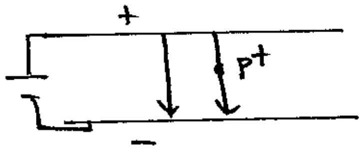
STAWA SET 15

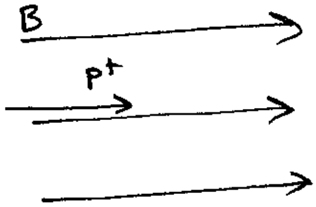
CHARGED PARTICLES IN ELECTRIC AND MAGNETIC FIELDS.

1) a)



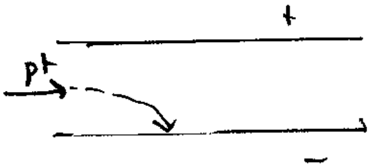
moves // in a straight line to field lines.

b)



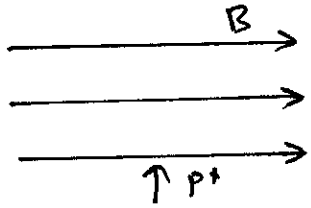
No force. Continues to move parallel to field in a straight line.

c)



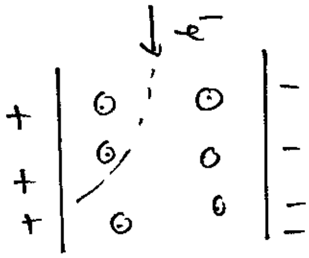
Curves towards negative plate.

d)



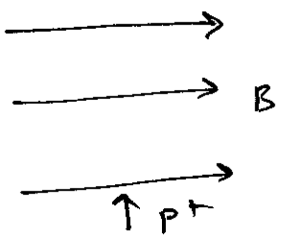
curves downward into page as it experiences a centripetal force.

2).



magnetic field must be outward out of the page.

3). $B = 24.5 \times 10^{-3}$ T



Force due to magnetic. $F = BqV$

Force due to electric field $F = Eq$

$Eq = Bqv$

$E = \frac{B\cancel{q}v}{\cancel{q}}$

$E = 24.5 \times 10^{-3} \times 4.50 \times 10^{6}$

$E = 1.10 \times 10^{5}$ Vm^{-1} or NC^{-1}

b) Since the electron and proton will experience the same force (independent of mass) it will be undeflected.

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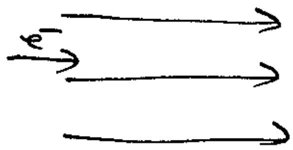
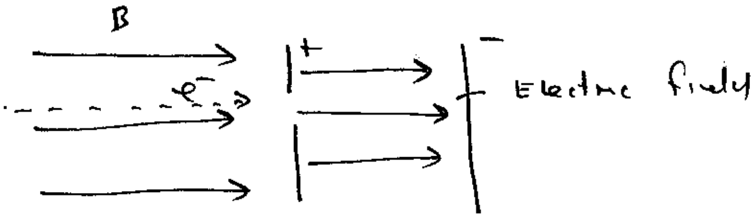
Q 4. $V_e = 6.00 \times 10^6 \, ms^{-1}$.

a) electron will experience a centripetal force which makes the electron move in a circula path into the page.

b) No effect. Electron will experience No force since moving parallel to the field.



c) electron will decellerate



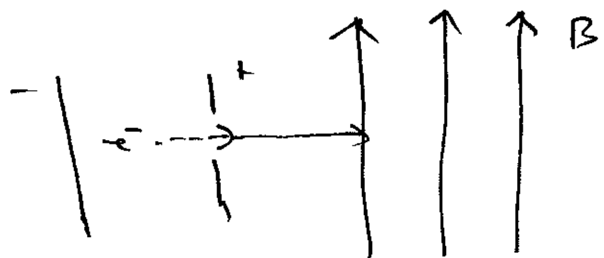
$F = Eq$

$F = 1.00 \times 10^3 \, Vm^{-1} \times 1.6 \times 10^{-19}$

$a = \frac{F}{m}$

$= \frac{1.6 \times 10^{-16}}{9.11 \times 10^{-31}}$

$= 1.76 \times 10^{14} \, ms^{-2}$ in the opposite direction to it's origanal motion.



Follows circula path into page.

5/ a) $V = 15.0 \, kV$, $B = 2.35T$

$W = Vq$

$W = \frac{1}{2}mv^2$

$\frac{1}{2}mv^2 = Vq$

$v^2 = \frac{15.0 \times 10^3 \times 1.6 \times 10^{-19} \times 2}{9.11 \times 10^{-31}}$

$v = 7.26 \times 10^7 \, ms^{-1}$

b) into page

c) $V = \frac{2\pi r}{T}$

$T = \frac{2\pi r}{V}$

$= 1.52 \times 10^{-11} \, s$

Determine radius of curvature.

