

KANTIPUR ENGINEERING COLLEGE
Dhapakhel, Lalitpur
Model Entrance Test (2073)
Solution Set: II (B)

Section: I

1. (B) 2. (C) 3. (A) 4. (D) 5. (D)
6. (D) 7. (A) 8. (A) 9. (A) 10. (C)
11. (C) 12. (C) 13. (B) 14. (B)
15. (B) If $A \subseteq B$ then $B^1 \subseteq A^1$ so $B^1 - A^1 = \emptyset$
16. (B) $x^2 - 6x + 13 = x^2 - 6x + 9 + 4 = (x - 3)^2 + 4$
17. (A) $\sin x = -\frac{\sqrt{3}}{2}$ and $\cos x = \frac{1}{2}$. Here sine is negative and cosine is positive so angle lies in 4th quadrant. So $x = 2\pi - \frac{\pi}{3} = \frac{5\pi}{3}$
 \therefore common general solution is $x = 2n\pi + \frac{5\pi}{3}$
18. (C) we have $|\text{adj } A| = |A|^{n-1}$
 $= 4^{3-1} = 16$
19. (D) $\lim_{x \rightarrow \infty} \frac{\sin x}{x} = \lim_{y \rightarrow 0} y \sin \frac{1}{y} = \left(\lim_{y \rightarrow 0} y \right) \times \left(\lim_{y \rightarrow 0} \sin \frac{1}{y} \right) = 0$
20. (D) $y = e^{-x} \quad \frac{dy}{dx} = -e^{-x} \quad \frac{d^2y}{dx^2} = e^{-x} \quad y$
21. (A) $\int \tan x \, dx = \log \sec x + c = -\log \cos x + c$
22. (C) We have $\vec{a} \cdot \vec{b} = |\vec{a}| |\vec{b}| \cos \theta$
 $\Rightarrow \cos \theta = 1 \Rightarrow \theta = 0^\circ$
23. (B) Centroid = $\left(\frac{3+c}{3}, \frac{a+b-3}{3} \right)$
 As centre lies on x-axis, so $\frac{a+b-3}{3} = 0 \Rightarrow a+b=3$
24. (B) If $k_1 - 2k, 3k$ are de's then
 $k^2 + (-2k)^2 + (3k)^2 = 1$
 $14k^2 = 1 \Rightarrow k = \pm \frac{1}{\sqrt{14}}$
25. (D) 26. (C) 27. (A) 28. (D) 29. (B)
30. (A) 31. (C) 32. (C) 33. (B) 34. (D)
35. (A) 36. (B) 37. (D) 38. (C)

39. (A) Here phase difference is constant and hence five periods must be equal i.e., velocities must be equal
40. (B) The displacement can be both positive and negative
41. (D) When electric fan is switched on in a closed room, the electric energy is converted into mechanical energy, which in turn is converted into heat energy. As a result, the kinetic energy of translational of molecules of air increases. Therefore, the temperature of room increases
42. (A) The critical angle for diamond is small due to high refractive index. So, large scale total internal reflection takes place
43. (C) Photoelectric effect can be explained on the basis of quantum theory.
44. (A) Electric field inside a charged conductor is zero and hence the charge being on outer surface
45. (A) $H = v i t = \frac{v^2}{R} \times t$
Keeping v constant, when R is doubled, (H/t) is halved
46. (C) In the rearrangement of the magnetic domains some work is done and the energy dissipated in the process is proportional to the area enclosed by hysteresis loop
47. (B) Diameter has no effect on frequency
48. (C) When a charged particle enters the magnetic field making angle other than 90° , the path is helix
49. (B) 50. (D)
51. (D) Solution:

$$\text{No. of mol of hydrogen} = \frac{\text{Wt. in gram}}{\text{Molar wt.}} = \frac{5}{2} = 2.5$$

$$1 \text{ mol} = 6.023 \times 10^{23} \text{ molecules}$$

$$2.5 \text{ mol} = 2.5 \times 6.023 \times 10^{23} = 1.505 \times 10^{24} \text{ molecules}$$
52. (B) 53. (C) 54. (A) 55. (A) 56. (B)
57. (C) 58. (D) 59. (B) 60. (D)
- Section: II**
61. (A) 62. (C)
63. (C) domain = \mathbb{R} as it is defined for all $x \in \mathbb{R}$

