Physics 30 – Lesson 21
Motor Effect

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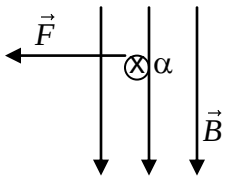
1) /2



The Right Hand Rule (karate grip) is where fingers point in the direction of the magnetic field, thumb points in direction of the particle's initial motion, and the palm indicates the direction of the force. The **force** is directed **to the left**.

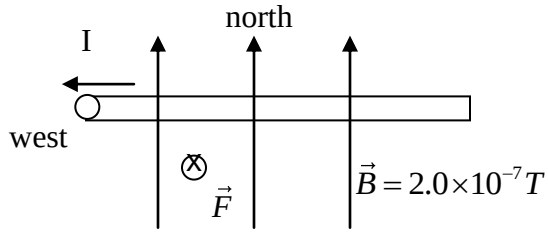
2) /2

$$B = \frac{F}{IL} \qquad T = \frac{N}{A \cdot m}$$

$$T = \frac{}{A \cdot m}\frac{kg \cdot m}{s^2}$$

$$\boxed{T = \frac{kg}{A \cdot s^2}}$$

3) /4

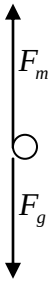


$$F_m = B_\perp IL$$

$$F_m = 2.0\times10^{-7}T(80A)(40m)$$

$$\boxed{F_m = 6.4\times10^{-4}N \text{ down}}$$

4) /4



$$F_m = F_g$$

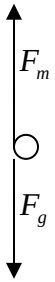
$$B_\perp IL = mg$$

$$I = \frac{mg}{B_\perp L}$$

$$I = \frac{0.020kg(9.81\,^{m}/_{s^2})}{0.12T(0.30m)}$$

$$\boxed{I = 5.5A}$$

5) /5



$$\vec{F}_{net} = \vec{F}_m + \vec{F}_g$$

$$m\vec{a} = B_\perp IL + m\vec{g}$$

$$I = \frac{m\vec{a} - m\vec{g}}{B_\perp L}$$

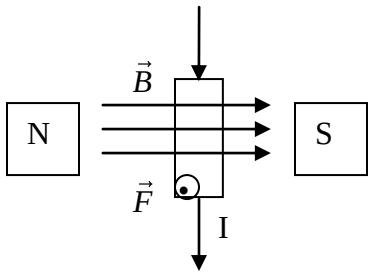
$$I = \frac{m(\vec{a} - \vec{g})}{B_\perp L}$$

$$I = \frac{45\times10^{-6}kg(+4.19\,^{m}/_{s^2} - (-9.81\,^{m}/_{s^2}))}{5.0\times10^{-3}T(0.15m)}$$

$$\boxed{I = 0.84A}$$

6)

/2



Using the Right Hand Rule, the fingers point in the direction of the magnetic field and the palm points in the direction of the force. The thumb indicates that the **current is flowing down the page**.

7)

/4

Only the length of wire perpendicular to the magnetic field results in a force.

$L = xy$

$L = 0.0190m$

$F_g = F_m$

$mg = B_\perp IL$

$B_\perp = \dfrac{mg}{IL} = \dfrac{(0.0176kg)(9.81\,{}^{m}\!/_{s^2})}{(6.00A)(0.0190m)}$

$\boxed{B = 1.51T}$

8)

/6

$m = 0.018\times10^{-3}kg$

$I_{xy} = ?$

$L_{xy} = 1.5cm$

$I_{coil} = 2.0A$

$L_{coil} = 0.15m$

first calculate B

$B = \mu\left(\dfrac{NI}{L}\right)$

$B = 4\pi\times10^{-7}\,{}^{T\cdot m}\!/_{A}\left(\dfrac{100(20A)}{(0.15m)}\right)$

$B = 0.0168T$

calculate I_{xy}

$F_m = F_g$

$mg = B_\perp IL$

$I = \dfrac{mg}{B_\perp L}$

$I = \dfrac{0.018\times10^{-3}kg(9.81\,{}^{m}\!/_{s^2})}{0.0168T(0.015m)}$

$\boxed{I = 0.70A}$

9)