$r = \frac{mv}{qB} = \frac{9.11 \times 10^{-31} \times 7.26 \times 10^7}{1.6 \times 10^{-19} \times 2.35}$

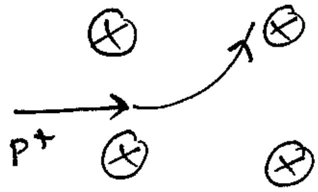
$= 1.76 \times 10^{-4} \, m$

Q 6)
a)

$r = 50.0\ mm$

$B = 1.50\ T$

$M_{p^+} = 1.672 \times 10^{-27}\ kg.$



$r = \frac{mv}{qB}$

$v = \frac{rqB}{m}$

$= \frac{50.0 \times 10^{-3} \times 1.6 \times 10^{-19} \times 1.5}{1.672 \times 10^{-27}}$

$v = 7.19 \times 10^{6}\ ms^{-1}$ of proton

b)

$v = \frac{2\pi r}{T}$

$T = \frac{2\pi r}{v}$

$= \frac{2\pi \times 50 \times 10^{-3}}{7.19 \times 10^{6}}$

$T = 4.369 \times 10^{-8}\ s$

$f = \frac{1}{T}$

$= \frac{1}{4.369 \times 10^{-8}}$

$= 2.29 \times 10^{7}\ Hz$

c)

$E_K = Vq$ work done equals the gain in E_K.

$\frac{1}{2}mv^2 = Vq$

$V = \frac{mv^2}{2q}$

$= \frac{1.672 \times 10^{-27} \times (7.19 \times 10^{6})^2}{2 \times 1.6 \times 10^{-19}}$

$V = 2.70 \times 10^{5}\ V$

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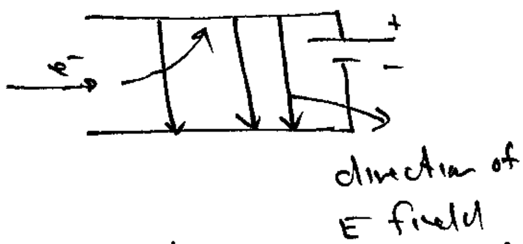
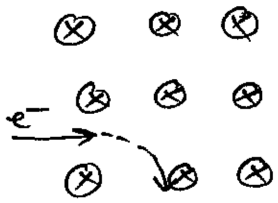
Q7) a). Electric field will deflect an electron towards the positive terminal.
electrons will be accelerated and their speed will increase.

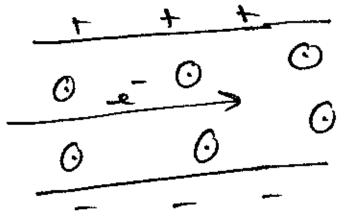


Magnetic fields will deflect electrons at right angles to a magnetic field.
electrons accelerate as a result of a centripetal force. Speed will be constant.

$r = \frac{mv}{qB}$ $\quad V = \frac{rqB}{m}$



b) Field must be out of page IN order for the electrons to be undeflected.



c) $V = ?$

$E = 1.00 \times 10^4 \ \text{Vm}^{-1}$.

$B = 0.100 \ \text{T}$

$BqV = Eq$

$V = \frac{Eq}{Bq} = \frac{E}{B} = \frac{1.0 \times 10^4}{0.100}$

$= 1.0 \times 10^5 \ \text{ms}^{-1}$

Only one velocity will result IN NO deflection of the electron. This occurs when $F = BqV$ & $F = Eq$

$V = \frac{E}{B}$

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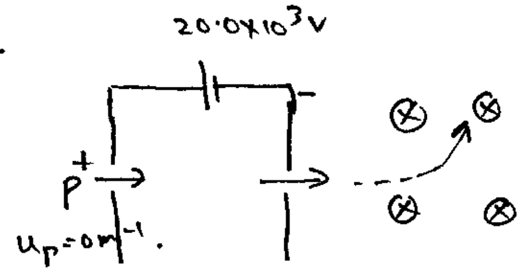
$u_p = 0\ ms^{-1}$ $m_p = 1.67\times10^{-27}$ $B = 0.20\ T$



8 a) $V = 20.0\times10^{3}\ V$

$W = Vq$

$= 20.0\times10^{3}\times1.6\times10^{-19}\ J$

$= 3.2\times10^{-15}\ J$

$3.2\times10^{-15} = \frac{1}{2}\times1.67\times10^{-27}v^{2}$

$v_p = 1.96\times10^{6}\ ms^{-1}$ is the velocity of the proton as it enters the magnetic field.

