SOLUTIONS

PHASE TEST-1

RB-1810 TO 1812

RBK-1805

(JEE ADVANCED PATTERN)

Test Date: 15-10-2017

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CHEMISTRY

1. (B)

(III) is most acidic due to ortho effect and (I) is least acidic due to $-NO_2$ do not participated in resonance with benzene ring. Therefore acidic strength of (III) > (IV) > (II) > (I)

2. (B)

Acidic strength $\propto k_a \ \alpha \dfrac{1}{P_{k_a}} \alpha \dfrac{1}{pH}$

3. (A)

+ M group increase the e^- density

4. (B)

The moles of the gas in the bubble remains constant, so that $n_1 = n_2$. To calculate the final volume, V_2,

$$V_2 = V_1 \times \frac{p_1}{p_2} \times \frac{T_2}{T_1}$$

$$= 2.0\,mL \times \frac{6.0\,atm}{1.0\,atm} \times \frac{298\,K}{281K}$$

= 12.72 mL.

5. (A)

Let wt. of NH_4NO_3 and $(NH_4)_2HPO_4$ are x and y gram prespectively

$$\frac{\frac{x}{80} \times 2 \times 14 + \frac{y}{132} \times 2 \times 14}{x + y} \times 100 = 30.4$$

$\Rightarrow$ x : y = 2 : 1

6. (D)

$X_2O_3 \ + \ 3H_2 \longrightarrow 2X + 3H_2O$

1 mol 3 mol

$(2a + 48)$g 6g

0.006 g H_2 is required by 0.1596 g oxide.

$\therefore$ 6g H_2 will be required by 159.6g oxide.

$\therefore$ $2a + 48 = 159.6 \quad \Rightarrow \quad a = 55.8$

where, a = atomic mass of metal M.

7. (C)

$\Delta En < 1.7 - \text{ionic bond (polar)}$

The reason is that $BaCl_2$ has the biggest difference in electronegativity, which gives ionic character, we can tell this since electronegativity increases up and to the right on the periodic table and decreases down and to the left. Since Barium is farthest down and to the left. It has the lowest electronegativity which gives at the most ionic character.

8. (B)

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

9. (A), (D)

10. (B, D)

$\therefore$ both are liquid & CH_3OH is solute (less amount)

Mass of $CH_3OH = 30 \times 0.8 = 24$ g,

Mass of $C_2H_5OH = 60 \times 0.92 = 55.2$ g

Mass of solution = 24 + 55.2 = 79.2 g

Volume of solution = $\frac{79.2}{0.88} = 90$ mL

Molarity = $\frac{nCH_3OH}{V(L)} = \frac{24/32}{90} \times 1000$ = 8.33 mol L^{-1}

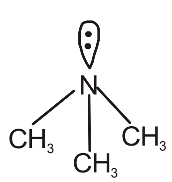
Molality = $\frac{n_{solute}}{w_{solvent}(kg)} = \frac{24/32}{55.2} \times 1000$ = 13.59

Mole fraction of solute = $\frac{\frac{24}{32}}{\frac{24}{32} + \frac{55.2}{46}} = 0.385$

Mole fraction of solvent = 1 – 0.385 = 0.615

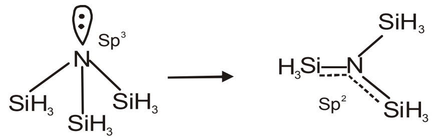
11. (A), (B)

12. (A,B,C)



$\theta = 120°$

No back bonding due to carbon has no vacant arbital.



(A) Nitrogen changing the hybridisation from sp^3 to sp^2 to acheive [2p – 3d] π effective back bonding.

(B) Trisilylamine has less basic due to back bonding tendency and Trimethylamine has no back bonding.

(C) Trisilylamine has $p\pi - d\pi$ back bonding.

13. (B)

At constant temperature T, $V \propto \frac{1}{P}$ (for 1 mol gas).

Thus, correct sequence of volume will be :

$$V_1 < V_2 < V_3 < V_4$$

14. (B)

$$M = \frac{V}{11.2} = \frac{11.2}{11.2} = 1$$

$\therefore$ M $\Rightarrow$ 1 and mol. mass of H_2O_2 = 34

$\therefore$ 34 g H_2O_2 persent per litre of solution of

3.4 g H_2O_2 present per 100 mL of solution.

