5 Light of frequency f and wavelength λ is incident on a metal surface having work function energy Φ. Electrons are emitted from the surface with maximum kinetic energy E_{MAX}.

Conservation of energy for this effect may be expressed as

$$E_{MAX} = hf - \Phi$$

where h is the Planck constant.

(a) Light at the threshold frequency for the metal surface has wavelength λ_0. Show that

$$E_{MAX} = hc\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$$

where c is the speed of light.

[1]

(b) The variation with $\frac{1}{\lambda}$ of E_{MAX} is shown in Fig. 5.1.

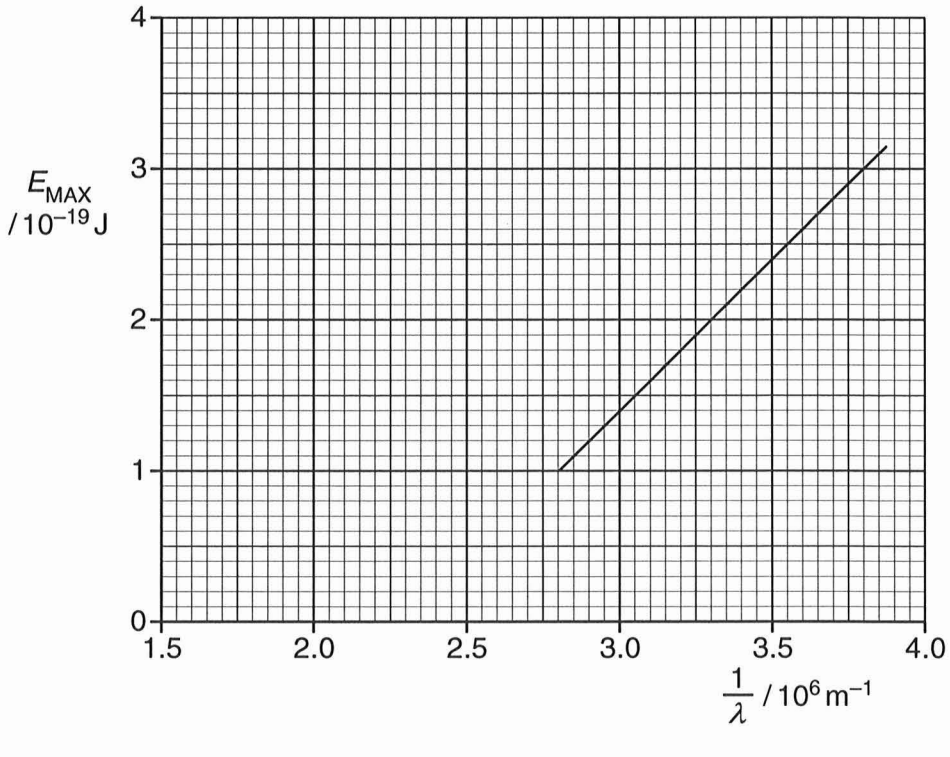

Fig. 5.1

Use Fig. 5.1 and the expression in **(a)** to

(i) determine, without using a value for h, the maximum wavelength λ_0 at which emission of electrons occurs,

λ_0 = ... m [2]

(ii) show that the Planck constant is approximately 6.7×10^{-34} J s.

[3]

(c) The metal surface becomes oxidised but photoelectric emission is still observed. The work function energy of this new surface has been increased.

On Fig. 5.1, draw a line to show the variation with $\frac{1}{\lambda}$ of E_{MAX} for this oxidised surface.

[1]