Acme Engineering College

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Set B (2075-04-09) Hints & Solution

Section I

1. (c)
   $v = \sqrt{v_x^2 + v_y^2}$
   At highest point $v_y = 0$ so
   $v = v_x$
2. (a)
3. (d)
   Couple always produce rotational motion only
4. (d)
5. (b)
6. (a)
   In equipotential surface work done is 0.
7. (d)
8. (a)
   Can see distant object clearly & unable to see near object.
9. (a)
   de-Broglie's wave length $\lambda = \frac{h}{p}$
   or, $p = \frac{h}{\lambda}$
10. (b)
11. (b)
    $\tan^{-1}a - \tan^{-1}b + \tan^{-1}b - \tan^{-1}c + \tan^{-1}c - \tan^{-1}a = 0$
12. (b)
    One root of $x^2 + ax + 12 = 0$ is 4
    or, $16 + 4a + 12 = 0$
    $\therefore \quad a = -7$
    For (ii), $x^2 - 7a + 6 = 0$ has equal roots
    or, $49 - 4b = 0$
    $\therefore \quad b = \frac{49}{4}$
13. (d)
    Circles touches each other so
    Common tangent $S_1 - S_2 = 0$
    $\therefore \quad -64 + 10x - 16 = 0$
    $x = 8$
14. (a)
    $1 = (1 - z) + z$
    $|1| = |(1 - z)\, z| \le |1 - z| + |z|$
    $\therefore \quad |1 - z| + |z| \ge 1$
    $\therefore$ Minimum value is 1
15. (c)
    For non-zero and non-collinear vectors $\vec{a}$ and $\vec{b}$
    St. $x\vec{a} + y\vec{b} = \vec{0} \Rightarrow x = y = 0$
16. (b)
    The projection of line along x-axis
    $(3 - 1).1 + (4 - 2).0 + (7 - 3).0 = 2$
    Similarly on y and z axis be 2 and 4 respectively
17. (b)
    $A^2 = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix} = 2A$
    $A^4 = A^2\, A^2 = (2A)\,(2A) = 2^2A^2 = 2^3.A$
    $\therefore \quad A^{100} = 2^{99}\, A$
18. (d)
    Women can be seated in a circle in 5! ways then men can be seated in 6! ways.
    Total no. of ways = $5! \times 6!$
19. (b)
    $\int 2^{\sin x}\, d(\sin x) = \frac{2^{\sin x}}{\log_e 2} + c$
    Since,
    $\int a^x\, dx = \frac{a^x}{\log_e a}$
    $= 2^{\sin x}.\log_2 e + c$
20. (b)
    $\lim\limits_{x \to 0} \frac{\log(1 + 3x)}{x} \quad \left[\frac{0}{0}\right]$
    $= \lim\limits_{x \to 0} \frac{\frac{1}{1 + 3x} \times 3}{1}$ [Using L-Hospital's rule]
    $= 3$
21. (b)
    $\frac{W_{O_2}}{W_{Al}} = \frac{E_{O_2}}{E_{Al}}$
    $W_{O_2} = \frac{8}{9} \times 2.7 = 2.4\ g$
22. (c)
    O.N. of S in $H_2S_2O_8$ is +6 although calculate O.N. is +7 but O.N. cannot be more than group no.
23. (b)
    $Mg(OH)_2$ have ionic bond between Mg^{++} and OH^- –ion and covalent bond in OH^- –ion
24. (a)
    Germanium was given name eka-silicon by Mendeleev.
25. (d)
    In redox rxn involving $K_2Cr_2O_7$ O.N. of Cr changes by 6.
26. (c)

CH_3COO^- is strong conjugate base of weak acid rest are conjugate base of strong acid.

27. (a)
Calgon is sodium hexameta phosphate and has formula is $Na_2\,[Na_4\,(PO_3)_6]$

28. (b)
NH_3 and CO_2 on heating under pressure gives urea.

29. (d)
Mn_2O_7 has highest O.N. of Mn so it is an acidic oxide.

30. (c)

$$CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_3 \xrightarrow[alo KOH]{} CH_3-CH=CH_2 \xrightarrow[Br]{HBr} CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_3$$

31. (c)
Benzene and Nitrobenzene can be separated by fractional distillation.

