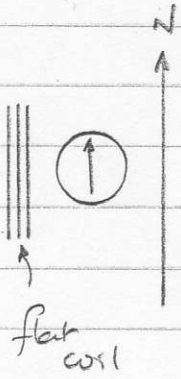
Electromagnetism – Topic Test ①

A Physics Electromagnetism

(Forces on ... wires ... charges)

A Electromagnetic fields

1. A flat coil, (diameter 8 cm, 20 turns) is parallel to the N-S direction and carries a current of 120 mA

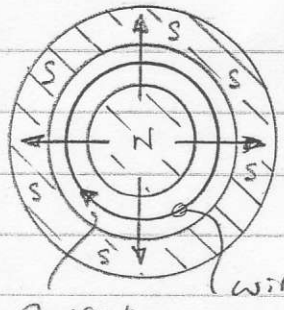


Data:-
- $B_{solenoid} = \mu_0 \frac{NI}{l}$
- $B_{coil} = \mu_0 NI / 2r$
- $\mu_0 = 4\pi \times 10^{-7}$ H/m
- electron mass $m_e = 9.1 \times 10^{-31}$ kg
- $B_{Earth} = 2 \times 10^{-5}$ T
- electron charge $= 1.6 \times 10^{-19}$ C

(a) What is the flux density and total flux through the coil? (3)

(b) a compass in placed inside the coil, what angle does it make to magnetic North? (3) [6]

2. In a loudspeaker, a wire coil of 200 turns, radius 1.5 cm, carrying a current of 400 mA is in a magnetic field of strength 0.25 T.

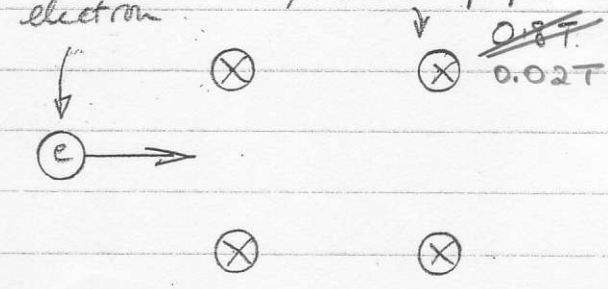


(a) What way does the coil move, with current shown? (1)

(b) What is the force on the whole coil? (3)

(c) If the coil carries a.c., how does it move and why? (3) [7]

3 A stream of electrons are accelerated by a pd of 750 V.



(a) Show that the velocity of electrons is about 1.6×10^7 m/s. (2)

(b) Copy the diagram, and sketch and explain the path of the electron beam. (4)

(c) Calculate the radius of the path of the beam in the field (3).

[9]

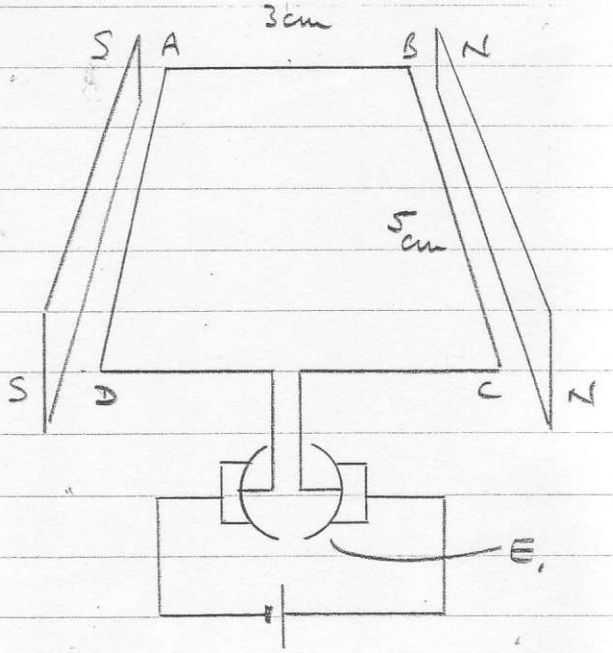
THT 11.9 ± 11.98

Electromagnetism — Topic Test (2) A Physics

Forces on — wires

— moving charges

4. The diagram shows a simple motor



(a) Which way will the coil rotate? (1)