15. (B)

m.eq. of $(MnO_4)_2$ = m.eq. of H_2O_2

$$\left(\therefore\ M = \frac{33.6}{11.2} \Rightarrow 3\right)$$

$\frac{w}{375} \times 10 \times 1000 = 3 \times 125 \times 2$; w = 28.125

% purity = $\frac{w}{40} \times 100$

$$= \frac{28.125}{40} \times 100 = 70.31$$

16. (A)

17. (C)

18. (C)

19. (3)

In HPh, Eq. of NaOH + Eq. of Na_2CO_3 = Eq. of HCl

(0.5) (1) + (0.5) (1) = (x) (1) x = 1

In MeOH, Eq. of NaOH + Eq. of Na_2CO_3 + Eq. of $NaHCO_3$ = Eq. of HCl

(0.5) (1) + (0.5) (2) + (0.5) (1) = (y) (1) = 2

x + y = 3

20. (7)

Balanced redox reaction

$$28NO_3^- + 3As_2S_3 + 4H_2O \longrightarrow 6AsO_4^{3-} + 28NO + 9SO_4^{2-} + 8H^+$$

21. (9)

$p_f = 1 + \frac{36}{76} = \frac{112}{76}$ atm. Final height = 19 cm

p_f =1 atm, initial length = h_i cm

$\therefore$ Boyle's law $P_i V_i = p_f V_f$

$$1 \times h_i A = \frac{112}{76} \times 19A$$

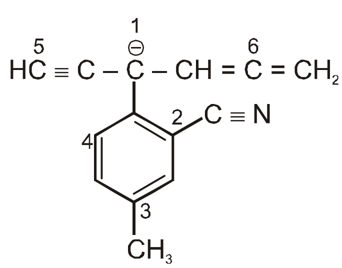
$$h_i = 28 \text{ cm}$$

$\therefore$ The length by which the Hg column shifts down = $h_i - h_f = 9$

22. (7)

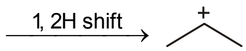
4	3	2	2

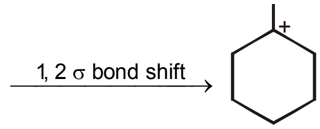
23. (6)

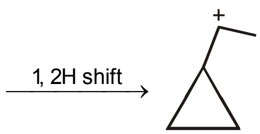


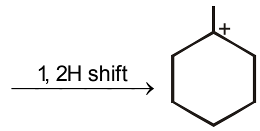
The negative charge is delocalised on the marked carbon atoms (1 - 6).

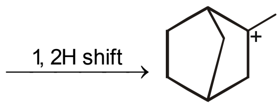
24. (9)

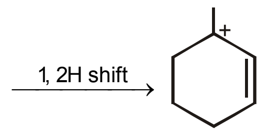
(b) 

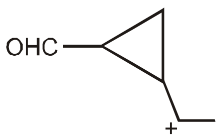
(c) 

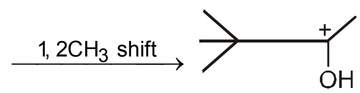
(d) 

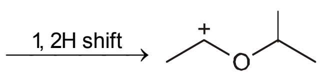
(e) 

(g) 

(i) 

(j) 

(k) 

(n) 

25. (1)

26. (4)

Automic size

(1) Kr > Ne (2) $Na > Na^+$ (3) $I^- > Cl^-$ (4) $Li^+_{(aq)} > Na^+_{(a)}$

27. (4)

$$E_N = \frac{IP + EA}{2 \times 2.80} (\text{When IP / EA are in electron volt})$$

$$3.05 = \frac{13.0 + E_A}{2 \times 2.80}$$

$= 5.60 \times 3.05 = 13— E_A$

$E_A = 4$

28. (5)

By POAC on 'By' – atom

$$2 \times nBr_2 = 1 \times n_{BrF_n}$$

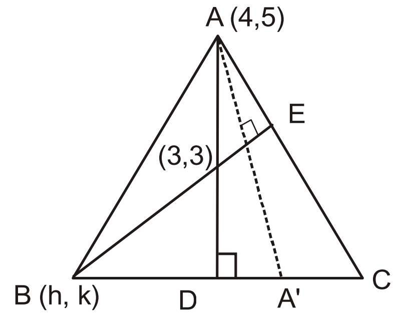
$$2 \times \frac{1 \times 0.423}{0.0821 \times 423} = 1 \times \frac{4.2}{(80 + 19n)} \qquad \Rightarrow n = 5$$

MATHEMATICS

29. (D)

The image of A in y = x will lie on BC

A' = (5, 4)



AD $\perp$ BC

$2\left(\frac{4-k}{5-h}\right)=-1 \quad \Rightarrow 8-2k=-5+h$

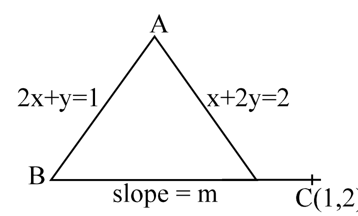
$\because h=k$

$\therefore h=k=\frac{13}{3}$

30. (B)

Slope of AB = – 2 ; slope of AC = $\frac{-1}{2}$; slope of BC = m

$\frac{m+2}{1-2m} = \frac{-\frac{1}{2}-m}{1-\frac{1}{2}m} \Rightarrow 4 - m^2 = -(1-4m^2) = 4m^2 - 1$



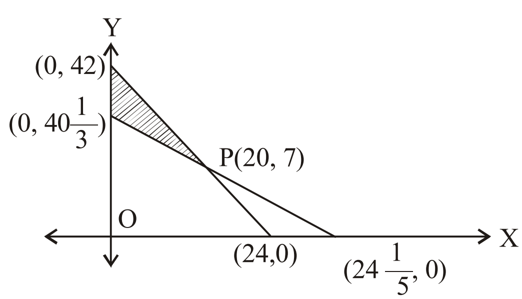
$5m^2 = 5 \qquad \Rightarrow \qquad m = \pm 1$

