For Examiner's Use

5 **(a)** Define *electric potential* at a point.

....

....

.... [2]

(b) An α-particle is emitted from a radioactive source with kinetic energy of 4.8 MeV.

The α-particle travels in a vacuum directly towards a gold ($^{197}_{79}Au$) nucleus, as illustrated in Fig. 5.1.

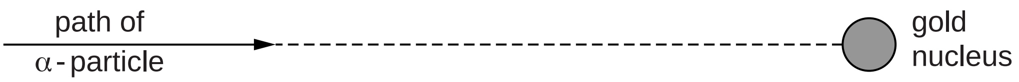

Fig. 5.1

The α-particle and the gold nucleus may be considered to be point charges in an isolated system.

(i) Explain why, as the α-particle approaches the gold nucleus, it comes to rest.

....

....

.... [2]

(ii) For the closest approach of the α-particle to the gold nucleus determine

1. their separation,

separation = ... m [3]

2. the magnitude of the force on the α-particle.

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force = ... N [2]

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6 The current in a long, straight vertical wire is in the direction XY, as shown in Fig. 6.1.

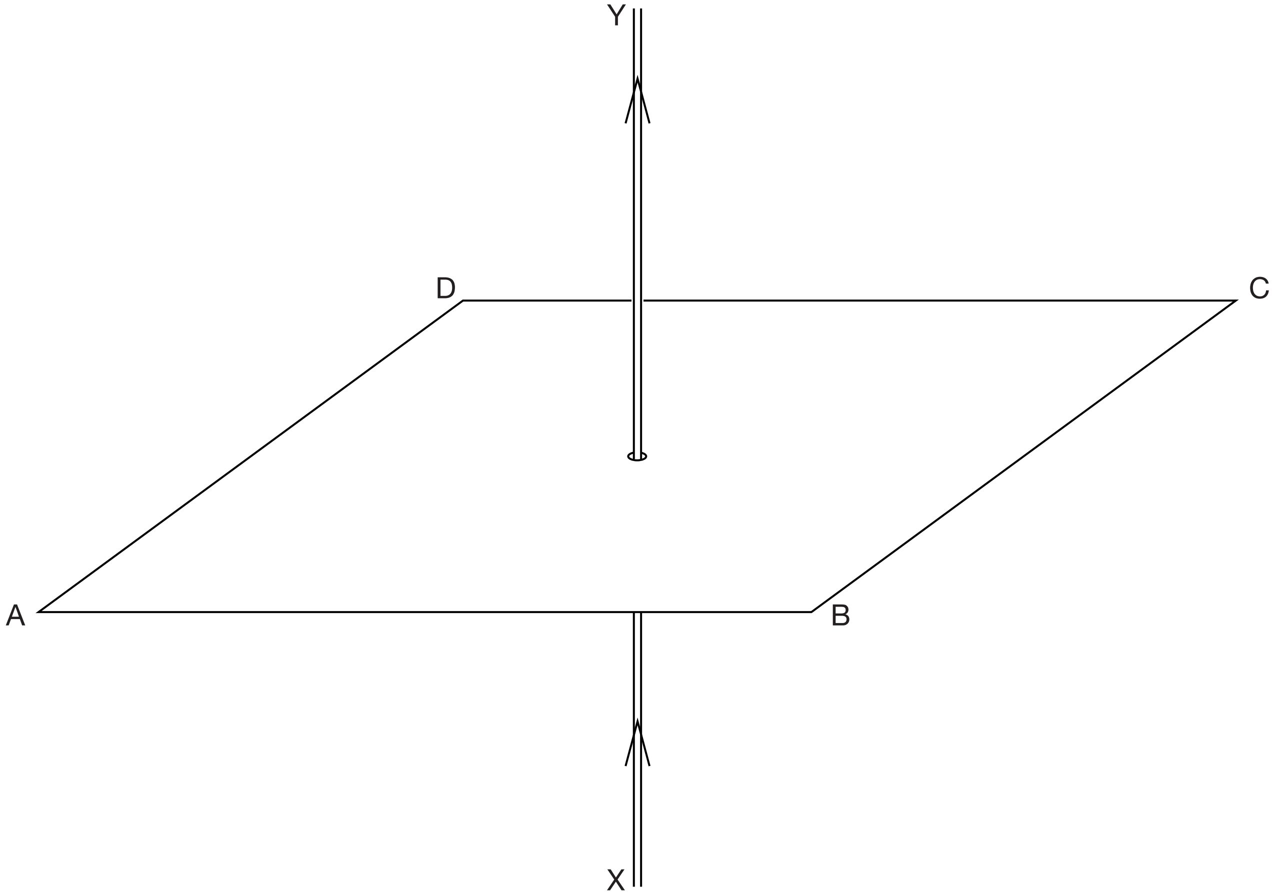

Fig. 6.1

(a) On Fig. 6.1, sketch the pattern of the magnetic flux in the horizontal plane ABCD due to the current-carrying wire. Draw at least four flux lines. [3]

(b) The current-carrying wire is within the Earth's magnetic field. As a result, the pattern drawn in Fig. 6.1 is superposed with the horizontal component of the Earth's magnetic field.

Fig. 6.2 shows a plan view of the plane ABCD with the current in the wire coming out of the plane.

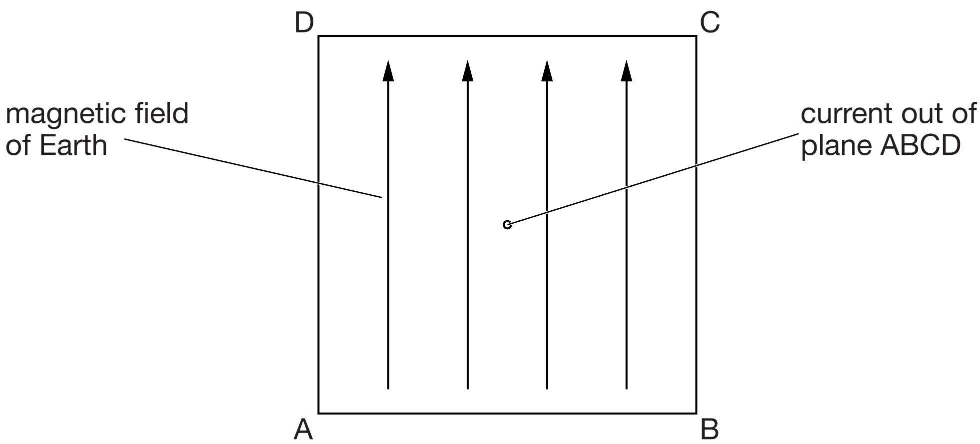

Fig. 6.2

The horizontal component of the Earth's magnetic field is also shown.

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(i) On Fig. 6.2, mark with the letter P a point where the magnetic field due to the current-carrying wire could be equal and opposite to that of the Earth. [1]

(ii) For a long, straight wire carrying current I, the magnetic flux density B at distance r from the centre of the wire is given by the expression

$$B = \mu_0 \frac{I}{2\pi r}$$

where μ_0 is the permeability of free space.

The point P in **(i)** is found to be 1.9 cm from the centre of the wire for a current of 1.7 A.

Calculate a value for the horizontal component of the Earth's magnetic flux density.

flux density = ... T [2]

(c) The current in the wire in **(b)(ii)** is increased. The point P is now found to be 2.8 cm from the wire.

Determine the new current in the wire.

current = ... A [2]