PART : PHYSICS

1. **Statement-1** If two light red and blue are present and if we see interference pattern separately then fringe width for blue is more than red.

Statement-2 Fringe width is proportional to wavelength

(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)**

2. In a series LCR circuit the maximum amplitude of current is I_0 when the resistance is R. What is the maximum amplitude of current if the resistor is replaced by a resistance $\frac{R}{2}$?

(1) $2I_0$ (2) I_0 (3) $\frac{I_0}{\sqrt{2}}$ (4) $\frac{I_0}{2}$

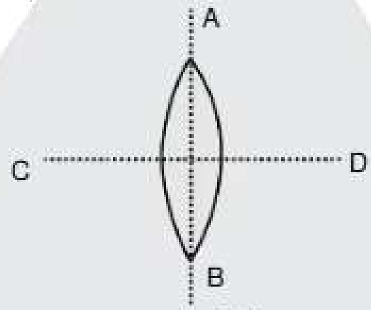
Ans. **(1)**

Sol. $X_L = X_C$

$I_0 = \frac{E_0}{R}$

$I' = = \frac{E_0}{R/2} = 2I_0$

3. A thin convex lens divided into four equal parts by plane AB and CD. The originals power is 4D. Then after dividing lens, power of each piece is ?



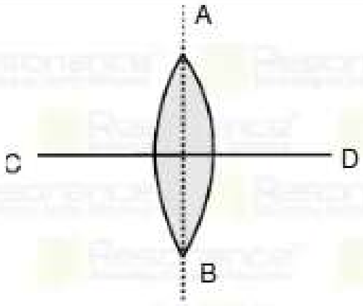
(1) 2D (2) 4D (3) D (4) 8D

Ans. **(1)**

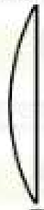
Sol. Focal length

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

$\frac{1}{f} = (\mu - 1)\frac{2}{R}$ $P = \frac{R}{2(\mu - 1)}$



After cutting vertically



$R_1 = R \quad R_2 = \infty$

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

$$P_{AB} = \frac{R}{(\mu - 1)} = \frac{P}{2}$$

$$P_{AB} = \frac{4}{2} = 2D$$

plane CD will not change the power of lens

4. Light of wavelength λ is incident on metal of work function 1eV then max K.E. of emitted e^- is 2eV. If incident wavelength is become $\frac{\lambda}{2}$ then maximum K.E. of e^- will be

(1) 1eV (2) 2eV (3) 5eV (4) 4eV

Ans. **(3)**

Sol. $E = K_m + W$

$E = 2eV + 1eV$

$\Rightarrow E = 3eV$

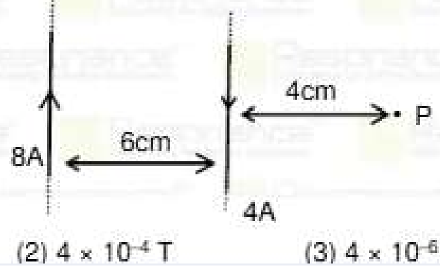
when wavelength is $\frac{\lambda}{2}$ then $E' = 2E = 6eV$

$E' = K'_m + W$

$6eV = K'_m + 1eV$

$K_m = 5eV$

5. Two infinite long parallel wire are placed as shown. Find net magnetic field at point P?



(1) 4×10^{-2} T (2) 4×10^{-4} T (3) 4×10^{-6} T (4) 2×10^{-6} T

Ans. (3)

Sol. Magnetic field due to infinite wire $B = \frac{\mu_0 I}{2\pi d}$

Net magnetic field at point P : –

$$B_p = \frac{\mu_0 I_1}{2\pi d_1} - \frac{\mu_0 I_2}{2\pi d_2}$$

$$\Rightarrow \frac{\mu_0}{2\pi}\left(\frac{4}{0.04} - \frac{8}{0.1}\right) \Rightarrow 2\times 10^{-7}(100 - 80)$$

$B_p = 4 \times 10^{-6}$ T

6. Find the correct dimensional formula for the capacitance in terms of M.L.T and C where they stand for unit of mass length time and charge ?