(y – 2) = 1(x – 1) or (y – 2) = – 1(x – 1)

x-intercept x = – 1 x = 3 **Ans.**

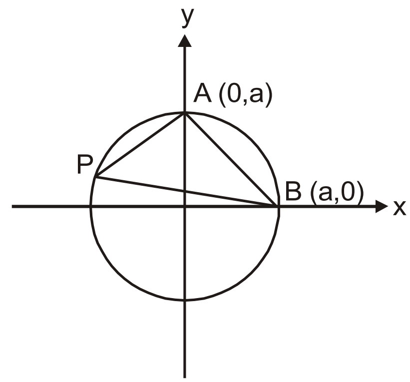
31. (A)

Clearly lines intersect at P(20, 7)



$\therefore$ Area of shaded region $= \frac{1}{2}\left(42-40\frac{1}{3}\right)20 = \frac{1}{2}\left(\frac{5}{3}\right)20 = \frac{50}{3}$ (square units)

32. (D)



Let $P \equiv (a\cos\theta, a\sin\theta)$

and centroid of $\triangle APB$ be (h, k).

Then $h = \dfrac{a\cos\theta + 0 + a}{3}, k = \dfrac{a\sin\theta + a + 0}{3}$

$\Rightarrow \cos\theta = \dfrac{3h}{a} - 1, \sin\theta = \dfrac{3k}{a} - 1$

$\because \sin^2\theta + \cos^2\theta = 1$

$\Rightarrow \left(\dfrac{3h}{a} - 1\right)^2 + \left(\dfrac{3k}{a} - 1\right)^2 = 1 \qquad \Rightarrow 9h^2 + 9k^2 - 6ah - 6ak + a^2 = 0$

so locus of centroid is

$9x^2 + 9y^2 - 6ax - 6ay + a^2 = 0$

33. (C)

We have, $\tan^{-1}x + \cos^{-1}\dfrac{y}{\sqrt{1+y^2}} = \sin^{-1}\dfrac{3}{\sqrt{10}}$

$\Rightarrow \quad \tan^{-1}x + \tan^{-1}\dfrac{1}{y} = \tan^{-1}3 \ \Rightarrow \ \tan^{-1}\left(\dfrac{x + \frac{1}{y}}{1 - \frac{x}{y}}\right) = \tan^{-1}3$

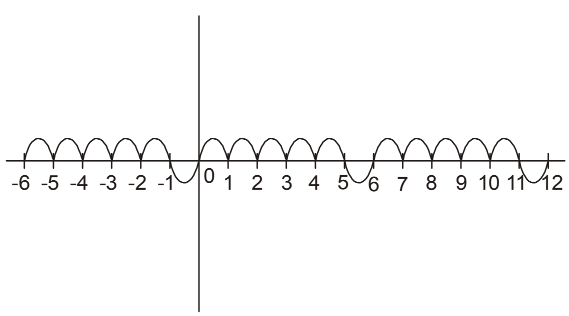
$\Rightarrow \quad \dfrac{xy+1}{y-x} = 3 \ \Rightarrow \quad y = \dfrac{3x+1}{3-x}$ ...(i)

Now, y > 0 $\Rightarrow \ \dfrac{3x+1}{3-x} > 0 \ \Rightarrow \ -\dfrac{1}{3} < x < 3 \ \Rightarrow \ x = 1, 2$

Hence, the required solutions are (1, 2) and (2, 7).

34. (A)

Graph of f(x) is given by



Therefore period of f(x) is 6 and |f(x)| is 1 $\qquad \Rightarrow \quad T_1^2 + T_2^2 = 37$

35. (D)

$x^2 + 4x + \alpha^2 - \alpha \ge 0 \ \forall \ x \in R$

According to given condition we must have D = 0 $\Rightarrow \quad \alpha = \frac{1 \pm \sqrt{17}}{2}$

36. (D)

$x = \frac{10[x] - 14}{[x] + 1}$

$\because \quad [x] \le x < [x] + 1$

$\therefore \quad [x] = 2, 6, 7$

37. (A,C)

$2x^2 + 5xy + 2y^2 + 4x + 5y + a = 0$ represents a pair of line.

$\therefore \ \Delta = 0 \quad \Rightarrow a = 2$

$\therefore$ the seperate straight lines are 2x + y + 2 = 0 and x + 2y + 1 = 0 .

If b = 2, then two of the three lines are parallel and then n = 2.

If $b = 1/2$, then again two lines are parallel and then n = 2.

If b = 5, then the lines are concurent, and then n = 0.

