SOLUTIONS

PHASE TEST-1

RB-1804 TO 1806,

RBK-1802 & 1803

RBS-1801 & 1802

(JEE MAIN PATTERN)

Test Date: 03-09-2017

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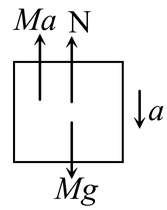
PHYSICS

1. F.B.D. of block is as shown



$$Mg = N + Ma$$

$$Mg = \frac{Mg}{4} + Ma$$

$$a = \frac{3g}{4}$$

$\therefore$ **(C)**

2. $a = \frac{Mg\sin\theta}{2M}$ and $T = Ma \Rightarrow T = \frac{Mg\sin\theta}{2}$

$\therefore$ **(C)**

3. $T - 35 = 3.5a$ .....(i)

$F - T - 65 = 6.5a$ .....(ii)

$T = 38.5N$

(i) $\Rightarrow a = 1$

(ii) $\Rightarrow F = 65 + 38.5 + 6.5 = 110N$

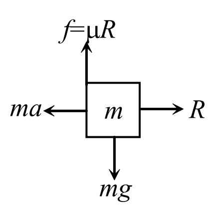
$\therefore$ **(A)**

4. $R = ma$

$f = mg \le \mu ma$

$\Rightarrow g \le \mu a$

$\Rightarrow \mu \ge \frac{g}{a} = 0.5$



$\mu_{min} = \frac{g}{a} = 0.5$

$\therefore$ **(C)**

5. $mg\sin\theta = 5N$,

$f = \mu mg\cos\theta = 3.4N$,

$F + f^{max} = 5.4N > mg\sin\theta = 5N$

hence acceleration, a = 0

$\therefore$ **(A)**

6. **(C)**

7. **(D)**

8. $mg - T = ma$

$T = 3ma$

$mg = 4ma \Rightarrow a = \dfrac{g}{4}$

$f = \dfrac{mg}{4} \le \mu mg$

$\Rightarrow \mu \ge \dfrac{1}{4}$

$\Rightarrow \mu_{min} = \dfrac{1}{4}$

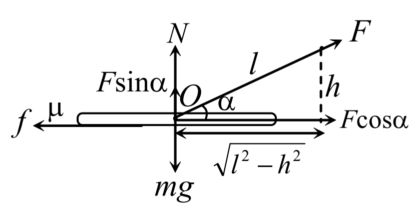
$\therefore$ **(C)**

9. **(A)**

10. $N = mg - F\sin\alpha$

$F\cos\alpha = f = \mu N$

$F\cos\alpha = \mu(mg - F\sin\alpha)$



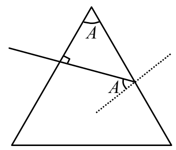
$$\mu = \frac{F\cos\alpha}{mg - F\sin\alpha} = \frac{F \times \dfrac{\sqrt{l^2 - h^2}}{l}}{mg - F \times \dfrac{h}{l}}$$

$$\mu = \frac{F\sqrt{l^2 - h^2}}{mgl - Fh}$$

$\therefore$ **(A)**

11. $A > i_c$

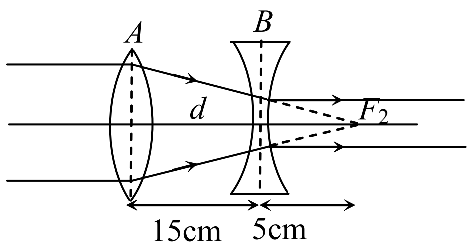
$\Rightarrow \sin A > \sin i_c = \frac{1}{\mu}$



$A > \sin^{-1}\frac{2}{3}$

$\therefore$ **(A)**

12. In the absence of concave lens the parallel beam will be focused at F_2 i.e. at a distance 20 cm from lens *A*. The focal length of concave lens is 5 cm i.e. if this lens is placed at 15 cm from *A*, then beam will become parallel. So, *d* = 15 cm



$\therefore$ **(B)**

13. For arrangement *P*,

$$\frac{1}{f_{eq}} = \frac{1}{2R} + \frac{1}{2R} - \frac{2}{3R} = \frac{1}{3R} \text{ (}R\text{ = radius of curvature)}$$

For arrangement *Q*, $\frac{1}{f_{eq}} = \frac{1}{2R} + \frac{1}{2R} - \frac{1}{3R} = \frac{2}{3R}$

$\therefore$ **(C)**

14. The maximum velocity of the insect is $A\sqrt{\frac{k}{M}}$.

Its component perpendicular to the mirror is $A\sqrt{\frac{k}{M}}\sin 60^0$.

