion of $(1 + x)^{15}$ is

a. $^{15}C_7 x^7$

b. $^{15}C_8 x^8$ and $^{15}C_9 x^9$

c. $^{15}C_7 x^7$ and $^{15}C_8 x^8$

d. $^{15}C_8 x^8$

80. If $\sin^{-1} x + \sin^{-1} y = \cos^{-1} x + \cos^{-1} y = \dfrac{\pi}{2}$ then $x, y =$ [IOE 2078]

a. $x = 0, y = 1$

b. $x = 1, y = -1$

c. $x = 1, y = 1$

d. $x = 0, y = 0$

81. If $A = 60°$ then $\dfrac{b - c}{2R}$ is [IOE 2078]

a. $\sin\left(\dfrac{B + C}{2}\right)$

b. $2\sin\left(\dfrac{B + C}{2}\right)$

c. $2\sin\left(\dfrac{B - C}{2}\right)$

d. $\sin\left(\dfrac{B - C}{2}\right)$

82. If $\vec{a} = -\vec{i} + 3\vec{j}, \vec{b} = 2\vec{j} - 4\vec{k}$, Find $(\vec{a} \cdot \vec{b})^2 + (\vec{a} \times \vec{b})^2$? [IOE 2078]

a. 20

b. 100

c. 200

d. 400

83. $Ax^2 + By^2 + Cx + Cy = 0$ represents a pair of straight lines if: [IOE 2077]

a. A+B=0

b. A=B

c. A-2B=0

d. A+2B=0

84. Find the center of the circle $3x^2 + 3y^2 - 6x + 9y - 8 = 0$? [IOE 2078]

a. (1,-3/2)

b. (-1,-3/2)

c. (1,3/2)

d. (-1,3/2)

85. Eccentricity of parabola $x^2 - 4x - 4y + 4 = 0$ is [IOE 2078]

a. 0

b. 1

c. 2

d. 4

86. Equation of a plane passing through the point (2,1,-1) and (1,1,-2) and perpendicular to the plane x + 2y + 3z =4, is [IOE 2078]

a. x + 2y + z -3 = 0

b. x + y − z -4 = 0

c. 2x -y + z -4 = 0

d. 2x + y - z -5 =0

87. $\displaystyle\lim_{x \to 0} \dfrac{\log(\cos x)}{x^2}$ [IOE 2076]

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

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

c. 1

d. -1

88. Let f be a differentiable function defined for all $x \in R$ such that $f(x^3) = x^5$ for all $x \in R$. Then, the value of $f'(8)$ is [IOE 2078]

a. 20

b. $\dfrac{20}{3}$

c. $\dfrac{5}{3}$

d. 5

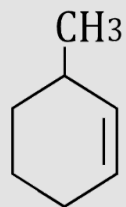**89. $\displaystyle\int \dfrac{\cos x}{\cos x + \sin x} dx$ [IOE 2074]**

a. $\dfrac{1}{2}[x - \log(\cos x + \sin x)] + c$

b. $\dfrac{1}{2}[x + \log(\cos x - \sin x)] + c$

c. $[x + \log(\cos x + \sin x)] + c$

d. $\dfrac{1}{2}[x + \log(\cos x + \sin x)] + c$

90. The IUPAC name of

CH3

a. 3-methylcyclohexene
b. 1-methyl-2-cyclohexene
c. 6-methyl cyclohexene
d. 1-methyl – 5- cyclohexene

91. The acid formed when iodine reacts with conc. HNO_3 is

a. Hydriodic acid
b. Periodic acid
c. Nitrous acid
d. Iodic acid

92. Sodium reacts with water more vigorously than lithium because it

a. Has higher atomic weight
b. Is more electronegative
c. Is more electropositive
d. Is a metal

93. Which law directly explain law of conservational of mass?

a. Dalton's law
b. Avogadro's law
c. Berzelius law
d. v

94. $20\,ml$ of $NaOH$ solution converts 8.3 ml of 0.240 M NaH_2O_4 in a solution to produce monohydrogen phosphate. The concentration of $NaOH$ solution is

a. 1
b. 0.5
c. 0.2
d. 0.1

95. A solution was prepared by dissolving 0.0005 mole of Ba(OH)2 in 100ml of gthe solution if the base is assumed to ionize completely, the pOH of the solution will be

a. 12
b. 10

c. 1
d. 2

96. A current of 4 Amp was passed for 1.5 hours through a solution of copper sulphate when 3.2 g of copper was deposited. The current efficiency is

a. 35.02%
b. 96.12%
c. 45.02%
d. 78.12%

Read the following passage carefully, and find out the correct answers for the questions given below (Questions from 97 to 100)

