INDIAN ASSOCIATION OF PHYSICS TEACHERS
NATIONAL STANDARD EXAMINATION IN PHYSICS 2018-19

Q. Paper Code: P160

ANSWERS

1.	**D**	2.	**C**	3.	**D**	4.	**D**
5.	**BONUS (Force is not given)**			6.	**D**	7.	**D**
8.	**C**	9.	**C**	10.	**B**	11.	**C**
12.	**C**	13.	**B**	14.	**C**	15.	**B**
16.	**B**	17.	**B**	18.	**B**	19.	**B**
20.	**A**	21.	**C**	22.	**D**	23.	**C**
24.	**C**	25.	**C**	26.	**A**	27.	**D**
28.	**C**	29.	**D**	30.	**D**	31.	**B**
32.	**D**	33.	**C**	34.	**D**	35.	**B**
36.	**B**	37.	**D**	38.	**C**	39.	**D**
40.	**A**	41.	**B**	42.	**BONUS / C**	43.	**C**
44.	**A**	45.	**B**	46.	**A**	47.	**A**
48.	**C**	49.	**C**				
50.	**BONUS (Value of emf not given in question)**					51.	**A**
52.	**D**	53.	**D**	54.	**C**	55.	**B**
56.	**C**	57.	**C**	58.	**A**	59.	**C**
60.	**D**	61.	**ABCD**	62.	**BD**	63.	**BC**
64.	**AD**	65.	**ABC**	66.	**AD**	67.	**AC**
68.	**BC**	69.	**AC**	70.	**ABC**		

HINTS AND SOLUTIONS

1. **D**

1. $[B] = \left[\frac{\mu_0 i}{2r}\right]$ $[\mu_0] = \frac{T_m}{A} = \frac{Tm^2}{Am} = \frac{Wb}{Am}$

2. **C**

2. $a = \frac{g\sin\theta}{1+\frac{1}{mR^2}} = \frac{2}{3}g\sin\theta$

3. **D**

3. $x = at$ $u_2 = a$ acceleration along x $f_x = 0$.
$y = at(1 - \alpha t)$ $\mu_2 = a - 2a\,\alpha t$ acceleration along y $f_x = -2a\alpha$.
Acceleration is constant along –ve y axis.

Thus, $\tan\frac{\theta}{4} = \frac{-\mu_y}{v_x}$

$\Rightarrow$ $a = -a(1 - 2\alpha t)$

$\Rightarrow$ $t = \frac{1}{\alpha}$

4. **D**

4. $F_x = -\frac{\partial U}{\partial x} = -\alpha$ $F_y = \frac{\partial_v}{\partial_y} = +\beta$

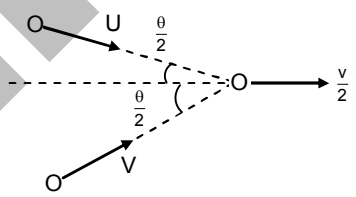
$a = \frac{F}{m} = \frac{\sqrt{\alpha^2+\beta^2}}{m}$

5. **BONUS**

5. **Force is not given.**

6. **D**

6. Com



$2mv\cos\frac{\theta}{2} = 2m\frac{v}{2}$

$\cos\frac{\theta}{2} = \frac{1}{2}$

$\theta = 120°$

7. **D**

7. $dT = \frac{dt}{n}$; $dT_1 = \frac{dt}{n_1}$; $dT_2 = \frac{dt}{n_2} = dT_2 = \frac{dT_1}{5}$

8. **C**

8. Let maximum separator be r. from conservation of angular momentum and conservation of mechanical energy.

$-\frac{GMm}{R} + \frac{1}{2}m\frac{3GM}{2R} = -\frac{2Gm}{r} + \frac{1}{2}m\frac{3GmR}{2r^2}$

$\Rightarrow$ $\frac{3}{4}\left(\frac{R}{r}\right)^2 - \left(\frac{R}{r}\right) + \frac{1}{4} = 0$

$\Rightarrow$ $r = 3R$.

