AVIRAL CLASSES
CREATING SCHOLARS
FOR JEE (Main & advance), PMTs & FOUNDATION

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FINAL TEST SERIES JEE -2017
TEST-03

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[PHYSICS]

1. Answer (2)
2. Answer (2)
3. Answer (2)

$P = \frac{\alpha}{T^2}$

PT^2 = constant

$P.\left(\frac{PV}{nR}\right)^2 = \text{constant}$

P^3V^2 = constant

$PV^{\frac{2}{3}} = \text{constant}$

$\gamma = \frac{2}{3}$

$B = \gamma P = \frac{2}{3}P$

4. Answer (1)

$W_{AB} = nRT\ln\left(\frac{V_2}{V_1}\right)$ (Temperature during AB is double the temperature during CD)

$= 3R(2T_0)\ln\frac{2V_0}{V_0} = 6RT_0\ln 2$

$U_0 = nC_vT_0$

$U_0 = 3\times\frac{3R}{2}T_0 \Rightarrow T_0 = \frac{2U_0}{9R}$

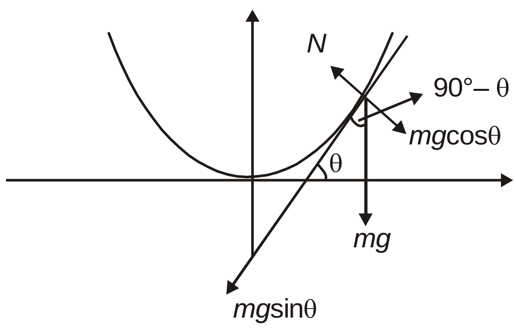
$\therefore \quad W_{AB} = 6R\cdot\frac{2U_0}{9R}\ln 2 = \frac{4U_0}{3}\ln 2$

5. Answer (4)
6. Answer (2)

$\Delta U : \Delta W : \Delta Q = C_v : C_p - C_v : C_p$

$= \frac{3}{2}R : R : \frac{5R}{2} = 3 : 2 : 5.$

7. Answer (4)



$x^2 = ay \Rightarrow 2x = \frac{ady}{dx} \Rightarrow \frac{dy}{dx} = \frac{2x}{a}$

$f_R = mg\sin\theta \cong mg\tan\theta$ (θ is small)

$ma' = mg\cdot\frac{2x}{a}$

$\Rightarrow \quad T = 2\pi\sqrt{\frac{a}{2g}}$

8. Answer (3)

$$f_1 = \frac{400\pi}{2\pi} = 200 \text{ Hz}$$

$$f_2 = \frac{404\pi}{2\pi} = 202\text{Hz}$$

$$|f_2 - f_1| = 2 \text{ Hz}$$

$$\frac{I_{\text{max.}}}{I_{\text{min.}}} = \frac{(5+2)^2}{(5-2)^2} = \frac{49}{9}$$

9. Answer (4)

10. Answer (3)

$$v = \sqrt{\frac{B}{\rho}} = \sqrt{\frac{\alpha P}{\rho}}$$

11. Answer (4)

$$f_0 = \frac{v}{4l} = \frac{340 \times 100}{4 \times 17}$$

$$f_0 = 500 \text{ Hz}\ ;\ 3f_0 = 1500 \text{ Hz}$$

12. Answer (4)

$$f = KT_1^{1/2};\ \frac{f}{2} = KT_2^{1/2}$$

$$\Rightarrow \frac{T_2}{T_1} = \frac{1}{4}\ \Rightarrow \frac{T_2 - T_1}{T_1} = -\frac{3}{4}$$

13. Answer (1)

$$\Delta f = \left(\frac{v}{v - v_s} - \frac{v}{v + v_s}\right) f \cong \frac{2fv_s}{v}$$

