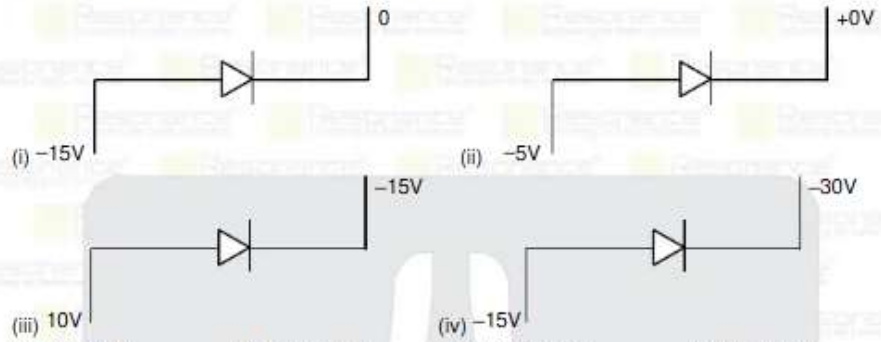
PART : PHYSICS

1. Forward bias will be :



(1) (i) and (ii) (2) (ii) and (iii) (3) (iii) and (iv) (4) (i) and (iv)

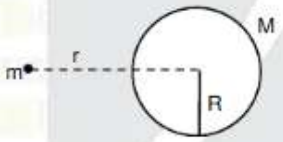
Ans. **(3)**

2. Solid sphere of mass M, radius R exerts force F on a point mass. Now a concentric spherical mass $\frac{M}{7}$ is removed from it. What is new force ?

(1) $\frac{F}{7}$ (2) $\frac{6}{7}$ F (3) $\frac{5}{7}$ F (4) $\frac{3}{7}$ F

Ans. **(2)**

Sol.



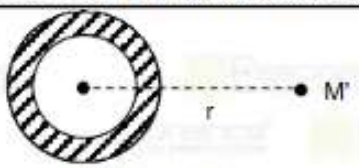
$F = \frac{GMm}{r^2}$

M'

$\frac{M}{7}$ removed

mass left = $M - \frac{M}{7}$

$M' = \frac{6M}{7}$



$$F' = \frac{G\frac{6M}{7}xM}{r^2}$$

$$F' = \frac{6}{7}\frac{GMm}{r^2}$$

$$F' = \frac{6}{7}F$$

3. Find dimension of $\frac{B}{\mu_0}$.

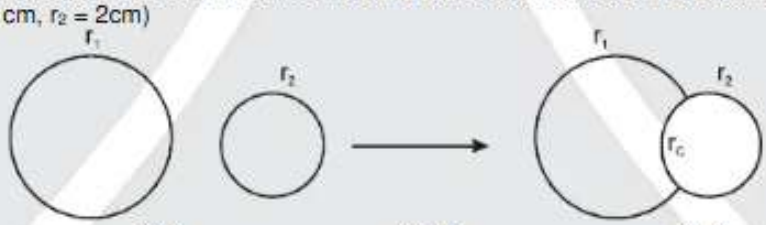
(1) AL (2) AL^{-1} (3) MAL (4) MAT^{-1}

Ans. **(2)**

Sol. $\therefore H = \frac{B}{\mu_0}$ or $B = \frac{\mu_0 i}{2r}$

$[AL^{-1}]$ $\therefore \frac{B}{\mu_0} = \frac{i}{2r} = [AL^{-1}]$

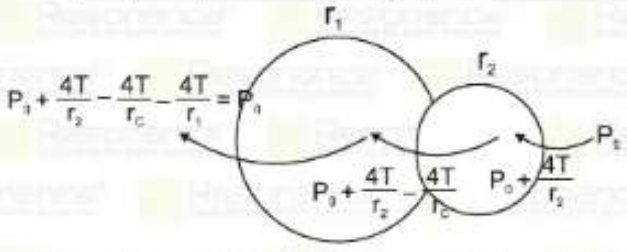
4. Two soap bubbles of radius r_1 and r_2 combine .Find radius of curvature of the common surface separating them.(r_1 = 4 cm, r_2 = 2cm)



(1) 2 (2) 4 (3) 6 (4) 8

Ans. **(2)**

Sol. $P_0 + \frac{4T}{r_2} - \frac{4T}{r_c} - \frac{4T}{r_1} = P_0, \quad \frac{1}{r_c} = \frac{1}{r_2} - \frac{1}{r_1}$



$$r_c = \frac{r_1 r_2}{r_1 - r_2} = \frac{4 \times 2}{4 - 2} = 4$$

5. If light of wavelength 550 nm is incident on a metallic surface. If work function of Cs and Li are 1.9 eV and 2.5 eV respectively. Which can emit photo electron