9. **C**

9. $\mu = \frac{3}{2}$

$\frac{1}{f} = \frac{M-1}{R}$

and $R = \frac{r^2}{2t}$ = 15 cm

f = 2R = 30 cm

10. **B**

10. $\Delta U = \Delta V - \Delta W$

and ΔW is –ve

Thus, $\Delta U > \Delta Q$

11. **C**

11. $\boxed{m + m} \longrightarrow u$

$dm\,(2.4 - v) \longleftarrow \boxed{M + (m - dm)} \longrightarrow v$

$-(-dm)2.4 + (-dm)V + MV + mV\,(-dm) = (M + m)u$

$\Rightarrow \quad (M + m)\,(v - u) = -dm\ 2.4$

$\Rightarrow \quad (M + m)dv = -dm\ 2.4$

$\Rightarrow \quad -2.4 \int_{M+m}^{M} \frac{dm}{M+m} = \int_{0}^{V} dv$

$\Rightarrow \quad \left[1 + \frac{m}{M}\right] = \frac{12}{2.4} = 5$

$\Rightarrow \quad \frac{m}{M} = e^5 - 1 = 148.4 - 1 = 147.4$ kg.

12. **C**

12. Constant force does not charge the period of oscillation.

$\therefore \quad T = 2\pi\sqrt{\frac{m}{k}}$

13. **B**

13. $\Delta U = \left(-\frac{GMm}{R+h}\right) - \left(-\frac{GMm}{R}\right)$

$= \frac{GMmh}{R(R+h)} = mgh\frac{R}{R+h}$

14. **C**

14. $\sqrt{0.4}\ \sqrt{u^2 - gH} = \sqrt{u^2 - 2gH}$

$\Rightarrow \quad \frac{4}{10}(u^2 - gH) = u^2 - 2gH$

$\Rightarrow$ 16 gH = $6u^2$

15. **B**

15. $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{T}{A\rho}}$

$\frac{\lambda}{2} = 20\text{cm}$; λ = 40 cm = 0.4 m

$$\nu = \frac{v}{\lambda} = \frac{1}{0.4}\sqrt{\frac{160}{10^{-6}\times 7.8\times 10^3}}$$

$$= 10\sqrt{\frac{10\times 10^3}{7.8}}$$

$$= \frac{10\times 100}{\sqrt{7.8}} = \frac{1000}{2.79} = 358 \text{ Hz}$$

16. **B**

16. Factual

17. **B**

17. Factual

18. **B**

18. $\Delta U = C_v(nT_0 - T_0)$ For one mole

$$\Delta Q = \int \frac{\alpha}{T} dT = \alpha \int_{T_0}^{nT_0} \frac{dT}{T} = \alpha \ln n$$

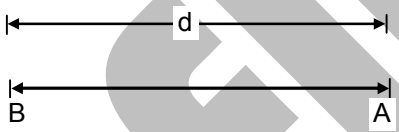
$\therefore$ $W = \Delta Q - \Delta U$

$= \alpha \ln n - C_v(n - t) T_0$

$= \alpha \ln n - \frac{(n-1)}{v-1} RT_0$

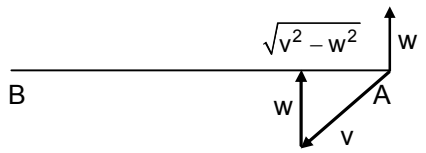
19. **B**

19.



$t_0 = \frac{2d}{v} f$

$$t_1 = \frac{d}{v+w} + \frac{d}{v-w} = \frac{2dv}{v^2 - w^2} = \frac{2d}{\left(v - \frac{w^2}{v}\right)}$$



$$t_2 = \frac{2d}{\sqrt{v^2 - w^2}}$$

20. **A**

20. $B_\theta = \frac{1.22\lambda}{d}$

$= \frac{1.22 \times 95 \times 10^{-9}}{2.4} = 4.83 \times 10^{-8}$ rad.

