	Marks
• In an electron microscope, to what minimum velocity must the electrons in the beam be accelerated in order to achieve a better spatial resolution (*i.e.*, have a shorter wavelength) than a visible light microscope? Assume an average wavelength of visible light of 500 nm.	**2**

The wavelength of the electrons must be shorter than 500 nm.

The de Broglie wavelength λ associated with a particle of mass m travelling with a velocity v is given by:

$$\lambda = \frac{h}{mv} \quad \textbf{or} \quad v = \frac{h}{m\lambda}$$

Hence, the velocity required for a wavelength of 500 nm = 500×10^{-9} m is:

$$v = \frac{6.626 \times 10^{-34}\ \text{J s}}{(9.1094 \times 10^{-31}\ \text{kg})(500 \times 10^{-9}\ \text{m})} = 1 \times 10^{3}\ \text{m s}^{-1}$$

Better resolution requires a shorter wavelength and so the velocity must be higher than this value.

Answer: **1×10^{3} m s^{-1}**