14. Answer (3)

15. Answer (2)

$$C = C_v + \frac{P}{n}\frac{dV}{dT}$$

$$\frac{P}{n}\frac{dV}{dT} = 3aT^2$$

$$\frac{nRT}{Vn}\frac{dV}{dT} = T^2$$

$$\frac{dV}{V} = \frac{3aT}{R}dT$$

$$\ln V = \frac{3aT^2}{2R} + C$$

$$\ln V = \ln_e e^{\frac{3aT^2}{2R}} + \ln K$$

$$Ve^{-\frac{3aT^2}{2R}} = \text{constant}$$

16. Answer (1)

Equation of line

$$P = \left(\frac{-P_0}{v_0}\right)v + 3P_0$$

$$T = \frac{1}{nR}\left[\left(\frac{-P_0}{v_0}\right)v^2 + 3P_0V\right]$$

$$\frac{dT}{dv} = 0 \Rightarrow v = \frac{3v_0}{2}$$

17. Answer (2)

$$PV^{-2} = \text{constant}$$

$$C = C_v + \frac{R}{1-x};\ x = -2$$

$$\frac{nR\Delta T}{1-x} = 200$$

$$\frac{nR\Delta T}{3} = 200$$

$$nR\Delta T = 600;\ \Delta U = nC_V\Delta T = \frac{5R}{2} \times \frac{600}{R} = 1500 \text{ J}$$

18. Answer (2)

$$\frac{K}{2}\frac{(T_1 - T)}{2e} = \frac{2K(T - T_2)}{e};\quad \left(e = \frac{l}{A}\right)$$

$T_1 - T = 8T - 8T_2$

$T_1 + 8T_2 = 9T$

$$T = \frac{T_1 + 8T_2}{9}$$

19. Answer (1)

for ***AB***

$P = KT \Rightarrow V$ is constant

for ***BC***

$$P = K_1T + P_0$$

$$\Rightarrow V = \frac{nRT}{K_1T + P_0}$$

20. Answer (1)

$$\frac{dx}{dt} = 3 \times 10\pi\cos(10\pi t)$$

$v_{max} = 30\pi$

$$K = \frac{1}{2} \times \frac{1}{\pi^2} \times 900\pi^2 = 450 \text{ J}$$

21. Answer (1)

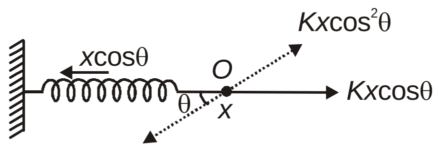
$P = KT$

$dP = KdT$

$$100 \times \frac{dP}{P} = \frac{dT}{T} \times 100$$

$T = 100$ K

22. Answer (1)



$$ma = (K\cos^2\theta)x$$

$$\omega = \sqrt{\frac{K\cos^2\theta}{m}}$$

23. Answer (3)
24. Answer (3)
25. Answer (3)

$$\frac{\lambda_1}{\lambda_2} = \frac{T_2}{T_1}$$

$$\frac{\lambda_m}{\lambda_2} = \frac{3000}{2000}$$

$$\lambda_2 = \frac{2}{3}\lambda_m$$

26. Answer (4)
27. Answer (2)
28. Answer (1)
29. Answer (1)
30. Answer (1)

[CHEMISTRY]

31. Answer (2)

Final volume of the gas at 600 torr pressure.

$$V_2 = \frac{P_1V_1}{P_2} = \frac{760 \times 1}{600} = 1.267 \text{ L}$$

or V_2 = 1267 mL

Volume occupied by gas = volume of vessel–volume occupied by charcoal.

$$= 1000 - \frac{12}{1.8} = 1000 - 6.67 = 993.33 \text{ mL}$$

Difference of volume is due to adosprtion by charcoal = 1267 – 993.33 = 273.67 mL

Volume of gas adsorbed per gram of charcoal

$$= \frac{273.67}{12} = 22.80 \text{ mL / g}$$

32. Answer (1)

Area of the triangle $= \frac{\sqrt{3}}{4}a^2$

Radius $r = \frac{a}{2}$

$\therefore$ Area of circle $= \pi r^2 = \frac{\pi}{4}a^2$

Hence percentage occupied $= \dfrac{\frac{1}{2} \times \frac{\pi}{4}a^2}{\frac{\sqrt{3}}{4}a^2} \times 100$

$$= \frac{\pi}{2\sqrt{3}} \times 100 = \frac{3.14}{2 \times 1.732} \times 100 = 90.64\%$$

$\therefore$ Percentage of free space = (100 – 90.64) = 9.36%

33. Answer (1)

$[H^+] = C\alpha$

$\Rightarrow$ $10^{-5} = 10^{-4}\alpha$

$\Rightarrow$ $\alpha = 0.1$

$i = 1 + (n - 1)\alpha$

$\Rightarrow$ $i = 1.1$

$\Delta T_b = 1.1 \times 0.52 \times 10^{-4}$

$= 5.72 \times 10^{-5}$

34. Answer (1)

$(\text{mol L}^{-1})^{1-n}\ \text{s}^{-1} = (\text{mol L}^{-1})^{-1}\ \text{s}^{-1}$

$1 - n = -1$

$\Rightarrow$ $n = 2$

As order of overall reaction is 2 and order w.r.t [A] is 1.