Read not to contradict and confute, nor to believe and take for granted, nor to find talk and discourse, but to weigh and consider. Some books are to be tasted, others to be swallowed, and some few to be chewed and digested; that is, some books are to be read only in parts; others to be read, but not curiously; and some few to be read wholly, and with diligence and attention. Some books may also be read by deputy, and extracts made of them by others; but that would be only in the less important arguments and the meaner sort of books; else distilled books are like common distilled waters, flashy things. Reading maketh a full man, conference a ready man, and writing an exact man. And therefore if a man write little, he had need have a good memory; if he confer little, he had need have a present wit; and if he read little, he had need have much cunning to seem to know that he doth not.

'Histories make man wise, poets witty; the mathematics subtle; natural philosophy deep; moral grave; logic and rhetoric able to contend.'

97. What does the art of writing do to man's character?

a. It makes him a full man
b. It makes him a ready man
c. It makes him an exact man
d. It makes him a good author

98. How should you read those books which are to be 'read wholly'?

a. By making extracts from them
b. They should be chewed and digested
c. They should be read in parts
d. They should be read with diligence and attention

99. What should be the real object of reading?

a. To distil the contents
b. To understand author's views and their application in day-to-day life
c. To weigh and consider
d. Not to contradict and confute

100. What can be done with regard to the 'meaner' sort of books?

a. To be read but not to contradict and confute
b. To be read only in parts
c. They can be "read by deputy and extracts made of them by others."
d. To be read, but not curiously

Answer Key							
1.d	2.a	3.a	4.d	5.c	6.d	7.c	8.d
9.c	10.b	11.c	12.b	13.c	14.c	15.a	16.b

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

Solutions

1. d

unit of v = unit of $\dfrac{b}{t}$

unit of b = unit of vt = unit of length = m

2. a

$$\mu = \frac{L - x}{x}$$

$$0.25x = L - x$$

$$1.25x = L$$

$x = 0.8L$

Hanging part = $L - x = 0.2L$

% hanging = 20%

3. a

Cause of winter and summer is due to revolution of earth around the sun.

The cause of day and night is due to rotation of earth around it axis.

4. d

Time period, $T = 2\pi\sqrt{\dfrac{L}{g}}$

$and, \omega = \dfrac{2\pi}{T} = \sqrt{\dfrac{g}{L}}$

Displacement, $y = a\cos\omega t = a\cos\sqrt{\dfrac{g}{L}} \times t$

5. c

Volume of the sphere with cavity V = Volume of water displaced

$V' = \dfrac{\text{mass of water displaced}}{\text{density of water}} = \dfrac{\text{Loss of weight}}{\text{density of water}} =$

$\dfrac{200 - 120}{1} = 80cm^3$

Volume of sphere without cavity

$V = \dfrac{200}{5} = 40cm^3$

6. d

Mercury Thermometer = -30 to $357°C$

Gas Thermometer = $-268°C$ to $1500°C$

Platinum resistance Thermometer = -20 to $1200°C$

Thermocouple thermometer = -200 to $1600°C$

Radiation pyrometer = $800°C$ to no upper limit

Magnetic thermometer = Near absolute zero temperature

Alcohol thermometer = $-110°C$ to $80°C$

7. c

Kirchoff's law of radiation states that

i) Good absorbers are good emitters.

ii) Good absorbers are bad reflectors.

8. d

$\mu = \dfrac{12}{6 + 12} = 1.5$

Actual real depth from first face = $\mu \times 6 = 1.5 \times 6 = 9$ cm

9. c

$\mu \propto \dfrac{1}{\lambda}$

or, $\dfrac{\mu_w}{\mu_a} = \dfrac{\lambda_a}{\lambda_w}$

or, $\dfrac{1.33}{1} = \dfrac{420}{\lambda_w}$

$\lambda = 315$ nm

10. b

$$:V = \frac{q_1 + q_2}{C_1 + C_2}$$

$$= \frac{C_1 V_o + 0}{C_1 + C_2}$$

$$= \frac{C_1 V_0}{C_1 + C_2}$$

11. c

Thermoelectric Series:

Sb, Fe, Cd, Zn, Ag, Au, Cr, Sn, Pb, Hg, Mn, Cu, Pt, Co, Ni, Bi

Sb–Bi (Antimony–Bismuth) shows a larger e.m.f for a given temperature difference. In the case of Cu–Fe thermocouple, the emf is lesser.

