6 **(a)** Electromagnetic radiation of frequency f is incident on a metal surface. The variation with frequency f of the maximum kinetic energy E_{MAX} of electrons emitted from the surface is shown in Fig. 6.1

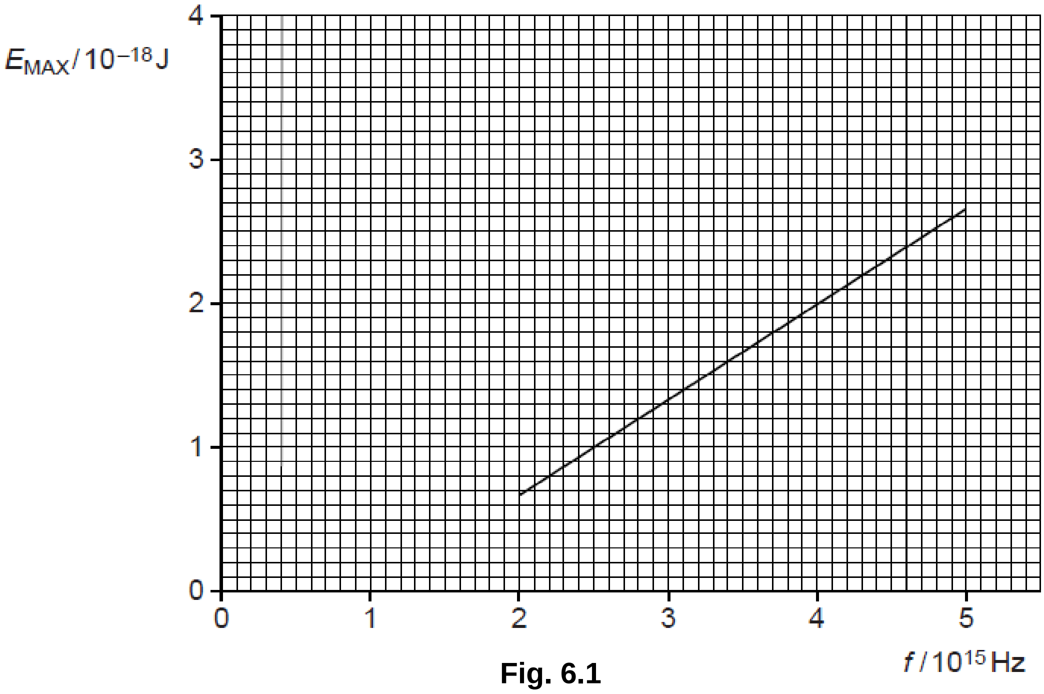

Fig. 6.1

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(i) Use Fig. 6.1 to determine the work function energy of the metal surface.

work function energy = ... J [3]

(ii) A second metal has a greater work function energy than that in **(i)**.

On Fig. 6.1, draw a line to show the variation with f of E_{MAX} for this metal. [2]

(iii) Explain why E_{MAX} does not depend on the intensity of the incident radiation.

....

....

.... [2]

(b) Some electron energy levels in atomic hydrogen are illustrated in Fig 6.2.

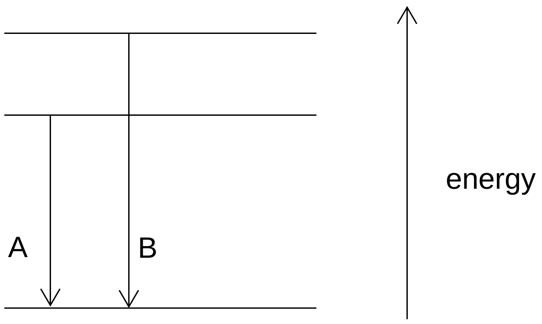

Fig. 6.2

Two possible electron transitions A and B giving rise to an emission spectrum are shown. These electron transitions cause light of wavelengths 654 nm and 488 nm to be emitted.

(i) On Fig 6.2, draw an arrow to show a third possible transition. [1]

(ii) Calculate the wavelength of the emitted light for the transition in part **(i)**.

wavelength = ... m [3]

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(c) The Heisenberg Uncertainty principle for position and momentum can be written as

$$\Delta p \; \Delta x \geq h$$

where Δp is the uncertainty in momentum, Δx is the uncertainty in the position of a particle and h is the Planck constant.

Calculate the percentage uncertainty in its momentum when an electron travelling at 3.00×10^{7} m s^{-1} passes through a narrow slit of width 1.00×10^{-10} m.

percentage uncertainty = ... % [3]

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