21. **C**

21. $\vec{v}_i = (u\cos\theta)\hat{i} + (4\sin\theta)\hat{j}$

$\vec{v}_f = (u\cos\theta)\hat{i} + (4\sin\theta - gt)\hat{j}$

$\vec{v}_i : \vec{v}_f = 0$

$\Rightarrow \quad t = \frac{u}{g\sin\theta}$

22. **D**

22. $\sin\theta = \frac{1}{\mu}$ and $\mu = \mu_0 + \frac{A}{\lambda^2} + \frac{B}{\lambda^4} + - - - - -$

$\Rightarrow \quad \theta_C \to \min$

$\Rightarrow \quad \mu \to \max$

$\Rightarrow \quad \lambda \to \min$

23. **C**

23. Hollow silvered lens will act libe mirror

f = –20 cm

Upon filling with water

$P_{eff} = P_\ell + P_m + P_\ell$

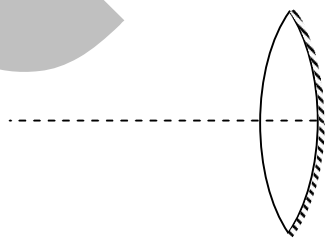
$= 2P_\ell + P_m$

$= 2(\mu - 1)\left(\frac{2}{R}\right) - \frac{1}{f_m}$

$= 2\left(\frac{1}{3}\right)\left(\frac{2}{40}\right) - \frac{1}{-20}$

$= \frac{1}{30} + \frac{1}{20}$

$\Rightarrow \quad f_{eff} = -12$ cm



24. **C**

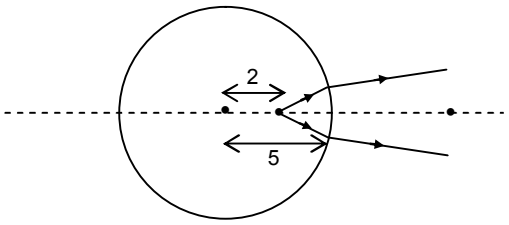
24. $\frac{\mu_1}{v} - \frac{\mu_2}{v} = \frac{\mu_1 - \mu_2}{R}$

$\frac{1.5}{-3} - \frac{1}{V} = \frac{-1}{10}$

$\frac{1}{v} = \frac{1}{10} - \frac{1}{2}$

$\frac{1}{v} = \frac{1-5}{10}$

$\Rightarrow \quad v = -2.5$ cm



25. **C**

25. Sonometer:

$\ell = n\frac{d}{2} \quad ; \quad \ell = \frac{n}{2}\left(\frac{V}{f}\right)$

$f = \frac{nV}{2\ell}$

Given:

$84 = \frac{n_1 v}{2(0.8)} = \frac{n_1 v}{1.6}$ …(1)

$140 = \frac{n_2 v}{1.6}$ …(2)

$224 = \frac{n_3 v}{1.6}$ …(3)

$\Rightarrow$ $n_1 : n_2 : n_3 = 3 : 5 : 8$

Put $n_1 = 3$ in equation (1)

$84 = \frac{3V}{1.6}$

$\Rightarrow$ V = 44.8 m/s

26. **A**

26. Option A is data based.

27. **D**

27. Newton's law of cooling

$$\frac{dT}{dt} = -\left(\frac{4e\sigma AT_0^3}{ms}\right)(T - T_0)$$

In this case, ratio of rate of cooling = $\frac{m_s}{m_c} = \frac{\left(\frac{4}{3}\pi R^3\right)(e)}{a^3} = \frac{R^3}{a^3}$

$4\pi R^2 = 6a^2$ (given)

28. **C**

28. Single slit diffraction

$\Delta x = a \sin\theta = n\lambda$ (Minima)

$= (2n+1)\frac{\lambda}{2}$ (maxima)

1st maxima

$a \sin\theta = \frac{3\lambda}{2}$

1st minima:

$A \sin\theta = \lambda = 660$

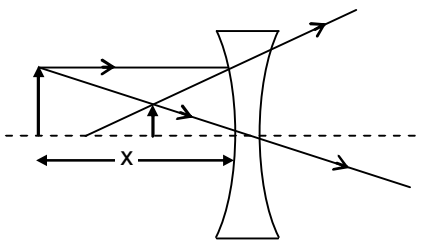
$\Rightarrow$ $\frac{3\lambda}{2} = 660$