12. b

$$K.E \propto B^2$$

So, $E' = 4^2 E = 16E$

13. c

$$V = 200\sqrt{2}\sin(100t)$$

$$V_{rms} = \frac{V_0}{\sqrt{2}} = \frac{200\sqrt{2}}{\sqrt{2}} = 200$$

$$\omega = 100s^{-1}$$

impedence of capacitive circuit, $X_C = \dfrac{1}{\omega C} =$

$$\frac{1}{100 \times 1 \times 10^{-6}} = 10^4$$

$$I_{rms} = \frac{E_{rms}}{X_C} = \frac{200}{10^4} = 20mA$$

14. c

$$E^2 = E_1^2 + E_2^2 + 2E_1 E_2$$

where E is the amplitude. For coherent sources, $E^2 = I$

$$I = E_1^2 + E_2^2 + 2E_1 E_2$$

$$I = I_0 + I_0 + 2I_0 = 4I_0$$

15. a
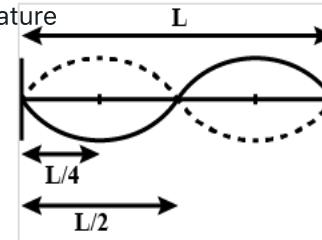
16. b

We know that,

$$\frac{1}{2}m_p v_p^2 = \frac{1}{2}m_e v_e^2$$

As, $m_p > m_e \Rightarrow v_e > v_p$

$$R = \frac{mv}{qB} = \frac{2K.E}{(qB)V}$$

$$v_e > v_p \Rightarrow R_p > R_e$$

17. b

In half wave rectifier, we get the output only in one half cycle of input AC. therefore, the frequency of the ripple of the output is same as that of input AC i.e. 50Hz

18. b

If 'm' is the no. of elements of a set then no of all the possible subsets are 2^m

19. d

$$\begin{vmatrix} 1 & 3 \\ 3 & 10 \end{vmatrix} = 1$$

$$A^{-1} = \frac{adj.A}{|A|}$$

$$\begin{bmatrix} 1 & 3 \\ 3 & 10 \end{bmatrix}^{-1} = \frac{1}{1}\begin{bmatrix} 10 & -3 \\ -3 & 1 \end{bmatrix} = \begin{bmatrix} 10 & -3 \\ -3 & 1 \end{bmatrix}$$

20. c

$$x^3 - 2x^2 - x + 2 = 0$$

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

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

Either $x = \pm 1$

or, $x = 2$ ∴ Two positive roots.

21. b

$$b = \frac{a+c}{2} \ldots \text{(i)}$$

$$c^2 = bd \ldots \ldots \text{(ii)}$$

$$d = \frac{2ce}{c+e} \ldots \text{(iii)}$$

From (i), (ii) and (iii)

$$c^2 = \frac{a+c}{2} \cdot \frac{2ce}{c+e}$$

or, $c^2 + ce = ae + ce$

or, $c^2 = ae$

∴ a, c, e are in G.P.

22. a

$$\tan^{-1}(2x) + \tan^{-1}(3x) = n\pi + \frac{3\pi}{4}$$

$$\tan^{-1}\left[\frac{2x + 3x}{1 - 2x \times 3x}\right] = n\pi + \frac{3\pi}{4}$$

$$\frac{5x}{1 - 6x^2} = \tan\frac{3\pi}{4} = -1$$

$$6x^2 - 5x - 1 = 0$$

$$6x^2 - 6x + x - 1 = 0$$

$$6x(x-1) + 1(x-1) = 0$$

$$(6x + 1)(x - 1) = 0$$

$$x = 1 \text{ or } x = -\frac{1}{6}$$

23. d

$\tan^{-1}(\tan 5)$

$\tan^{-1}(\tan 286.478°)$ coverting in degree

$-73.522°$

Checking all answers in degree;

option (a) $5 = 286.478°$

option (b) $\dfrac{1}{5} = 11.461°$

option (c) $2\pi - 5 = 73.522°$

option (d) $5 - 2\pi = -73.522°$

Hence option (d) is a correct answer.