Hence, order w.r.t. [B] will also be 1.

35. Answer (3)

Conc. of NaCl = $\frac{0.1}{2}$ N = 0.05 N

$$\lambda_{eq} = \frac{\sigma \times 1000}{N}$$

$$\Rightarrow \lambda_{eq} = \frac{0.0055 \times 1000}{0.05} = \frac{5.5}{0.05} = \frac{550}{5}$$

= 110 S cm^2 equivalent^{-1}

36. Answer (2)

$$E_{MnO_4^-/Mn^{2+}} = E^\circ_{MnO_4^-/Mn^{2+}} - \frac{0.0591}{5} \log \frac{[Mn^{2+}]}{[MnO_4^-][H^+]^8}$$

$$= 1.51 - \frac{0.0591}{5} \times 8(pH)$$

$$= 1.321\text{ V}$$

37. Answer (3)

$$\frac{5}{342} = \frac{1}{X}$$

$$\Rightarrow X = \frac{342}{5} = 68.4 \text{ g/mole}$$

38. Answer (3)

O = N

Ti = $\frac{N}{2}$

hence formula = T_iO_2

Percentage of T_i = $\frac{48}{80} \times 100 = 60\%$

39. Answer (4)

Loss in mass of solution $\propto P_S$

Loss in mass of solvent $\propto P_0 + P_S$

$$\frac{\text{loss in mass of solvent}}{\text{loss in mass of solution}} = \frac{P_0 - P_S}{P_S} = \frac{n_B}{n_A}$$

$$\Rightarrow \frac{0.04}{2.5} = \frac{5 \times 18}{M \times 80}$$

$$\Rightarrow M = \frac{5 \times 18}{80} \times \frac{2.5}{0.04} = \frac{90 \times 2.5}{80 \times 0.04} = 70.31 \text{ g/mole}$$

40. Answer (3)

For $ClCH_2COOH$ n = 2

$i = 1 + (n - 1)\alpha = 1.4$

41. Answer (1)

$$t_{1/2} \propto \frac{1}{[P_o]^{n-1}}$$

42. Answer (3)

$X = \frac{1}{8} \times 8 = 1$ (Corners)

Y = 1 (Body center)

43. Answer (2)

$\Delta T_f = iK_f \times m$

Also $\Delta T_b = iK_b \times m$

$$\frac{\Delta T_f}{\Delta T_b} = \frac{K_f}{K_b}$$

$$\Rightarrow \frac{0.186}{\Delta T_b} = \frac{1.86}{0.512}$$

$$\Rightarrow \Delta T_b = \frac{0.186 \times 0.512}{1.86}$$

= 0.0512 K

44. Answer (1)

Weight of Cu = 100 × 10^{-2} × 8.94 g = 8.94 g

W = ZQ (according to Faraday's first law)

$$\Rightarrow W = \frac{M}{96500 \times 2} \times Q$$

$$\Rightarrow Q = \frac{8.94 \times 2 \times 96500}{63.5} = 2.71 \times 10^4 \text{ C}$$

45. Answer (4)

46. Answer (2)

47. Answer (2)

Spinel structure is AB_2O_4 type

in which O^{2-} forms FCC

A^{2+} occupies $\frac{1}{8}$ of the tetrahedral voids

B^{3+} occupies $\frac{1}{2}$ of the octahedral voids

48. Answer (3)

In both the experiments pH is kept constant

hence $-\frac{d[A]}{dt} = K'[A]^x$

Given half life is independent of [A] hence $\boxed{x = 1}$

also $K' = \frac{0.693}{t_{1/2}}$

$$\frac{(t_{1/2})_1}{(t_{1/2})_2} = \left(\frac{H_1^+}{H_1^+}\right)$$

$\Rightarrow n = 2$

$\therefore$ Overall order = 1 + 2 = 3

49. Answer (1)
50. Answer (3)

$$W = \frac{M \times I \times t}{96500 \times \text{n-factor}}$$

$$\Rightarrow 11.67 = \frac{93 \times I \times 3600}{96500 \times 6}$$

$\Rightarrow I = \frac{11.67 \times 96500 \times 6}{3600 \times 93}$ ampere hour = 20.18 amphere hours