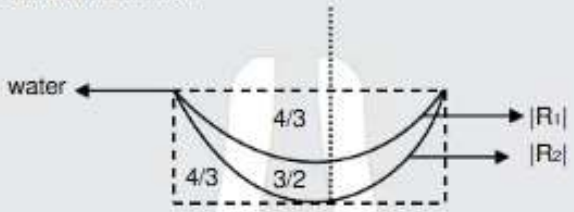
(1) Cs (2) Li (3) CsLi (4) None

Ans. **(1)**

Sol. Energy of light $E = \frac{hc}{\lambda} = \frac{1240}{550} = 2.25$ eV

Energy of light is only greater than work function of Cs(ϕ_0 = 1.5 eV), then only Cs will emit photo electrons

6. Find the power of combination of lens.



(1) $\frac{1}{6}\left[\frac{1}{R_2}-\frac{1}{R_1}\right]$ (2) $\frac{1}{3}\left[\frac{1}{R_2}-\frac{1}{R_1}\right]$ (3) $\frac{1}{5}\left[\frac{1}{R_2}+\frac{1}{R_1}\right]$ (4) $\frac{1}{8}\left[\frac{1}{R_2}+\frac{1}{R_1}\right]$

Ans. **(1)**

Sol. $\frac{1}{f_1}=\left[\frac{4}{3}-1\right]\left[\frac{1}{\infty}-\frac{1}{-R_1}\right]=\frac{1}{3R_1}$

$\frac{1}{f_2}=\left[\frac{3}{2}-1\right]\left[\frac{1}{-R_1}-\frac{1}{-R_2}\right]=\frac{1}{2}\left[\frac{1}{R_2}-\frac{1}{R_1}\right]$

$\frac{1}{f_3}=\left[\frac{4}{3}-1\right]\left[\frac{1}{-R_2}-\frac{1}{\infty}\right]=\frac{1}{3}\left[-\frac{1}{R_2}\right]$

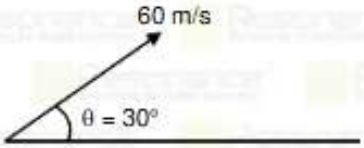
$\frac{1}{f_{eq}}=\frac{1}{f_1}+\frac{1}{f_2}+\frac{1}{f_3}$

$P_{eq} = P_1 + P_2 + P_3$

$= \frac{1}{3R_1}+\frac{1}{2R_2}-\frac{1}{2R_1}-\frac{1}{3R_2}$

$P_{eq}=\frac{2R_2+3R_1-3R_2-2R_1}{6R_1R_2}=\frac{R_1-R_2}{6R_1R_2}=\frac{1}{6}\left[\frac{1}{R_2}-\frac{1}{R_1}\right]$

7.

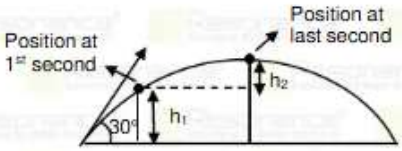


An object is thrown with speed 60 m/s making an angle 30° with the horizontal. Find the ratio of height covered in first second and last second of the upward journey.

(1) 3 : 2 (2) 5 : 1 (3) 5 : 6 (4) 6 : 1

Ans. **(2)**

Sol.



$u_y = 60 \sin 30° = 30$ m/s

$y = u_y t - \frac{1}{2} gt^2$

$h_1 = 30 \times 1 - \frac{1}{2} \times 10 \times (1)^2 = 25$ m

$h_2 = \frac{1}{2} gt^2 = \frac{1}{2} \times (10)(1)^2 = 5$

$\frac{h_1}{h_2} = \frac{25}{5} = \frac{5}{1}$

8. Statement-1 Fringe come closer in denser medium in YDSE

Statement-2 Light travel slower in denser medium.

