Magnetic fields (Questions) - 1. A Physics

Data

$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{H\,m^{-1}}$

$B_{Earth} = 2 \times 10^{-5}$ T

Flux densities near conductor

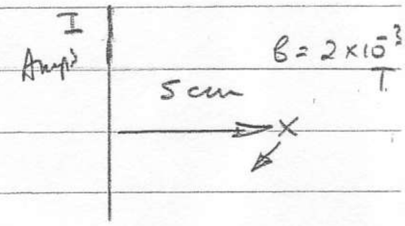
$B_{wire} = \mu_0 I / 2\pi r$

$B_{coil} = \mu_0 N I / 2r$

$B_{solenoid} = \mu_0 N I / l$

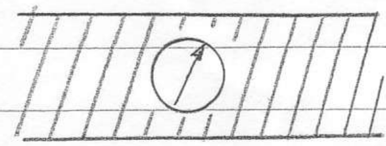
1. A straight wire carrying a steady current is laid on a table top. Explain how you would use a compass to find the <u>direction</u> of current if the wire is laid (a) N-S (b) E-W (4)

2. The magnetic field near a wire is as shown. What is size of current and direction? (3)



3. The magnetic field strength at the centre of a flat coil, radius 5 cm, carrying current of 800 mA, is 4×10^{-4} T.
How many turns has the coil? (3)

4. A student wants to measure the current in the solenoid, but her ammeter is broken. She thinks she knows a way to estimate the current. She lines up the solenoid E-W, and measures a deflection of 25° with current flowing.



100 turns, 15 cm.

(a) Sketch the magnetic fields of Earth + solenoid (2)
(b) What field does the solenoid produce? (2)
(c) What is the current in the solenoid - magnitude + direction please (3) [7]

5. A large electromagnet has circular pole pieces of diameter 0.2 m, and produces a total flux of 0.050 Wb
(a) What is the average flux density between the poles (2)
(b) Sketch the flux lines. (1) [3]

6. If the average flux density inside a 6 cm diameter coil is 0.15 T, what is the total flux through it?

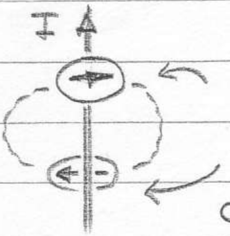
7. A vertical wire, placed in the Earth's magnetic field, carries a current vertically upwards. There is <u>one</u> <u>place</u> where the resultant field = 0. Draw a diagram to show where it is. (2)

TW
9.98

Magnetic fields — Answers — A Physics

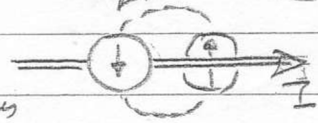
1. (a)

wire N-S



compasses turn (2)

(b)



compass reverses (2) /4

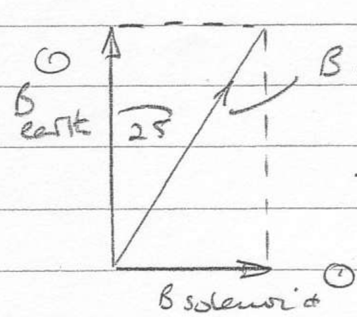
2. $B = \frac{\mu_0}{2\pi}\frac{I}{d}$ (1) $= \frac{4\pi\times10^{-7}}{2\pi}\cdot\frac{I}{5\times10^{-2}} = 4\times10^{-6} I \rightarrow I = \frac{2\times10^{-3}}{4\times10^{-6}} = \underline{500\ A}$ (1)

down (1) /3

3. B flat coil $= \frac{\mu_0}{2r} N I$ (1) $= \frac{4\pi\times10^{-7}}{2\times5\times10^{-2}} \times N \times 800\times10^{-3}$ (1) $= 10.05\times10^{-6} N$

So 4×10^{-4} (T) $= 10\times10^{-6} N \rightarrow N = 39.78 = \underline{40 \text{ turns}}$ (1) /3

4. (a) (1)



(c) B solenoid $= \mu_0 \frac{NI}{l} = 838\times10^{-6}\ I$ Tesla

(b) From triangle of forces

$\tan 25 = B_{sol} / B_{earth}$ (1)

so $B_{sol} = \tan 25 \times B_{earth} = 9.3\times10^{-6}$ T (1) /2

(c) But B solenoid $= \mu_0 \frac{NI}{l}$ (1) $= 838\times10^{-6} I$ (Tesla) so $I = \frac{9.3\times10^{-6}}{838\times10^{-6}} = \underline{0.011\ A}$

$= 11$ mA (1)

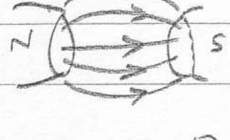
from the diagram

current (1) $\boxed{7}$

5 (a) Flux density $B = \Phi / A$ (1) $= 0.05/A = 0.05/\pi r^2 = 0.05/0.0314$

$= \underline{1.6}$ Tesla (1) (wb/m^2) /2

(b)



(1)

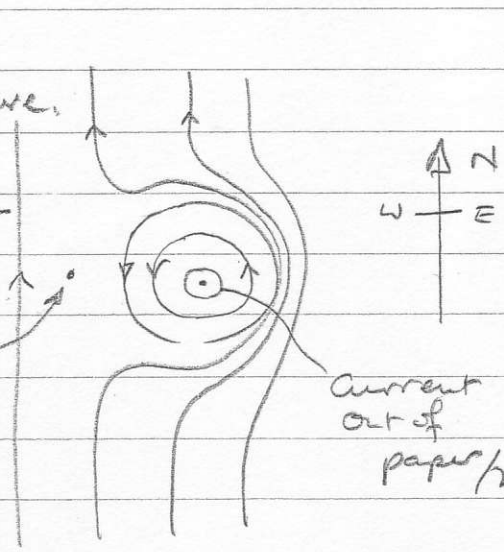
6 (a) total $\Phi = BA$ (1) $= 0.15\times\pi r^2$

$= 0.15 \times 2.83\times10^{-3}$

$= \underline{424\times10^{-6}}$ webers

(7) from above.

Earth's flux lines —



field is zero due W of the wire

(there will be a teeny-tiny motor force on the wire)

current out of paper /2

Q... 1/4 2/3 3/3

4/7 5/3 6/2 7/2

Total /24

TJN 10.98 phew.

× 12