$\Rightarrow$ λ = 440 nm

29. **D**

29. $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$\frac{1}{v} - \frac{1}{-x} = \frac{1}{-f}$; $\frac{1}{v} = -\frac{1}{x} - \frac{1}{f}$



$$v = \frac{-fx}{f+x}$$

$$m = \frac{v}{u} = \frac{f}{f+x} = \frac{1}{n}$$

$\Rightarrow$ $fn = f + x$

$\Rightarrow$ $x = (n-1)f$

30. **D**

30. Stetan's law:

$U = e\sigma AT^4$

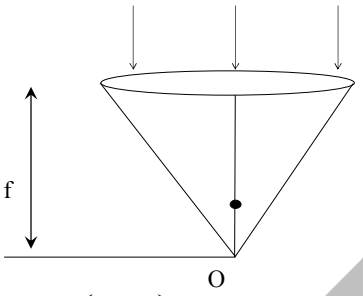
$= \sigma(4\pi R^2)T^4$

It divides in all directions along radially outward.

Required radiation energy = $\frac{U}{4\pi r^2} \times (\pi R_e^2)$

31. **B**

31.



$$\frac{1}{25} = \left(\frac{3}{2} - 1\right)\frac{2}{R} \qquad \Rightarrow R = 25$$

$u = 25$

$R = -24$ $m_1 = 1$, $m_2 = \frac{4}{3}$

$$\frac{m_2}{v} - \frac{m_1}{4} = \frac{m_2 - m_1}{R}$$

$$\frac{4}{3v} - \frac{1}{25} = -\frac{1}{75}$$

$$\frac{4}{3v} = \frac{2}{75}$$

$v = 50$ cm

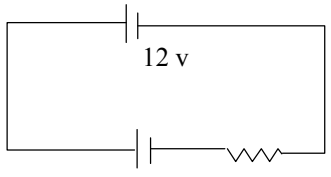
32. **D**

32. $\vec{f}_{net} = i\vec{L}_{e/d} \times \vec{B}$

$L_{eh} = 0$ for closed loop

33. **C**

33.



$$E - \frac{q}{C} - iR = 0$$

$$12 - \frac{30}{10} - iR = 0$$

$iR = 9$

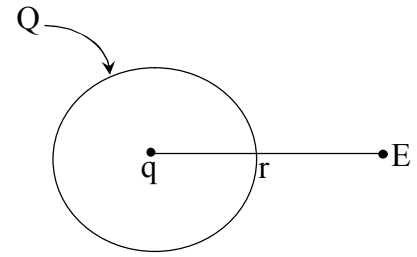
$$\frac{dH}{dt} = i^2R = \frac{(iR)^2}{R} = \frac{9^2}{3\times10^3}$$

$= 27\times10^{-3}$

$=27$ mv

34. **D**

34.



$$\vec{E}_1 = \frac{K\theta}{r^2}\hat{r}$$

$$\vec{E}_2 = \frac{K(\theta+q)}{r^2}\hat{r}$$

$\Rightarrow \vec{E} = -\vec{E}_2$

$-\theta = Q + q$

$q - 2\theta$

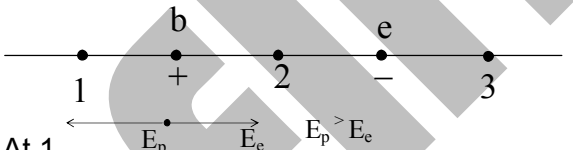
$= -2\times4\pi R^2\sigma$

$= -8\times3.14\times225\times10^{-4}\times3.2$ MC

$= -1081$ MC

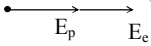
35. **B**

35.