38. (A, D)

$$f(x) = \begin{cases} ax^2 + bx & \text{for } -1 < x < 1 \\ \frac{a - b - 1}{2} & x = -1 \\ \frac{a + b + 1}{2} & x = 1 \\ \frac{1}{x} & \text{for } x > 1 \text{ or } x < -1 \end{cases}$$

for continuity at x = 1

a + b = 1 ....(1)

for continuity at x = – 1

a – b = – 1 $\Rightarrow$ a – b = – 1 ....(2)

hence a = 0 and b = 1

39. (A, C)

$4^x - 2^{x+2} + 5 + ||b - 1| - 3| = |\sin y|$

$= 4^x - 2^x \cdot 4 + 4 + 1 + ||b - 1| - 3| = |\sin y|$

$\Rightarrow \ (2^x - 2)^2 + 1 + ||b - 1| - 3| = |\sin y|$

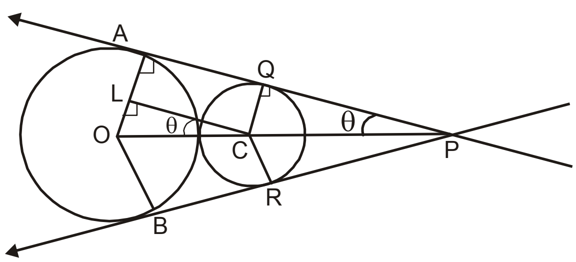
Now, LHS $\ge$ 1 and RHS $\le$ 1 , equality is possible only when LHS = RHS = 1.

$\therefore ||b-1|-3|=0$

$\Rightarrow |b-1|=3 \Rightarrow b-1=\pm 3$

$\therefore b=4,-2$

40. (A, B, C,D)



If CL || AP then OL = OA – AL = OA – CQ = 36 – 9 =27

$\sin\theta = \frac{OL}{OC} = \frac{27}{45} = \frac{3}{5} \Rightarrow \tan\theta = \frac{3}{4}$

$\because \quad \angle APB = 2\theta = 2\tan^{-1}\frac{3}{4} = \sin^{-1}\left(\frac{24}{25}\right)$

Further, length of common tangent is distance between points of contact = AQ

Here, $AQ = CI = \sqrt{45^2 - 27^2} = 36$

Also, area $(\Delta OAP) = \frac{1}{2} OA \times AP = \frac{1}{2} \times 36 \times 48 = 864$

41. (A, D)

We have line $x + \lambda y = 1 + k\lambda$

$\Rightarrow (x-1) + \lambda(y-k) = 0 \qquad (L_1 + \lambda l_2 = 0)$

hence (1,k) lies on circle C_1

$\Rightarrow k^2 + 1 = 4 \Rightarrow k = \pm\sqrt{3}$

$\Rightarrow$ length of tangent from $(1, \pm 3)$ to the circle C_2 is $\sqrt{1+9-1} = 3$

42. (B)

43. (A)

44. (D)

$x = 3^{\log 5 - \log 7}$

$y = 5^{\log 7 - \log 3}$

$z = 7^{\log 3 - \log 5}$

$\therefore \quad x \cdot y \cdot z = 1 \qquad \therefore \quad A = 1$

$\log_2 (6 \log_2 |x| - 3) - \log_2 (4 \log_2 |x| - 5) = \log_2 3$

$\frac{6\log_2 |x| - 3}{4\log_2 |x| - 5} = 3$ let $\log_2 |x| = t$ $\therefore$ $\frac{6t-3}{4t-5} = 3$

$6t - 3 = 121 - 15$, $6t = 12$ $\therefore$ $t = 2$, $\log_2 |x| = 2$, $|x| = 4$ $\therefore$ $x = \pm 4$

$B = 16 + 16 = 32$

$\log_2 (\log_2 3) + \log_2 (\log_3 4) + \log_2 (\log_4 5) + \log_2 (\log_5 6) + \log_2 (\log_6 7) + \log_2 (\log_7 8)$

$= \log_2 (\log_2 8) = \log_2 3$

$\therefore$ C = 1. **Ans.**]

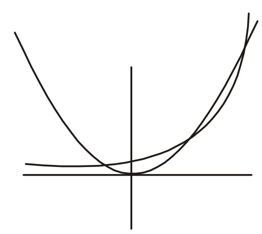
45. (D)

46. (C)

$f(xf(y)) = x^2 y^n$, $(n \in R)$ ------(1)

putting x = 1, $f(f(y)) = y^n$

Now putting $f(y) = \frac{1}{x}$ in ------(2)



$f(1) = \frac{y^n}{(f(y))^2} \Rightarrow$ put y = 1

$f(1) = \frac{1}{(f(1))^2} \Rightarrow (f(1))^3 = 1 \Rightarrow f(1) = 1$

$\Rightarrow \therefore f(x) = x^2$

$2f(x) = e^x$

$2x^2 = e^x$

for $x > 0$

47. (1)

$a = \log_{12} 18$ & $b = \log_{24} 54$

$a = \frac{\log_2 18}{\log_2 12} = \left(\frac{2\log_2 3 + 1}{\log_2 3 + 2}\right)$, $b = \frac{\log_2 54}{\log_2 24} = \left(\frac{3\log_2 3 + 1}{\log_2 3 + 3}\right)$