(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

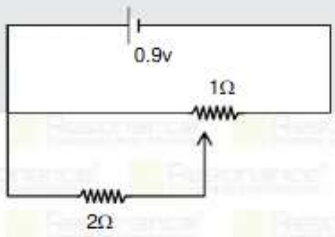
(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

Ans. **(1)**

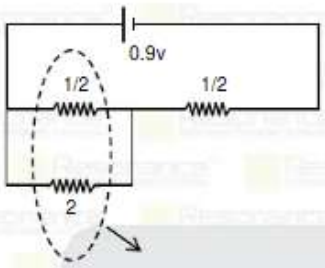
9. Find current in the circuit. Jockey is at middle point of 1Ω .



(1) 10 Amp. (2) 0.1 Amp (3) 1 Amp (4) 2 Amp

Ans. **(3)**

Sol.



$$\frac{\frac{1}{2}\times 2}{\frac{1}{2}+2} \Rightarrow \frac{2}{5}$$

$$\text{Req.} = \frac{2}{5} + \frac{1}{2} \Rightarrow \frac{4+5}{10} \Rightarrow \frac{9}{10} \Rightarrow 0.9\,\Omega$$

$$i = \frac{v}{\text{Req.}} = \frac{0.9}{0.9} \Rightarrow 1 \text{ Ans .}$$

10. For H, radius of first and second excited states are 5.3×10^{-11} m and 8.48×10^{-10} m ratio of debroglie wave lengths is :

(1) $\lambda_1 : \lambda_2 :: 16 : 15$ (2) $\lambda_1 : \lambda_2 :: 14 : 15$

(3) $\lambda_1 : \lambda_2 :: 15 : 16$ (4) $\lambda_1 : \lambda_2 :: 17 : 15$

Ans. **(3)**

Sol. $2\pi r = n\,.\lambda$

$2\pi\,(5.3 \times 10^{-11}) = 2(\lambda_1)$

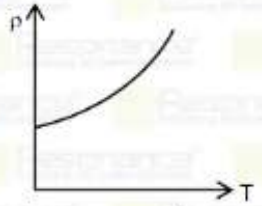
$2\pi\,(8.48 \times 10^{-10}) = 3(\lambda_2)$

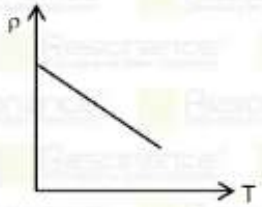
$$\frac{5.3}{8.48}\times 10^{-1}\times\frac{3}{2} = \frac{\lambda_1}{\lambda_2}$$

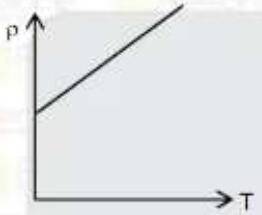
$$\frac{0.53}{8.48}\times\frac{3}{2} = \frac{\lambda_1}{\lambda_2}$$

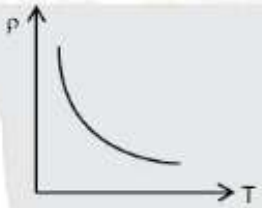
$$\frac{\lambda_1}{\lambda_2} = \frac{15}{16}$$

11. Which of the following represent correct relation between resistivity of conductor (F) and temperature (T)

(1) 

(2) 

(3) 

(4) 

Ans. **(1)**

12. Two organ pipe, one is open and other is closed and the densities of gas filled in the ratio of 1 : 16. 9 th harmonic frequency of closed organ pipe is equal to 4th harmonics of open organ pipe. Find the length of the open organ pipe if length of closed pipe is 10 cm & Bulk Modulus is same for both.

(1) 32.5 cm (2) 35.5 cm (3) 25.5 cm (4) 45.5 cm

Ans. **(2)**

Sol.

$f_1 = \frac{v_1}{2\ell_1}$ $f_2 = \frac{v_2}{4\ell_2}$

Given $\frac{\rho_1}{\rho_2} = \frac{1}{16}$

Acceleration to equation $\frac{v_1}{v_2} = \sqrt{\frac{\rho_2}{\rho_1}}$

$9f_2 = 4f_1$ $= 4$

$\Rightarrow 9\frac{v_2}{4\ell_2} = 4\frac{v_1}{2\ell_1}$

$\Rightarrow \ell_1 = \frac{16\ell_2 v_1}{18 v_2}$

$\Rightarrow \ell_1 = \frac{16}{18} \times 10 \times 4$

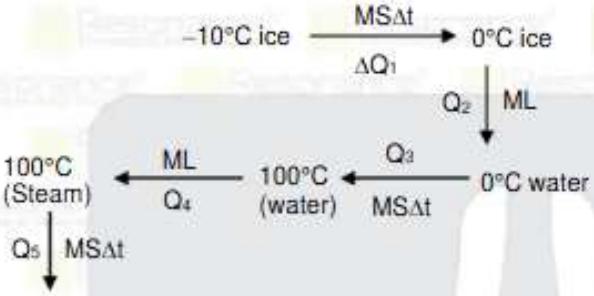
$\Rightarrow \ell_1 = \frac{8}{9} \times 10 \times 4 = 35.5$ cm