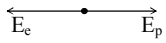
At 1

$\Rightarrow \longleftarrow$



At 2

$\Rightarrow \longrightarrow$



At 3

$E_e > E_p$

$\Rightarrow \longleftarrow$

36. **B**

36. Balanced wheat stone as no change in current

$\Rightarrow I_2 = I_G$

As no current will pass through switch

37. **D**

37. $\ell = \hat{k}\ \vec{v} = \hat{\ell} - \hat{j}$

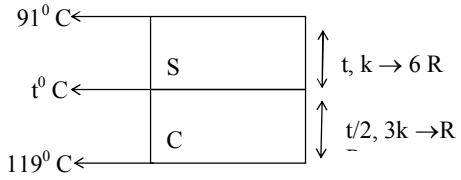
$\vec{B} = \hat{\ell} + 4\hat{j}$

$E = \left|\left(\vec{v} \times \vec{B}\right).\vec{L}\right|$

$= \left|\left(4\hat{\ell} - \hat{j}\right) \times \left(\hat{\ell} + 4\hat{j}\right).\hat{k}\right|$

E = 17 V

38. **C**

38. 

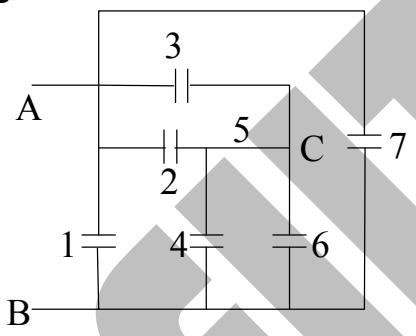
38. $\frac{R_c}{R_s} = \frac{t/2 \times 3KA}{t/KA} = \frac{1}{6}$ $i_t = \frac{119-91}{7R} = \frac{28}{7R} = \frac{4}{R}$

$119 - t = i_t \times R$

119 – t = 4

t = 115° C

39. **D**

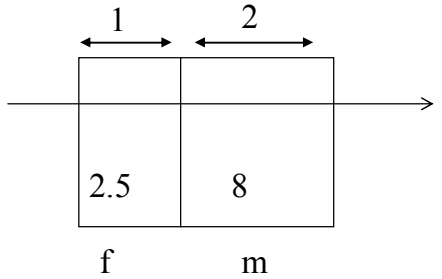
39. 

Balanced wheatsone between ABCD

$C_{AB} = 7 + 2 + 1 + \frac{4}{3}$

$= 10 + \frac{4}{3} = \frac{34}{3}\mu F$

40. **A**

40. 

$\frac{E}{2.5} = 6400$

$$E_m = \frac{E}{8} = \frac{6400 \times 2.5}{8} = 2000 \text{ k V/m}$$

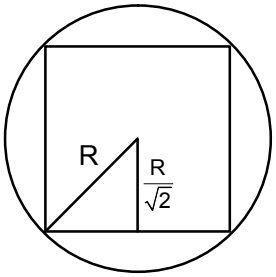
41. **B**

41. $\left.\begin{matrix} X = at \\ y = bt^2 \end{matrix}\right] \Rightarrow y = b\frac{x^2}{a^2} \Rightarrow \text{Parabola}$

42. **BONUS / C**

43. **C**

43.

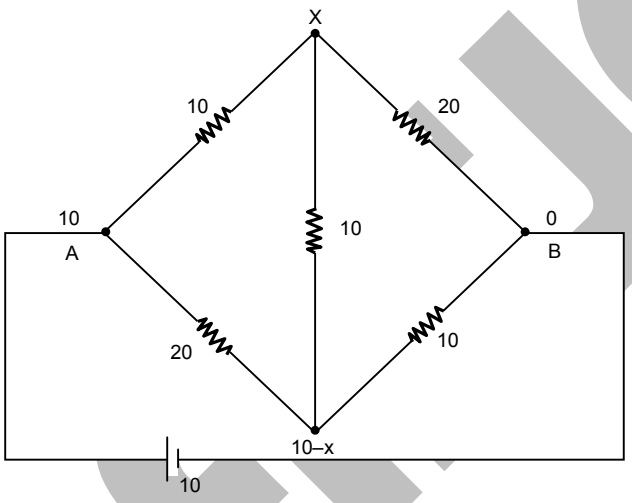


$$B = \left[\frac{\mu_o i}{4\pi\left(R\cos\frac{\pi}{n}\right)} 2\sin\left(\frac{\pi}{n}\right)\right] n$$

$$= \frac{\mu_o i}{2R}\frac{\tan(\pi/n)}{(\pi/n)}$$

44. **A**

44.