$$\text{range} = \left[\frac{1}{3 - (-1)}, \frac{1}{3 - 1} \right] = \left[\frac{1}{4}, \frac{1}{2} \right]$$
64. (A) we know that $\cos B = \frac{c^2 + a^2 - b^2}{2ca} = \frac{c^2 + 4c^2 - 9c^2}{2 \cdot c \cdot 2c} = \frac{-4c^2}{4c^2} = -1$
65. (B) (C) $n = \frac{n(n-3)}{2} \Rightarrow 2 = n-3 \Rightarrow n = 5$
66. (D) $t_4 = p \Rightarrow ar^3 = p$

$$t_7 = q \Rightarrow ar^6 \Rightarrow br = q^2$$

$$t_{10} = r \Rightarrow ar^9 = r$$

67. (A) Equating real and imaginary parts, we get

$$x = k + 3, \quad y = \sqrt{5 - k^2}$$

$$(x - 3)^2 = k^2 \quad y^2 = 5 - k^2$$

$$\Rightarrow (x - 3)^2 + y^2 = 5$$

68. (A) $\log(1 - 5x + 6x^2) = \log(6x^2 - 3x - 2x + 1)$
- $$= \log_0 \{3x(2x - 1) - 1(2x - 1)\}$$
- $$= \log_e (2x - 1)(3x - 1)$$
- $$= \log_e (1 - 2x) + \log_e (1 - 3x)$$
- $$= 2x - \frac{(2x)^2}{2} - \frac{(2x)^3}{3} - \dots + \left[3x - \frac{(3x)^2}{2} - \frac{(3x)^3}{3} - \dots \right]$$
- $$\text{Coeff. of } x^3 = -\frac{8}{3} - \frac{27}{3} = -\frac{35}{3}$$

69. (C) $|\vec{a}| = \sqrt{3^2 + (-5)^2}, |\vec{b}| = \sqrt{6^2 + (3)^2}$
- $$\vec{a} \times \vec{b} = 39\vec{k}, \quad |\vec{a} \times \vec{b}| = 39$$
- So, $|\vec{a}| : |\vec{b}| : |\vec{a} \times \vec{b}| = \sqrt{34} : \sqrt{45} : 39$

70. (C) Equation of bisectors is $h(x^2 - y^2) = (a - b)xy$
- Combined equation of axes is $xy = 0$
- So $h = 0$

71. (D) $2nr = 10\pi \Rightarrow r = 5$
- Equation circle is $(x - 2)^2 + (y + 3)^2 = 5^2$
- ie. $x^2 + y^2 - 4x + 6y - 12 = 0$

72. (D) The line is $lx + my + n = 0$ ie. $y = -\frac{l}{m}x - \frac{n}{m}$ is
- tangent to $y^2 = 4ax$ if $-\frac{n}{m} = -\frac{a}{-\frac{l}{m}} \Rightarrow ln = am^2$

73. (B) equation of plan is $(2 - 0)(x - 2) + (6 - 0)(y - 6) + (3 - 0)(z - 3) = 0$
- $$2x - 4 + 6y - 36 + 3z - 9 = 0$$
- ie. $2x + 6y + 3z = 49$

74. (B) $y = \sin x - \cos x$
- $$\frac{dy}{dx} = \cos x + \sin x$$
- $$\frac{d^2y}{dx^2} = -\sin x + \cos x$$
- $$\frac{d^3y}{dx^3} = -\cos x - \sin x$$
- $$\frac{d^4y}{dx^4} = \sin x - \cos x$$
- and soon

75. (D) (B) $f'(x) = x^x (1 + \log_e x)$
 For stationary point $f'(x) = 0$
 $\Rightarrow 1 + \log_e x = 0$
 $\Rightarrow \log_e x = -1$
 $\Rightarrow x = \frac{1}{e}$

76. (D) $\int_0^{\frac{\pi}{2}} \frac{(\sin x + \cos x)^2}{\sqrt{1 + \sin 2x}} dx = \int_0^{\frac{\pi}{2}} (\sin x + \cos x) dx$
 $= (\sin x - \cos x)_0^{\pi/2}$
 $= (1 - 0) - (0 - 1)$
 $= 1 + 1 = 2$