Thus maximum relative speed $= \sqrt{3}A\sqrt{\frac{k}{M}}$.

$\therefore$ **(C)**

15. $2\mu_1 t = (2n-1)\dfrac{\lambda}{2}$, $t = \dfrac{(2n-1)\,\lambda}{4\mu_1}$ $\Rightarrow$ t = 120 nm, 360 nm, 600 nm.....

$\therefore$ **(A)**

16. $I = 4I_0 \cos^2 \dfrac{\phi}{2} \Rightarrow 2I_0 = 4I_0 \cos^2 \dfrac{\phi}{2}$

$\Rightarrow \cos\dfrac{\phi}{2} = \dfrac{1}{\sqrt{2}}$

$\Rightarrow \phi = 2 \times \dfrac{\pi}{4} = \dfrac{\pi}{2}$

Path difference $\Delta x = \dfrac{\lambda}{2\pi} \times \phi = \dfrac{\lambda}{2\pi}\dfrac{\pi}{2} = \dfrac{\lambda}{4}$

$\Rightarrow (\mu - 1)t = \dfrac{\lambda}{4}$ or $0.5t = \dfrac{\lambda}{4} \Rightarrow t_{\min} = \dfrac{\lambda}{2}$

$\therefore$ **(C)**

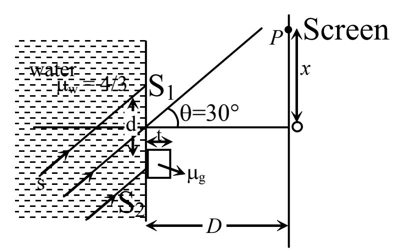
17. If central maxima is formed at point P on the screen, then

Path difference = $S_2P + (\mu_g - 1)t - S_1P - \mu_w d \sin 30° = 0$

$\Rightarrow S_2P - S_1P = \dfrac{xd}{D} = \mu_w d \sin 30° - (\mu_g - 1) \times t$

$\Rightarrow x = -1.66$ cm

$\therefore$ **(D)**



18. Applying Snell's law between the points *O* and *P*, we have

$2 \times \sin 60^0 = (\sin 90^0) \times \dfrac{2}{(1 + H^2)}$, $\qquad 2 \times \dfrac{\sqrt{3}}{2} = 1 \times \dfrac{2}{(1 + H^2)}$

$(1 + H^2) = \dfrac{2}{\sqrt{3}}$, $\qquad H = \sqrt{\left(\dfrac{2}{\sqrt{3}} - 1\right)}$

$\therefore$ **(A)**

19. **(B)**

20. **(B)**

21. **(B)**

$$T = \frac{x}{v} + \frac{\sqrt{(L-x)^2 + \ell^2}}{nv}$$

$$\frac{dT}{dx} = \frac{1}{v} + \frac{1}{nv}\,\frac{2(L-x)(-1)}{2\sqrt{(L-x)^2 + \ell^2}} = 0$$

$$\Rightarrow \frac{1}{v} = \frac{L-x}{nv\sqrt{(L-x)^2 + \ell^2}}$$

$$n^2\left((L-x)^2 + \ell^2\right) = (L-x)^2$$

$$n^2\ell^2 = (L-x)^2\left(1-n^2\right)$$

$$L - x = \sqrt{\frac{n^2\ell^2}{1-n^2}} = \frac{n\ell}{\sqrt{1-n^2}}$$

22. **(B)**

$$v = 54 \times \frac{5}{18} = 15\ ms^{-1},\ \vec{a}_{av} = \frac{\left(-15\hat{i} - 15\hat{i}\right)m\,s^{-1}}{10\,s}$$

