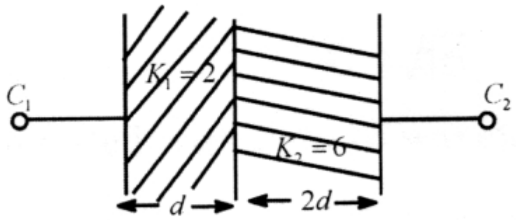
JEE

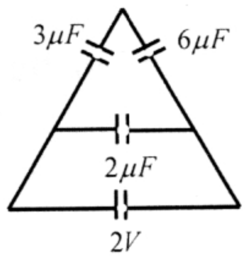
PHYSICS

1. A parallel plate capacitor has two layers of dielectrics as shown in figure. This capacitor is connected across a battery then the ratio of potential difference across the dielectric layers is



1) $\frac{4}{3}$ 2) $\frac{1}{2}$ 3) $\frac{5}{2}$ 4) $\frac{3}{2}$

2. The total energy stored in the condenser system shown in the figure will be

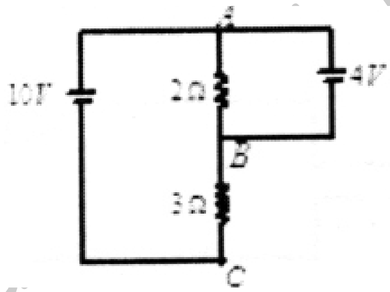


1) 2×10^{-6} J 2) 4×10^{-6} J 3) 8×10^{-6} J 4) 16×10^{-6} J

3. A spherical charged conductor has surface charge density σ. The electric field on its surface is E and the electric potential of conductor is V. Now the radius of the sphere is halved keeping the charge to be constant. The new values of electric field and potential will be

1) 2E, 2V 2) 4E, 2V 3) 4E, 4V 4) 2E, 4V

4. Current passing through 3Ω resistance is



1) $\frac{14}{3}$ A 2) 3 A 3) 2 A 4) $\frac{12}{5}$ A

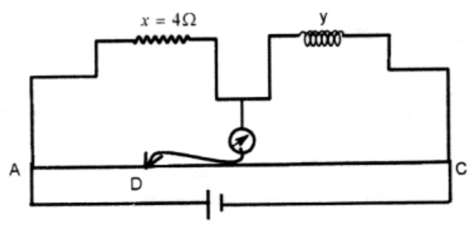
5. Figure shows a meter bridge, wire AC is 100 cm. X is a standard resistor of 4Ω and Y is a coil. When Y is immersed in melting ice the null point is at 40 cm from point A. When the coil Y is heated to 100° C, a 100Ω resistor has to be connected in parallel with Y in order to keep the bridge balanced at the same point. Temperature coefficient of resistance of the coil is

1) 6.3×10^{-4} K^{-1}

2) 4.3×10^{-4} K^{-1}

3) 8.3×10^{-4} K^{-1}

4) 2.3×10^{-4} K^{-1}



6. Power generated across a uniform wire connected across a supply is H . If the wire is cut into 'n' equal parts and all the parts are connected in parallel across the same supply, the total power generated in the wire is

1) $\frac{H}{n^2}$ 2) n^2 H 3) nH 4) $\frac{H}{n}$

7. A wire of fixed length is wound on a solenoid of length 'l' and radius 'r'. Its self-inductance is found to be L . Now if same wire is wound on a solenoid of length $\frac{l}{2}$ and radius $\frac{r}{2}$, then the self – inductance will be

1) 2L 2) L 3) 4L 4) 8L

8. Ratio of magnetic field at the centre of a current carrying coil of radius R and at a distance of 3R on its axis is

1) $10\sqrt{10}$ 2) $20\sqrt{10}$ 3) $2\sqrt{10}$ 4) $\sqrt{10}$

9. When a metallic surface is illuminated with light of wavelength λ, the stopping potential is V . When the same surface is illuminated by light of wavelength 2λ, the stopping potential is $\frac{V}{3}$. The threshold wave length of the surface is