77. (B) Solving $y = x^2$ and $y = x$,
 $x = 0, 1$
 \therefore Required are $a = \int_0^1 (y_1 - y_2) dx$
 $= \int_0^1 (x^2 - x) dx$
 $= \left[\frac{1^3}{3} - \frac{x^2}{2} \right]_0^1$
 $= \frac{1}{3} - \frac{1}{2} = -\frac{1}{6} = \frac{1}{6}$

78. (C)

79. (A)

80. (A)

81. (B)

82. (C) Given that $R = A = B$.

Also, $R^2 = A^2 + B^2 + 2AB \cos \theta$
 $\Rightarrow R^2 = 2R^2 (1 + \cos \theta)$
 $\Rightarrow \frac{1}{2} - 1 = \cos \theta$
 $\Rightarrow \cos \theta = -\frac{1}{2} \Rightarrow \theta = 120^\circ$

83. (D) Using $v = u + gt$, we have,

$0 = u - gT \Rightarrow u = gT$
 Also, $v^2 = u^2 + 2gs \Rightarrow 0 = u^2 - 2gH$
 $\therefore H = \frac{u^2}{2g} = \frac{g^2 T^2}{2g} = \frac{gT^2}{2} \dots \dots \dots$ (i)

Let h be the distance travelled in time t , then,

$h = ut - \frac{1}{2} gt^2 = gTt - \frac{1}{2} gt^2 \dots \dots \dots$ (ii)

Now, $h - H = gTt - \frac{1}{2} gt^2 - \frac{1}{2} gT^2 = -\frac{g}{2} (T-t)^2$
 $\therefore h = H - \frac{g}{2} (T-t)^2$

84. (B) $u = 0$, $v = 20 \text{ m/s}$ and $t = 10 \text{ sec}$

$\therefore v = u + at \Rightarrow 20 = a \times 10 \Rightarrow a = 2 \text{ m/s}^2$

Further $s = ut + \frac{1}{2} at^2 = 0 + \frac{1}{2} \times 2 \times (10)^2 = 100 \text{ m}$

$\therefore \text{Work} = \text{Force} \times \text{Distance} = \text{Mass} \times \text{Acceleration} \times \text{Distance} = 100 \times 2 \times 100 = 2 \times 10^4 \text{ J}$

85. (D) $\alpha = \frac{10}{2} \text{ rad/s}^2 = 5 \text{ rad/s}^2$
 $I = MR^2 = \frac{1}{2} \times (0.2)^2 = 0.02 \text{ kgm}^2$
 $T = I \alpha = 5 \times 0.02 = 0.10 \text{ Nm}$
86. (A) The radius R of the single drop so formed will be $R = 2^{1/3}r$, where r = radius of each drop
 For each drop, $mg = 6\pi\eta r v$ (i)
 For combined drop, $2mg = 6\pi\eta R v'$ (ii)
 From equation (i) and (ii),
 $2 \times 6\pi\eta r v = 6\pi\eta R v' \Rightarrow v' = \frac{2rv}{R} = \frac{2rv}{2^{1/3}r} = 2^{2/3}v$
87. (C)
 $\frac{F_1 - 32}{9} = \frac{C_1}{5}$ and $\frac{F_2 - 32}{9} = \frac{C_2}{5}$
 $\Rightarrow \frac{F_1 - F_2}{9} = \frac{C_1 - C_2}{5}$
 $\Rightarrow \frac{F_1 - F_2}{9} = \frac{25^\circ}{5} = 5$
 $\therefore F_1 - F_2 = 9 \times 5 = 45^\circ\text{F}$
88. (C) $P = \frac{1}{3} \rho v^2 = \frac{2}{3} \left(\frac{1}{2} \rho v^2 \right) = \frac{2}{3} E$
89. (A)
 Given $\frac{a_1}{a_2} = \frac{3}{5}$
 Also, $\frac{\sqrt{I_1}}{\sqrt{I_2}} = \frac{3}{5}$ [$\because I_1 \propto a_1^2$]
 Intensity is maximum when $\cos\theta = 1$,
 $\therefore I_{\max} = (\sqrt{I_1} + \sqrt{I_2})^2$
 And intensity is minimum when $\cos\theta = 0$,
 $\therefore I_{\min} = (\sqrt{I_1} - \sqrt{I_2})^2$
 $\therefore \frac{I_{\max}}{I_{\min}} = \frac{(\sqrt{I_1} + \sqrt{I_2})^2}{(\sqrt{I_1} - \sqrt{I_2})^2} = \frac{\left(\frac{3}{5} + 1\right)^2}{\left(\frac{3}{5} - 1\right)^2} = 64/4 = 16:1$
90. (B) We know that $\frac{\sin i}{\sin r} = \frac{v_1}{v_2}$
 Where v_1 and v_2 are the velocities of light in denser and rarer medium respectively.
 Now, $\frac{\sin i}{\sin r} = \frac{\mu_1}{\mu_2}$
 Given that, $\mu_1 = v$ and $\mu_2 = 2v$
 $\frac{\sin i}{\sin r} = \frac{v}{2v} = \frac{1}{2}$
 If $r = 90^\circ$, then $i = C$
 So, $\sin C = 1/2 \therefore C = 30^\circ$
91. (D) Here $v = -40\text{cm}$, $u = \infty$
 Using the lens formula,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}, \text{ we get,}$$