$$\left|\vec{a}_{av}\right| = 3\,ms^{-2}$$

23. **(C)**

For Car A,

$$1000 = 35t + \frac{1}{2} \times \frac{2}{5}t^2$$

$$5000 = 175t + t^2$$

$$t^2 + 175t - 5000 = 0 \Rightarrow t = 25\,sec$$

For Car B,

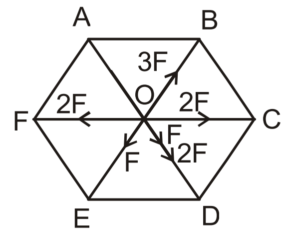
$$1200 = 44t + \frac{1}{2} \times \frac{1}{2}t^2$$

$$176t + t^2 - 4800 = 0$$

$$\Rightarrow t = 24\,sec$$

24. (D)

$$F = \frac{Keq}{r^2}$$



$$\frac{Ke2q}{r^2} = 2F$$

$$\frac{Ke3q}{r^2} = 3F$$

resultant force will pass between OC & OD.

25. (A)

$$\frac{4}{(\ell - x)^2} = \frac{1}{x^2}$$

$$\Rightarrow 2x = \ell - x$$

$$\Rightarrow x = \frac{\ell}{3}$$

$$\frac{4q}{\ell^2} = \frac{Q}{x^2} \Rightarrow Q = \frac{4}{9}q$$

26. (B)

$$\frac{9 \times 10^9 \times 2 \times 10^{-6} q_2}{100 \times 10^{-4}} = 0.2 \times 100 \times 10^{-3} \times 10 \Rightarrow q_2 = \frac{0.2}{18} \times 10^{-5} = \frac{1}{9}\mu c$$

27. (C)

28. (D)

$v_0 = 2cm,\ f_0 = 0.5cm$

apply lens formula for objective, $\frac{1}{2} - \frac{1}{-u_0} = \frac{1}{0.5}$

$$\Rightarrow \frac{1}{u_0} = 2 - \frac{1}{2} = \frac{3}{2} \Rightarrow u_0 = \frac{2}{3}\text{ cm}$$

29. (B)

(i)

$$a = \frac{Mg}{(M+m)}$$

$$T_1 = \frac{m}{2}.a$$

$$= \frac{mMg}{2(M+m)}$$

$$T_1 : T_2 = \frac{m}{M+m}$$

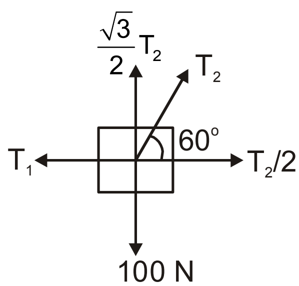
(ii)

$$a = \frac{Mg}{m}$$

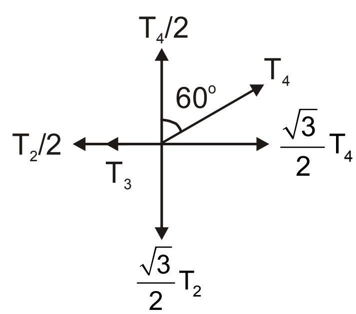
$$T_2 = \frac{m}{2} \times \frac{Mg}{m}$$

$$T_2 = \frac{Mg}{2}$$

30. (B)



$$T_2 = \frac{200}{\sqrt{3}} \text{ N}$$



$$\frac{T_4}{2} = \frac{\sqrt{3}\,T_2}{2}$$

$$\therefore \quad T_4 = \sqrt{3}\,T_2 = \sqrt{3} \times \frac{200}{\sqrt{3}} = 200 \text{ N}$$

CHEMISTRY

31. (B)

Moles of $Zn = \frac{9.81}{65} = 0.15$

Moles of $Cr = \frac{1.8 \times 10^{23}}{6.02 \times 10^{23}} = 0.3$

Moles of O = 0.6

$Zn_{0.15}Cr_{0.3}O_{0.6}$

$ZnCr_2O_4$

32. (B)

$$CO_2 + 2NaOH \longrightarrow Na_2CO_3 + H_2O$$

$n_{NaOH} = 1;$

$\therefore$ CO_2 present in mixture = 0.5 and CO present = 0.3 mole

Moles of CO_2 obtained from CO = 0.3, extra moles of NaOH required = 0.3 × 2 = 0.6 mole