1) $\frac{4\lambda}{3}$ 2) 4λ 3) 6λ 4) $\frac{8\lambda}{3}$

10. The ratio of the maximum wavelength of Lyman series in hydrogen spectrum to the maximum wavelength in the Paschen series is

1) $\frac{3}{105}$ 2) $\frac{6}{15}$ 3) $\frac{52}{7}$ 4) $\frac{7}{108}$

11. Number of nuclei of a radioactive substance at time t = 0 are 1000 and 900 at time t = 2s. Then number of nuclei at time t = 4s will be

1) 800 2) 810 3) 790 4) 700

12. The hydrogen atoms in its ground state are excited by means of monochromatic radiation of wavelength 1023 A°. The number of lines which can be seen in the resulting spectrum is

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

13. The angle of incidence for an equilateral prism is 60°. What should be the refractive index of prism so that the ray is parallel to the base inside the prism?

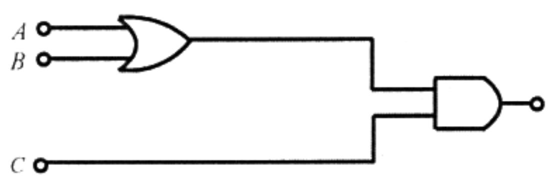
1) $\sqrt{2}$ 2) $\sqrt{3}$ 3) $\frac{4}{3}$ 4) $\frac{9}{8}$

14. In a Young's double slit experiment, the fringes are displaced by a distance x when a glass plate of refractive index 1.5 is introduced in the path of one of the beams. When this plate is replaced by another plate of same thickness, the shift of fringes is $\left(\frac{3}{2}\right)$x. The refractive index of second plate is?

1) 1.75 2) 1.40 3) 1.25 4) 1.67

15. To get an output 1 from the circuit shown in the figure, the input must be

1) A = 0, B = 1, C = 0
2) A = 1, B = 0, C = 0
3) A = 1, B = 0, C = 1
4) A = 1, B = 1, C = 0



16. A transmitting antenna at the top of a tower has a height 32m and the height of the receiving antenna is 50m. What is the maximum distance between them for satisfactory communication in line of sight mode?

1) 55.4 km 2) 45.5 km 3) 54.5 km 4) 44.5 km

KEY

1-4; 2-3; 3-2; 4-3; 5-1; 6-2; 7-4; 8-1; 9-2; 10-4; 11-2; 12-3; 13-2; 14-1; 15-3; 16-1.

HINTS & SOLUTIONS

1. Capacitance of left section = $\frac{2\varepsilon_0 A}{d} = 2C_0$

$C_0 = \frac{\varepsilon_0 A}{d}$

Capacitance of right section $= \frac{6\varepsilon_0 A}{2d} = 3C_0$

Since charge on each section will be same

So $V \propto \frac{1}{C} \Rightarrow \frac{V_1}{V_2} = \frac{C_2}{C_1} = \frac{3}{2}$

2. $C_{net} = 4\mu F$

$U_{total} = \frac{1}{2} C_{net} V^2$

$= \frac{1}{2} \times 4 \times (4) \times 10^{-6}$

$= 8 \times 10^{-6}$ J

3. $E = \frac{1}{4\Pi\varepsilon_0} \frac{q}{R^2} \propto \frac{1}{R^2}$ (q = constant)

Radius is halved therefore the electric field will become 4 times or 4E.

Further $V = \frac{1}{4\Pi\varepsilon_0} \frac{q}{R} \propto \frac{1}{R}$

Radius is halved so potential will become two times or 2V.

