7 **(a)** In an experiment to investigate the photoelectric effect, a student measures the wavelength λ of the light incident on a metal surface and the maximum kinetic energy E_{max} of the emitted electrons.

(i) The student observes that the emission of electrons is almost instantaneous.

Explain how this observation supports the particulate nature of photon.

....

....

.... [1]

(ii) Suggest why the emitted electrons have a range of energies, from very low to a maximum value of E_{max}.

....

....

.... [1]

(iii) The variation with E_{max} of $\frac{1}{\lambda}$ is shown in Fig. 7.1.

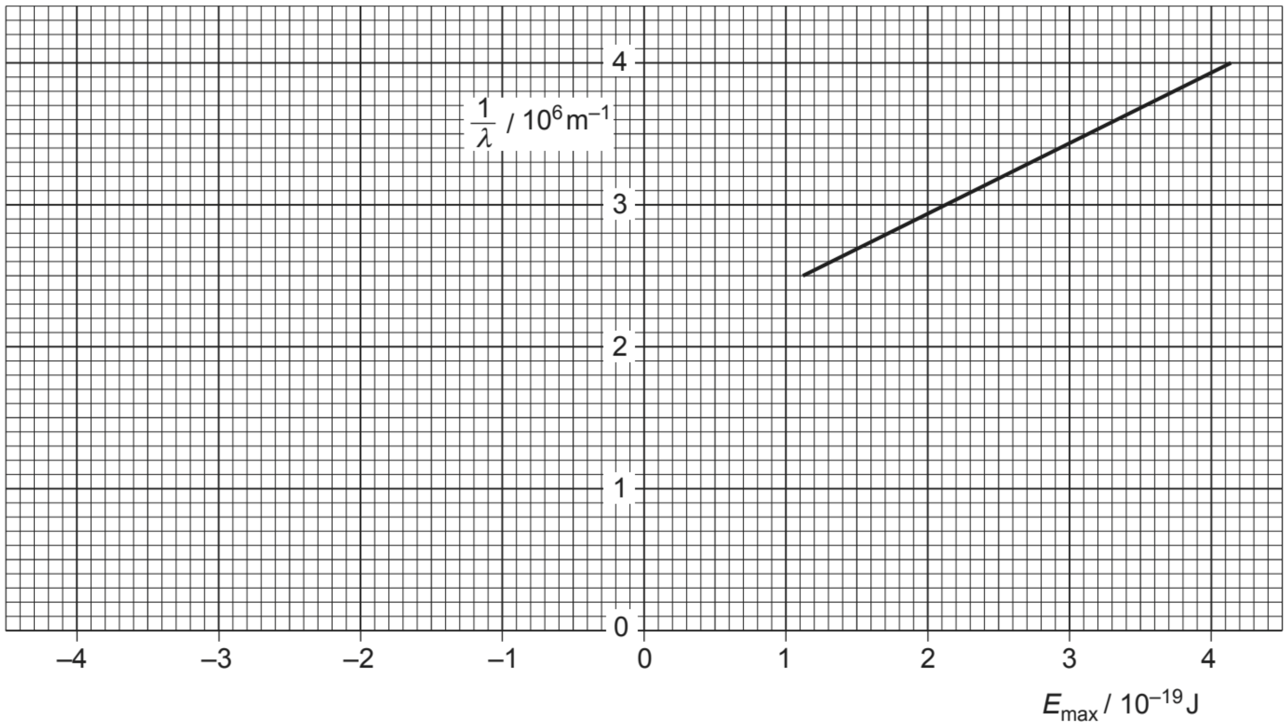

Fig. 7.1

1. Use Fig. 7.1 to determine work function of the metal the student used.

work function = ... J [1]

2. Use Fig. 7.1 to determine a value for the Planck's constant obtained by the student.

Planck's constant = ... J s [2]

(iv) In a separate experiment, the student increases the intensity of a monochromatic light incident on the metal.

State and explain the effect, if any, on E_{max}.

....

....

....

.... [2]

(b) Fig. 7.2 shows three of the energy levels in an isolated hydrogen atom. The lowest energy level is known as the ground state.

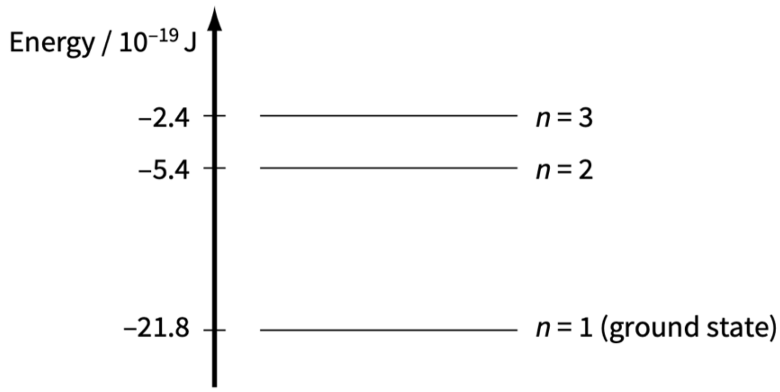

Fig. 7.2

(i) A particular dark spectral line of the hydrogen absorption spectrum has wavelength 663 nm.

Determine the transition that results in this dark line. Show your working clearly.

n = ... to n = ... [3]

(ii) The energy E in each energy levels are labelled with n, the principal quantum number.

Use Fig. 7.2 to show that E is inversely proportional to n^2. Show your working clearly.

[2]