34. (D)

$$M = \frac{n_{Solute}}{\text{vol of solution (in mL)}} \times 1000 \quad \text{..............(1)}$$

$$m = \frac{n_{Solute}}{\text{Weight of solvent (in g)}} \times 1000 \quad \text{..............(2)}$$

$$m = \frac{n_{Solute}}{\text{Weight of solution (in g)} - \text{wt of solute (in g)}} \times 1000$$

$$m = \frac{M \times \text{vol of solution (in mL)} \times 1000}{1000 \times [\text{wt of solution (in g)} - \text{wt of solute (in g)}]}$$

$$m = \frac{M \times 1000}{\text{Density of solution (g / mL)} \times 1000 - \frac{\text{wt of solute} \times \text{Msolute} \times 1000}{\text{Msolute} \times \text{volume of solution (in mL)}}}$$

$$m = \frac{M \times 1000}{\rho \times 1000 - M.Msolute}$$

34. (B)

n. factor = |1+5×2| = 11

35. (C)

Milli–equivalent of NH_3 reacted with HNO_3

= 45 ×0.4 – 20 × 0.1 = 16

$$\therefore \frac{W}{17}\times 1000 = 16; \qquad W_{NH_3} = 0.272\,g;$$

$$\text{mass of N} = 0.272 \times \frac{14}{17} = 0.224$$

$$\%\text{ N in the sample} = \frac{0.224}{1.12}\times 100 = 20\%$$

36. (A)

m–eq. of acid = m–eq. of base

$$\therefore N_1V_1 = N_2V_2$$

$$\frac{29.4}{\left(\frac{98}{n}\right)}\times 100 = 90\times\left(\frac{20}{40}\times\frac{1000}{500}\right) \qquad \Rightarrow n = 3$$

37. (C)

Because the number of moles is constant.

$$\frac{P_iV_i}{T_i} = \frac{P_fV_f}{T_f}; \quad P_f = \frac{P_iV_iT_f}{V_fT_i}$$

$$P_f = \frac{P_iV_iT_f}{V_fT_i} = 3.21\times 10^5\,Pa\times\frac{V_i}{1.03\,V_i}\times\frac{(273+28.0)}{(273-5.00)}$$

$$= 3.50\times 10^5\,Pa$$

38. (A)

$$P_{Atm} = \frac{h}{13.6} + P_{Gas} + \text{aq Tension}$$

$$P_{Gas} = P_{Atm} - \left(\text{aq tension} + \frac{h}{13.6}\right)$$

39. (D)

$$Fe^{2+} + MnO_4^- \longrightarrow Fe^{3+} + Mn^{2+}$$

$$n_{Fe^{2+}}\times 1 = 1\times 5$$

$Fe^{2+} + Cr_2O_7^{2-} \longrightarrow Fe^{3+} + Cr^{3+}$

$n_{Fe^{2+}} \times 1 = 1 \times 6$

Since 5 : 6

40. (A)

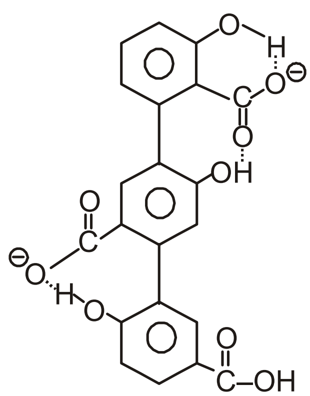
$n_i = n_f$

$$\frac{PV}{PT_1} = \frac{P_f V}{RT_1} + \frac{P_f \cdot V/2}{RT_2}$$

$$\frac{P}{T_1} = P_f\left(\frac{2T_2 + T_1}{2T_1 T_2}\right)$$

$$P_f = \frac{2T_2 \cdot P}{(2T_2 + T_1)}$$

41. (A)



42. (A)

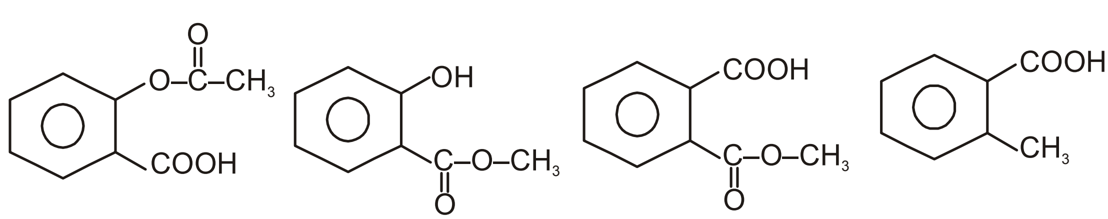
43. (C)

'X' is conjugated 'W' is isolated 'Y' is antiaromatic 'Z' is cumulated

44. (A)

In (A) more number of double bond.

