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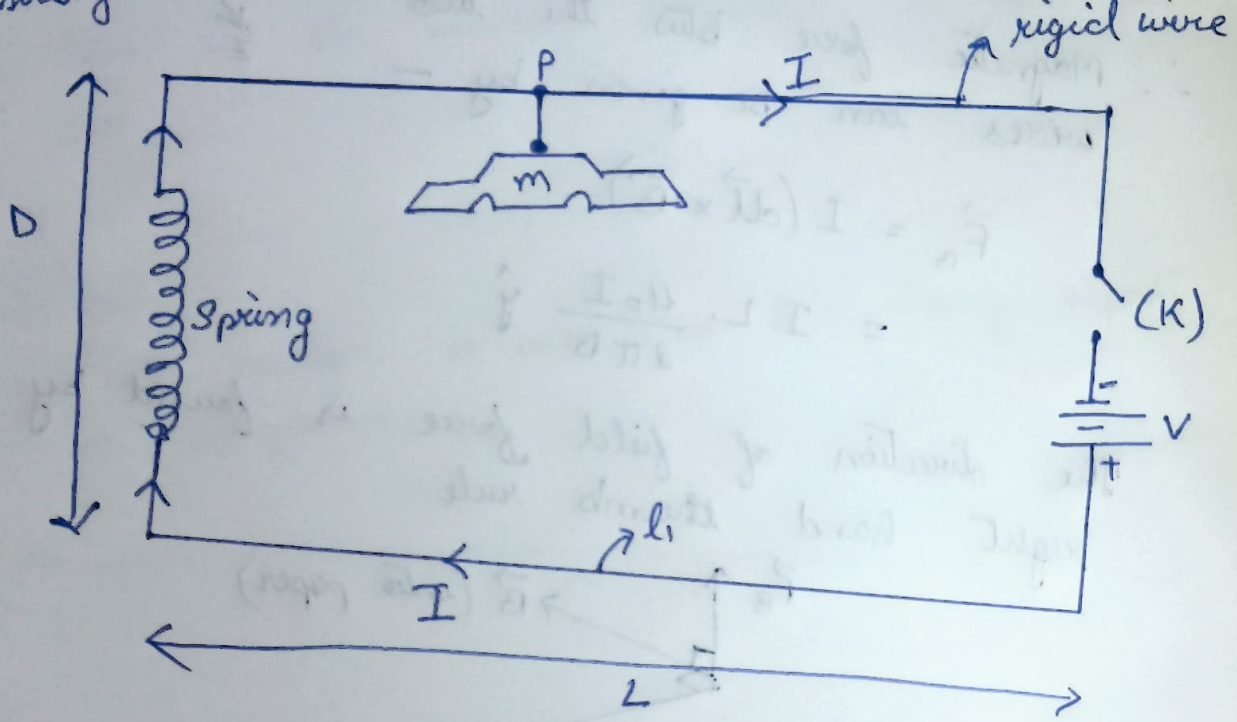
Q.) A car company needs a spring to lift the car for the manufacturing and painting staff. The setup is described below. The wires are strengthened by metalic bars and plastic covers.



Now, the problem is that in order to lift the car of mass m, what current is required to pass through the spring of turns per unit length N.

* Outlining the solution →

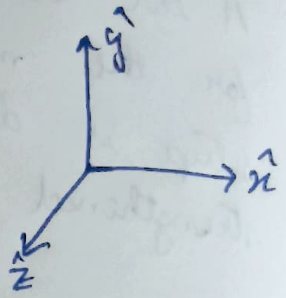
Here, we have to balance magnetic force and gravitational force,

We will find magnetic field at point P due to wire l_1 and then find magnetic force.

Sol^n

According to Biot - Savarts law -
Magnetic field due to l_1 wire at P is -

$$\vec{B} = \frac{\mu_0 I}{2\pi D}(-\hat{z}) \quad , \text{ where } I \to \text{current}$$

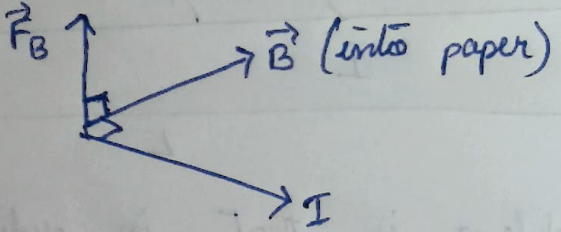


∴ Magnetic force btw the two wires can be given by -

$$\vec{F}_B = I(d\vec{l} \times \vec{B})$$

$$= I.L.\frac{\mu_0 I}{2\pi D}\hat{y}$$

The direction of field force is found by right hand thumb rule



∴ In order for the weight to be balanced without the spring being not broken,

$$|\vec{F}_B| = |\vec{F}_g|$$

$$\vec{F}_g = mg(-\hat{y}) \quad \{\text{gravity acts downwards}\}$$

$$\therefore \quad \frac{I L \mu_0 I}{2\pi D} = mg$$

$$\Rightarrow \frac{I^2 \mu_0 L}{2\pi D} = mg$$

$$\Rightarrow I^2 = \frac{2\pi mgD}{\mu_0 L}$$

$$\Rightarrow I = \left(\frac{2\pi mgD}{\mu_0 L}\right)^{1/2}$$

This is the current required to lift the car.

* **Uses ⇒**

This method is used to lift heavy objects in companies -