$$\Rightarrow \text{Current efficiency} = \frac{20.18}{25.6} \times 100$$

$= 78.83\%$

51. Answer (2)

$$K_b = \frac{MRT_0^2}{100\Delta H_{vap}} \qquad (C_6H_5CH_3)$$

$$\Delta H_{vap} = \frac{92 \times 8.314 \times (383.7)^2}{1000 \times 3.32} = 33.92 \text{ kJ}$$

52. Answer (3)

$A = 7 \times \frac{1}{8} = \frac{7}{8}$ (Corners)

$B = 6 \times \frac{1}{2} = 3$ (Face centres)

$A : B = \frac{7}{8} : 3 = 7 : 24$

A_7B_{24}

53. Answer (2)
54. Answer (1)

$P_S = \left(5 \times \frac{2}{5}\right) + \left(10 \times \frac{3}{5}\right)$

$= 2 + 6 = 8$

55. Answer (2)
56. Answer (2)
57. Answer (1)
58. Answer (1)
59. Answer (4)
60. Answer (1)

[MATHEMATICS]

61. Answer (4)

In any triangle, four circles can be drawn touching all the three sides of triangle. But in this case, the three lines are concurrent.

62. Answer (2)

Vertices $\equiv \left(0, -\frac{n}{m}\right), \left(-\frac{n}{l}, 0\right), \left(0, \frac{n}{m}\right)$ and $\left(\frac{n}{l}, 0\right)$.

Hence, the area is $\frac{1}{2} \times \frac{2n}{m} \times \frac{2n}{l} = 2.$

$n^2 = lm$

$\Rightarrow$ l, n, m are in G.P.

63. Answer (1)

Let focus be (a, b).

Equations are

$S_1 : (x - a)^2 + (y - b)^2 = x^2$

$S_2 : (x - a)^2 + (y - b)^2 = y^2$

Common chord $\equiv S_1 - S_2 = 0$, $x^2 - y^2 = 0$

$\Rightarrow$ $x = \pm y$.

64. Answer (2)

Let (x, y) be the other end of the chord.

$$\frac{x+0}{2} = 2a, \ \frac{y+0}{2} = 3b \ \Rightarrow x = 4a, y = 6b.$$

$(4a, 6b)$ lies on the parabola.

$\Rightarrow$ $36b^2 = 4(4a)$

$\Rightarrow$ $9b^2 = 4a.$

65. Answer (1)

Mid-point of the chord is $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

$$T = S_1 \Rightarrow \frac{x}{x_1 + x_2} + \frac{y}{y_1 + y_2} = 1$$

66. Answer (4)

As $x \to 0$

$\tan x \to 0$

$\cot x \to \infty$

$$\Rightarrow \lim_{x \to 0} (1 + \tan x)^{\cot x} = e^{\lim_{x \to 0} \tan x . \cot x} = e$$

67. (3) Let the eccentric angle of point 'P' be θ, then equation of tangent and normal at point are

$$\frac{x}{6}\cos\theta + \frac{y}{3}\sin\theta = 1$$

and $\frac{6x}{\cos\theta} - \frac{3y}{\sin\theta} = 27$

Thus, $A \equiv \left(0, \frac{3}{\sin\theta}\right)$

and $B \equiv \left(\frac{27}{6}\cos\theta, 0\right)$

Area of ΔOAB

$$= \frac{1}{2}.\frac{3}{\sin\theta}.\frac{27}{6}.\cos\theta = \frac{27}{4} \qquad \text{(given)}$$

$$\Rightarrow \cot\theta = 1 \Rightarrow \theta\frac{\pi}{4}, \frac{5\pi}{4}$$

68. Answer (3)

Case(i) $x > 0$, $\frac{2}{3} < x$

Case(ii) $x < 0$, $x < \frac{2}{3}$

$\Rightarrow x < 0$

Hence from case (i) & (ii),

$$x \in (-\infty, 0) \cup \left(\frac{2}{3}, \infty\right)$$

69. Answer (3)

$$\begin{vmatrix} 5 & 10 & 7 \\ 1 & 2 & 3 \\ 2 & 2 & -2 \end{vmatrix} = 16 \neq 0. \text{ Hence skew.}$$

