PHYSICS

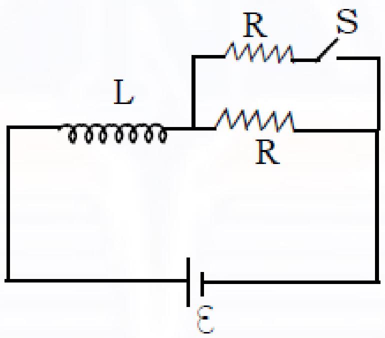
1. A point charge 'q' is placed at the centre of one of the faces of an imaginary hollow cube. The electric flux through the opposite face is ϕ. Then

1) $\phi = \frac{q}{10\varepsilon_0}$
2) $\phi = \frac{q}{(10+4\sqrt{5})\varepsilon_0}$
3) $\phi = \frac{q}{(6+2\sqrt{6})\varepsilon_0}$
4) $\frac{q}{(10+4\sqrt{5})\varepsilon_0} < \phi < \frac{q}{(6+2\sqrt{6})\varepsilon_0}$

2. An infinite current carrying straight wire placed along y – axis is moving with velocity $v_1\hat{j}$. The magnetic field $\vec{B}$ at a point $(x_0, 0, 0)$ is measured by an observer who is also moving with velocity v_2 (in any direction). Then $\vec{B}$ at the given point depends upon

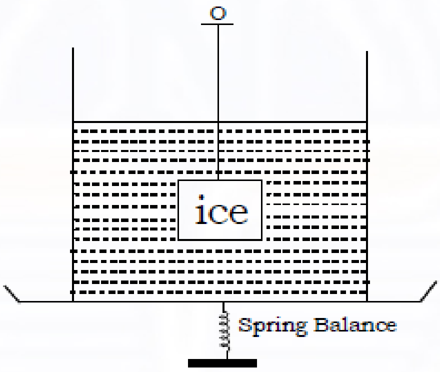
1) v_1
2) v_2
3) both v_1 and v_2
4) neither v_1 nor v_2

3. In the circuit given below, switch 'S' is open for long time and then it is closed at $t = 0$. Then current through the inductor at time 't' is given by



1) $i = \frac{\varepsilon}{R}\left(1 - \frac{1}{2}e^{-\frac{Rt}{2L}}\right)$.
2) $i = \frac{\varepsilon}{R}\left(1 - e^{-\frac{Rt}{2L}}\right)$.
3) $i = \frac{2\varepsilon}{R}\left(1 - e^{-\frac{Rt}{2L}}\right)$.
4) $i = \frac{2\varepsilon}{R}\left(1 - \frac{1}{2}e^{-\frac{Rt}{2L}}\right)$.

4. An ice cube of specific gravity 1.2 is lowered in a vessel of normal water (specific gravity is 1) by a light string whose upper end is fixed at 'O' as shown. Now ice is being slowly melted and it is converted into normal water. The reading of spring balance will



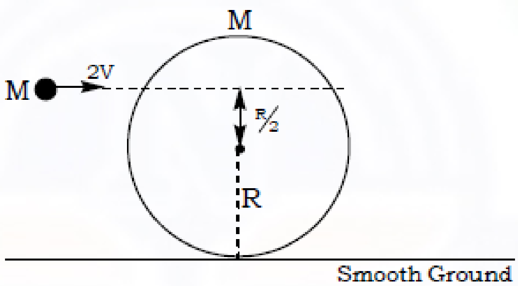
1) First increase and finally become constant

2) First decrease and finally become constant

3) First increase, then decrease and finally become constant

4) Remain unchanged

5. A small ball of mass M strikes a stationary disc of same mass with velocity 2V horizontally as shown. All the surfaces are smooth. The velocity of centre of disc after the collision is V.



Which of the following is **incorrect**?

