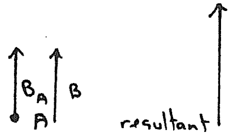
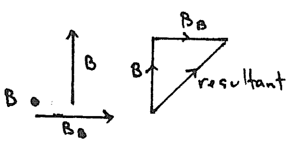
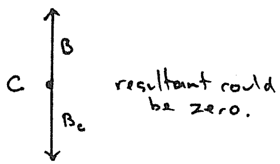
11. at A



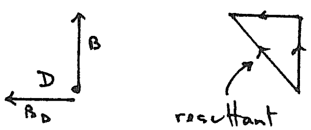
at B



at C



at D



12.(1)

(2) The initial current would cause the cone to move out / in once producing a single pulse. Then no further movement ∴ no further sound.

(3) The cone would move in & out producing a continuous wave of pulses ∴ sound at the frequency of the switching

(4) A stronger magnet produces a stronger magnetic field and as the force is ∝ to the field strength a bigger force is produced.

(5) In this way the coil current is always at 90° to the magnetic field lines ∴ maximum force.

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13. (1) $C = \pi d = \pi \times 0.02$

∴ length of 1 turn is

0.063 m.

(2) ∴ total length

$= 400 \times 0.063$

$= 25.13$ m.

(3) $F = BI\Delta l \sin\theta$

$\theta = 90°$

∴ $F = 1.6 \times 1.0 \times 10^{-3} \times 25.13$

$F = 0.04$ N.

(4) $a = F/m$

$= \dfrac{0.04}{0.045}$

$= 0.89\ \text{ms}^{-2}$

(5) $S = V_0 t + \frac{1}{2}at^2$

$S = 0 + \frac{1}{2} \times 0.89 \times (.05)^2$

$S = 0.001$ m

$S = 1$ mm.

1 (1) $F = Bqv\sin\theta$ ($\theta = 90°$)

∴ $F = Bqv$

∴ $F = 0.16 \times 1.6 \times 10^{-19} \times 8.0 \times 10^6$

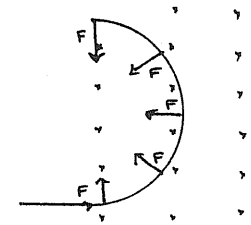
$F = 2.05 \times 10^{-13}$ N.

(2) $r = \dfrac{mV}{Bq}$

$r = \dfrac{1.673 \times 10^{-27} \times 8.0 \times 10^6}{0.16 \times 1.6 \times 10^{-19}}$

$r = 0.52$ m

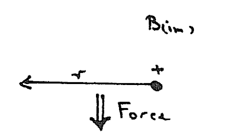
(3)



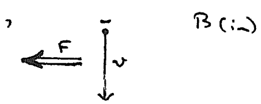
(4) The magnetic force is always at 90° to the velocity of the proton ∴ it moves in a circle i.e. the force is a centripetal force.

2.

(1)



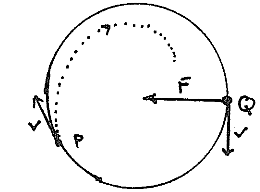
(2)



(3) no force

(4) no force.

3. (1) by a right hand rule – negative.



(4) $r = \dfrac{mv}{Bq}$ ∴ $r \propto v$

∴ radius decreases if it slows down.

(.........› on diagram)

(5) $r \propto mv$

∴ $\dfrac{r_1}{r_2} = \dfrac{m_1 v_1}{10 m_1 v_2} = 1$

∴ $V_1 = 10V_2$

---

(6) $F = \dfrac{mv^2}{r}$ ∴ $F \propto mv^2$

∴ $\dfrac{F_1}{F_2} = \dfrac{m_1 v_1^2}{m_2 v_2^2} = \dfrac{m_1 (10V_2)^2}{10 m_1 V_2^2}$

∴ $\dfrac{F_1}{F_2} = \dfrac{100 V_2^2}{10 V_2^2} = \dfrac{10}{1}$

∴ $F_1 = 10F_2$

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4. (1) By a right hand rule:

A is positive

C is negative

(2) . charge C is bigger than A's

. mass A is bigger than the mass of C.

