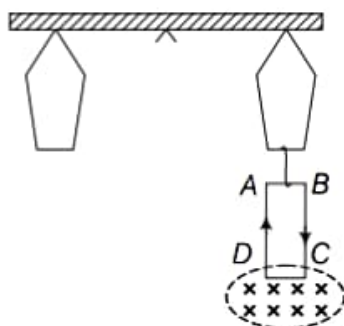


- Q. 23** A 100 turn rectangular coil $ABCD$ (in X - Y plane) is hung from one arm of a balance figure. A mass 500g is added to the other arm to balance the weight of the coil. A current 4.9 A passes through the coil and a constant magnetic field of 0.2 T acting inward (in x - z plane) is switched on such that only arm CD of length 1 cm lies in the field. How much additional mass m must be added to regain the balance?



K Thinking Process

The magnetic force applied on CD by magnetic field must balance the weight.

Ans. For equilibrium/ balance, net torque should also be equal to zero.

When the field is off $\sum \tau = 0$ considering the separation of each hung from mid-point be l .

$$\begin{aligned} Mgl &= W_{\text{coil}} l \\ 500 \text{ g } l &= W_{\text{coil}} l \\ W_{\text{coil}} &= 500 \times 9.8 \text{ N} \end{aligned}$$

Taking moment of force about mid-point, we have the weight of coil

When the magnetic field is switched on

$$\begin{aligned} Mgl + mgl &= W_{\text{coil}} l + IBL \sin 90^\circ l \\ mgl &= BIL l \end{aligned}$$

$$m = \frac{BIL}{g} = \frac{0.2 \times 4.9 \times 1 \times 10^{-2}}{9.8} = 10^{-3} \text{ kg} = 1 \text{ g}$$

Thus, 1g of additional mass must be added to regain the balance.