6 Experiments are conducted to investigate the photoelectric effect.

(a) It is found that, on exposure of a metal surface to light, either electrons are emitted immediately or they are not emitted at all.

Suggest why this observation does not support a wave theory of light.

……..

……..

……..

……..

…….....[2]

(b) Data for the wavelength λ of the radiation incident on the metal surface and the maximum kinetic energy E_K of the emitted electrons are shown in Fig. 6.1.

λ/ nm	E_K/ 10^{-19}J
650	–
240	4.44

Fig. 6.1

(i) Without any calculation, suggest why no value is given for E_K for radiation of wavelength 650 nm.

…….....

……..... [1]

(ii) Use data from Fig. 6.1 to determine the work function energy of the metal.

work function energy = …….J [2]

(c) Radiation of wavelength 240 nm gives rise to a maximum photoelectric current *I*.

The intensity of the incident radiation is maintained constant and the wavelength is now reduced.

State and explain the effect of this change on

(i) the maximum kinetic energy of the photoelectrons,

……

……

…… [1]

(ii) the maximum photoelectric current *I*.

……

……

…… [1]

(d) Light in a beam has a continuous spectrum that lies within the visible region. The photons of the light beam have energies ranging from 1.60 eV to 2.60 eV.

The beam passes through some hydrogen gas. It then passes through a diffraction grating and an absorption spectrum is observed.

(i) All of the light absorbed by the hydrogen is re-emitted. Explain why dark lines are still observed in the absorption spectrum.

……

……..... [1]

(ii) Some of the energy levels of an electron in a hydrogen atom are illustrated in Fig. 6.2.

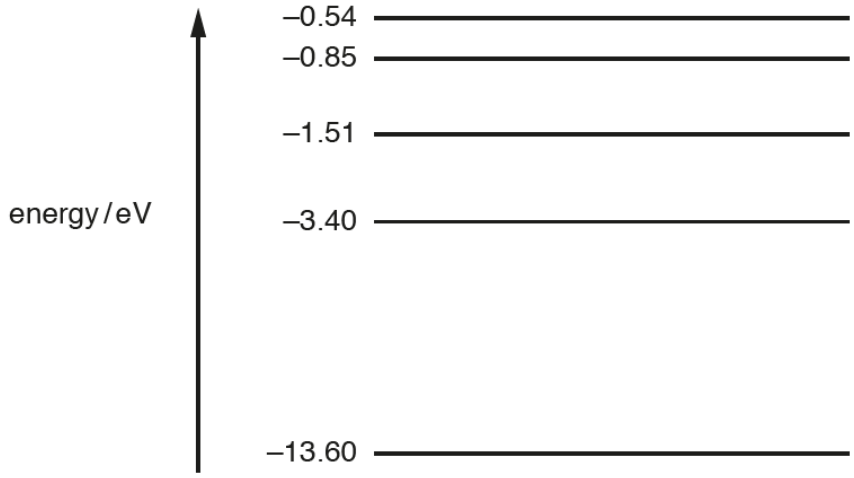

Fig. 6.2 (not to scale)

The dark lines in the absorption spectrum are the result of electron transitions between energy levels.

On Fig. 6.2, draw arrows to show the initial electron transitions between energy levels that could give rise to dark lines in the absorption spectrum. [2]

(iii) Calculate the shortest wavelength of the light in the beam.

wavelength = …….m [2]

[Total: 12]