Let $\log_2 3 = x \Rightarrow a = \left(\frac{2x+1}{x+2}\right)$ $b = \left(\frac{3x+1}{x+3}\right)$

$ab + 5(a - b) = \frac{(2x+1)(3x+1)}{(x+2)(x+3)} + 5\left(\frac{2x+1}{x+2} - \frac{3x+1}{x+3}\right)$

$$= \frac{6x^2+5x+1+5(2x^2+7x+3-3x^2-7x-2)}{(x+2)(x+3)}$$

$$= \frac{x^2+5x+6}{(x+2)(x+3)} = \frac{(x+2)(x+3)}{(x+2)(x+3)} = 1$$

48. (1)

Any line through A (10, – 8) is $\frac{x-10}{\cos\theta}=\frac{y+8}{\sin\theta}=r$

$\Rightarrow x=10+r\cos\theta, \qquad y=-8+r\sin\theta$

If the point lies on the curve $x^2-xy+y^2+4x-5y-2=0$, then

$(10+r\cos\theta)^2-(10+r\cos\theta)(r\sin\theta-8)+(r\sin\theta-8)^2+4(10+r\cos\theta)-5(r\sin\theta-8)-2=0$

$\Rightarrow r^2(1-\sin\theta\cos\theta)+r(32\cos\theta-31\sin\theta)+322=0$

$\therefore\ r_1+r_2=\frac{31\sin\theta-32\cos\theta}{1-\sin\theta\cos\theta}, \qquad r_1r_2=\frac{322}{1-\sin\theta\cos\theta}$

Let $AB=r_1$, $AC=r_2$, and AP = r, then $\frac{2}{r}=\frac{1}{r_1}+\frac{1}{r_2}$

$\Rightarrow\ 644=31r\sin\theta-32r\cos\theta=31(y+8)-32(x-10)$

$\Rightarrow$ 32x – 31y + 76 = 0

$\therefore$ a = 32, b = – 31

49. (5)

$3x-7\le x^2-3x+2<3x-7+1 \qquad \& \ 3x\in Z$

$\Rightarrow 0\le x^2-6x+9<1 \qquad \& \ 3x\in Z$

$\Rightarrow 2<x<4 \qquad \& \ 3x=n$ for some $n\in Z$

$\Rightarrow 2<\frac{n}{3}<4 \quad \& \ x=\frac{n}{3}, n\in Z \qquad \Rightarrow 6<n<12 \quad \& \ x=\frac{n}{3}, n\in Z$

. $\Rightarrow n\in\{7,8,9,10,11\}\ \& \ x=\frac{n}{3}, n\in Z \qquad \Rightarrow x\in\left\{\frac{7}{3},\frac{8}{3},3,\frac{10}{3},\frac{11}{3}\right\}$

50. (4)

The period of the function is 8

$$\therefore \sum_{r=0}^{\infty}\left(f\left(1+8r\right)\right)^{r}=5$$

$$\Rightarrow 1+f\left(1\right)+\left(f\left(1\right)\right)^{2}+....\infty \text{ terms} = 5$$

$$\frac{1}{1-f\left(1\right)}=5$$

$$5f\left(1\right)=4$$

51. (8)

By symmetry, the quadrilateral is a rectangle having y = x and y = –x as axis of symmetry.

Let (a, b) be one of the vertex then

Area = 2 $|a^2 - b^2|$

$$= 2\sqrt{\left(a^4+b^4-2a^2b^2\right)}=16$$

52. (2)

$\left[\cot^{-1}x\right]+2\left[\tan^{-1}x\right]=0,$ will be satisfied only when

$$\left[\cot^{-1}x\right]=0 \ \& \ \left[\tan^{-1}x\right]=0$$

$$\text{or } \left[\cot^{-1}x\right]=2 \ \& \ \left[\tan^{-1}x\right]=-1$$

Case–I $\left[\cot^{-1}x\right]=0 \Rightarrow x\in\left(\cot 1,\infty\right)$

$$\&\left[\tan^{-1}x\right]=0 \Rightarrow x\in\left[0,\tan 1\right)$$

$$\therefore x\in\left(\cot 1,\tan 1\right)$$

Case–II $\left[\cot^{-1}x\right]=2 \Rightarrow x\in\left(\cot 3,\cot 2\right]$

$\&\left[\tan^{-1}x\right]=-1 \Rightarrow x\in\left[-\tan 1, 0\right)$

$\therefore x\in\left[-\tan 1, \cot 2\right]$

Thus the solution set for the given equation is

$\left[-\tan 1, \cot 2\right]\cup\left(\cot 1, \tan 1\right) \Rightarrow x = 1, -1$

53. (7)

Let x = I + f $\quad 0\le f<1$

$73\,I + \left[f+\frac{1}{19}\right]+\left[f+\frac{1}{20}\right]+\ldots+\left[f+\frac{1}{91}\right]=546$

Now 546 = 7 × 73 + 35

$\Rightarrow I = 7$

54. (4)