$$= \frac{x-10}{10} + \frac{2x-10}{10} + \frac{x}{20} = 0$$

$$= 7x = 40 \Rightarrow \boxed{x = \frac{40}{7}}$$

$$\Rightarrow \frac{10}{R} = \frac{x}{20} + \frac{10-x}{10} + \frac{2}{7} + \frac{3}{7} = \frac{5}{7}$$

$$\Rightarrow \boxed{R = \frac{70}{5} \Rightarrow 14\Omega}$$

45. **B**

45. $$m = \frac{e\nu}{2\pi r}\left(\pi r^2\right) = \frac{er\nu}{2} = \frac{\left(1.6\times10^{-19}\right)\left(5.27\times10^{-11}\right)\left(2.2\times10^{6}\right)}{2}$$

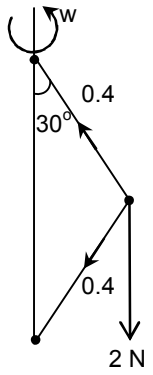
$= 9.28 \times 10^{24}$

46. **A**

46. $$\frac{W}{A} = T_{max}$$

47. **A**

47.



$$= \frac{x-10}{10} + \frac{2x-10}{10} + \frac{x}{20} = 0$$

$$= T\frac{\sqrt{3}}{2} = 4\frac{\sqrt{3}}{2} + 2 \Rightarrow T\frac{\sqrt{3}}{2} = 2\left(\sqrt{3}+1\right)$$

$$\Rightarrow \boxed{T = \frac{4\left(\sqrt{3}+1\right)}{\sqrt{3}}}$$

$$\Rightarrow \boxed{T = 6.3\,N}$$

$$\Rightarrow \frac{T}{2} + \frac{4}{2} = (0.2)\left(\frac{0.4}{2}\right)w^2$$

$$\Rightarrow 10.3 = (0.2)\,(0.4)\,w^2$$

$$\Rightarrow w = 11.32$$

48. **C**

49. **C**

50. **BONUS (Value of emf not given in question)**

51. **A**

52. **D**

53. **D**

54. **C**

55. **B**

56. **C**

56. $K_i = U_f$

$$\Rightarrow K = \frac{\kappa(2e)(Ze)}{\vartheta} \quad \text{------ (1)}$$

For nucleus 2z

$$\Rightarrow K = \frac{\kappa(2e)(2Ze)}{r} \quad \text{------ (2)}$$

From (1) & (2)

$$\boxed{r = 2\,\vartheta}$$

57. **C**

57. $$\Delta E = \frac{1240}{\lambda(nm)}$$

$$\frac{1240}{620} = 2\,e\upsilon$$

58. **A**

58. Energy of photon released

$$-E_o = \left(\frac{1}{1^2} - \frac{1}{4^2}\right)$$

$\therefore$ |momentum by photon| =|momentum of atom|

$$\Rightarrow \quad \frac{15}{16} \times \frac{13.6 \times 10^{-19}}{3 \times 10^8}$$

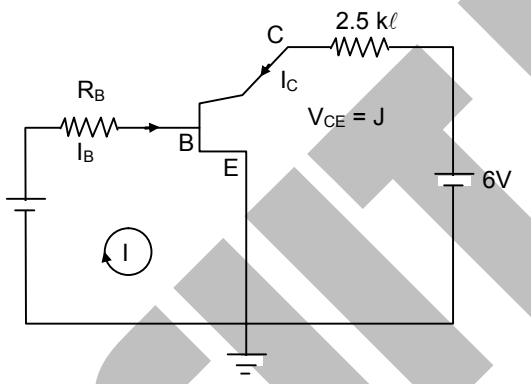
$\Rightarrow$ $4.25 \times 10^{-27} = \rho \longrightarrow$ Closet to option (a)