/4

$L_1 = 0.20m$

$I_1 = 1.0A$

$B_1 = 0.02T$

$L_2 = 0.10m$

$I_2 = 3.0A$

$B_2 = 0.02T$

$\dfrac{F_{m_2}}{F_{m_1}} = \dfrac{B_2 I_2 L_2}{B_1 I_1 L_1}$

$\dfrac{F_{m_2}}{F_{m_1}} = \dfrac{3.0A(0.10m)}{1.0A(0.20m)}$

$\boxed{\dfrac{F_{m_2}}{F_{m_1}} = \dfrac{1.5}{1} \quad 1.5 \text{ to } 1}$

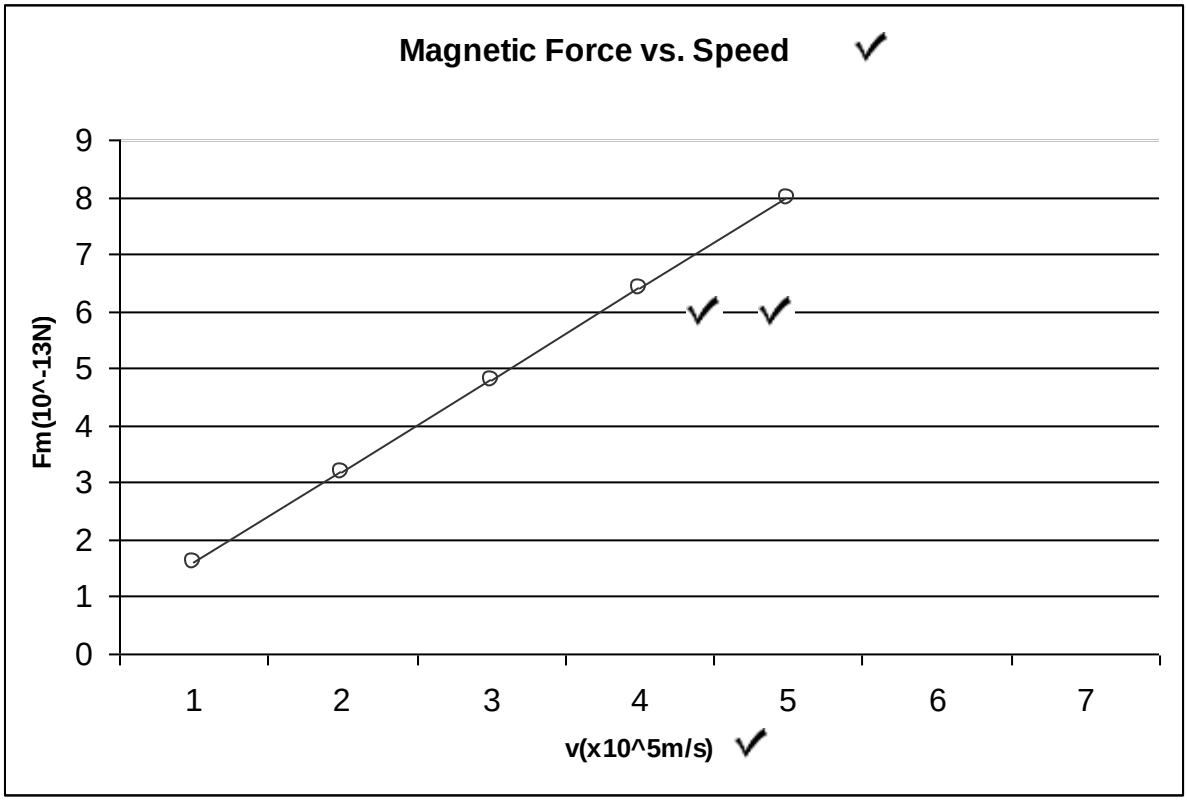
10) $F_m = B_\perp IL$

$$I = \frac{F_m}{B_\perp L}$$

/3 $$I = \frac{1.0\times10^{-3}\,N}{0.015T(0.12m)}$$

$$\boxed{I = 5.6\times10^{-1}\,A}$$

11)



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$F_m = qvB$ ✓

slope $\rightarrow qB = \frac{F_m}{v} \frac{\leftarrow \text{rise}}{\leftarrow \text{run}}$ ✓

✓ ✓

$$slope = \frac{(8.0\times10^{-19}\,N) - (1.6\times10^{-19}\,N)}{(5.0\times10^{5}\,{}^{m}\!/_{s}) - (1.0\times10^{5}\,{}^{m}\!/_{s})} = 1.6\times10^{-24}\,\frac{N\cdot s}{m}$$

$qB = slope$

$B = \frac{slope}{q}$ ✓

$$B = \frac{1.6\times10^{-24}\left(\frac{N\cdot s}{m}\right)}{3.2\times10^{-19}\,C}$$

$\boxed{B = 5.0\times10^{-6}\,T}$ ✓