24. c

$\cos^2 B + \cos^2 C$

$\dfrac{1 + \cos 2B}{2} + \dfrac{1 + \cos 2C}{2}$

$1 + \dfrac{\cos 2B + \cos 2C}{2}$

$1 + \dfrac{2\cos(B + C)\cos(B - C)}{2}$

$1 + \cos(B + C)\cos(B - C)$

$1 + \cos(\pi - A)\cos(B - C)$

$1 + \cos\left(\pi - \dfrac{\pi}{2}\right)\cos(B - C)$

$1 + \cos\dfrac{\pi}{2}\cos(B - C)$

$1 + 0 = 1$

25. a

It is mid point theorem in a triangle.

26. c

$y = mx + c$

The line with slope $0 \rightarrow m = 0$

$y = c$ which is parallel to x-axis.

27. c

$x^2 + y^2 - 8x - 2y + 9 = 0$

$x^2 + y^2 - 4x + 10y + 8 = 0$

subtracting we get:

$-4x - 12y + 1 = 0$

$4x + 12y - 1 = 0$

28. b

$y^2 = 8x$

Slope at (x_1, y_1)

$$\frac{dy}{dx} = \frac{4}{y_1}$$

Slope of tangent $= -\frac{y_1}{4} = 1 \rightarrow y_1 = -4$

Then $x_1 = 2$

The equation of normal is

$$y - y_1 = 1(x - x_1)$$

$$y - (-4) = 1(x - 2)$$

$$y + 4 = x - 2$$

$$x - y - 6 = 0$$

29. d

$$x = \sec t + \tan t \dots \text{(i)}$$

$$y = \sec t - \tan t \dots \text{(ii)}$$

$$xy = (\sec t + \tan t)(\sec t - \tan t) = \sec^2 t - \tan^2 t = 1$$

$$xy = 1$$

30. a

The plane containing the given line is

$A(x - a) + B(y - b) + C(z - c) = 0$, where, $Al + Bm + Cn = 0$

Since the plane passes through the origin,

$$Aa + Bb + Cc = 0$$

$$\therefore \frac{A}{mc - nb} = \frac{B}{na - cl} = \frac{C}{bl - am}$$

Substituting for A, B, C

$$(mc - nb)(x - a) + (na - cl)(y - b) + (bl - am)(z - c) = 0$$

$$\therefore x(bn - cm) + y(cl - an) + z(am - bl) = 0$$

31. d

$$\lim_{x \to 0} \left(\frac{1}{x} \tan^{-1} \left(\frac{3x - x^3}{1 - 3x^2} \right) \right)$$

$$\lim_{x \to 0} \frac{\tan^{-1} 3x}{x} (0/0)$$

Using L'Hospital

$$\lim_{x \to 0} \frac{3}{1 + 9x^2}$$

3

32. a

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

$$y = x^{-1}$$

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

33. c

$x \sin(a + y) = \sin y$

$\Rightarrow x = \dfrac{\sin y}{\sin(a + y)}$

Differentiating w.r.t y we get,

$\dfrac{dx}{dy} = \dfrac{\sin(a + y) \cdot \cos y - \sin y \cdot \cos(a + y)}{\sin^2(a + y)}$

$\quad = \dfrac{\sin(a + y - y)}{\sin^2(a + y)}$

$\quad = \dfrac{\sin a}{\sin^2(a + y)}$

$\therefore \dfrac{dy}{dx} = \dfrac{\sin^2(a + y)}{\sin a}$

34. c

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

$y = x(x^2 - 2x + 1)$

$y = x^3 - 2x^2 + x$

$\dfrac{dy}{dx} = 3x^2 - 4x + 1$

$0 = 3x^2 - 3x - x + 1$

$0 = 3x(x - 1) - 1(x - 1)$

$0 = (3x - 1)(x - 1)$

$x = 1, \dfrac{1}{3}$

$\dfrac{d^2y}{dx^2} = 6x - 4$

So, $\dfrac{d^2y}{dx^2}\big|_{x=1} = 6 \times 1 - 4 = 2$ Minimum

So, $\dfrac{d^2y}{dx^2}\big|_{x=1/3} = 6 \times 1/3 - 4 = -2$ Maximum

$y_{max} = \left(\dfrac{1}{3}\right)\left(\dfrac{1}{3} - 1\right)^2 = \dfrac{4}{27}$