45. (C)



(A) (B) (C) (D)

46. (D)

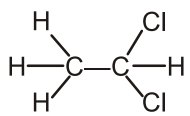
47. (C)

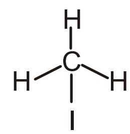
48. (B)

49. (D)

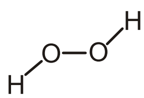
50. (A)

51. (A)

(A) 

(B) 

(C) $NaN_3 = Na^+ \cdots N_3^-$ $Na \cdots N \equiv N = N^-$ (ionic and covalent bond)

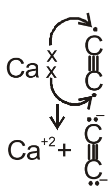
(D) 

52. (B)

$$CaC_2 \longrightarrow Ca^{+2} + C_2^{-2}$$

$$\bar{:}C \equiv C\bar{:}$$

$2\pi, 1\sigma$ bond



53. (D)

Conceptual.

54. (B)

Order of I.E: Active metal < Non-metal < inert gas

55. (A)

$NaOH \rightarrow Na + :\ddot{O}^{\ominus}-H$

56. (D)

Number of unpaired electron α paramagnetic character

57. (D)

$$\Delta H_{hyd}\ \alpha\ \frac{1}{\text{size of ion}}$$

58. (C)

Hypo Valent : When the central atom having less than 8 es^- in the outermost shell, then it is said to be Hypo valent :

AlF_3	$AlCl_3$	BF_3	BH_3
10es	$6es^-$	$6es^-$	$6es^-$

AlF_3 have ionic bond and valence electron is more than 8 es^-.

59. (D)

According to data

60. (B)

$NaCl_{(s)}$ and NaCl (Molten) both are soluble in water but are two keys to conducting electrically.

(i) Charged particles

(ii) The charged particles must be free to move in the case of any form of NaCl there are charged particales (the positive and negative ions).

However, in solid NaCl to charged particles are locked in place to the crystal lattice and not able to move and thus NaCl doe not conduct electricity.

When NaCl (molted) dissolved in water the crystal lattic break down and the charge particles are able to move and electrical conductivity is higher than NaCl(s).

MATHEMATICS

61. (B)

$$\frac{3\sin 80^\circ \sin 20^\circ + \cos 80^\circ \cos 20^\circ}{\cos 80^\circ \sin 20^\circ + \cos 20^\circ \sin 80^\circ} = \tan 50^\circ$$

62. (C)

$$f(\theta) = \frac{13}{2}\cos\theta - \frac{3\sqrt{3}}{2}\sin\theta + 3.$$

63. (B)

64. (C)

$$\tan 3\theta = \frac{3\tan\theta - \tan^3\theta}{1 - 3\tan^2\theta} \ ; \ \text{Let } \theta = \frac{\pi}{9}$$

$$3\left(1 - 3\tan^2\frac{\pi}{9}\right)^2 = \left(3\tan\frac{\pi}{9} - \tan^3\frac{\pi}{9}\right)^2$$

65. (B)

put x = 2 and x = 1001 in the given relation and get the value of f (2)

66. (D)

$\frac{\tan x}{\tan y} = \frac{1}{3}$; $\tan(x+y) = \frac{\tan x + \tan y}{1 - \tan x \tan y}$

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

Now $1 = \sin^2 y + \cos^2 y = 4\sin^2 x + \frac{4}{9}\cos^2 x$, $9 = 36 \sin^2 x + 4 \cos^2 x$

$9 \sec^2 x = 36 \tan^2 x + 4$, $9 + 9 \tan^2 x = 36 \tan^2 x + 4$

$\tan^2 x = \frac{5}{27}$

67. (C)

68. (A)

