

# Acme Engineering College

Sitapaila, Ph:- 01-4282962 / 4280445 / 4670924 / 4670925

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

### Section I

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

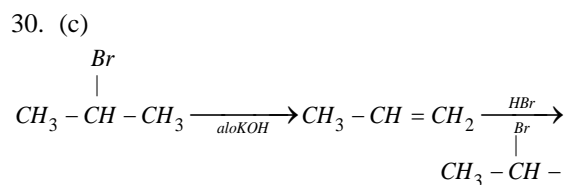
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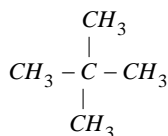
$\text{CH}_3\text{COO}^-$  is strong conjugate base of weak acid rest are conjugate base of strong acid.

27. (a) Calgon is sodium hexameta phosphate and has formula is  $\text{Na}_2[\text{Na}_4(\text{PO}_3)_6]$
28. (b)  $\text{NH}_3$  and  $\text{CO}_2$  on heating under pressure gives urea.
29. (d)  $\text{Mn}_2\text{O}_7$  has highest O.N. of Mn so it is an acidic oxide.



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

32. (d) Neopentane has only primary Hydrogen.



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)

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

$$= 5833 \text{ w}$$

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

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

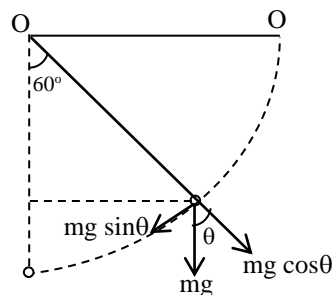
62. (b)

$$a = \frac{\left(\frac{v}{2}\right)^2 - v^2}{2 \times 40} = \frac{0^2 - \left(\frac{v}{2}\right)^2}{2x}$$

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

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

63. (b)



$$mg \sin \theta = ma_t$$

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

Now, Loss in PE = Gain in PE

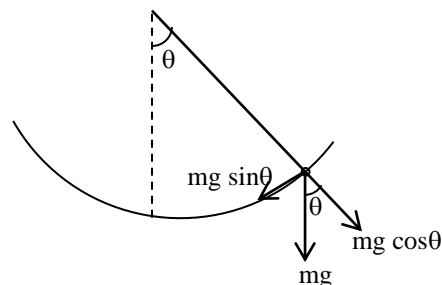
$$\text{or, } mgl \cos \theta = \frac{1}{2} mv^2$$

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

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

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

64. (a)



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

$$\text{or, } \tan \theta = \mu$$

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

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

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)

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

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

67. (c)

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

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68. (b)

$$\frac{N'}{N_0} = 1 - \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}} = 2.68 \times 10^{18} \left\{ 1 - \left(\frac{1}{2}\right)^{3240/1620} \right\}$$

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

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)

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

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

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

71. (d)

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

$$R_{eq} = R$$

72. (c)

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

$$\text{Emf (E)} = 220 \text{ V}$$

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

73. (b)

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

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

74. (c)

Loss in PE = Gain in elastic PE

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

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

$$\text{or, } 250r^2 = 40(3+r)$$

$$\text{or, } 25r^2 - 4r - 12 = 0$$

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

$$\therefore r = 0.86 \text{ m}$$

75. (b)

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

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

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

$$= (1 - 0.95) \times 5 \text{ mA}$$

$$= 0.25 \text{ mA}$$

76. (c)

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

Now,

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

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

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

77. (a)

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

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

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

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)

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

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

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

79. (c)

The equation of tangent is

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

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

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

80. (d)

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

$$Y^2 = -4X$$

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

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

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

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81. (a)

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

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

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

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

$\therefore \theta = 0$

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)

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

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

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

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

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

85. (b)

$f'(x) = x [4 + 4.2^2.x^2 + \dots + 20.2^{10}x^{18}]$   
 or,  $f'(x) = 0 \Rightarrow x = 0$  only and  $f''(0) > 0$   
 $\therefore$  Exactly one minimum

86. (c)

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

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

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

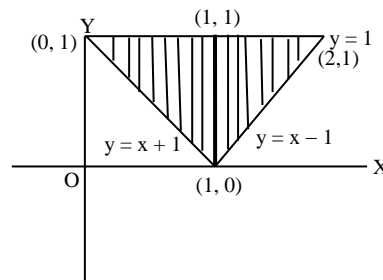
87. (a)

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

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

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

88. (a)



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

89. (c)

Let a and b be two quantities

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

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

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

90. (a)

Operating  $R_1 \rightarrow R_1 + R_3$

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

$$= 0 \quad [R_1 = R_2]$$

91. (a)

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

92. (a)

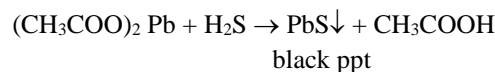
$\text{pH} = -\log[H^+] = -\log 0.01 = 2$

93. (c)

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

94. (d)

$\text{H}_2\text{S}$  gives black PPT  $\text{PbS}$  with lead acetate



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