35. a

$\sin x \cos x$

$\dfrac{1}{2} 2 \sin x \cos x$

$\dfrac{1}{2} \sin 2x$

$-1 \le \sin 2x \le 1$

So, Maximum is $\dfrac{1}{2}$

36. b

$y = \sin^{-1} x$

$dy = \dfrac{1}{\sqrt{1 - x^2}} dx$

Then,

$$\int \frac{1}{\sqrt{1-x^2}\sin^{-1}x}\,dx = \int \frac{dy}{y} = \log y + c = \log(\sin^{-1}x) + c$$

37. a

Curve: $x^2 + y^2 = 4$

Line: $x + y = 2$

Point of intersection are $(0, 2)$ and $(2, 0)$

$$\Delta AOB = \frac{1}{2}OA \cdot OB = \frac{1}{2} \cdot 2 \cdot 2 = 2\,\text{sq units}$$

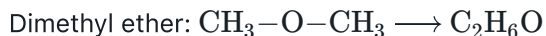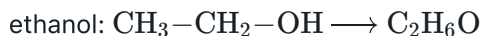Required area = area bounded by the circle = area of ΔAOB in the first quardant.

$$= \frac{\pi \cdot 2^2}{4} - 2$$
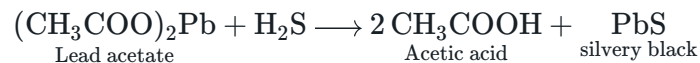
$$= (\pi - 2)\text{ sq. units.}$$

38. b

Due to delocalisation of pi electrons of double bond, all C–C bond length of benzene are equal and this delocalisation process is called resonance.

39. b

ethanol: $CH_3-CH_2-OH \longrightarrow C_2H_6O$

Dimethyl ether: $CH_3-O-CH_3 \longrightarrow C_2H_6O$

40. d

When hydrogen sulfide gas is tested with filter paper moistened with lead acetate paper. It turns silvery black due to the formation of lead sulfide.

$$(CH_3COO)_2Pb + H_2S \longrightarrow 2\,CH_3COOH + \underset{\text{silvery black}}{PbS}$$
$$\underset{\text{Lead acetate}}{} \qquad \underset{\text{Acetic acid}}{}$$

41. d

42. d

Na^+ ion is surrounded by six H_2O molecules i.e., hydrated.

43. c

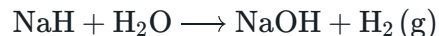Coordination compounds have complex structures and bonding capabilities.

In $CuSO_4 \cdot 5\,H_2O$, four water molecules are coordinated to Cu^{2+}, while one is hydrogen bonded with SO_4^{2-}.

44. b

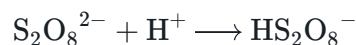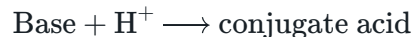Cosmetic powders and zinc ointments contains: ZnO (white in color).

45. b

When sodium hydride dissolved in water, the following reaction takes place:

$$NaH + H_2O \longrightarrow NaOH + H_2\,(g)$$

The solution is basic in nature because of $NaOH$.

46. c

$$Base + H^+ \longrightarrow \text{conjugate acid}$$

$$S_2O_8^{2-} + H^+ \longrightarrow HS_2O_8^{-}$$

47. a

48. c

The radius of the ion is subject to the effective nuclear charge, more the effective nuclear charge, more strongly the electrons are attracted towards the nucleus and the size of the ion decreases. Therefore the ionic radius is inversely proportional to effective nuclear charge.

49. c

50. c

51. b

52. b

53. b

54. c

55. d

56. c

57. b

58. b

a pit is a hole and a peak is the top of a hill or mountain

59. a

60. a

61. c

Due to constant velocity along horizontal and vertical downward force of gravity stone will hit the ground following parabolic path.

62. b

We know that,

$$v_1 = \frac{2m_2u_2 + (m_1 - m_2)u_1}{m_1 + M_2}$$

When, $m_1 = m_2$ then,

$v_1 = u_2$ and $v_2 = u_1$

so, according to question,

$v_1 = u_2 = -3$m/s

and $v_2 = u_1 = 5m/s$

63. c

64. d

65. d

$$\eta = 1 - \frac{T_2}{T_1}$$

T_2 should be low, T_1 should be high.

66. d

$$\mu = \frac{\text{Real depth}}{\text{Apparent depth}}$$

Apparent length of glass slab = 6 + 4 = 10 cm.

$$...\mu = \frac{t}{6+4} \rightarrow \frac{3}{2} = \frac{t}{10}$$

.. t = 15 cm

67. a

$U = \dfrac{q^2}{2C}$ In given case C increases so U will decrease.