$F = m.a$

$a = \frac{F}{m}$

$= \frac{Bqv}{m}$

$= \frac{0.20T\times1.6\times10^{-19}\times1.96\times10^{6}}{1.67\times10^{-27}}$

$a_{p^+} = 3.75\times10^{13}\ ms^{-2}$ at right angle to the magnetic field

b) Path of the proton is circular since the force is a centripetal force.

c). Force due to electric and magnetic fields must be equal.

$Eq = Bqv$.

$E = Bv$

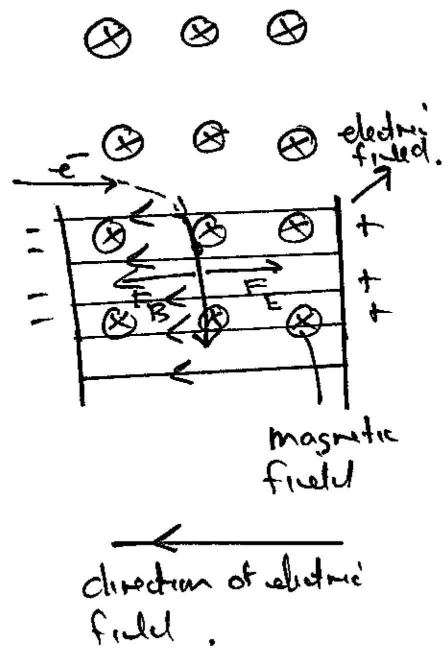
$= 0.20\times1.96\times10^{6}$

$E = 3.92\times10^{5}\ Vm^{-1}$ or NC^{-1}

Set 15 STAWA PHYSICS 3A 3B

a) $V_e = 1.60 \times 10^{4}\ ms^{-1}$

$B = 3.00 \times 10^{-2}\ T$



a) $r = \frac{mv}{qB} = \frac{9.11 \times 10^{-31} \times 1.60 \times 10^{4}}{1.6 \times 10^{-19} \times 3.00 \times 10^{-2}}$

$= 3.04 \times 10^{-6}\ m$

b) $E_{electric} = \frac{F}{q}$ $\quad F = qvB$

$E_{electric} = vB$ $\quad v =$ velocity.

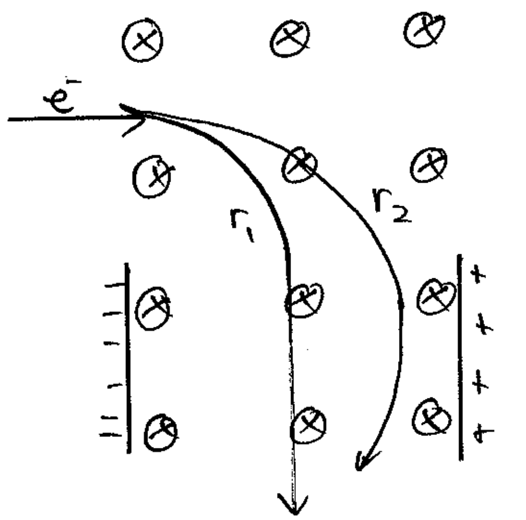
$= 1.60 \times 10^{4} \times 3.0 \times 10^{-2}$

$= 4.8 \times 10^{2}$

$= 480\ NC^{-1}$

d) $r = \frac{mv}{qB}$ $\quad F = Bqv$

radius due to magnetic field will increase since radius is directly propotional to velocity



$F_E = Eq$

Force due to electric field does not affect velocity

with higher velocity the force due to magnetic field would increase.

$Eq = Bqv$

$v = \frac{E}{B}$

Note: If we know E, B then this will give the velocity v for electrons to follow a straight path as they enter the region of both electric and magnetic field.

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Q 10/ $B = 1.5\ T$

a/ Each time the electron enters the region between the D's it will be accelerated. On entering the D's the electrons will be travelling faster and hence the radius of their circular path must increase

$$r = \frac{mv}{qB}.$$

b)

$$F_c = F_B \quad \text{IN the magnetic field.}$$

$$\frac{mv^2}{r} = Bqv$$

$$v = \frac{Bqr}{m}$$

at P

$$v = \frac{1.5 \times 1.6\times10^{-19} \times 0.20}{1.67\times10^{-27}}$$

$$= 2.87 \times 10^{-7}\ ms^{-1}$$

at Q

$$v = \frac{Bqr}{m}$$

$$= \frac{1.5 \times 1.6\times10^{-19} \times 0.40}{1.67\times10^{-27}}$$

$$= 5.75 \times 10^{7}\ ms^{-1}$$

NOTE: If the radius is double the velocity will also be double.