$$F = -40\text{cm} = -0.40\text{m} \therefore P = -\frac{1}{0.40} = -2.5 \text{ D}$$

92. (A) $B = \mu_0 H = 4\pi \times 10^{-7} \times 28 = 352 \times 10^{-7} \text{ T} = 352 \times 10^{-3} \text{ gauss} = 0.352 \text{ gauss}$

93. (A) $F_e = 9 \times 10^9 \left(\frac{e \times e}{r^2} \right)$ and $F_G = 6.6 \times 10^{-11} \left(\frac{m_e \times m_e}{r^2} \right)$

$$\frac{F_G}{F_e} = \frac{6.6 \times 10^{-11}}{9 \times 10^9} \left(\frac{m_e}{e} \right)^2 = \frac{6.6 \times 10^{-11}}{9 \times 10^9} \left(\frac{9.1 \times 10^{-31}}{1.6 \times 10^{-19}} \right)^2 \cong 10^{-42}$$

94. (C)

$$e = N \frac{d\phi}{dt} = N \frac{d(BA)}{dt} = NA \frac{d(B)}{dt}$$

$$= 500 \times 100 \times 10^{-4} \times \left(\frac{0.1 - 0}{0.1} \right) = 5\text{V}$$

95. (C) $E_n = \frac{13.6}{n^2} = \frac{13.6}{100} = 0.136 \text{ eV}$

96. (D) In this reaction, the energy released will be in the form of heat energy.

Energy released = Binding energy of $2\text{H}^{\text{e}4}$ minus twice the binding energy of $1\text{H}^2 = 28 - 2 \times 2.2 = 23.6 \text{ Mev}$

97. (D) Solution: 127 g of Iodine (1 g eqvt.) is liberated by 96,500 coulomb

10 of Iodine is liberated by

$$= \frac{96500}{127} \times 10 \text{ coulomb}$$

Let current strength be = I, Time in _____ seconds

The quantity of electricity, Q, is given by

$Q = I \times \text{time in seconds,}$

$$\frac{Q}{t} = \frac{96500 \times 10}{127 \times 3600}$$

$$= 2.11 \text{ ampere}$$

98. (B) Solution:

250 ml of 0.4M H_2SO_4 is mixed with 600 ml of 0.25M KOH

250 ml of 0.8N H_2SO_4 is mixed with 600 ml of 0.25N KOH

200 ml of 1N H_2SO_4 is mixed with 150 ml of 1N KOH

As the vol. of H_2SO_4 is greater than KOH, the solution is acidic

$V_1 = (200 - 150) = 50 \text{ ml}$; $V_2 = (250 + 600) = 850 \text{ ml}$

$S_1 = 1 \text{ N}$; $S_2 = ?$; $V_1 S_1 = V_2 S_2$

$= 0.0588 \text{ N}$

$$S_2 = \frac{50 \times 1}{850}$$

99. (B) 100. (D)