Centre $\equiv C_n = 1+(n-1).3 \Rightarrow C_n = 3n-2$

$C_5 = (13,0), C_3 = (7,0)$

Radius $\equiv R_n = ar^{n-1} = 2^{n-1} \Rightarrow R_3 = 4$

tangents from $C_5(13,0)$ to C_3 are given by y – 0 = m(x – 13) $\Rightarrow m = \pm\frac{2}{\sqrt{5}} \Rightarrow m_1.m_2 = \frac{4}{5}$

55. (1)

$$\lim_{x\to\infty}\left\{x^{3c}\left(1+\frac{4}{x}+\frac{1}{x^3}\right)^c - x\right\}$$

$$\lim_{x\to\infty} x\left[x^{3c-1}\left\{1+\left(\frac{4}{x}+\frac{1}{x^3}\right)\right\}^c - 1\right]$$

$$\lim_{x\to\infty} x\left[x^{3c-1}\left\{1+c\left(\frac{4}{x}+\frac{1}{x^3}\right)\right\}+\ldots. -1\right]$$

$3c = 1$

56. (4)

The equation of circle can be taken as $(x+r)^2+(y-r)^2=r^2$

If it passes through $(2\alpha,3\beta)$ then $4\alpha^2+9\beta^2+4\alpha r-6\beta r+r^2=0$

$\Rightarrow\ r^2+\left(4\alpha-6\beta\right)r+4\alpha^2+9\beta^2=0$ is a quadratic equation in 'r'

If radii are r_1 and r_2 of the circles then $r_1+r_2=6\beta-4\alpha,\quad r_1r_2=4\alpha^2+9\beta^2$

Now two circles intersect each other orthogonally,

therefore $(r_1-r_2)^2+(r_1-r_2)^2=r_1^2+r_2^2$

$\Rightarrow\ r_1^2+r_2^2=4r_1r_2$

$\Rightarrow\ (6\beta-4\alpha)^2=6(4\alpha^2+9\beta^2)$

$\Rightarrow\ 2(9\beta^2+4\alpha^2-12\alpha\beta)=3(4\alpha^2+9\beta^2)$

$\Rightarrow\ 4\alpha^2+9\beta^2+24\alpha\beta=0$

$(2\alpha+3\beta)^2=-12\alpha\beta$

PHYSICS

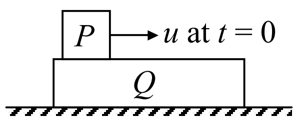
57. **(C)**

58. **(C)**

Friction between *P* and *Q* will retard *P* (and accelerate *Q*) till slipping is stopped

Masses of the blocks are same so

$\therefore$ Retardation of *P* = acceleration of $Q = \mu g$



Thus $v_p = u - \mu gt$ and $v_q = \mu gt$

Once slipping is stopped both blocks will move with same velocity $\left(\text{i.e.} \frac{u}{2}\right)$. Graph (C) depicts this treatment.

59. **(A)**

Focal length of the convex lens

$$\frac{1}{f} = \left(\frac{\mu_2 - \mu_1}{\mu_1}\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{f} = \left(\frac{1.5-1}{1}\right)\left(\frac{1}{R} - \frac{1}{\infty}\right) = \frac{1}{2R} \Rightarrow f = 2R$$

So the ray would become parallel to the principal axis after the refraction and fall $\perp^r$ to the mirror and hence would get reflected back along the same path.

60. **(C)**

In the case of minimum deviation, ray inside the prism is parallel to base.

Therefore, ray is deviated equally from both refracting faces

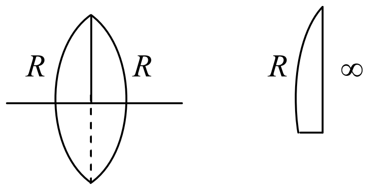
If, $\delta = 34°$, $\delta' = \frac{\delta}{2} = 17°$

61. Net force on any charge = 0.Force on any charge *Q* at end

$F = K\frac{Q^2}{4x^2} + \frac{KqQ}{x^2} = 0$. Hence, $q = \frac{-Q}{4}$

$\therefore$ **(A)**

62. **(C)**



$$\frac{1}{20} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{-R}\right)$$

$$= \frac{1}{f} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{\infty}\right)$$

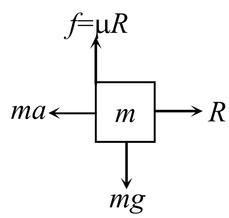
$$f = 40cm$$

63. $\Sigma F_y = 0$, $R = ma$

$mg = \mu R = \mu ma$

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

$\therefore$ **(C)**



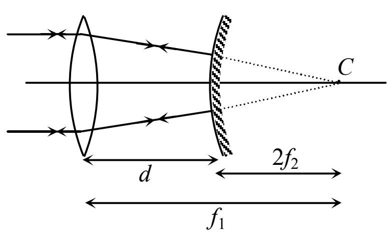
64. For charge + q at A to come down, $F_e < mg$