(1) $[M^{-1}L^{-3}T^{1}C^{+2}]$
(2) $[M^{-1}L^{-2}T^{-2}C^{-2}]$
(3) $[M^{-3}L^{2}T^{2}C^{+2}]$
(4) $[M^{-1}L^{-2}T^{2}C^{+2}]$

Ans. (4)

Sol. $U = \frac{Q^2}{2C}$

$$C = \frac{Q^2}{2U} = \frac{C^2}{M^1L^2T^{-2}}$$

$C = [M^{-1}L^{-2}T^{2}C^{+2}]$

7. **Statement 1 :** when a simple pendulum bring on a planet whose mass is four time of mass of earth and radius is equal to 2 time radius of earth then time period of simple pendulum is same as on earth.
Statement 2: mass of pendulum does not change on any planet

(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. (2)

Sol. $T_E = 2\pi\sqrt{\frac{\ell}{g_E}}$

$T_p = 2\pi\sqrt{\frac{\ell}{g_p}}$

$$\frac{T_p}{T_E} = \sqrt{\frac{g_E}{g_p}} = \sqrt{\frac{G.M_E}{R_{E^2}} \times \frac{(2R_E)^2}{G \times 4M_e}} = 1$$

8. The maximum percentage error in the measurement of density of a wire is :
If mass m = (0.60 ± 0.003) g
Radius r = (0.50 ± 0.01) cm
Length ℓ = (10.00 ± 0.05) cm

(1) 5 % (2) 8 % (3) 10 % (4) 15 %

Ans. (1)

Sol. $\rho = \frac{m}{V} = \frac{m}{\pi r^2 \ell}$

$\frac{\Delta\rho}{\rho} = \left|\frac{\Delta m}{m}\right| + \left|\frac{2\Delta r}{r}\right| + \left|\frac{\Delta \ell}{\ell}\right|$

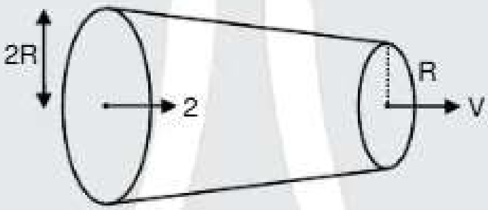
$= \frac{0.003}{0.6} + \frac{2 \times 0.01}{0.5} + \frac{0.05}{10}$

$= 0.005 + 0.04 + 0.005$

$\frac{\Delta\rho}{\rho} = 0.05$

% error = 5 %

9. Radius of a tube decreases from 2R to R in which ideal liquid is flowing at same level.



Speed at one end is 2 m/s as shown, find speed V at other end.

(1) 2 m/s (2) 5 m/s (3) 8 m/s (4) 10 m/s

Ans. **(3)**

Sol. from continuity equation

$A_1 V_1 = A_2 V_2$

$\pi (2R)^2 \times 2 = \pi (R)^2 \times V$

$8 = V$

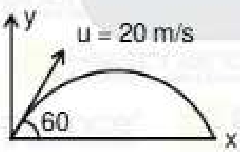
$V = 8$ m/s

10. A ball of mass 100 gm is thrown with speed 20 m/s at an angle 60° with horizontal. Find loss in kinetic energy of the ball when it reaches of its maximum height.

(1) 15J (2) 20 J (3) 5 J (4) 30 J

Ans. **(1)**

Sol.



$u_y = 20\sin 60°$

$= 10\sqrt{3}$

Max. height $H = \frac{u_y^2}{2g} = \frac{10\sqrt{3} \times 10\sqrt{3}}{2 \times 10} = 15$ m

So loss in K.E. = mgh

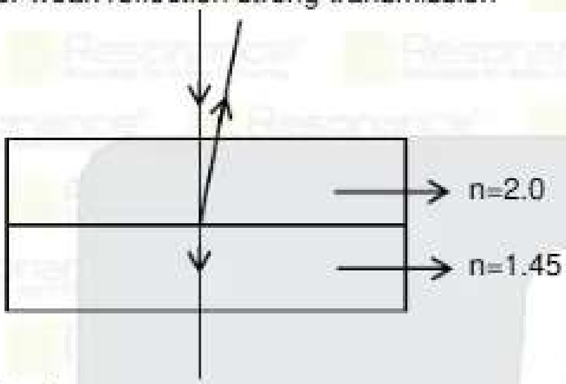
$= \frac{100}{1000} \times 10 \times 15 = 15$J

11. A glass slab of refractive index 1.45 is coated with some substance of refractive index 2 and thickness of substance is t. If light of wavelength $\lambda = 550$ nm is falls on surface then what will be thickness of substance, if transmission of light is maximum.

