8 **(a)** **(i)** State what is meant by photoelectric effect.

……

…… [1]

(ii) State two observations of photoelectric effect which provided evidence of the particulate nature of electromagnetic radiation.

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……

…… [2]

(iii) Describe, using a circuit diagram, an experiment to determine the maximum kinetic energy of photoelectrons.

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…… [4]

(b) State the forms of energy associated with an orbiting electron in an atom.

……

…… [1]

(c) **Fig. 8.1** shows a cooler region of hydrogen gas surrounding a hot gas cloud emitting white light. Point C lies within the cooler hydrogen gas.

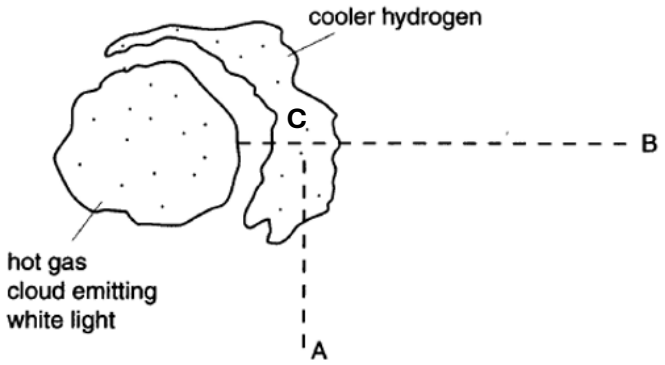

Fig. 8.1

(i) Using a prism or diffraction grating, state and explain the types of line spectra that can be observed from

1. point A , along the line AC.

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……

……

…… [2]

2. point B , along the line BC.

……

……

……

…… [2]

(ii) **Fig. 8.2** shows some of the energy levels of a hydrogen atom.

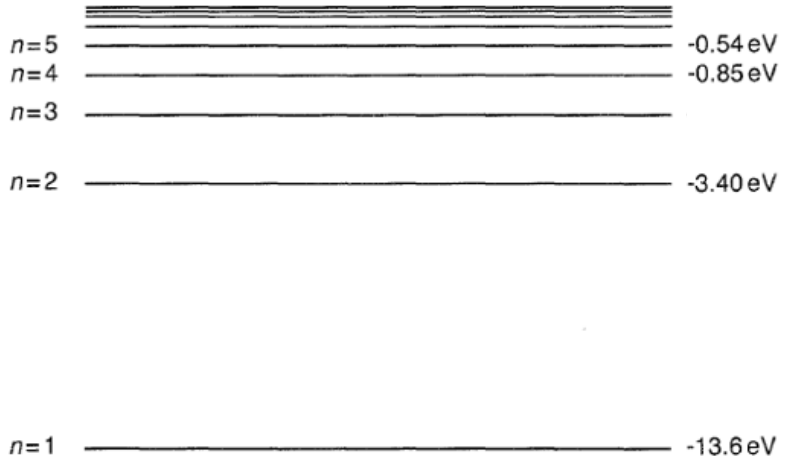

Fig. 8.2

1. Calculate the frequency of the electromagnetic radiation emitted when an electron makes a transition between energy levels $n = 4$ and $n = 2$ shown in **Fig. 8.2**.

Frequency = …… Hz [1]

2. The frequency of radiation emitted when an electron makes a transition between energy levels $n = 4$ and $n = 3$ is 1.60×10^{14} Hz. Determine the wavelength of the electromagnetic radiation when an electron makes a transition between energy levels $n = 3$ and $n = 2$.

Wavelength = ... m [2]

(d) A neutron of mass 1.00 u is travelling with velocity $1.0 \times 10^5 \text{ m s}^{-1}$.

(i) Calculate the de Broglie wavelength of the neutron.

Wavelength = …… m [2]

(ii) Explain why it is much more difficult to demonstrate the wave nature of neutrons than it is for electrons. Assume that a neutron beam is available.

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…… [3]

******** END *******