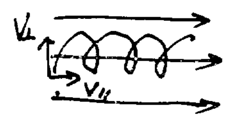
chp. 29.

#25.



The parallel component of the velocity $V_{\parallel}$ doesnot change; thus

$$S_{longitudinal} = V_{\parallel} \cdot T = V\cos\theta\, T$$

Where T is the period of the transverse motion:

$$T = \frac{2\pi m}{qB}$$

$$\Rightarrow S_{longitudinal} = V\cos\theta \cdot \frac{2\pi m}{qB} = 3\times10^5 \times \cos 40° \times \frac{2\times\pi\times 9.11\times10^{-31}}{1.6\times10^{-19}\times 0.12} = 6.8\times10^{-5}\ m$$

#36. the velocity of the proton: $V = \sqrt{\frac{2(K.E.)}{m}} = \sqrt{\frac{2\times 50\times10^6\times 1.6\times10^{-19}}{1.67\times10^{-27}}} = 9.8\times10^7\ m/s$

Since $\vec{F} = q\vec{v}\times\vec{B} = ma\hat{j}$ while $\vec{v} = v\hat{i}$

$$\Rightarrow qv\hat{i}\times(B_x\hat{i} + B_y\hat{j} + B_z\hat{k}) = ma\hat{j}$$

$\Rightarrow B_y = 0$, since $\hat{i}\times\hat{j} = \hat{k}$ which doesnot appear on the r.H.S.

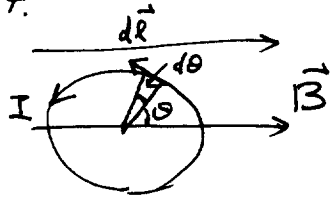
$$\Rightarrow \vec{B} = B_x\hat{i} + B_z\hat{k}$$

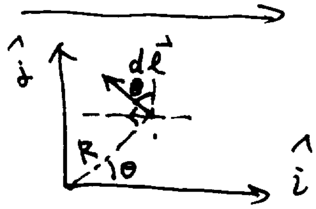
$$\Rightarrow \vec{F} = qv\hat{i}\times(B_x\hat{i} + \cancel{B_y\hat{j}}^{\,0} + B_z\hat{k}) = -qvB_z\hat{j} = ma\hat{j}$$

$$\Rightarrow B_z = \frac{ma}{-qv} = -1.67\times10^{-27}\times10^{12} / 1.6\times10^{-19}\times 9.8\times10^7 = -1.07\times10^{-4}\ T$$

$\Rightarrow \vec{B} = B_x\hat{i} - 1.1\times10^{-4}\hat{k}$, where B_x is undetermined.

#44.





From $d\vec{F} = I d\vec{\ell}\times\vec{B}$

$\vec{B} = B\hat{i}$

$d\vec{\ell} = -d\ell\sin\theta\,\hat{i} + d\ell\cos\theta\,\hat{j}$ and $d\ell = R d\theta$

$$\Rightarrow d\vec{F} = I(-d\ell\sin\theta\,\hat{i} + d\ell\cos\theta\,\hat{j})\times(B\hat{i})$$

$$= -BIR\cos\theta\, d\theta\,\hat{k}$$

#55 (a) To get the current, using $\tau_{max} = \mu B = INAB$

$$\Rightarrow I = \frac{\tau_{max}}{NAB} = 3\times10^{-5} / 50\times6\times10^{-4}\times0.2 = 5\times10^{-3} A$$

(b) The work required to rotate the coil,

$$W = \Delta U = (-\vec{\mu}\cdot\vec{B})_f - (-\vec{\mu}\cdot\vec{B})_i = \mu B(-\cos\theta_f + \cos\theta_i)$$

~~Fro~~ For a rotation of 180°, we have

$$W = \mu B(-\cos(180+\theta_i) + \cos\theta_i) = 2\mu B\cos\theta_i = 2\tau_{max}\cos\theta_i = 6\times10^{-5}\cos\theta_i \ ($$

Thus the work does depend on the initial angle.

#58. a) the mag. mom. of an electron moving in a circle.

$$\mu_0 = IA = \frac{e}{T}A = \frac{e}{\frac{\pi D}{V}}A = \frac{1.6\times10^{-19}}{4}\times10^{-10}\times2.2\times10^{6} = 8.8\times10^{-24} A\cdot m$$

b) The tot. # of electrons:

$$N = V_{tot}/V_{cube} = 1\times10 / (10^{-8})^3 = 1\times10^{25}$$

$$\Rightarrow \mu_{tot} = fN\mu_0 = f\ 1\times10^{25}\times8.8\times10^{-24} = 88\ f\ (A\cdot m^2)$$

(c) $\tau = \mu_{tot}B = 88f\times10^{-3} = 8.8\times10^{-2}f$ N·m

perpendicular to $\vec{\mu}_{tot}$ and $\vec{B}$.

#66. a) Since $T = \frac{2\pi m}{qB} \Rightarrow m = \frac{qB}{2\pi}T$ q, B are accurate compared to T.

$$\therefore dm = \frac{qB}{2\pi}dT = \frac{1.6\times10^{-19}}{2\pi}\times1\times10^{-9} = 2.5\times10^{-29} kg$$

(b) The time for N revolutions is NT

Thus: $t = NT = \frac{2\pi Nm}{qB} \Rightarrow dm = \frac{qB}{2\pi N}dt \Rightarrow N = \frac{qB\,dt}{2\pi\,dm} = \frac{1.6\times10^{-19}\times1\times10^{-19}}{2\pi\times10^{-30}} = 25$ re