. velocity of A could be bigger than C's velocity

5. magnetic force $F = BqvSin\theta$
If $\theta = 90°$ then
$F = Bqv$.
But this force is a centripetal force because it is at 90° to the charge's velocity.
$\therefore F = Bqv = \frac{mv^2}{r}$

$\therefore r = \frac{mv}{Bq}$

6. (1) $F = BqvSin\theta$
$\therefore F = BqvSin80°$

$F = 0.09 \times 3.2 \times 10^{-19} \times 5.0 \times 10^5 \times Sin80°$
$F = 1.43 \times 10^{-14} N$

$F = 1.43 \times 10^{-14} N$

(2) $a = F/m$

$\therefore a = \frac{1.43 \times 10^{-14}}{6.644 \times 10^{-27}}$

$a = 2.1 \times 10^{12} ms^{-2}$

(3) weight of alpha particle
$W = mg$
$= 6.644 \times 10^{-27} \times 9.8$
$= 6.5 \times 10^{-26} N$

ie the magnetic force is about 10^{11} times the size of its weight!

7. (1) $K = \Delta V q$
$= 50,000 \times 1.6 \times 10^{-19}$
$= 8.0 \times 10^{-15}$ Joules

(2) $K = \frac{1}{2} mv^2$
$\therefore 8.0 \times 10^{-15} = \frac{1}{2} \times 9.11 \times 10^{-31} \times v^2$

$\therefore v = 1.3 \times 10^8 ms^{-1}$.

(3) $F = BqvSin90°$

$\therefore F = 2.0 \times 1.6 \times 10^{-19} \times 1.3 \times 10^8$
$F = 4.2 \times 10^{-11} N$

(4)

The electrons now move in a straight line – no force outside the field $\therefore$ obey Newton's First Law.

(5) Moving at 90° to the field ensures the maximum force – $F = BqvSin\theta$
$\therefore$ if $\theta = 90°$
F is a max.

8.
(1) $T = \frac{2\pi m}{Bq}$

$T = \frac{2\pi \times 1.673 \times 10^{-27}}{1.9 \times 1.6 \times 10^{-19}}$

$T = 3.45 \times 10^{-8}$ seconds.

(2) $f = 1/T = \frac{1}{3.45 \times 10^{-8}}$
$\therefore f = 3 \times 10^7 Hz$.

8. (3)
$K = \frac{q^2 B^2 r^2}{2m}$

$\therefore K = \frac{(1.6 \times 10^{-19})^2 (1.9)^2 (.45)^2}{2 \times 1.673 \times 10^{-27}}$

$K = 5.6 \times 10^{-12}$ Joules
$K = 3.5 \times 10^7 eV$
$= 35 MeV$.

(4) (a) $T = \frac{2\pi m}{Bq}$
ie T does not depend on diameter
$\therefore$ no effect.

(b) $K = \frac{q^2 B^2 r^2}{2m}$
ie $K \propto r^2$
$\therefore$ double r, 4 times K
$\therefore$ K is 4 times bigger.

9. (1) Radius of the circular path in the magnetic field is $r = \frac{mv}{Bq}$

$\therefore v = \frac{rBq}{m}$

The time to traverse a semicircle $t = \frac{\pi r}{v}$

$\therefore t = \frac{\pi r m}{rBq}$

$\therefore t = \frac{\pi m}{Bq}$

$\therefore$ for a complete circle ×2
$\therefore t = \frac{2\pi m}{Bq}$

(2) $K = \frac{1}{2} mv^2$

$\therefore K = \frac{1}{2} m \left(\frac{rBq}{m}\right)^2$

$\therefore K = \frac{1}{2} \frac{q^2 B^2 r^2}{m}$

ie $K = \frac{q^2 B^2 r^2}{2m}$.

10. (1)(a) $E = \Delta V q$
$E = 60,000 \times 1.6 \times 10^{-19}$
$= 9.6 \times 10^{-15}$ Joules

(b) $100 \times 9.6 \times 10^{-15}$
$E_{Total} = 9.6 \times 10^{-13} J$.

(c) $K = \frac{1}{2} mv^2$
$\therefore 9.6 \times 10^{-13} = \frac{1}{2} \times 1.673 \times 10^{-27} v^2$

$v = 3.4 \times 10^7 ms^{-1}$

(2) The proton gains K as it moves across the gap between the Dees.
$\therefore$ its speed increases each time. But in the magnetic field the radius is
$r = \frac{mv}{Bq}$.
$\therefore$ a bigger speed means a bigger radius

(3) (a) doubles [$E \propto \Delta V$]
(b) no effect [see equation]

(c) decrease (more energy, bigger 'r' values $\therefore$ emerges after less rotations)
(d) no effect. (see equation)