13. Ice at –10°C is to be converted into steam at 110°C. Mass of ice is 10^{-3} kg. What amount of heat is required ?

(1) $\Delta Q = 730$ cal (2) $\Delta Q = 900$ cal (3) $\Delta Q = 1210$ cal (4) $\Delta Q = 870$ cal

Ans. **(1)**

Sol.



$\Delta Q = Q_1 + Q_2 + Q_3 + Q_4 + Q_5$

$Q_1 = Ms\,(0 - (-10))$ $\quad S_{ice} = \frac{1}{2}$ KC/kg°C

$Q_1 = 10^{-3} \times \frac{1}{2} \times 10^3 \times 10$ $\quad L_{ice} = 80$ Kcal/kg

$Q_1 = 5$ cal

$Q_2 = 10^{-3} \times 80 \times 10^{-3} = 80$

$Q_3 = 10^{-3} \times 1 \times (100 - 0) \times 10^3$

$Q_3 = 100$

$Q_4 = 10^{-3} \times 540$ cal $\quad L_v = 540$ Kcal/kg

$Q_4 = 540$ cal

$Q_5 = 10^{-3} \times \frac{1}{2} \times 10^3\,(110 - 100)$

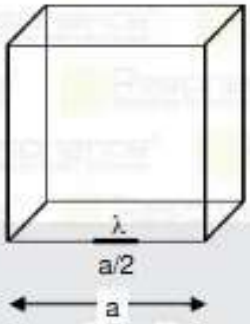
$Q_5 = \frac{1}{2} \times 10 = 5$

$\Delta Q = Q_1 + Q_2 + Q_3 + Q_4 + Q_5$

$\Delta Q = 5 + 80 + 100 + 540 + 5$

$\Delta Q = 730$ cal

14. Wire of length $\frac{a}{2}$ of linear charge density λ is placed on edge of cube then find the flux passing through cube.



(1) $\frac{\lambda a}{2\varepsilon_0}$ (2) $\frac{\lambda a}{4\varepsilon_0}$ (3) $\frac{\lambda a}{8\varepsilon_0}$ (4) $\frac{\lambda a}{\varepsilon_0}$

Ans. **(3)**

Sol. $\phi = \frac{q_{in}}{\varepsilon_0} = \frac{\lambda \frac{a}{2}}{4\varepsilon_0} = \frac{\lambda a}{8\varepsilon_0}$

15. The radius of ground state of H atom is a_0. The radius of first excited state of He^+ is :

(1) a_0 (2) $2a_0$ (3) $3a_0$ (4) $4a_0$

Ans. **(2)**

Sol. $r_0 = a_0$ $r_n = a_0 \times \frac{n^2}{Z}$

$r'_{He} = a_0 \times \frac{Z^2}{2}$

$n = 2 = 2a_0$

16. Which of the following is not true ?

(1) decay constant does not depend on temperatures

(2) decay constant increases with temperature

(3) $t_{1/2} = \frac{\ln(2)}{\lambda}$

(4) None

Ans. **(2)**

17. **Statement -1** Vernier scale division always has small division than main scale division

Stetement- 2 Vernier constant is number of division of vernier scale multiply by main scale division

(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is false

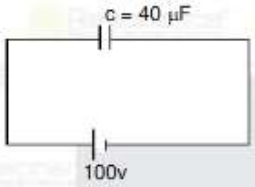
Ans. **(3)**

18. Capacitor having capacity of 40 μF is connected with 100 v battery. If dielectric constant (k = 2) is inserted between plates of capacitor, then change in charge of capacitor plate and change in energy stored in capacitor will be :

(1) 4 mc, 0.2 J (2) 6 mc, 0.2 J (3) 8 mc, 2 J (4) 2 mc, 4 J

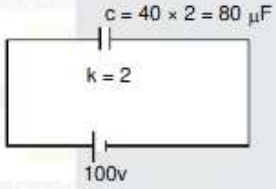
Ans. **(1)**

Sol.



