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)

.....

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

(2)

.....

.....

.....

.....

(b) Some radioactiv

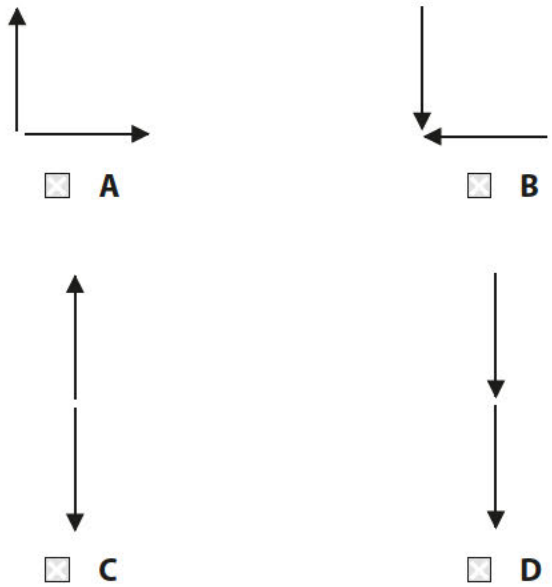
Positrons are used to make gamma rays.

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)

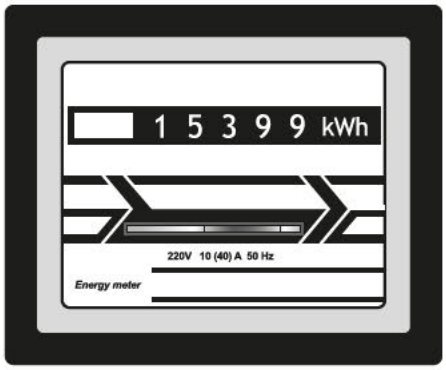
(iii) Explain how mass and energy are conserved when an electron annihilates a positron.

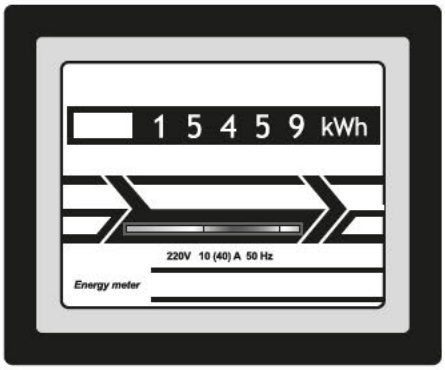
(2)

(Total for Question 4 = 10 marks)

Electrical power

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)

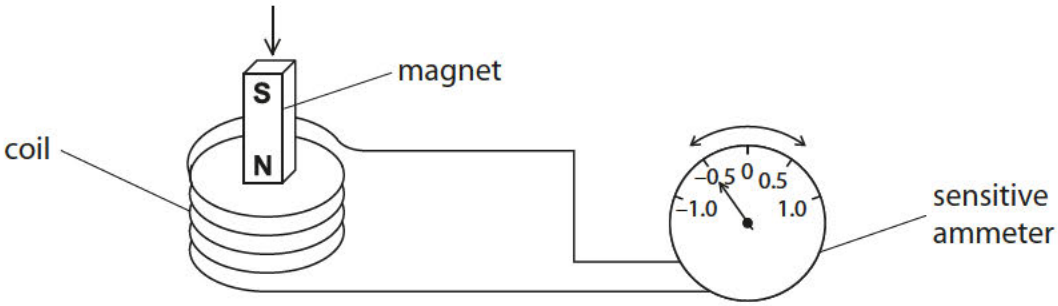
average power = ... kW

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

(2)

*(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.

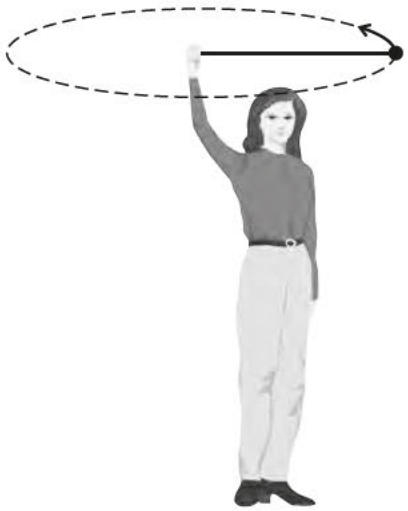
Describe changes that can be made to produce different currents and the effect of each change.

(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)

.....

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

(2)

.....

.....

.....

.....

(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)

.....

.....

.....

.....

*(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)

.....

.....

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

(3)

.....

.....

.....

.....

.....

.....

(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)

.....

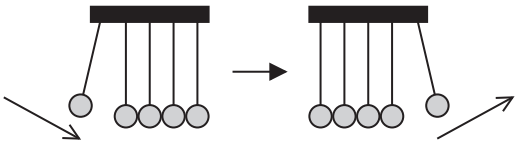
.....

*(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)