Cyclotrons and collisions

1 (a) Cyclotrons are used to make radioactive isotopes for medical purposes.

Charged particles move in a circular path.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The field used to keep charged particles moving in a circular path in a cyclotron is

(1)

☒ **A** nuclear

☒ **B** magnetic

☒ **C** gravitational

☒ **D** electric

(ii) State what causes the charged particles to increase their speed as they go around the cyclotron.

(1)

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(iii) Describe how scientists use the charged particles from a cyclotron to produce radioactive isotopes.

(2)

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(b) Some radioactiv

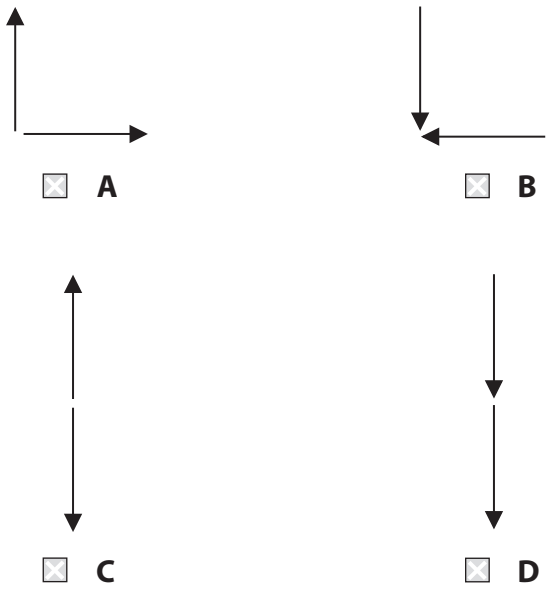
Positrons are used to make gamma rays.

When a positron annihilates an electron, two gamma rays are produced.

(i) Which diagram shows the directions of the two gamma rays produced?

Put a cross (☒) in the box next to your answer.

(1)



(ii) Explain how charge is conserved when an electron annihilates a positron.

(3)

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(iii) Explain how mass and energy are conserved when an electron annihilates a positron.

(2)

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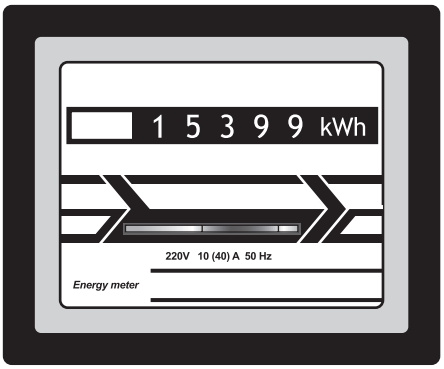
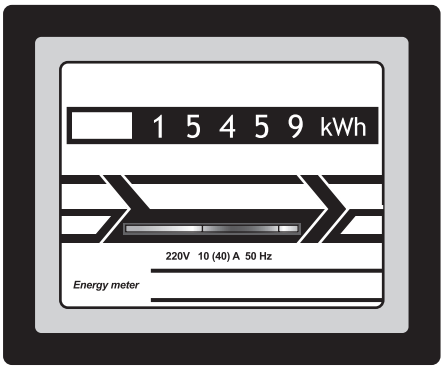
(Total for Question 4 = 10 marks)

2 (a) Electricity costs 20 p for each kW h.
The pictures show a domestic electricity meter at two different times.





(i) Calculate the cost of the electricity used between the two readings.

(2)

cost = ... p

(ii) The time between these two readings is 15 hours.

Calculate the average power supplied.

(2)

average power = ... kW

(b) Explain why step-up transformers are used in the transmission of electricity in the National Grid.

(2)

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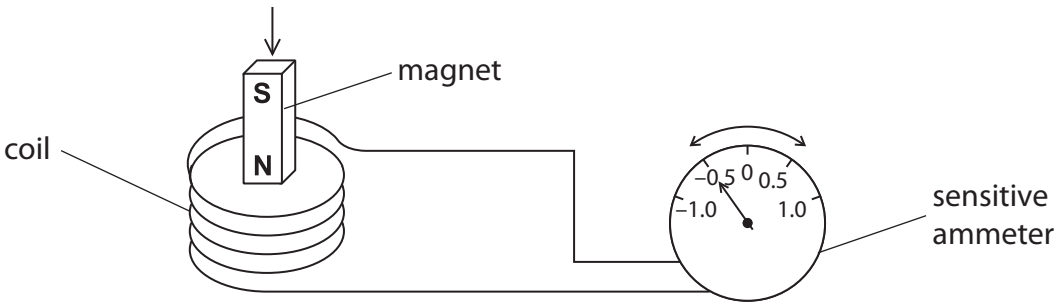
*(c) The diagram shows a magnet moving into a coil of wire.

The coil of wire is attached to a sensitive ammeter.



The moving magnet and the coil of wire are producing an electric current.

The size and direction of the current can be changed in a number of ways.

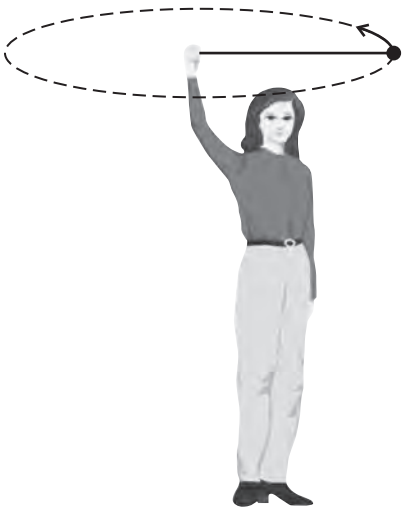
Describe changes that can be made to produce different currents and the effect of each change.

(6)

(Total for Question 6 = 12 marks)

Circular motion

3 (a) The diagram shows a girl swinging a rubber ball in a horizontal circle above her head.



(i) In which direction does the resultant force act on the ball?

Put a cross (☒) in the box next to your answer.

(1)

- ☒ **A** away from the centre of the circle
- ☒ **B** in the direction of the arrow on the diagram
- ☒ **C** in the opposite direction to the arrow on the diagram
- ☒ **D** towards the centre of the circle

(ii) State the name of the resultant force acting on the ball.

(1)

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(iii) Suggest what would happen to the ball as the girl gets tired.

(2)

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(iv) The girl lets go of the string and the ball hits a wall.

The collision is not elastic.

Explain what happens to both momentum and kinetic energy when the ball hits the wall.

(2)

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*(b) Describe a cyclotron and how charged particles move inside it.

You may draw a labelled diagram to help with your answer.

(6)

(Total for Question 5 = 12 marks)

Cyclotrons and Collisions

4 (a) A cyclotron accelerates charged particles.

(i) Describe the shape of the path a charged particle takes in the cyclotron.

(1)

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(ii) Explain how radioactive isotopes can be produced using cyclotrons.

(3)

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(b) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

In an **inelastic** collision there is conservation of

(1)

☒ **A** kinetic energy

☒ **B** momentum

☒ **C** kinetic energy and momentum

☒ **D** velocity

(ii) State why momentum has the unit kg.m/s.

(1)

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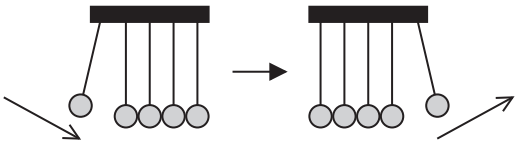
*(iii) Different types of collision are shown in the diagrams.

Analyse both collisions in terms of momentum and kinetic energy.

collision 1



collision 2

(6)

(Total for Question 6 = 12 marks)