59. **C**

59.
$$Y = AB + A(B + C) + B(B + C) + \overline{B}$$
$$= AB + AB + AC + BB + BC + \overline{B}$$
$$= AB + AC + B + BC + \overline{B}$$
$$+1$$

60. **D**

60.
$$\beta = \delta_o = \frac{I_C}{I_B} \qquad \text{------ (1)}$$
$$= V_{BE} = 0.7$$



KVL (1)

$4 - I_B R_B - 0.7 = 0$

$I_B R_B = 3.3$

$6 - 2.5 \times 10^3 I_C - 3 = 0$

$$I_C = \frac{3}{2.5 \times 10^3}$$

$$\text{So, } I_B = \frac{I_C}{\delta_o} = \frac{3}{2.5 \times 10^3 \times \delta_o}$$

$$\text{So, } R_B = \frac{3.3}{I_B}$$

$$= \frac{3.3}{3} \times 2.5 \times 10^3 \times \delta_o$$

$$= \boxed{2.20 \times 10^3 \Omega}$$

61. **ABCD**

62. **BD**

62. $w = \dfrac{1}{\sqrt{LC}}$

$T = 2\pi\sqrt{LC}$

63. **BC**

64. **AD**

64. $(h - r) = R\sin(2r)$ .....(i)

$\sin 1 = \sin . r . \sqrt{3}$

$h = R\left(1 + 2 \times \dfrac{2}{1\sqrt{7}} \times \dfrac{\sqrt{7}}{\sqrt{7}}\right)$

$\Rightarrow R\left(1 + \dfrac{4\sqrt{3}}{7}\right)$

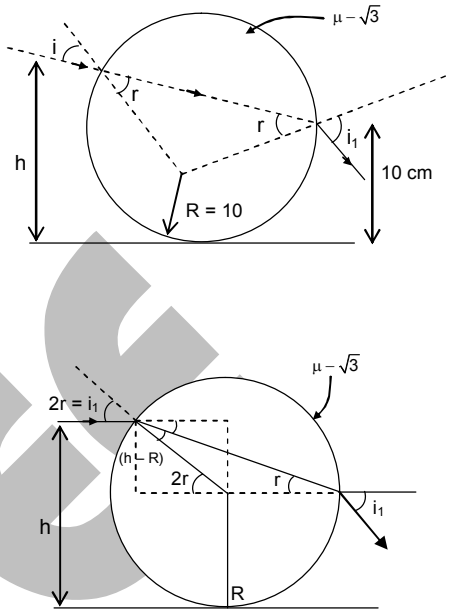
$\Rightarrow R\left(1 + \dfrac{4\sqrt{3}}{7}\right)$

= 19.77 cm

$\Rightarrow \sin(2r) = \sin r\sqrt{3}$

$\Rightarrow 2.\cos r = \sin\sqrt{3}$

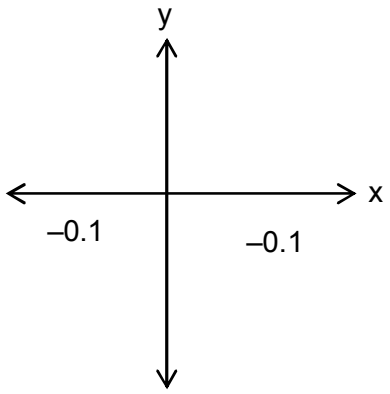
$\Rightarrow \dfrac{2}{\sqrt{3}} \Rightarrow \sin\dfrac{2}{\sqrt{7}}, \cos r = \dfrac{\sqrt{3}}{\sqrt{7}}$