$Q_i = 100 \times 40\ \mu C$

$Q_i = 4 \times 10^3\ \mu C$



$Q_F = 80 \times 100 = 8 \times 10^3 \mu C$

$\Delta Q = q_F - q_F = (8 \times 10^3 - 4 \times 10^3)\ \mu c$

$= 4 \times 10^3\ \mu c$

$= 4 \times 10^3 \times 10^{-6} \times 10^3$

$= 4$ mc

$E_1 = \frac{1}{2} C_1 V^2$ → Initial energy

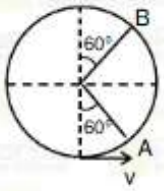
$E_2 = \frac{1}{2} C_2 V^2$ → Final energy

$E_2 - E_1 = \frac{1}{2} V^2 (C_2 - C_1)$

$= \frac{1}{2} \times (100)^2 (80 - 40)$

$= 20 \times 10^{-2} = 0.2$ J

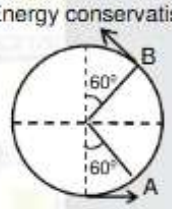
19. The particle shown in the fig is just able to complete the vertical circular motion find the ratio of kinetic energy at A to the kinetic energy at B.



(1) 3 : 2 (2) 4 : 1 (3) 2 : 1 (4) 1 : 2

Ans. **(3)**

Sol. Energy conservatism at (P) and (A)



$$0 + \frac{1}{2} m \times 5gl = mgl(1 - \cos\theta) + \frac{1}{2} m v_A^2$$

$$\frac{1}{2} m v_A^2 = mgl\left(\frac{5}{2} - \frac{1}{2}\right) = 2mgl$$

energy conservator at (P) and (B)

$$O + \frac{1}{2} \times m \times 5gl = \frac{1}{2} m v_B^2 + mgl(1 + \cos\theta)$$

$$\frac{1}{2} m v_B^2 = mgl\left(\frac{5}{2} - \frac{3}{2}\right) = mgl$$

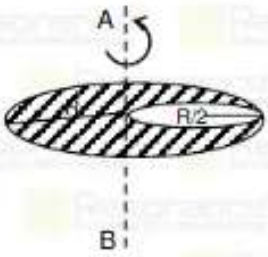
$$\frac{\frac{1}{2} m v_A^2}{\frac{1}{2} m v_B^2} = \frac{2mgl}{mgl} = \frac{2}{1}$$

20. A mass of a disc is M and radius R. A cavity of radius $\frac{R}{2}$ is created. Find the moment of inertia about an axis passing through the centre of disc.

(1) $\frac{17MR^2}{32}$ (2) $\frac{13MR^2}{32}$ (3) $\frac{7MR^2}{32}$ (4) $\frac{19MR^2}{32}$

Ans. **(2)**

Sol.



$I = I_{disc} - I_{cavity}$

$$= \frac{MR^2}{2} - \left[\frac{M}{4}\frac{(R/2)^2}{2} + \frac{M}{4}(R/2)^2\right]$$

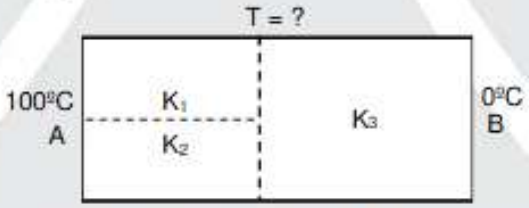
$$= \frac{MR^2}{2} - \left[\frac{MR^2}{32} + \frac{MR^2}{16}\right]$$

$$= \frac{MR^2}{2} - \left(\frac{MR^2 + 2MR^2}{32}\right)$$

$$= \frac{16MR^2 - MR^2 - 2MR^2}{32}$$

$$\frac{13MR^2}{32}$$

21. Unit of all quantities is in S.I. System.

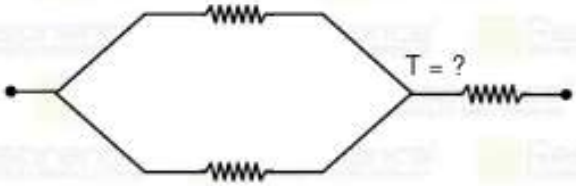


Given $K_1 = 60$, $K_2 = 120$ one K_3 135 °C find final junction T = ?

(1) 20°C (2) 35°C (3) 40°C (4) 45°C

Ans. **(3)**

Sol.