32. (d)
Neopentane has only primary Hydrogen.

$$CH_3-\underset{\displaystyle CH_3}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}}-CH_3$$

33. (b) 34. (b) 35. (c) 36. (b) 37. (b) 38. (c)
39. (c) 40. (b) 41. (a) 42. (b) 43. (a) 44. (b)
45. (a) 46. (b) 47. (d) 48. (b) 49. (d) 50. (a)
51. (b) 52. (c) 53. (b) 54. (c) 55. (b) 56. (b)
57. (d) 58. (a) 59. (c) 60. (a)

Section – II

61. (b)

$$\text{Input for 1 s } (Q_1) = \frac{10^6 \times 4.2 \times 5}{3600}\ \text{w}$$

$$= 5833\ \text{w}$$

$$\eta = \frac{w}{Q_1} \times 100\%$$

or, $$w = \frac{30 \times 5833}{100} = 1750\ \text{w}$$

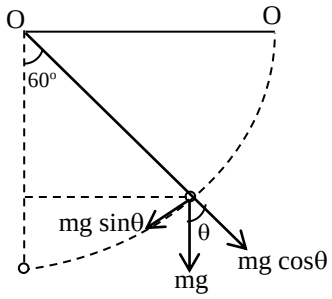
62. (b)

$$a = \frac{\left(\frac{v}{2}\right)^2 - v^2}{2 \times 40} = \frac{O^2 - \left(\frac{v}{2}\right)^2}{2x}$$

or, $$-\frac{3v^2}{4 \times 40} = -\frac{v^2}{4x}$$

$$x = \frac{40}{3}\ \text{cm}$$

63. (b)



$mg\sin\theta = ma_t$

$\therefore \quad a_t = \frac{\sqrt{3}}{2} g$

Now, Loss in PE = Gain in PE

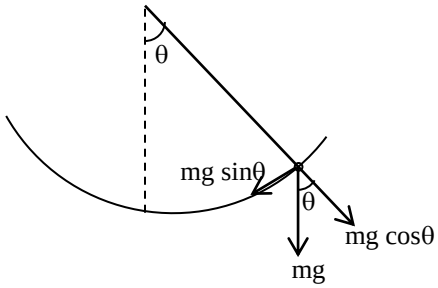
or, $mgl\cos\theta = \frac{1}{2} mv^2$

$\therefore \quad v = \sqrt{gl}$

And, $a_c = \frac{v^2}{l} = \frac{gl}{l} = g$

$\therefore \quad a = \sqrt{a_c^2 + a_t^2} = \frac{\sqrt{7}}{2} g$

64. (a)



$mg\sin\theta = \mu R = \mu mg\cos\theta$

or, $\tan\theta = \mu$

or, $\frac{1}{\cot\theta} = \mu = \frac{1}{3}$

$\therefore \quad \theta = \cot^{-1}(3)$

65. (c)

$$2.5\,\beta = 2.5\,\frac{D\lambda}{d} = \frac{2.5 \times 1 \times 6 \times 10^{-7}}{10^{-3}} = 1.5 \times 10^{-3}\text{m}$$

$$= 1.5\ \text{mm}$$

66. (a)

$$\mu = \frac{\text{Real depth}}{\text{App. depth}}$$

$\therefore$ App. depth $= \frac{\text{Real depth}}{\mu} = 4.5$ cm

67. (c)

$KE = \frac{hc}{\lambda} - \phi = 1.1$ ev

68. (b)

$$\frac{N'}{N_o} = 1 - \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}} = 2.68 \times 10^{18}\left\{1 - \left(\frac{1}{2}\right)^{3240/1620}\right\}$$

$\therefore \quad N' = 2.01 \times 10^{18}$

69. (d)

$$E = E_3 - E_1 = 3^2\left(-\frac{13.6}{3^2} + \frac{13.6}{1}\right) = 108.8 \text{ ev}$$

70. (a)

$U_1 = U$ (stored energy on capacitor)

$C_{eq} = C'' = 2C$

$$\frac{U_1}{U_2} = \frac{\frac{1}{2}\frac{q^2}{C}}{\frac{1}{2}\frac{q^2}{C'}} = 2$$