1) Impulse exerted by ground on disc is $\frac{MV}{\sqrt{3}}$

2) Angular velocity of disc is zero after collision

3) Coefficient of restitution for the collision is $e = \frac{1}{6}$

4) If the disc is replaced by a solid sphere keeping the other values remain same, the velocity of small ball just after collision is $\frac{V}{\sqrt{3}}$

6. A cubical body is floating in a liquid contained in a stationary vessel. The bottom of cube is horizontal and submerged volume of cube is V_1. Now the vessel is moving with constant horizontal acceleration and submerged volume of cube becomes V_2. Select the **correct** statement regarding the cube in accelerating vessel

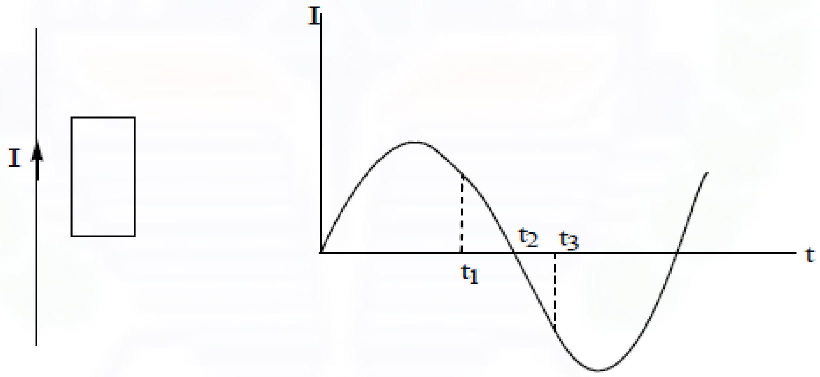
1) $V_2 = V_1$ & The bottom of cube remains horizontal.

2) $V_2 = V_1$ & The bottom of cube will be in parallel with the free surface of liquid.

3) $V_2 > V_1$ & The bottom of cube remains horizontal.

4) $V_2 > V_1$ & The bottom of cube will be in parallel with the free surface of liquid..

7. The current I in the straight conductor varies sinusoidally as shown (positive value of I is in the direction indicated). At time t_1, the induced current in the rectangular loop is clockwise. What is the current in the rectangular loop at time t_2 and time t_3 respectively?



1) zero, clockwise

2) zero, counter clockwise

3) clockwise, clockwise

4) clockwise, counter clockwise

8. A 3m long straight metal rod is moving with a constant velocity $\bar{v} = (2\hat{i} - \hat{j} + 3\hat{k}) m/s$ in a uniform magnetic field $\bar{B} = (3\hat{i} + \hat{j} - 2\hat{k})T$. The length of rod is oriented along the vector $\hat{i} - 2\hat{j} + 2\hat{k}$. The potential difference (in volts) between the ends of rod is

1) 42 2) 28 3) 17 4) 27

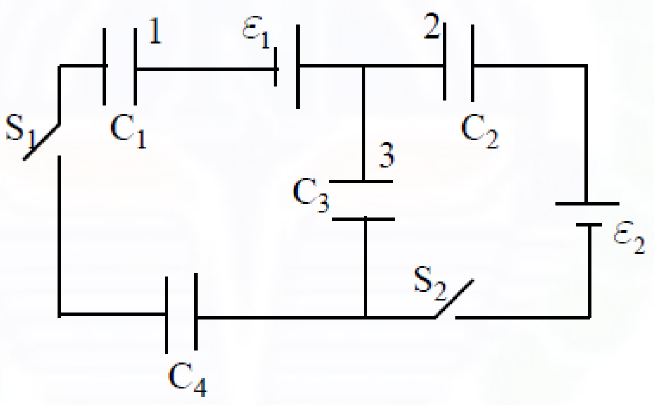
9. A charge 'q' is given to a solid conducting sphere of mass 'm' and is rotating about it's diameter with angular velocity ω. Then ratio of it's magnetic moment to its angular momentum is

1) $\frac{5q}{4m}$ 2) $\frac{q}{2m}$ 3) $< \frac{q}{2m}$ 4) $> \frac{q}{2m}$

10. Two point charges +2q and –q are placed on x-axis at (0, 0, 0) and (3, 0, 0) respectively. How many points of zero electric potential are there in the plane X = 5?

1) 0 2) 1 3) 2 4) many

11. In the circuit given below 1, 2 and 3 represent right, left and upper plates of capacitors C_1, C_2 *and* C_3 respectively. There are some initial charges on all the capacitors



Now S_1 *and* S_2 are closed. Then total charge on which of the following combination of plates must remain conserved?

1) 1 and 2 2) 1, 2 and 3 3) 2 and 3 4) none