(1) 135.5 nm (2) 120.5 nm (3) 125.5 nm (4) 137.5 nm

Ans. (1)

Sol. For weak reflection strong transmission



$2\mu t = \lambda$

$t = \frac{\lambda}{2\mu}$

$\lambda = (1)\ \lambda$

$t = \frac{\lambda}{2\mu} = \frac{550}{2(2)}$

$t = 137.5$ nm

12. A proton is moving with uniform velocity 2×10^5 m/s in uniform magnetic and electric fields which are perpendicular to each other. If electric field is switched off then proton moves in circular path of radius 2×10^{-2} m and if the value of electric field in terms of $\alpha \times 10^4$ V/m, then write the value of α.

Ans. 10

Sol. $r = \frac{mv}{qB}$

$B = \frac{mV}{qr} = \frac{1.67\times10^{-27}\times2\times10^{5}}{1.6\times10^{-19}\times2\times10^{-2}}$

$B \Rightarrow 0.5$

$E = V_B = 2 \times 10^5 \times 0.5$

$E = 10 \times 10^4$ V/m $= \alpha \times 10^4$ V/m $\Rightarrow \alpha = 10$

13 The displacement of a particle moving under the action of a force $\vec{F} = 2\hat{i} - 2b\hat{j} - \hat{k}$ is $\vec{d} = \hat{i} + \hat{j} + \hat{k}$. Find the value of b if the work done by the force is zero ?

(1) $\frac{1}{2}$ (2) 1 (3) 2 (4) 0

Ans. (1)

Sol. $w = \vec{F}.\vec{s} = 0$

$\left(2\hat{i} - 2b\hat{j} - \hat{k}\right).\left(\hat{i} + \hat{j} + \hat{k}\right) = 0$

$2 - 2b - 1 = 0$

$2b = 1$

$b = \frac{1}{2}$

14. Calculate the radius of He^{+} ion in first exited state.

(1) 1.045Å (2) 2.058Å (3) 1.058Å (4) 1.028Å

Ans. **(3)**

Sol. Formula $\Rightarrow r = 0.529\frac{n^2}{z}$ Å

for He^{+}

$z = 2$

$n = 2$ (First exited state)

$r = 0.529\frac{2^2}{2}$ Å

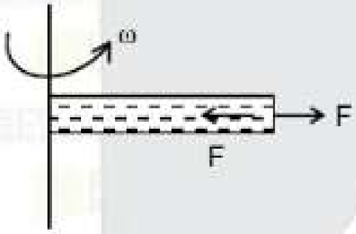
$r = 1.058$Å

15. A massless tube of length 1m is filled with a liquid of mass 2m about an axis passing through its one end and with angular velocity ω. If force exerted by liquid on the other end of tube is F then $\omega = \sqrt{\frac{F}{\alpha m}}$. Find value of α.

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

Ans. **(4)**

Sol.



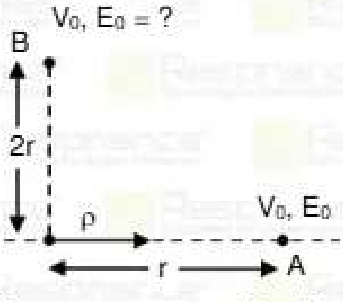
for liquid

$F = 2m\omega^2\frac{\ell}{2}$ $\{\ell = 1\}$

$\Rightarrow F = m\omega^2$

$\Rightarrow \omega = \sqrt{\frac{F}{m}}$ So $\alpha = 1$

16. The point A is situated on the axis of dipole at a distance 'r' from the dipole with E_0 and V_0 the electric field and electric potential at A. Find the electric field and potential at point B at distance '2r' from dipole on its perpendicular Bisector in terms of E_0 and V_0.