(b) What is part E, what does it do, and why? (4)

(c) Calculate the forces on sides (i) AB

(ii) ~~CD~~ BC (3)

(d) Calculate the torque on the coil (2)

(e) If the coil has a moment of inertia of 2×10^{-3} kg m^2, calculate the initial angular acceleration. (2)

B = 0.25 T I = 1.8 A

N = 100 turns

(12)

TMW
11.98

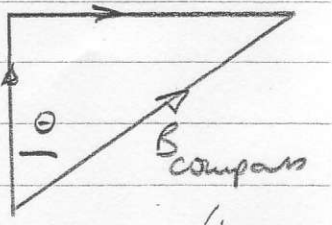
Electromagnetism Test – Answers

BIL + Ber

A Physics

1 (a) Flux density $B = \mu_0 N I / 2r = 3.8 \times 10^{-5}$ T ① $\quad \Phi = BA = 1.9$ Wb ①

(b) $\tan\theta = \frac{3.8\times10^{-5}}{1.9\times10^{-5}}$ ① $= 1.9 \rightarrow \theta = 62°$ from N ① $\quad B_L = 3.8\times10^{-5}$ T



6

2 (a) L. H. Rules ok.... up towards you ① /1

(b) $F_m = BIl$ ① $= 0.25 \times 0.14 \times (2\pi \times 1.5\times10^{-2} \times 200) = 1.9$ ① N /3

(c) Direction of flux constant ... current reverses (a.c.) ①

So force will reverse ① ∴ So coil will oscillate ① /3

7

3. (a) Elec PE = KE gained

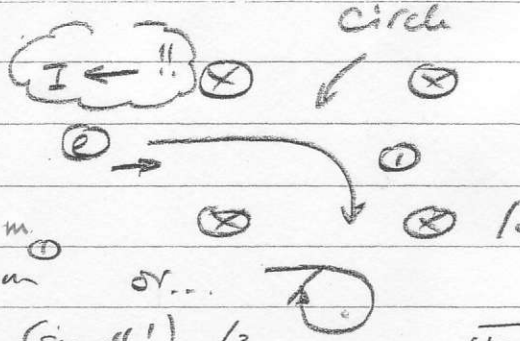
eV ① $= \frac{1}{2} m_e v^2$ ① $\rightarrow v = \sqrt{\frac{2eV}{m_e}} = 1.63\times10^{7}$ ① m/s /

(b) Magnetic force always at 90° to electron path ①

So direction changes but

speed is constant, so F_m is constant ①

So electron path is a circle ①



(c) $F_m = F_c$

Bev ① $= \frac{mv^2}{r}$ ① $\rightarrow r = \frac{mv}{Be} = \frac{4.64\times10^{-3}}{1.15\times10^{-4}}$ m ① or...

$= 0.1$ mm (small!) /3

4.6 mm (now not so small)

10

4. (a) rotates ↶ anticlockwise /1

(b) commutator ① reverses current ① every half turn ①

to keep coil spinning ① /4

(c) (i) AB $F_m = 0$ ①

(ii) BC $F_m = BIl$ ① $= 0.25 \times 1.8 \times 5\times10^{-2} = 0.0225$ N for 1 turn

Force on 100 turns $= 2.25$ N ① /3

(d) $T = F \times$ length AB ① $= 2.25 \times 3\times10^{-2} = 0.0675$ ① N m /2

(e) $T = I\alpha$ ① $\rightarrow \alpha = T/I = \frac{0.0675}{2\times10^{-3}} = 33.8$ rad/s² ① /2

I = moment of inertia

12

TW. 11.11.98

Q... 1 /6 2 /7 3 /10 4 /12 Total /35