Equation satisfied when $\cos^2\left(\frac{\pi}{4}\left(\sin x + \sqrt{2}\cos^2 x\right)\right) = 1$ ....(i)

and $\tan^2\left(x + \frac{\pi}{4}\tan^2 x\right) = 0$ ....(ii)

From equation (i) $\sin x + \sqrt{2}\cos^2 x = 4m, m \in I$

This is true only when m = 0

Thus $\sin x + \sqrt{2}\cos^2 x = 0$

$\Rightarrow \sin x = -\frac{1}{\sqrt{2}}, \sqrt{2}\,(\text{Re jected})$

$\Rightarrow x = -\frac{\pi}{4} + 2n\pi, \frac{5\pi}{4} + 2n\pi$ (not satisfied by equation (ii))

$\therefore x = -\frac{\pi}{4} + 2n\pi, n \in I$

69. (A)

For point of interaction,

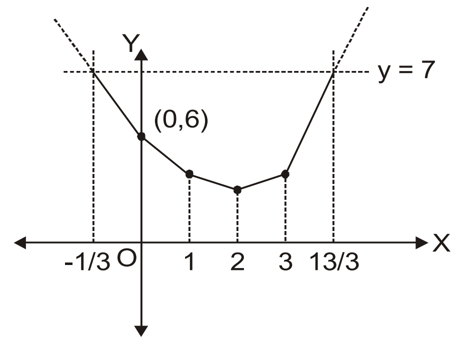
$3x + 4mx + 4 = 9 \Rightarrow x = \frac{5}{3+4m} \Rightarrow 3 + 4m = \pm 1, \pm 5$

$\Rightarrow m = -1/2, \ -1, \ 1/2, \ -2$

number of integral values of m is 2

70. **(D)**

$$f(x) = \begin{cases} 6-3x, & x \le 1 \\ 4-x, & 1 < x \le 2 \\ x, & 2 < x \le 3 \\ 3x-6, & x > 3 \end{cases}$$



$$6-3x \le 7 \Rightarrow x \in \left[-\frac{1}{3}, 1\right]$$

$$4-x \le 7 \Rightarrow x \in (1,2]$$

$$x \le 7 \Rightarrow x \in (2,3]$$

$$3x-6 \le 7 \Rightarrow x \in \left(3, \frac{13}{3}\right]$$

Hence solution of given inequality never lies between $\left[\frac{9}{2}, 5\right]$

71. **(A)**

$$\tan\left\{\underbrace{\text{arc}\tan(2)}_{A} + \underbrace{\text{arc}\tan(20k)}_{B}\right\} = k; \quad \frac{\tan A + \tan B}{1 - \tan A \tan B} = k; \quad \frac{2+20k}{1-(2)(20k)} = k$$

or $40k^2 + 19k + 2 = 0$

$\therefore$ sum of solutions, $k_1 + k_2 = -\frac{19}{40}$ Ans.]

72. **(D)**

$x \ne 0$

Case I when $x \ge -2$

$$\frac{|x+2|-x}{2} < 2 \quad \Rightarrow \quad \frac{2}{x} < 2 \quad \Rightarrow \quad \frac{1}{x} < 1 \Rightarrow (x-1)/x > 0$$

$x \in [-2, 0] \cup [1, \infty]$ .....(i)

Case II when $x < -2$

$$\frac{|x+2|-x}{x} < 2 \quad \Rightarrow \quad \frac{-2-2x}{x} < 2 \Rightarrow \frac{1+x}{x} + 1 > 0$$

$\Rightarrow (1 + 2x) / x > 0 \Rightarrow x \in (-\infty, -2)$ ...(ii)

$\therefore$ from (i) and (ii) we get $x \in (-\infty, 0) \cup (1, \infty)$

73. **(A)**

$x^2 + 2x + 3 + \sin \pi x = (x + 1)^2 + 2 + \sin \pi x > 1$

$\therefore$ f (x) = 1 $\forall x \in R$]

74. (A)

$f(x) = \dfrac{4}{\sqrt{1-x^2}}$; $f(\sin x) = \dfrac{4}{|\cos x|}$ and $f(\cos x) = \dfrac{4}{|\sin x|}$;

hence $g(x) = |\sin x| + |\cos x|$ $\Rightarrow$ (A)

