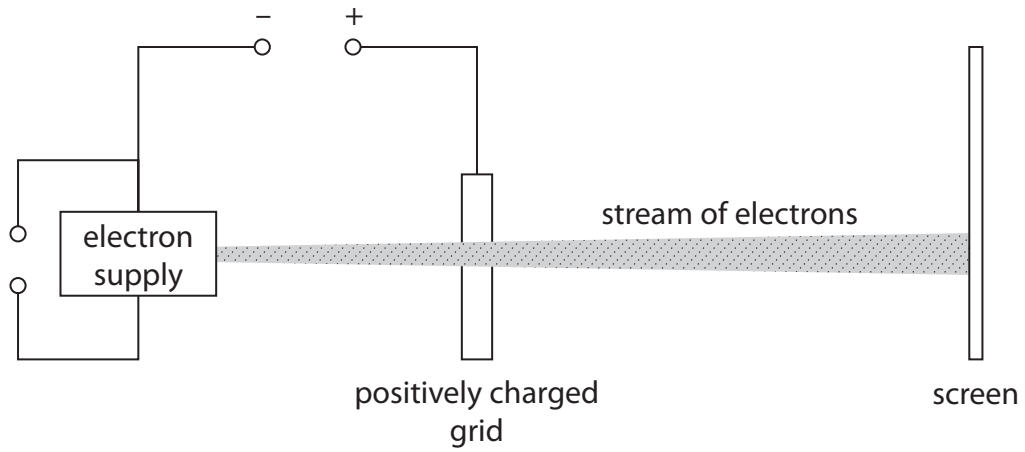
3 The diagram shows the inside of an oscilloscope.

Electrons leave the electron supply and accelerate towards the screen.

The stream of electrons hits the screen.



(a) The grid is connected to the positive terminal of a high voltage power supply.

(i) Explain, in terms of the movement of particles, how the grid has become positively charged.

(2)

.....

.....

.....

.....

(ii) State the formula linking kinetic energy, mass and speed.

(1)

(iii) Calculate the speed of an electron when it has 1.3×10^{-15} J of kinetic energy.

The mass of an electron is 9.1×10^{-31} kg.

(3)

speed = ... m / s

(b) The stream of electrons spreads out as it travels towards the screen.

Explain why the electrons in the stream move apart from each other.

(2)

.....

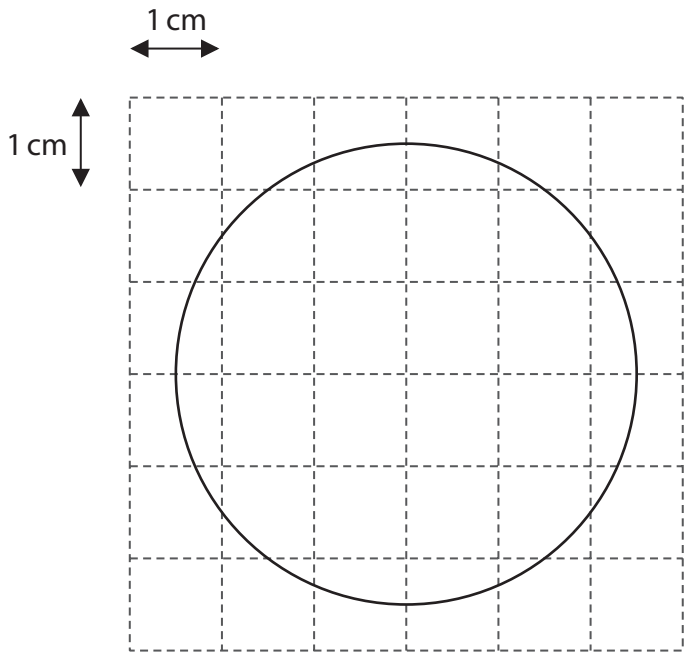
.....

.....

.....

(c) The oscilloscope can cause the electrons to move in a circle.

This produces a circular pattern on the screen.



(i) Use the scale to determine the **radius** of the circle.

(1)

radius = ... cm

(ii) The time taken for the electrons to complete one orbit of the circle is 24 ms.

Calculate the orbital speed of the electrons.

Use the formula

$$\text{orbital speed} = \frac{2\pi \times \text{orbital radius}}{\text{time period}}$$

(3)

orbital speed = ... m / s

(Total for Question 3 = 12 marks)