68. a

69. a

For a circular wire carrying of current,

$$B = \frac{\mu_o nI}{2r}$$

Case I,

$$B = \frac{\mu_o I}{2r}$$

Case II,

$$2ar = n \times 2ar'$$
$$n = rr'$$

$$B' = B = \frac{\mu_o I}{2r'} \times \frac{r}{r'} = \frac{\mu_o I}{2r'} \times \frac{r^2}{rr'}$$

$$B' = \frac{\mu_o I}{2r} \times \frac{r^2}{r'^2} = \frac{\mu_o I'}{2r} \times \frac{r^2}{rr'}$$

$$B' = n^2 B$$

70. a

$$0.7 i_1 V_1 = i_2 V_2$$

$$0.7 \times i_1 \times 220 = i_2 \times 110$$

$$\frac{i_1}{i_2} = \frac{10}{14} = \frac{5}{7}$$

71. d

$$(f_2)_{open\ pipe} = 100 + (f_2)_{closed\ pipe}$$

$$2 \times \frac{V}{2l} = 100 + 3 \times \frac{V}{4l}$$

$$\text{Or,}\ \frac{V}{l} - \frac{3V}{4l} = 100$$

$$\text{Or,}\ \frac{V}{4l} = 100$$

$$\text{Or,}\ \frac{320}{4l} = 100 \rightarrow l = 0.8m$$

72. d

Here change in frequency takes place in two steps hence:

$$\Delta f = \frac{2v}{c} \times f$$

$$v = \Delta f \times \frac{c}{2} \times f = \frac{2.8 \times 10^8}{2} \times 840 \times 10^3$$

$$= \frac{1}{2} \times 10^3 m/s$$

$$v = 0.5 km/s$$

73. c

Energy (E) $= 20eV = 20 \times 1.6 \times 10^{-19}$

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

$$mE_k = \frac{1}{2}m_2 v^2$$

$$2mE_k = p^2$$

$$p = \sqrt{2mE_k} = 10.66 \times 10^{-27}\ \text{kg m/ sec}$$

74. c

Here Z for Li^{++} is 3.

$$f = \frac{c}{\lambda} = c\frac{1}{\lambda}$$

$$f \propto z^2 \left(\frac{1}{n_2^2} - \frac{1}{n_1^2} \right)$$

$$f_2 = 9f_0$$

75. d

For $x = 0 \in [-1, 1]$, $y = \pm 1$ hence has two images. So, it is not a function.

76. a

$$A = \begin{bmatrix} 9 & 4 \\ 2 & 1 \end{bmatrix}$$

$$A^{-1} = \frac{1}{1} \begin{bmatrix} 1 & -4 \\ -2 & 9 \end{bmatrix} = \begin{bmatrix} 1 & -4 \\ -2 & 9 \end{bmatrix}$$

$$A + A^{-1} = \begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix} = 10I$$

77. a

$$\begin{vmatrix} 1 & 1+i+\omega^2 & \omega^2 \\ 1-i & -1 & \omega^2 - 1 \\ -i & -i+\omega-1 & -1 \end{vmatrix}$$

$$R_1 \to R_1 - R_2 + R_3$$

$$\begin{vmatrix} 0 & 0 & 0 \\ 1-i & -1 & \omega^2 - 1 \\ -i & -i+\omega-1 & -1 \end{vmatrix}$$

0

78. d

$$\log_3 2,\ \log_3(2^x - 5),\ \log_3 \left(2^x - \frac{7}{2}\right) \text{ are in A.P \$}$$

$$\Rightarrow \log_3 2 + \log_3 \left(2^x - \frac{7}{2}\right) = 2 \times \log_3(2^x - 5)$$

$$\Rightarrow \log_3 \left[2 \times \left(2^x - \frac{7}{2}\right)\right] = \log_3(2^x - 5)^2$$

$$2^{x+1} - 7 = (2^x - 5)^2$$

$$2^{x+1} - 7 = 2^{2x} - 2^{x+1} \cdot 5 + 25$$

$$2^{2x} - 6 \times 2^{x+1} + 32 = 0$$

$$2^{2x} - 12 \times 2^x + 32 = 0$$

$$(2^x - 4) \times (2^x - 8) = 0$$

$$2^x = 4, 8 \text{ and } x = 2, 3$$

However, when x is $2, 2^x - 5$ becomes -1 which is not allowed inside logarithm.