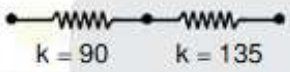


$$R_1 = \frac{L}{K_1 A}, \quad R_2 = \frac{L}{K_2 A}$$

$$R_{ev} = \frac{R_1R_2}{R_1+R_2} = \frac{L^2/K_1K_2A^2}{\frac{L}{A}\left(\frac{1}{K_1}+\frac{1}{K_2}\right)}$$

$$\text{So } \frac{Leq}{K_{eq}} = \frac{L/K_1K_2A}{\frac{K_2K_1}{K_1K_2}} = \frac{L}{(K_1+K_2)A}$$

$$\Rightarrow \frac{1}{2k_{ev}} = \frac{1}{K_1+K_2} \Rightarrow K_{eq} = \frac{K_2+K_1}{2} = \frac{60+120}{2} = 90$$



$$\frac{100-T}{\frac{L}{90(2A)}} = \frac{T-0}{\frac{L}{135(2A)}}$$

$\Rightarrow 90 \times 100 = T$

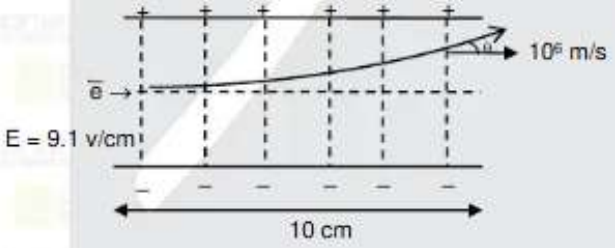
$\Rightarrow T = 40^{\circ}C$

22. An electron projected horizontally between two horizontal charged plates , emerges with horizontal speed 10^6 m/s if length of plates is 10cm and electric field between plate is 9.1 volt/cm then vertical component of velocity of electron when it emerges wile be (e & m are given)

(1) 16×10^4 (2) 16×10^6 (3) 1.6×10^5 (4) 32×10^7

Ans. **(3)**

Sol.



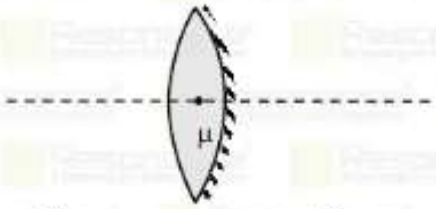
To coure the 10 cm horizontally time taken by electron will be

→ there is no force on horizontal direction so velocity will remain constant. 10^6m/s

$$t = \frac{10cm}{10^6 m/s} = \frac{10cm}{10^6 \times 100} = 10^{-7} \text{ sec.}$$

$$V_y = \frac{eE}{mt} = 1.6 \times 10^7$$

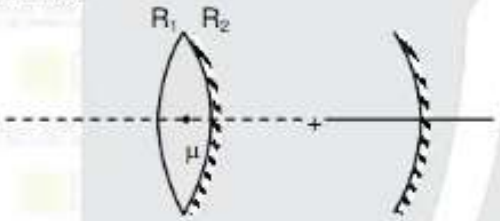
23. The object is placed in front of convex lens then one surface of lens get silvered. the R is radius of curvature of lens of μ is refractive index. Whose should object be placed so that image formed on object. (options are in R and μ):



(1) $\frac{-R}{(\mu-1)}$ (2) $\frac{-R}{(2\mu+1)}$ (3) $\frac{-R}{(2\mu-1)}$ (4) $\frac{R}{(\mu-1)}$

Ans. **(3)**

Sol. For lens



$$\frac{1}{f_l} = (\mu-1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$R_2 = -R_0$

$R_1 = R$

$$\frac{1}{f_l} = (\mu-1)\left(\frac{2}{R}\right) \quad .....(1)$$

focal length of mirror :

$$f_m = -\frac{R}{2}$$

$$\frac{1}{f_m} = -\frac{2}{R} \quad .....(2)$$

equaling focal length of system :

$$\frac{1}{f_{eq}} = \frac{1}{f_m} - \frac{2}{f_l} = \frac{-2}{R} - \frac{2(2)(\mu-1)}{R}$$

$$\frac{1}{f_{eq}} = \frac{-2}{R}(1+2\mu-2)$$

$$\frac{1}{f_{eq}} = \frac{-2}{R}(2\mu-1)$$

$$f_{eq} = \frac{-R}{2(2\mu-1)}$$

Image will form when object is placed at centre of curvature :

So $R_{eq} = 2f$

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

$$R_{eq} = \frac{-R}{(2\mu-1)}$$