70. Answer (2)

$$\lim_{n\to\infty} \frac{n(n+1)}{2(n+2)(2n+3)}.$$

$$\lim_{n\to\infty} \frac{n^2\left[1+\frac{1}{n}\right]}{2n^2\left[1+\frac{2}{n}\right]\left[2+\frac{3}{n}\right]} = \frac{1}{2(1)(2)} = \frac{1}{4}.$$

71. (1) (Let the tangent be

$S_1 = (ae, 0)$, $S_2 = (-ae, 0)$

$xb \cos\theta + ay \sin\theta - ab = 0$

$$\Rightarrow \cot\theta = 1 \Rightarrow \theta\frac{\pi}{4}, \frac{5\pi}{4}$$

Similarly, $S_2P_2 \; \frac{ab(1+e\cos\theta)}{\sqrt{b^2\cos^2\theta + a^2\sin^2\theta}}$

$$\Rightarrow S_1P_1.S_2P_2 = \frac{a^2b^2(1-e^2\cos^2\theta)}{b^2\cos^2\theta + a^2\sin^2\theta}$$

$$= \frac{a^2b^2(1-e^2\cos^2\theta)}{a^2 + (b^2-a^2)\cos^2\theta}$$

$$= \frac{a^2b^2(1-e^2\cos^2\theta)}{a^2 - a^2e^2)\cos^2\theta} = b^2$$

Which is clearly a constant.

Thus, (S_1P_1) (S_2P_2) = 9

72. Answer (1)

$1^2 + b^2 = a^2 + 1^2$ (equilateral triangle)

$\Rightarrow a = \pm b$

$a = -b$ rejected.

Also area of triangle $= \sqrt{3}a$.

73. Answer (3)

If they touch $x = y$ is a tangent to both the circles.

$$\Rightarrow -\frac{2}{\sqrt{2}} = \sqrt{4-c} \Rightarrow 4 - c = 2 \Rightarrow \boxed{c = 2}$$

74. Answer (3)

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

or $a\left(y + \frac{b}{2a}\right)^2 = x + \frac{b^2}{4a} - c$

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

Hence $\text{L.R.} = \frac{1}{a}$

75. Answer (4)

$2 - \lambda > 0, \lambda - 5 > 0$

$\Rightarrow \lambda < 2 \text{ and } \lambda > 5 \quad \Rightarrow \quad \lambda \in \phi$

76. Answer (3)

Equation of the normal at the point $(9m^2, -18m)$ (for $a = 9$) to the parabola $y^2 = 4(9x)$ is

$y = mx - 2(9m) - 9m^3$

$\Rightarrow m = -\frac{2}{3}$ or 0

For $m = -\frac{2}{3}$ the normal is $2x + 3y = 44$.

77. Answer (3)

Equation of plane parallel to x-axis be

$ax + by + cz + d = 0$

Since normal to the plane is perpendicular to x-axis

$al + b \times 0 + c \times 0 = 0 \qquad \Rightarrow a = 0$

So that required equation is $by + cz + d = 0$

where $b, c \neq 0$.

78. Answer (2)

Equation of plane

$$\frac{x}{20}+\frac{y}{15}+\frac{z}{-12}=1$$

It meets coordinate axis in points.

$A(20, 0, 0)$, $B(0, 15, 0)$, $C(0, 0, -12)$

$\therefore$ Volume $=\frac{1}{6}\left|20\times15\times(-12)\right|=600$ cubic units

79. Answer (3)

$$\lim_{x\to\infty}\left(1-\frac{5}{x+2}\right)^x=e^{\lim_{x\to\infty}\left(\frac{-5}{x+2}\right)x}=e^{-5}$$

