5 **(a)** Wire A is a long current-carrying low resistance wire that passes through and is normal to the horizontal plane as shown in Fig. 5.1. d is the horizontal distance away from wire A.

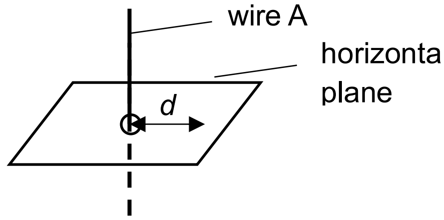
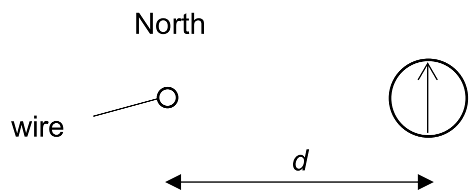


Fig. 5.1

The magnetic field due to the Earth and wire A are B_E and B_W respectively. A miniaturized compass is placed at d = 0.8 cm due East of wire A as shown in Fig. 5.2. At this position, B_W is slightly larger than B_E.



(i) When the current in the wire A is switched off, there is no change in the angle of deflection of the compass.

State the direction of the current in the wire A as shown in Fig. 5.2.

…………………………………………………………………………………………[1]

(ii) The compass is replaced by a magnetic field sensor connected to a datalogger. By varying d, the resultant magnetic field B at that position is obtained.

Fig. 5.3 shows the variation of B against $\frac{1}{d}$.

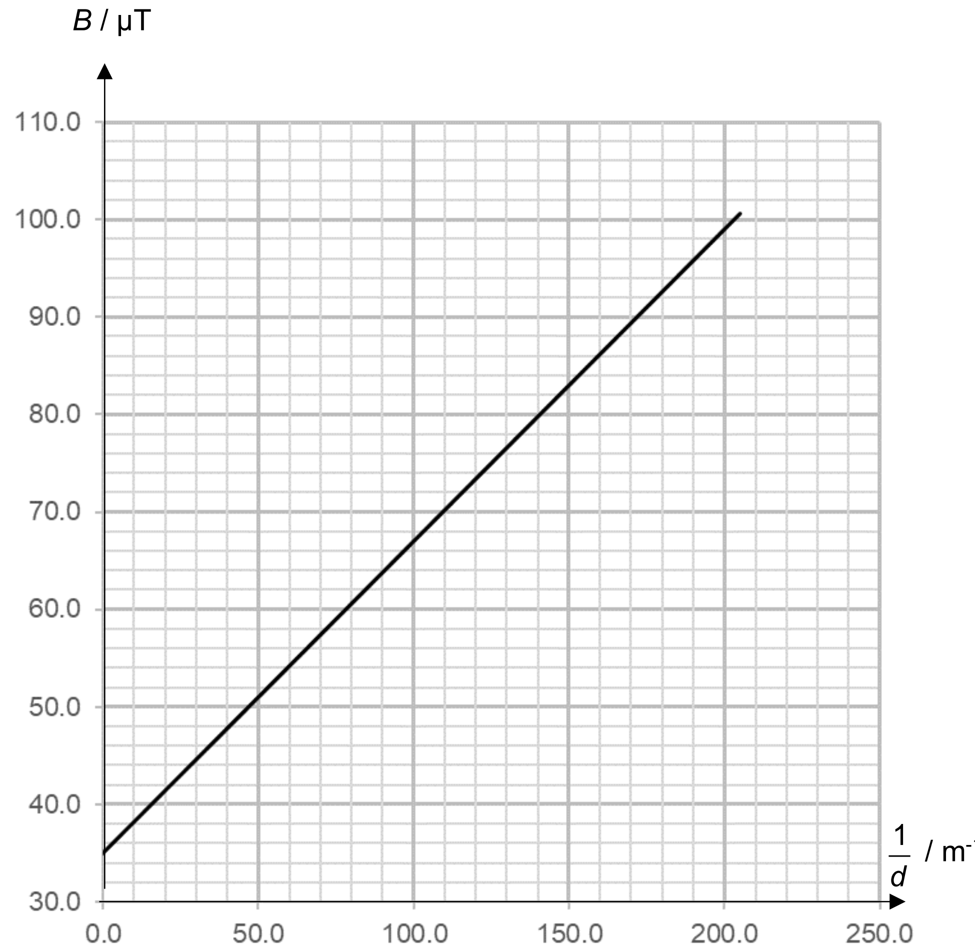


Fig. 5.3

1. B_E is the value of the y-intercept in Fig. 5.3. State the magnitude of B_E.

B_E = ... μT [1]

2. Explain why the y-intercept is the magnitude of B_E.

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3. Using your answer in **(a)(ii)1.** and Fig. 5.3, determine the current in the wire A, I_W.

(iii) Another current carrying wire, wire B, is placed parallel to wire A and at d = 0.8 cm due South of it as shown in Fig. 5.4. The direction of current in wire B points into the page.

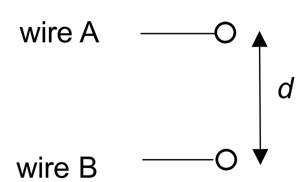

Fig. 5.4

On Fig. 5.4, draw the resultant magnetic force that acts on wire A and the resultant magnetic force that acts on wire B. Label the forces F_A and F_B respectively.

[1]

(b) A copper disc spins freely between the poles of an unconnected electromagnet as shown in Fig. 5.5.

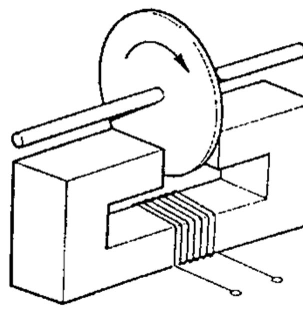

Fig. 5.5

Describe and explain what will happen to the speed of rotation of the disc when a direct current is switched on in the electromagnet.

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