

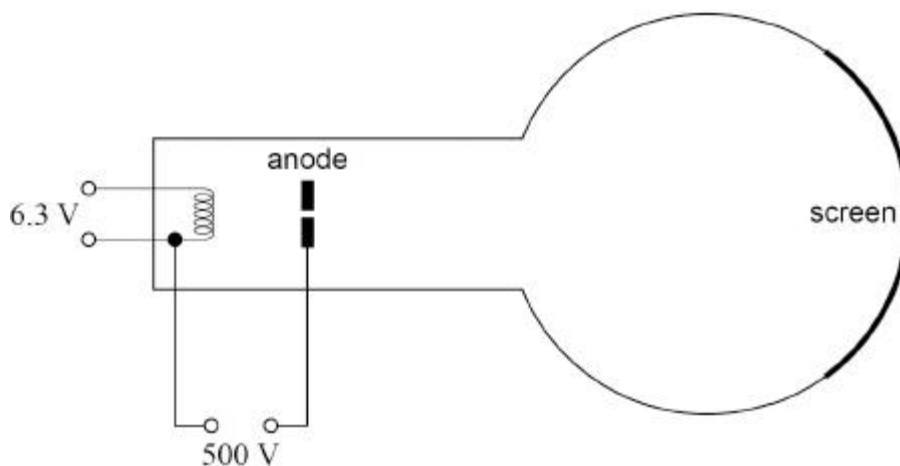
Name of the Student: _____

Max. Marks : 25 Marks

Time : 25 Minutes

Q1.

In the figure below, a beam of electrons travels through the aperture in the anode and hits the screen.



(a) Explain how the electrons that form the beam are emitted.

(1)

(b) Show that the maximum speed of the electrons in the beam is about $1.3 \times 10^7 \text{ m s}^{-1}$.

(1)

(c) A student suggests that the apparatus can be used to demonstrate the wave properties of electrons in the beam, provided that the aperture in the anode has a suitable diameter.

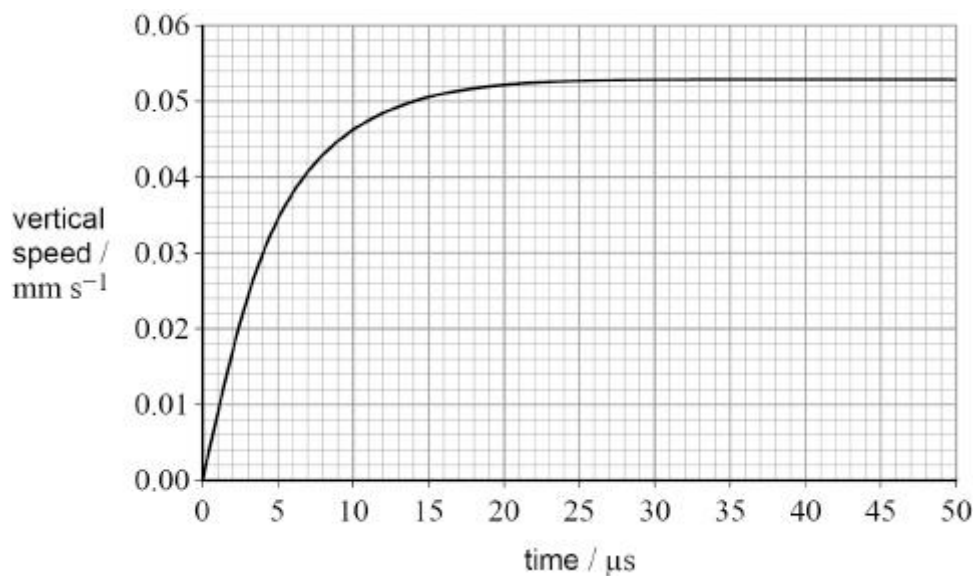
Discuss whether the student is correct.
Support your answer with a calculation.

Q2.

In an experiment to determine the electronic charge, a charged oil drop falls from rest between two uncharged plates.

The oil drop has a weight of $1.2 \times 10^{-14} \text{ N}$ and a radius of $6.8 \times 10^{-7} \text{ m}$. Ignore the buoyancy force of the air on the oil drop.

The figure below shows the variation of the vertical speed of the oil drop with time.



- (a) Calculate the viscosity of the air between the plates.

$$\text{viscosity} = \text{_____} \text{ N s m}^{-2}$$

(3)

- (b) During the experiment, an electric field is produced between the plates and is adjusted until the oil drop is stationary.
The electric field strength is 18.8 kV m^{-1} .

Discuss whether the outcome of the experiment is consistent with the accepted value for electronic charge.

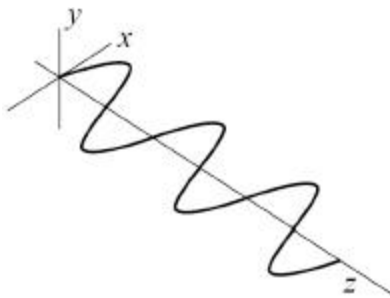
(3)
(Total 6 marks)

Q3.

An electromagnetic wave is propagating through space.

The figure below shows the variation of the magnetic flux density of the wave with distance. The magnetic field is in the xz plane.

The y -axis is at right-angles to the xz plane.



(a) Draw and label on the figure above:

- the corresponding electric field
- the direction of propagation of the wave.

(1)

(b) Which scientist proposed the electromagnetic wave model of light?

Tick ✓ **one** box.

Hertz

Huygens

Maxwell

Young

(1)

(c) Another theory of the nature of light was proposed by Isaac Newton.

Describe how Newton's theory was used to explain the refraction of light as it moves from air into glass.

(3)

- (d) Describe a demonstration using visible light that can be performed in a school laboratory to show that Newton's theory is not correct.

(3)

(Total 8 marks)