$\therefore \quad U_2 = \frac{U}{2}$

71. (d)

Wheat bridge's is balanced, then resistance of galvanometer will be uneffective

$R_{eq} = R$

72. (c)

$I_1 = 10A, \quad I_2 = 0, \quad t = 0.5$ sec

Emf (E) = 220 V

So, $E = -L\frac{dI}{dt} \qquad \therefore L = \frac{220}{20} = 11$ H

73. (b)

$$r = \frac{mv\sin\theta}{Be} = \frac{3 \times 10^5 \sin 30^o}{0.3 \times 10^8}$$

$$= \frac{3 \times 10^5 \times 1}{3 \times 10^7 \times 2} = 0.5 \text{ cm}$$

74. (c)

Loss in PE = Gain in elastic PE

or, $mg(h + r) = \frac{1}{2}kr^2$

or, $4 \times 10\ (3 + r) = \frac{1}{2} \times 500r^2$

or, $250r^2 = 40(3 + r)$

or, $25r^2 - 4r - 12 = 0$

or, $r = \frac{+4 \pm \sqrt{(-4)^2 - 4 \times 25\ (-12)}}{2 \times 25} = \frac{4 \pm 38.8}{50}$

$\therefore \quad r = 0.86$ m

75. (b)

$$\alpha = \frac{\Delta I_c}{\Delta I_e}$$

or, $\alpha = \frac{\Delta I_e - \Delta I_b}{\Delta I_e}$

or, $\Delta I_b = (1 - \alpha)\ \Delta I_e$

$= (1 - 0.95) \times 5$ mA

$= 0.25$ mA

76. (c)

a, b, c are in A.P. then $2b = a + c$

Now,

$$3\tan\frac{A}{2}.\tan\frac{C}{2} = 3\sqrt{\frac{(s-b)(s-c)}{s(s-a)}} \cdot \sqrt{\frac{(s-b)(s-a)}{s(s-c)}}$$

$$= 3\frac{(s-b)}{s} = 3\frac{\left(\frac{a+b+c}{2} - 6\right)}{\frac{a+b+c}{2}} = 3\left(\frac{a+c-b}{a+b+c}\right)$$

$$= 3\left(\frac{2b-b}{3b}\right) = 1$$

77. (a)

$\tan^{-1}(a) + \tan^{-1}(b) = \tan^{-1}3$

$\tan^{-1}\left(\frac{a+b}{1-ab}\right) = \tan^{-1}3$

$\therefore \quad a + b = 3 - 3ab = 3(1 - ab)$

Where a, b are non-negative integers

If $a = 0, b = 3$ and $b = 0, a = 3$

$\Rightarrow$ Numbers of positive integral pairs is zero.

Since 0 is not positive integral

78. (d)

Given series $= 2\left[x + \frac{1}{3}x^3 + \frac{1}{5}x^5 + \ldots.\right]$

Where $x = \frac{1}{7}$

$$= \log\left(\frac{1+x}{1-x}\right) = \log\left(\frac{8}{6}\right) = \log_e\left(\frac{4}{3}\right)$$

79. (c)

The equation of tangent is

$$y = mx \pm a\sqrt{1+m^2} = \frac{1}{\sqrt{3}}x \pm 5\sqrt{1+\frac{1}{3}}$$

$$= \frac{x}{\sqrt{3}} \pm \frac{10}{\sqrt{3}}$$

$\therefore \quad x - y\sqrt{3} \pm 10 = 0$

80. (d)

$(y + 2)^2 = -4x + 2 = -4\left(x - \frac{1}{2}\right)$

$Y^2 = -4X$

$\therefore$ Directrix of parabola: $X = 1$

or, $x - \frac{1}{2} = 1$

$\therefore \quad x = \frac{3}{2}$

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81. (a)

$9(x^2 + 8x) - 16(y^2 + 2y) = 16$

or, $9(x + 4)^2 - 16(y + 1)^2 = 16 + 144 - 16 = 144$

$\therefore \quad \frac{(x + 4)^2}{16} - \frac{(y + 1)^2}{9} = 1$

Length of LR $= 2 \times \frac{9}{4} = \frac{9}{2}$

82. (a)

d.r's of line $x^2 + y^2 = 0$ are 0, 0, 1 sine in 3D

$x^2 + y^2 = 0$ is equation of z-axis.

