Magnetic Effects of Electric Current

Standard difficulty · 20 questions · 40 marks · Time: 37 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. A wire carrying a current towards the east lies in a magnetic field pointing north. The force on the wire is:

(a) vertically upwards **(b)** vertically downwards
(c) east **(d)** south

2. A horizontal wire carries a current towards the south. A small compass is placed just above the wire. The north pole of the needle points:

(a) vertically upwards **(b)** vertically downwards
(c) west **(d)** east

3. An LED bulb rated 22 W is used on the 220 V household supply. The current it draws is:

(a) 0.1 A **(b)** 0.2 A **(c)** 10 A **(d)** 1.1 A

4. Seen from end P, the current in a circular coil flows anticlockwise. End Q behaves like:

(a) both poles at once **(b)** a south pole
(c) a north pole **(d)** neither pole

5. Magnetic field lines outside a bar magnet go from:

(a) one end straight to infinity **(b)** the south pole to the north pole
(c) the north pole to the south pole **(d)** the middle to both ends

6. An alpha particle moves towards the south through a magnetic field pointing west. The force on it is:

(a) nowhere (no force) **(b)** vertically upwards
(c) north **(d)** vertically downwards

7. A toaster (880 W), a microwave oven (1,320 W) and an electric iron (1,100 W) run together on a 220 V supply. The total current is:

(a) 17 A **(b)** 6 A **(c)** 30 A **(d)** 15 A

8. Assertion (A): A current flowing towards the east in a magnetic field pointing south feels a force vertically upwards.
Reason (R): By Fleming's left-hand rule, with the forefinger along the field and the middle finger along the current, the thumb points along the force.

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

Section B — Short answer — 8 × 2 = 16 marks

9. A straight conductor carries a current towards the south in a magnetic field pointing vertically upwards. Find the direction of the force on it, and name the rule you used.

10. A microwave oven (1,320 W) and an electric iron (1,100 W) are switched on together on a 220 V circuit with a 15 A fuse. Find the current. Will the fuse blow?

11. A horizontal wire carries a current towards the south. A small compass is placed just below the wire. In which direction does the north pole of the needle point? What happens if the current is reversed?

12. Distinguish between overloading and short-circuiting.

13. Why is a fuse connected in series with the live wire?

14. A wire carrying current towards the east in a field pointing vertically downwards is pushed north. What happens to the force if the current is reversed?

15. How many 200 W bulbs can be run together on a 220 V line with a 10 A fuse?

16. An electron enters a magnetic field pointing west, moving towards the south. In which direction is it pushed?

Section C — Word problems — 4 × 4 = 16 marks

17. A house has a ceiling fan (110 W), a room heater (2,200 W), a microwave oven (1,320 W), a water heater (1,980 W) on a 220 V supply. (a) Find the total current when all are on. (b) Choose the smallest fuse from 5, 10, 15, 20, 25 and 30 A that will not blow. (c) Why are they connected in parallel?

18. A horizontal brass rod hangs between the poles of a horseshoe magnet, with the south pole above and the north pole below it. A current flows through the rod towards the north. (a) Which way does the rod move? (b) Which way if the current is reversed? (c) Which way if the magnet is turned over as well?

19. A horizontal wire carries a current towards the south. A small compass is placed just below the wire. (a) Which way does the north pole of the needle point? (b) Which way if the compass is moved to the opposite side of the wire (above)? (c) How would doubling the current change what you see?

20. A solenoid of 400 turns has ends L and M. Seen from end L, the current flows anticlockwise. (a) Which end is the north pole? (b) What happens when a soft iron rod is placed inside? (c) Give two ways to reverse its poles.

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Answer key

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Q	Answer	Working
1	**(a) vertically upwards**	Fleming's left-hand rule: forefinger along the field, middle finger along the current, thumb gives the force
2	**(c) west**	right-hand thumb rule: thumb along the current, curled fingers give the field
3	**(a) 0.1 A**	I = P ÷ V = 22 ÷ 220
4	**(b) a south pole**	the face where the current looks anticlockwise is a north pole; P is a north pole
5	**(c) the north pole to the south pole**	—
6	**(d) vertically downwards**	a positive charge moving is a current in the same direction; use Fleming's left-hand rule
7	**(d) 15 A**	appliances in parallel: I = total power ÷ V = 3,300 ÷ 220
8	**(d) A is false, but R is true.**	A is false: the force is vertically downwards, not vertically upwards. R is true.
9	**West; Fleming's left-hand rule**	forefinger: field; middle finger: current; thumb: force
10	**11 A; no, it is within 15 A**	I = (1,320 + 1,100) ÷ 220
11	**East; it turns to point west**	right-hand thumb rule; reversing the current reverses the field
12	**A short circuit happens when the live and neutral wires touch, so the current rises suddenly; overloading happens when too many appliances draw current from one socket or the supply voltage rises.**	—
13	**So that when it melts it cuts the appliance off from the live wire, leaving no part of it at high voltage.**	—
14	**The force is now south**	Fleming's left-hand rule
15	**11**	the fuse allows 220 × 10 = 2,200 W; 2,200 ÷ 200 = 11, so 11
16	**Vertically upwards**	the electron's motion is a current in the opposite direction; then Fleming's left-hand rule
17	**(a) 25.5 A; (b) 30 A; (c) each gets 220 V and can be switched on and off separately**	I = 5,610 ÷ 220
18	**(a) east; (b) west; (c) east**	the field goes from N to S, so it points up; Fleming's left-hand rule
19	**(a) east; (b) west; (c) the deflection would be stronger, since the field grows with the current**	right-hand thumb rule

Q	Answer	Working
20	**(a) end L; (b) it becomes a strong electromagnet; (c) reverse the current, or wind the coil the other way**	the end where the current looks anticlockwise is the north pole