(1) $\frac{E_0}{16}, 0$ (2) $\frac{E_0}{8}, \frac{V_0}{2}$ (3) $\frac{E_0}{4}, \frac{V_0}{4}$ (4) $\frac{E_0}{8}, 0$

Ans. **(1)**

Sol. $E_A = E_0 = \frac{2kp}{r^3}$

$E_B = \frac{kp}{(2r)^3} = \frac{kp}{8r^3} = \frac{1}{16}\left(\frac{2kp}{r^3}\right)$

$\left(E_B = \frac{E_0}{16}\right)$

and potential will be zero at point B.

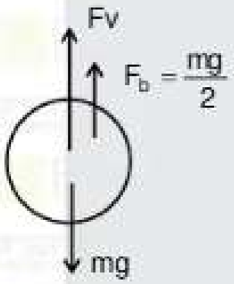
$(E_B, V_B) = \left(\frac{E_0}{16}, 0\right)$

17. A ball of mass m attains terminal velocity in a liquid when it is dropped in the liquid. If density of ball is twice the density of liquid find viscous force on the ball when it attains terminal velocity.

(1) $\frac{mg}{2}$ (2) mg (3) $\frac{3mg}{4}$ (4) $\frac{mg}{4}$

Ans. **(1)**

Sol.



$F_b = \rho_\ell V g$

$= \rho_\ell \frac{m}{2\rho_\ell} g$

$= \frac{mg}{2}$

So $F = \frac{mg}{2}$

18. For a diatomic gas if $\gamma_1 = \frac{c_p}{c_v}$ for rigid molecules and $\gamma_2 = \frac{c_p}{c_v}$ for another diatomic molecule having vibrational modes then

(1) $\gamma_2 < \gamma_1$ (2) $\gamma_2 > \gamma_1$ (3) $\gamma_2 = \gamma_1$ (4) $\gamma_2 = 2\gamma_1$

Ans. **(1)**

Sol. $f_1 = 5$

$\gamma_1 = 1 + \frac{2}{f} = \frac{7}{5}$

$f_2 = 5$ + vibration modes = 7

$\gamma_2 = \frac{9}{7}$

$\gamma_1 > \gamma_2$

19. Current through a capacitance of plate area A = 16 cm² is 4A. If distance between plates is 10 cm then displacement current through an area 3.2 cm² in mA will be :

(1) 200 mA (2) 500 mA (3) 600 mA (4) 800 mA

Ans. **(4)**

Sol. $I_d = \varepsilon_0 A \frac{dE}{dt}$

$I_d \propto A$

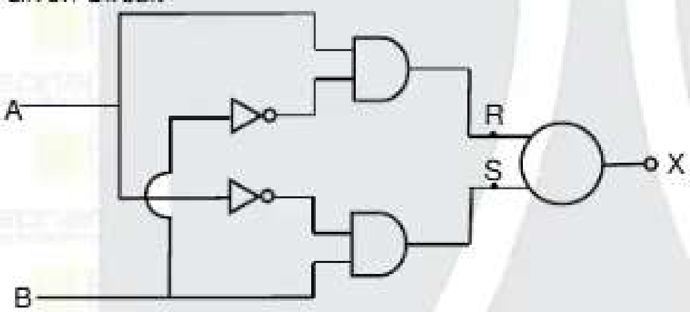
$\frac{4}{I_d} = \frac{16}{3.2}$

$\therefore\ I_d = \frac{4 \times 3.2}{16}$

= 0.8 A

= 800 mA

20. Given Circuit



Identify the gets in given CKt by following truth table

A	B	X
0	0	1
0	1	0
1	0	0
1	1	1

(1) AND (2) NOR (3) OR (4) NAND

Ans. **(2)**

Sol. At point R = $A\overline{B}$

$S = \overline{A}B$

R	S	X
0	0	1
0	1	0
1	0	0
0	0	1

$\overline{R+S} \rightarrow$ NOR gate