$$\therefore \quad \frac{q^2}{4\pi\varepsilon_0 h^2} < \text{mg}$$

$\therefore$ **(C)**

65. **(B,D)**

66. **(A, B)**



67. $v_x = 3$ m/s

$a_x = -1.0$ m/s^2

$$\therefore \quad v_x^2 = u_x^2 + 2a_x.x$$

or $0=(3)^2+2(-1)(x)$ or x = 4.5 m

Also $v_x=u_x+a_xt$

$0=3-(1.0)t$ or t = 3s

$y=u_yt+\frac{1}{2}a_yt^2=0+\frac{1}{2}(-0.5)(3)^2=$ -2.25 m

and $v_y=a_yt=(-0.5)(3)=-$ 1.5 m/s

$\therefore$ $\vec{v}=v_x\hat{i}+v_y\hat{j}=0-1.5\hat{j}=(-1.5\hat{j})$ m/s

and $\vec{r}=x\hat{i}+y\hat{j}=(4.5\hat{i}-2.25\hat{j})$ m

$\therefore$ **(B) and (C)**

68. If the image is real and magnified means object is between *f* and 2*f*.

When lens immersed in water focal length, $f_1=\frac{(\mu-1)}{\left(\frac{\mu}{\mu_r}-1\right)}f=4f$

Now object is between pole and focus so image is virtual and magnified.

$\therefore$ **(A) and (C)**

69. Friction maximum = 24 N

So net applied force on *P* is less than f_{max}.

Hence acceleration is zero and T_A = 20 N, T_B = 40 N

Contact force $=\sqrt{N^2+(f)^2}=\sqrt{(40)^2+(20)^2}=20\sqrt{5}$ N

$\therefore$ **(A) (B) (C) and (D)**

70. $F\cos\theta=ma$, $13\cos\theta=5$, $\cos\theta=\frac{5}{13}$

$\therefore$ **(B)**

71. $F\sin\theta-\mu mg=ma_1$

$13\times\frac{12}{13}-0.6\times10=ma_1$ (a_1 = acceleration of the particle with respect to train)

$a_1=6$ m/s^2

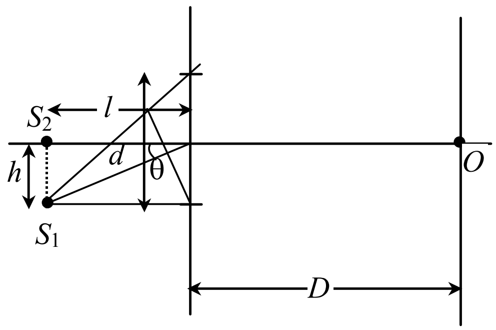
a_{net} = $\sqrt{36+25}$ = $\sqrt{61}$ m/s^2

$\therefore$ **(A)**

72. K.E. = $\frac{1}{2}\times 1\times 100^2$ = 5 × 10^3 J

$\therefore$ **(A)**

73. **(A)**



Here

(A) $\Delta x = d\sin\theta = d\tan\theta = d\times\frac{h}{l}$

For green light to be missing

$\Delta x = \frac{\lambda_g}{2}$ $\Rightarrow$ $h = \frac{\lambda_g l}{2d}$

for minimum h, n should be equal to 1

or $h_{min} = \frac{\lambda_g l}{2d} = \frac{5\times 10^{-7}\times 0.5}{2\times 10^{-3}} = 1.25\times 10^{-4}$ m

Here fringe width $\beta = \frac{\lambda_g D}{d} = \frac{5\times 10^{-7}\times 1}{10^{-3}} = 5\times 10^{-4}$ m

74. **(B)**

If intensity due to S_2 any point on the screen is, $I_2 = 4I_0\cos^2\frac{\phi}{2}$, then intensity due to S_1 at the same point $I_1 = 4I_0\cos^2\left[\frac{\phi+\phi_1}{2}\right]$

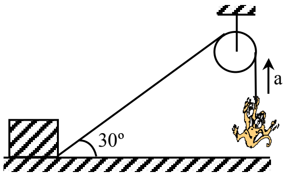
where, $\phi_1 = \left(\frac{hd}{l}\right)\times\frac{2\pi}{\lambda} = 2\times\frac{\lambda l}{2d}\times\frac{d}{l}\times\frac{2\pi}{\lambda} = 2\pi$

i.e. $I_1 = 4I_0\cos^2\left[\frac{\phi+2\pi}{2}\right] = 4I_0\cos^2\frac{\phi}{2} = I_2$

$\therefore$ total intensity $I = I_1 + I_2 = 8I_0\cos^2\frac{\phi}{2}$

$\therefore$ minimum distance of maximum from $O = \frac{\beta}{2} =$ **2.5 × 10^{-4}m**

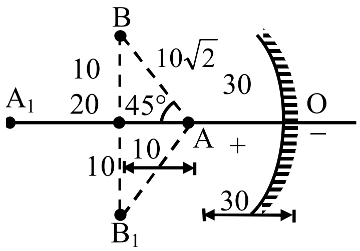
75. (6)



Let T be the tension in the string. The upward force exerted on the clamp = T sin 30° = T/2