So, $\sin\theta = \frac{1.0 + 3.0 + 0.1}{\sqrt{10}} = 0$

$\therefore \quad \theta = 0$

83. (a)

$f(x)\, f(y) - \frac{1}{2}\left[f\left(\frac{x}{y}\right) + f(xy) \right]$

$= \cos(\log(x) \cos(\log y) - \frac{1}{2}[\cos(\log x - \log y) + \cos(\log x + \log y))$

$= \cos(\log x).\cos(\log y) - \frac{1}{2}[2\cos(\log x).\cos(\log y)] = 0$

84. (b)

$|\vec{a}.\vec{b}| = 3 \Rightarrow ab\cos\theta = 3$

$|\vec{a} \times \vec{b}| = 4 \Rightarrow ab\sin\theta = 4$

or, $\tan\theta = \frac{4}{3}$

or, $\cos\theta = \frac{3}{5}$

$\therefore \quad \theta = \cos^{-1}\left(\frac{3}{5}\right)$

85. (b)

$f'(x) = x[4 + 4.2^2.x^2 + \ldots + 20.2^{10}x^{18}]$

or, $f'(x) = 0 \Rightarrow x = 0$ only and $f''(0) > 0$

$\therefore$ Exactly one minimum

86. (c)

$f(g(x)) = I(x) = x \qquad f'(b).2 = 1$

or, $f'(g(x)).g'(x) = 1 \qquad f'(b) = \frac{1}{2}$

$\therefore \quad f'(g(a)).g'(a) = 1$

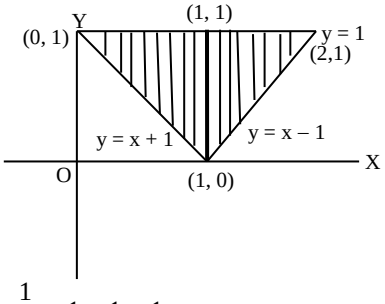
87. (a)

$$\int \frac{1 + \frac{1}{x^2}}{x^2 + \frac{1}{x^2}}\,dx = \int \frac{d\left(x - \frac{1}{x}\right)}{\left(x - \frac{1}{x}\right)^2 + 2}$$

$$= \frac{1}{\sqrt{2}} \cdot \tan^{-1}\left(\frac{x - \frac{1}{x}}{\sqrt{2}}\right) + c$$

$$= \frac{1}{\sqrt{2}} \tan^{-1}\left(\frac{x^2 - 1}{\sqrt{2}\,x}\right) + c$$

88. (a)



Area $= 2 \times \frac{1}{2} \times 1 \times 1 = 1$

89. (c)

Let a and b be two quantities

Then, $G = \sqrt{ab}$, $\quad A_1 = \frac{2a + b}{3} \qquad A_2 = \frac{a + 2b}{3}$

or, $2A_1 - A_2 = a, \qquad 2A_2 - A_1 = b$

$\therefore$ L.H.S. $= ab = G^2$

90. (a)

Operating $R_1 \to R_1 + R_3$

$$\begin{vmatrix} 1-i & \omega+\omega^2 & \omega^2-\omega^3 \\ i-i & -1 & \omega^2-1 \\ -i & -i+\omega-1 & -1 \end{vmatrix} = \begin{vmatrix} 1-i & -1 & \omega^2-1 \\ 1-i & -1 & \omega^2-1 \\ -i & -i+\omega-1 & -1 \end{vmatrix}$$

$= 0 \quad [R_1 = R_2]$

91. (a)

$N_{mix} = \frac{20 \times 1 - 30 \times 0.5}{20 + 30} = 0.1$ N (w.r.t HCl)

92. (a)

$pH = -\log[H^+] = -\log 0.01 = 2$

93. (c)

1 gram equivalent of any element requires 1F charge. Hence 4 gram equivalents require 4F charge.

94. (d)

H_2S gives black PPt PbS with lead acetate

$(CH_3COO)_2\,Pb + H_2S \to PbS\downarrow + CH_3COOH$

black ppt

95. (d) 96. (a) 97. (b) 98. (b) 99. (c) 100. (b)