

Question 14**(12 marks)**

An electron microscope creates a coherent beam of electrons which then travels through two narrow slits. The resulting interference pattern is detected on a photographic plate. The speed of the electrons is 1.00% of the speed of light.

(a) Show that the de Broglie wavelength of the electrons used is $2.43 \times 10^{-10} \text{ m}$. (2 marks)

(b) Describe what you expect to see on the photographic plate. (2 marks)

(c) Explain the behaviour of the electrons in this experiment. (2 marks)

- (d) If the experiment were to be repeated using protons, at what speed would a proton need to travel to have the same de Broglie wavelength as the electrons? (2 marks)

Answer _____ m s^{-1}

- (e) Calculate the potential difference required for the electron microscope to accelerate the electrons to 1.00% of the speed of light. (4 marks)