**Stage 2 Physics**

The following examination-style questions are suitable for assessing evidence of learning in **Topic 2**.

They do not constitute a complete test.

1. The diagram below shows the electric field created by two point charges, *q*1 and *q*2, in a vacuum.



*q*1

*q*2

* 1. State the sign of *q*2. Give a reason for your answer.

(2 marks)

* 1. State how the diagram shows that the magnitude of *q*1 is greater than the magnitude of *q*2.

(1 mark)

1. A photocopier uses an electric force to transfer positively charged toner particles from the drum of the photocopier to the paper. The drum and the paper are both negatively charged. A toner particle with a charge of  4.51  10**–**10 C is between the drum and the paper, as shown in the diagram below.

*Ignore gravity in all parts of this question.*

drum

toner particle

paper

* 1. The electric force that the drum exerts on the toner particle is 9.57  10**–**2 N, vertically up this page.

Determine the magnitude of the electric field of the drum at the location of the toner particle.

(2 marks)

* 1. The electric force that the paper exerts on the toner particle is 0.252 N, vertically down this page.

Calculate the net force on the toner particle.

(2 marks)

1. When a metal is heated to a high enough temperature, it may emit charged particles. In 1897 physicist Joseph John Thomson measured the charge-to-mass ratio *q* of particles that were

*m*

emitted from a heated metal cathode and accelerated through a potential difference  *Δ V* from rest to speed *v*. The charge-to-mass ratio *q* of a charged particle can be determined by measuring the

*m*

speed *v* of the particle.

* 1. Show that the charge-to-mass ratio of the accelerated charged particle is given by



(3 marks)

* 1. A charged particle is accelerated through a potential difference of 2400 V, to a speed of

2.9  107 m s**–**1.

* + 1. Show that the charge-to-mass ratio for this particle is 1.8  1011 C kg**–**1.

(1 mark)

* + 1. Determine whether this particle is an electron or whether it is a proton.

(2 marks)

1. The diagram below shows a cyclotron that is used to accelerate protons, in order to produce radioisotopes. The cyclotron has a radius of 0.600 m and a magnetic field of magnitude 0.979 T.



alternating potential difference

target

(a) Explain why the protons follow a circular path in the dees of the cyclotron.

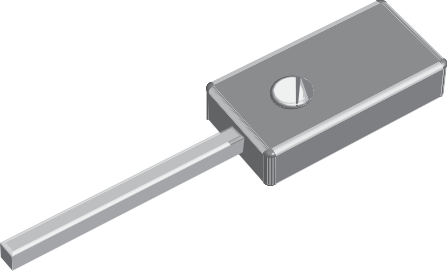
1. marks)
2. Show that the kinetic energy of the protons emerging from the cyclotron is given by



1. marks)

1. Calculate the kinetic energy of the protons emerging from the cyclotron. Write your answer in MeV.
2. marks)
3. The diagram below shows a solenoid and a magnetic field sensor, which detects the magnitude of a magnetic field.

solenoid



magnetic field sensor



[*This diagram is not drawn to scale.*]

This equipment can be used to investigate the relationship between the magnitude of the current in a solenoid and the magnitude of the magnetic field that is produced.

A group of students wishes to investigate this relationship.

1. State a suitable hypothesis for this investigation and describe the variables that they need to consider. For the controlled variables, explain how and why they are controlled.

(6 marks)

1. Describe a procedure for this investigation. Include safety considerations and a blank data table.

(6 marks)