WEEKLY TEST OYM TEST - 36 RAJPUR
SOLUTION Date 12-01-2020

[PHYSICS]

1. $F = k\dfrac{(Q)(-2Q)}{r^2}$; $F' = k\dfrac{(-Q/2)(-Q/2)}{r^2}$

2. For $x = \dfrac{r}{2}$, $E = 0$

   For $x = 0$ and $x = r$, $E = \infty$

3. $V = \dfrac{1}{4\pi\varepsilon_0} \times \dfrac{q}{R} = 9 \times 10^9 \times \dfrac{3.2\times10^{-9}}{8\times10^{-2}} = 3.6\times10^2$ V.

   The electric potential at all the points inside the sphere remains constant.

4. The potentials of A and B are the same. The direction of the electric field is always from high potential point to low potential point $\left(E = \dfrac{-dV}{dx}\right)$. Therefore, potential at C is less than the potential at D.

5. The effective capacitance of the parallel combination $C_p = 2C$ where C the capacitance between each pair of plates. The effective capacitance between A and B

   $\dfrac{1}{C_{AB}} = \dfrac{1}{C_p} + \dfrac{1}{C} = \dfrac{1}{2C} + \dfrac{1}{C}$

   $C_{AB} = \dfrac{2}{3}C = \dfrac{2}{3}\dfrac{\varepsilon_0 A}{d}$

6. Given: $m \times n = 24$. If the current should be maximum, then $nR = mr \Rightarrow n\times3 = m\times0.5 \Rightarrow n = \dfrac{m}{6}$

   i.e., $m\times\dfrac{m}{6} = 24$ or $m^2 = 144$ $\therefore$ $m = 12$

   and $n = \dfrac{m}{6} = \dfrac{12}{6} = 2$

7. Since the field is uniform and the loop moves with a uniform speed, the magnetic flux linked with the coil $\phi = B \times A = BL^2$ = constant. The induced emf $e = -d\phi/dt = 0$.

8. With the increase in frequency, the impedance of the *LCR* circuit decreases and hence the current ($I = V/Z$) increases. At a particular frequency called resonant frequency, the impedance becomes minimum and hence the current becomes maximum. Above the resonant frequency, the impedance of the circuit again increases. This causes decrease in current.

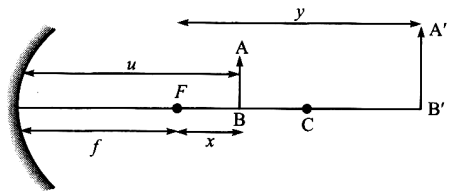
9. $\cos\phi = \frac{R}{Z} = 1 \quad \therefore R = Z \qquad \therefore X_L = X_C$

$$\therefore f = \frac{1}{2\pi\sqrt{LC}} \qquad \therefore C = \frac{1}{4\pi^2 f^2 L}$$

$$= \frac{1}{4(3.14)^2(50)^2(0.5)} = 20\ \mu F$$

10. D

11.



$$u' = -(f+x)\ v = -(f+y)\ f = \frac{-uv}{u+v}$$

$$= \frac{(f+x)(f+y)}{-(f+x)+(f+y)}$$

$$\Rightarrow f = \sqrt{xy}$$

12. $n_{gw} = \frac{n_g}{n_w} = \frac{1}{\sin C}$

$$C = \sin^{-1}\left(\frac{n_w}{n_g}\right) = \sin^{-1}\left[\frac{(4/3)}{(5/3)}\right] = \sin^{-1}\left(\frac{4}{5}\right)$$

13. D

14. Refractive index, $n = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in medium}}$

Therefore, n is dimensionless. By the principle of homogeneity, each term in the given equation must be dimensionless. B should have the dimensions of λ^2 i.e., area.

15. Speed of light in glass $= \frac{3\times10^8}{1.5} = 2 \times 10^8 \text{ m s}^{-1}$

$\therefore$ time taken by light to travel the thickness of glass slab $= \frac{2\times10^{-2}}{2\times10^8} = 10^{-10} \text{ s}$

Alternatively, optical path length $= 2 \times 10^{-2} \times 1.5$
$= 3 \times 10^{-2} \text{ m}$

16. $P = P_1 + P_2 = 2 + 3 = 5D$

$F = \frac{1}{P} = \frac{1}{5} = 0.2 \text{ m}$

$= 20 \text{ cm}$

$u = -30$

17. A
18. B

19. Half–life, $T = 0.693\ T_{av}$;

$\frac{T}{T_{av}} = 0.693 \Rightarrow T < T_{av}$. T is the time during which half the nuclei in the sample disintegrate. Since $T_{av} > T$, more than half nuclei disintegrate in time T_{av}.

20. The input to OR gate is A and Y_1.

$\therefore\ Y = A + Y_1 = A + (\overline{A.B})$.