$T/2 = 40N \Rightarrow T = 80N, a = \frac{T - mg}{m} = \frac{80-50}{5} = 6m/s^2$

76. (1)



for B, u = 30 + 10 = 40 cm

f = – 20 cm

v = – 40 cm

$m = -\frac{v}{u} = -1$

for A u = – 30 f = – 20, v = – 60

$A_1B_1 = \sqrt{20^2 + 10^2} = \sqrt{500} = 10\sqrt{5}$ cm

77. (3)

For image formed by lens

$\frac{1}{v_1} - \frac{1}{-15} = \frac{1}{+10}$

$\Rightarrow v_1 = +30$ cm

i.e. 20 cm behind mirror

For mirror

$\frac{1}{v_2} + \frac{1}{20} = \frac{1}{-20}$

$\Rightarrow v_2 = -10$ cm

Overall magnification = $\left(\frac{30}{-15}\right) \times \left(\frac{-10}{20}\right) = 1$

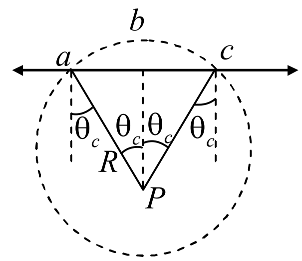
Length of image = 1 × 3 = 3 mm

78. (1)

79. (2)

80. (1)

The light escape is confined within a cone of apex angle '$2\theta_c$' where θ_c is the critical angle. Imagine a sphere with source of light as its centre and the surface area *abc* is *A*.



here

$$A = \int_0^{\theta_c} 2\pi R^2 \sin\theta \, d\theta = 2\pi R^2 (1 - \cos\theta_c)$$

$$= \pi R^2 \qquad \left[\therefore \theta_c = \sin^{-1}\left(\frac{\sqrt{3}}{2}\right) = 60^\circ\right]$$

$\therefore$ Power transfer $= P \times \dfrac{A}{4\pi R^2}$

$$= 4 \times \frac{1}{4} = 1\,\text{W}$$

81. (4)

Here 3[rd] maxima is shifted by 3×10^{-4} m. It indicates fringe width increases by 1×10^{-4} m.

Hence $\beta = \dfrac{\lambda(D + 0.5)}{d} = \dfrac{\lambda D}{d} + 1 \times 10^{-4}$

or $\dfrac{0.5\lambda}{d} = 1 \times 10^{-4}\,\text{m}$ or $\lambda = \dfrac{2 \times 10^{-3} \times 1 \times 10^{-4}}{0.5} = 4 \times 10^{-7}\,\text{m}$ = **400 nm**

82. (6)

Let *AS* = *h*

Now, $\beta = \dfrac{\lambda D}{d}$

In the first case, $d = 2h$

$\therefore \quad \beta = \dfrac{\lambda D}{2h}$ … (i)

In the second case, $d = 2(h + \Delta x)$, where Δx = shift in the source away from the mirror along *AB.*

$\therefore \quad \beta' = \dfrac{\lambda D}{2(h + \Delta x)}$ … (ii)

Dividing equation (i) by equation (ii), we have,

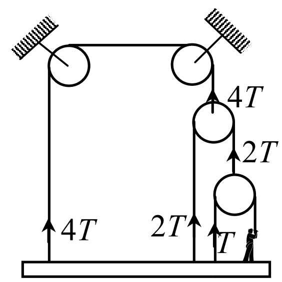
$$\frac{\beta}{\beta'} = \frac{h+\Delta x}{h} = 1 + \frac{\Delta x}{h}$$

or, $\frac{\beta-\beta'}{\beta'} = \frac{\Delta x}{h}$ $\Rightarrow$ $h = \left(\frac{\Delta x \times \beta'}{\beta-\beta'}\right) = \frac{.6\times\frac{1}{6}}{\frac{1}{4}-\frac{1}{6}}$ = 1.2 mm

Putting the value of h in equation (1), we get

$$\lambda = \frac{2\times\beta\times h}{D} = \frac{2\times1.4\times10^{-3}\times1.2\times10^{-3}}{1} = \mathbf{6\times10^{-7}\ m}$$

83. (7)



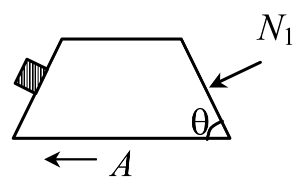
$7T - N - Mg = Ma$ … (i)

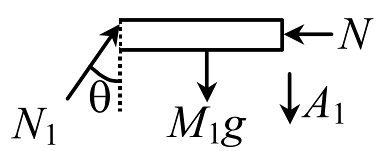
$T + N - mg = ma$ … (2)

Dividing the equation (1) and (2)

$\left(\frac{7m-M}{m+M}\right)T = N > 0$, $\frac{M}{m} > 7$

84. (3)





Let M_1 be the mass of the rod.

$M_1 g - N_1\cos\theta = M_1 A_1$ … (i)

$N_1\sin\theta = (M+M)A$ … (ii)

$A = g\tan\theta$ … (iii)

relation between A_1 and A

$A_1 = A\tan\theta$

So by solving these equations $M_1 = 3M$