4. $V_A - V_B = 4V$

$V_A - V_C = 10V$

$V_B - V_C = 6V$

So, p.d between 3Ω resistance is 6V . So current passing through it is $i = \frac{6}{3} = 2A$

5. $\frac{x}{R_0} = \frac{l}{100 - l}$

Since null point remains unchanged

$\frac{x}{R_0} = \frac{40}{60}$ or $R_0 = 6\Omega$

$6 = \frac{100Rt}{R_t + 100}$

$R_t = 6.38\Omega$

$\alpha = \dfrac{R_t - R_0}{R_e\, t} = 6.3 \times 10^{-4}\ K^{-1}$

6. $R^1 = \dfrac{R}{n^2}$

$P = \dfrac{V^2}{R}$ or $P \propto \dfrac{1}{R}$

$\dfrac{P^1}{P} = \dfrac{R}{R^1} = n^2$

$P^1 = n^2 P = n^2 H$

7. $L \propto \dfrac{N^2 A}{l}$ where

N = total no of turns

A = cross sectional area of the solenoid

'l' length of the solenoid, 'r' radius of the solenoid and therefore circumference of solenoid have becomes half. Therefore N will becomes four times. A has becomes $\dfrac{1}{4}$ th .

$\dfrac{L^1}{L} = \dfrac{N^{12} A^1}{l^1} \times \dfrac{l}{N^2 A^2}$

$= \dfrac{16}{4} \dfrac{N^2 A}{l} \times 2 \times \dfrac{l}{N^2 A^2} = 8$ or $L^1 = 8L$

8. The desired ratio is

$$\frac{B_C}{B_{axis}} = \frac{\dfrac{\mu_0 i}{2R}}{\dfrac{\mu_0 i R^2}{2\left(R^2 + 9R^2\right)^{3/2}}} = (10)^{3/2}$$

$= 10\sqrt{10}$

9. $eV = \dfrac{hC}{\lambda} - \dfrac{hC}{\lambda_0}$ ………..(1)

$e\dfrac{V}{3} = \dfrac{hC}{2\lambda} - \dfrac{hC}{\lambda_0}$ ………..(2)

Solving these two equations we will get

$\lambda 0 = 4\lambda$

10. Maximum wavelength of Lyman series will correspond to the transition of electron from n = 2 to n = 1 and maximum wavelength of Paschen series will correspond to n = 4 to n = 3

$$\frac{\lambda_1}{\lambda_2} = \frac{\left(\dfrac{1}{9} - \dfrac{1}{16}\right)}{\left(\dfrac{1}{1} - \dfrac{1}{4}\right)} = \frac{7}{108}$$

11. In 2s only 90% nuclei are left behind. Thus in next 2s, 90% of 900 or 810 nuclei will be left.

12. $E = \frac{hC}{\lambda} = \frac{12400}{1023} = 12.1eV$

Thus transition is from n = 1 to n = 3

Number of spectral line is

$3 = \frac{n(n-1)}{2} = \frac{3(3-1)}{2} = 3$

13. For an equilateral prism the ray inside the prism will be parallel to the base at minimum deviation

At minimum deviation $r_1 = r_2 = \frac{A}{2} = 30°$

$\mu = \frac{\sin i_1}{\sin r_1} = \frac{\sin 60°}{\sin 30°} = \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = \sqrt{3}$

$\therefore \mu = \sqrt{3}$

14. $\text{Shift} = \frac{(\mu - 1)tD}{d}$

$x = \frac{(1.5-1)tD}{d}$ .... (1)

$\frac{3}{2}x = \frac{(\mu - 1)tD}{d}$ .... (2)

Dividing equation (1) by equation (2)

$\frac{2}{3} = \frac{0.5}{(\mu - 1)}$

Or $2\mu - 2 = 1.5$

$2\mu = 3.5 \therefore \mu = \frac{3.5}{2} = 1.75$

15. The Boolean expression for the given combination is Y = (A + B).C

Truth table is

A	**B**	**C**	**Y = (A + B).C**
0	0	0	0
1	0	0	0
0	1	0	0
0	0	1	0
1	1	0	0
0	1	1	1
1	0	1	1
1	1	1	1

Hence A = 1, B = 0 and C = 1

16. $d = \sqrt{2Rh_T} + \sqrt{2RhR}$

$= 37500(\sqrt{32} + \sqrt{50}) = 45.5 \times 103$ m

$= 45.5$km.