Hence $x = 3$

79. c

Total number of terms after binomial expansion $= 15 + 1 = 16$ which is even.

$$\frac{16}{2} = 8 \text{ There are two middle terms} \implies 8^{\text{th}} \text{ and } 9^{\text{th}} \text{ term.}$$

$$t_{r+1} = {}^{15}C_r (1)^{15-r} x^r$$

To get the 8th term put $r = 7$

$$t_{7+1} = {}^{15}C_7 x^7$$

To get the 9th term put $r = 8$

$$t_{8+1} = {}^{15}C_8 x^8$$

80. a

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

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

$$\sin^{-1} x = \cos^{-1} y$$

$$\sin^{-1} x = \sin^{-1} \sqrt{1 - y^2}$$

$$x^2 + y^2 = 1$$

81. d

$$\frac{b - c}{2R} = \frac{2R \sin B - 2R \sin C}{2R} = \sin B - \sin C$$

$$= 2 \cos \left(\frac{B + C}{2}\right) \sin \left(\frac{B - C}{2}\right)$$

$$= 2 \cos \left(\frac{\pi}{2} - \frac{A}{2}\right) \sin \left(\frac{B - C}{2}\right)$$

$$= 2 \sin \left(\frac{A}{2}\right) \sin \left(\frac{B - C}{2}\right)$$

$$= 2 \sin \left(\frac{60°}{2}\right) \sin \left(\frac{B - C}{2}\right)$$

$$= \sin \left(\frac{B - C}{2}\right)$$

82. c

$$(\vec{a} \cdot \vec{b})^2 + (\vec{a} \times \vec{b})^2$$

$$(ab \cos \theta)^2 + (ab \sin \theta)^2$$

$$a^2 b^2$$

$$((-1)^2 + 3^2) \times (2^2 + (-4)^2)$$

200

83. a

84. a

85. b

86. b

87. b

$$\lim_{x \to 0} \frac{\log(\cos x)}{x^2} \, 0/0$$

using L'hospital rule

$$\lim_{x \to 0} \frac{-\sin x}{\cos x \times 2x}$$

$$\lim_{x \to 0} \frac{-\tan x}{2x} \, (0/0)$$

using L'hospital rule

$$\lim_{x \to 0} \frac{-\sec^2 x}{2}$$

$$-\frac{1}{2}$$

88. b

$$f(x^3) = x^5 = (x^3)^{5/3}$$

$$f(x) = x^{5/3}$$

$$f'(x) = \frac{5}{3}x^{5/3-1} = \frac{5}{3}x^{2/3}$$

$$f'(8) = \frac{5}{3}8^{2/3} = \frac{20}{3}$$

89. d

$$\int \frac{\cos x}{\cos x + \sin x}dx$$

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

$$\frac{1}{2}\left[\int \frac{\cos x - \sin x + \cos x + \sin x}{\cos x + \sin x}dx\right]$$

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

$$\frac{1}{2}[x + \log(\cos x + \sin x)] + c$$

90. a

91. d

$$10\,HNO_3 + I_2 \longrightarrow 2\,HIO_3 + 10\,NO_2 + 4\,H_2O$$

92. c

As one moves down the group, the electropositive nature rises. Therefore, sodium is more electropositive than lithium and its size is larger as well. As a result, Sodium reacts with water more violently than Lithium.
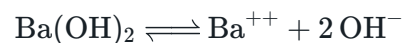
93. a

94. d

$$M_1V_1 = M_2V_2$$

$$M_1 \times 20 = 0.240 \times 8.3$$

$$M_1 = 0.1\,M$$

95. d

$$Ba(OH)_2 \rightleftharpoons Ba^{++} + 2\,OH^-$$

Conc. of $Ba(OH)_2 = 0.0005 \times 10 = 0.005\,M$

$$OH^- \text{ conc}\cdot = 2 \times 0.005 = 0.01 = 10^{-2}$$

$$pOH = -\log[OH^-] = -\log(10^{-2}) = 2$$

96. c

$$Q = it = 4 \times 5400 = 21600\,C$$

$$31.75\,g \text{ of } Cu = 96500\,C$$

$$3.2\,g \text{ of } Cu = 9725.98\,C$$

$$\text{Current efficiency} = \frac{9725.98}{21600} \times 100 = 45.02\%$$

97. c

98. d

99. c

100. c