75. (A)

$f(-1) = b(1-1)+1 = 1$

$\lim_{h\to 0} f(-1+h) = 1$

$\lim_{h\to 0} f(-1-h) = \sin((-1+h+a)\pi) = -\sin \pi a$

76. (D)

$$\lim_{x\to 3-} \frac{[x]^2-9}{x^2-9} = \infty$$

$$\lim_{x\to 3+} \frac{[x]^2-9}{x^2-9} = 0$$

77. (A)

Let $E = n\sin^2\theta + n\cos(\theta+\alpha)(\cos(\theta-\alpha)-\cos(\theta+\alpha)) + 2\cos^2(\theta+\alpha) - 1$

$= n\sin^2\theta + n(\cos^2\theta - \sin^2\alpha) - n\cos^2(\theta+\alpha) + 2\cos^2(\alpha+\theta) - 1$

$= n\sin^2\theta + n\cos^2\theta - n\sin^2\alpha + (2-n)\cos^2(\theta+\alpha) - 1$

$= (n-1) - n\sin^2\alpha + (2-n)\cos^2(\theta+\alpha)$

$\therefore$ For E to be independent of $\theta, (2-n) = 0 \Rightarrow n = 2$

78. (D)

$|x^2 - 9| + |x^2 - 4| = 5$

$|x^2 - 9| + |x^2 - 4| = |(x^2 - 9) - (x^2 - 4)|$

$\Rightarrow (x^2 - 9)(x^2 - 4) \le 0$ $\{\because |a| + |b| = |a - b| \Leftrightarrow a.\ b \le 0\}$

$\Rightarrow x \in [-3, -2] \cup [2, 3]$

79. (B)

$$P_1 = \frac{|a^2 + 2a\tan\theta + \tan^2\theta|}{|\sec\theta|} = \frac{(a+\tan\theta)^2}{|\sec\theta|}$$

$$P_3 = \frac{(b+\tan\theta)^2}{|\sec\theta|}$$

$$P_2 = \frac{|ab + (a+b)\tan\theta + \tan^2\theta|}{|\sec\theta|} = \frac{|(a+\tan\theta)(b+\tan\theta)|}{|\sec\theta|}$$

$$\Rightarrow \; P_2^2 = P_1P_3$$

80. (B)

$$\because \log_{\cos x}\left(\frac{\sqrt{3}}{2}\sin x\right) - \log_{\cos x}(\tan x) = 2$$

or, $\log_{\cos x}\left(\frac{\sqrt{3}}{2}\cos x\right) = 2$

$$\Rightarrow \frac{\sqrt{3}}{2}\cos x = \cos^2 x$$

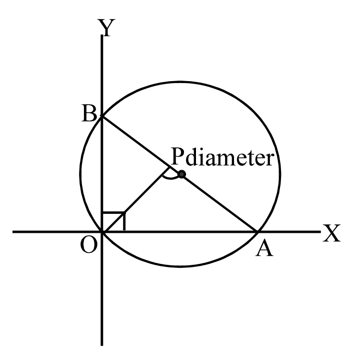
$$\Rightarrow \cos x(\cos x - \sqrt{3}/2) = 0$$

$$\therefore x = \frac{\pi}{6} \quad \left(\because x = \frac{\pi}{2} \text{ is rejected}\right)$$

81. (D)

$$\lim_{x\to\infty} \frac{\frac{2}{x} + 2 + \frac{\sin 2x}{x}}{\left(2 + \frac{\sin 2x}{x}\right)e^{\sin x}} \text{ and } -1 \le \sin x \le 1$$

82. (B)



Let the coordinate of A and B are (a, 0) and (0, b)

$$a^2 + b^2 = 4r^2 \quad \text{... (i)}$$

Equation of AB is $\frac{x}{a} + \frac{y}{b} = 1$ ... (ii)

Let P(h, k) lies on AB, so

$$\frac{h}{a} + \frac{k}{b} = 1 \quad \text{... (iii)}$$

OP is perpendicular to AB, therefore we have $\frac{k}{a} = \frac{h}{b} = \frac{\sqrt{h^2 + k^2}}{2r}$