65. **ABC**

65. $p = i\mu c\lambda 0.2m$

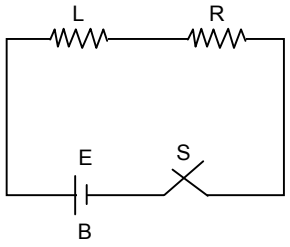
$= 0.2\mu c - m$



66. **AD**

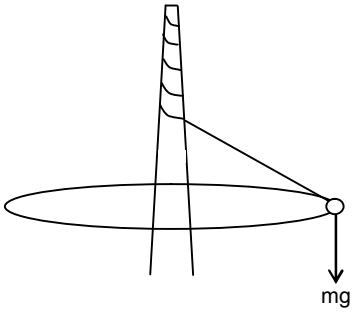
66. So, $V_L = E, V_R = 0$

$i = \dfrac{\in}{R}\left(1 - e^{-\frac{tR}{L}}\right)$



67. **AC**

67. Due to torque of my, angular momentum will not be conserved.

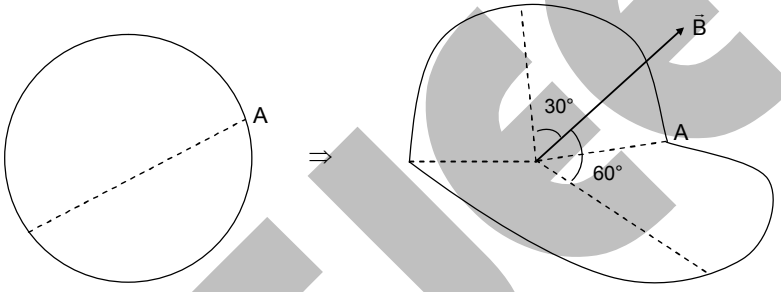


68. **BC**

68. Total Inf = $\frac{d\beta}{d\alpha}A(\sin i+\sin 3i)$

$$=\frac{100}{4.28}\times\frac{\pi\times(10^2)^2}{2}\times\left(\frac{\sqrt{3}}{2}+\frac{1}{2}\right)$$

$$=4.95\times10^{-3}=5\,mV$$



69. **AC**

69. Due to .....(i)

$$\frac{1}{v}-\frac{1}{-120}=\frac{1}{40}$$

$$\frac{1}{v}=\frac{1}{40}-\frac{1}{120}$$

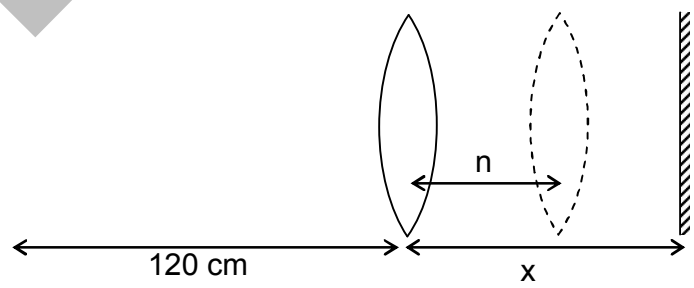
$$=\frac{3-1}{120}$$

$$V=60$$

For I

$$\frac{1}{40-x}-\frac{1}{60-x}=\frac{1}{40}$$

$$\frac{d\beta}{dt}=\frac{100\times10^{-3}}{4.28\times10^{-3}}$$



70. **ABC**

70. $QE = q \cup B$

$$\Rightarrow \frac{2000}{2\times10^{-2}} = \nu_0 \times 4.57 \times 10^{-2}$$

$$\Rightarrow \frac{10^5 \times 10^2}{4.57} = \nu_0$$

$$2.12 \times 10^6 = \nu_0 \qquad \text{.....(i)}$$

$$5.7 \times \frac{n}{180} = \frac{5\,cm}{R} \Rightarrow R = 50 \text{ cm}$$

$$\Rightarrow \frac{1}{10} = \frac{5\times10^{-2}}{\left(\frac{m\nu_0}{q\beta}\right)}$$

$$\Rightarrow \frac{m}{q} = \frac{5\times10^{-2}\times10\times4.5\times10^{-2}}{2.12\times10^6}$$

$$= 10.77\infty\times10^{-9}$$

$$\Rightarrow \frac{q}{m} = 9.27\times10^7$$