80. Answer (2)

Let $y=\cos\frac{x}{2}\cos\frac{x}{4}...\cos\frac{x}{2^n}$

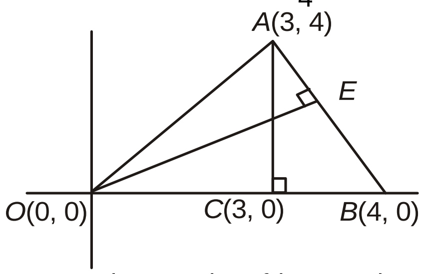
$$=\frac{1}{2\sin\frac{x}{2^n}}\left(\cos\frac{x}{2}\cos\frac{x}{4}...\cos\frac{x}{2^{n-2}}\sin\frac{x}{2^{n-2}}\right)$$

$$=\frac{\sin x}{2^n\sin\frac{x}{2^n}}$$

$$\lim_{n\to\infty}y=\lim_{n\to\infty}\frac{\frac{x}{2^n}}{\sin\frac{x}{2^n}}.\frac{\sin x}{x}=1.\frac{\sin x}{x}=\frac{\sin x}{x}$$

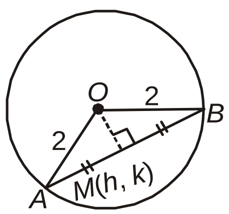
81. Answer (3)

Equation of altitude OE is $y=\frac{x}{4}$



Solving AC and OE, point of intersection comes out to be $\left(3,\frac{3}{4}\right)$.

82. Answer (3)



$AM = MB = OM$

$\Rightarrow$ $OM=\sqrt{2}$

$\Rightarrow$ $h^2 + k^2 = 2$

Hence locus of (h, k) is $x^2 + y^2 = 2$.

83. Answer (3)

For given slope, there exist 2 parallel tangents to ellipse. Hence, there are 2 values of C.

84. (2) Given parabola are :

$y^2 = 4ax$ ......(i)

and $y_2 = 4c (x - b)$ .....(ii)

Equation of any normal to parabola (i) may be taken as

$y - 2at = - t (x - at^2)$

or $lx + y - (2at + at^3 = 0$ .....(iii)

Equation of any normal to parabola (ii) may be taken as

$y- 2c\lambda = -\lambda (x - at^2)$

or $tx + y - (2c\lambda + b\lambda + c\lambda^3) = 0$ ...(iv)

Equation (iii) and (iv) must be identical.

$$\therefore\quad \frac{t}{\lambda}=\frac{1}{1}=\frac{2at+at^3}{2c\lambda+b\lambda+c\lambda^3}$$

$\therefore$ $t = \lambda$ and $2c\lambda + b\lambda + c\lambda^3 = cat + at^3$

$\Rightarrow$ $(c - a) t^3 + 2 (c - a) t + bt = 0$

$\Rightarrow$ $t[c-a) t^2 + 2c - 2a + b] = 0$

$$\Rightarrow\quad t = 0,\ t=\pm\sqrt{\frac{2a-2c-b}{c-a}}$$

$$=\pm\sqrt{\frac{b}{c-c}-2}$$

For common normal to the two parabolas (i) and (ii) other than their axis,

$$\frac{b}{a-c}-2>0 \text{ or } \frac{b}{a-c}>2$$

85. Answer (1)

$$\lim_{x\to0}\frac{2^x\log2}{\frac{1}{2}(1+x)^{-1/2}}=2\log2$$

86. Answer (1)

Both statements are correct.

$$\frac{\alpha-\lambda-2}{2}=\frac{\beta-\lambda}{-1}=\frac{-2(2\lambda+4-\lambda-5)}{5} \text{ gives}$$

$$\alpha=\frac{\lambda+14}{5},\ \beta=\frac{7\lambda-2}{5}$$

$\Rightarrow$ Locus $\to 7x-y=20$

87. Answer (1)

88. Answer (4)

89. (2) For ellipse $\frac{x^2}{\frac{27}{12}}-\frac{y^2}{\frac{27}{4}}=1,$

$e\sqrt{1-\frac{16}{25}}=\frac{3}{5}$

and

The foci are (± 3, 0).

For hyperbola $\frac{x^2}{\frac{27}{12}}-\frac{y^2}{\frac{27}{4}}=1,$ $e=\sqrt{1+\frac{12}{4}}=2$

and $a=\frac{3}{2}$

The foci are (±3,0)

Therefore, the two conics are confocal.

Hence, curves are othogonal.

90. Answer (1)