Now the equation of the required locus is $(x^2 + y^2)^2\left(\frac{1}{x^2} + \frac{1}{y^2}\right) = 4r^2$

83. (C)

We have $\lim\limits_{n\to\infty} \dfrac{n\cdot 3^n}{n(x-2)^n + n\cdot 3^{n+1} - 3^n} = \dfrac{1}{3};$

So $\lim\limits_{n\to\infty} \dfrac{1}{\left(\dfrac{x-2}{3}\right)^n + 3 - \dfrac{1}{n}} = \dfrac{1}{3}$

Clearly $-1 < \dfrac{x-2}{3} < 1 \Rightarrow -1 < x < 5$

$\therefore$ Possible integers in the range 'x' are 0, 1, 2, 3, 4 $\Rightarrow$ 5 integers

84. (D)

For continuity $\lim\limits_{x\to 0} \dfrac{1-e^x}{x} = f(0) \Rightarrow f(0) = -1$

Now,

$$f'(0) = \lim_{h\to 0} \frac{f(h)-f(0)}{h} = \lim_{h\to 0} \frac{\dfrac{1-e^h}{h}+1}{h}$$

$$= \lim_{h\to 0} \frac{1-e^h+h}{h^2} = \lim_{h\to 0} \frac{1+h-\left(1+\dfrac{h}{1!}+\dfrac{h^2}{2!}+...\right)}{h^2} = -\frac{1}{2}$$

85. (D)

$$x = \frac{p}{q}; p, q \in I \Rightarrow y = \sqrt{1-\frac{p^2}{q^2}}$$

$$\Rightarrow \quad y = \frac{\sqrt{q^2-p^2}}{q}$$

$$\Rightarrow \quad y = \frac{n}{q};$$

$q^2 - p^2 = n^2$

$\Rightarrow \; p^2 + n^2 = q^2$

and no. of pythagorean triplets is infinite.

86. (B)

$$\lim_{x\to\infty} \left(\sqrt[3]{(x+a)(x+b)(x+c)} - x\right)$$

$$= \lim_{x\to\infty} \frac{(x^3 + (a+b+c)x^2 + (ab+bc+ca)x + abc) - x^3}{((x+a)(x+b)(x+c))^{2/3} + x^2 + x((x+a)(x+b)(x+c))^{1/3}} \quad \left(\because \; x - y = \frac{x^3 - y^3}{x^2 + xy + y^2}\right)$$

$$= \lim_{x\to\infty} \frac{(a+b+c)x^2 + (ab+bc+ca)x + abc}{((x+a)(x+b)(x+c))^{2/3} + x^2 + x((x+a)(x+b)(x+c))^{1/3}}$$

$= \frac{a+b+c}{3}$ (Dividing numerator and denominator by x^2)

87. (D)

It is obvious

88. (C)

$$\lim_{x\to 0} \log_{\cos\left(\frac{x}{2}\right)} \cos x = \lim_{x\to 0} \frac{\ln(\cos x)}{\ln\left(\cos\frac{x}{2}\right)} = 4.$$

89. (C)

$$\lim_{x\to 0} \frac{1}{x^2}(\log(2+x^2) - \log(2-x^2)) = \lim_{x\to 0} \frac{1}{x^2}\left(\log\left(\frac{2+x^2}{2}\right) - \log\left(\frac{2-x^2}{2}\right)\right)$$

$$= \lim_{x\to 0}\left(\log\left(1+\frac{x^2}{2}\right)^{\frac{1}{x^2}} - \log\left(1-\frac{x^2}{2}\right)^{\frac{1}{x^2}}\right) = \frac{1}{2} + \frac{1}{2} = 1.$$

90. (C)

$$L_1 = \lim_{x\to 0^+} (x\cos x)^x$$

$$\ell n L_1 = \lim_{x\to 0^+} \frac{\ell n(x\cos x)}{\frac{1}{x}} \quad \Rightarrow \; L_1 = 1$$

$$L_2 = \lim_{x\to 0^+} (\mathrm{cosec}x)^{\frac{1}{\ell n x}} \quad \Rightarrow \; L_2 = \frac{1}{e}$$

$$L_3 = \lim_{x\to 0^+} (x\sin x)^x \quad \Rightarrow \; L_3 = 1$$