

- 6 (a)** With reference to energy levels, explain briefly how an electric discharge lamp filled with hydrogen gas produces light.

.. [2]

- (b)** Describe the appearance of a visible emission line spectrum.

[1]

- [1]

- (c) Some electron energy levels of an isolated hydrogen atom are illustrated in Fig. 6.1.

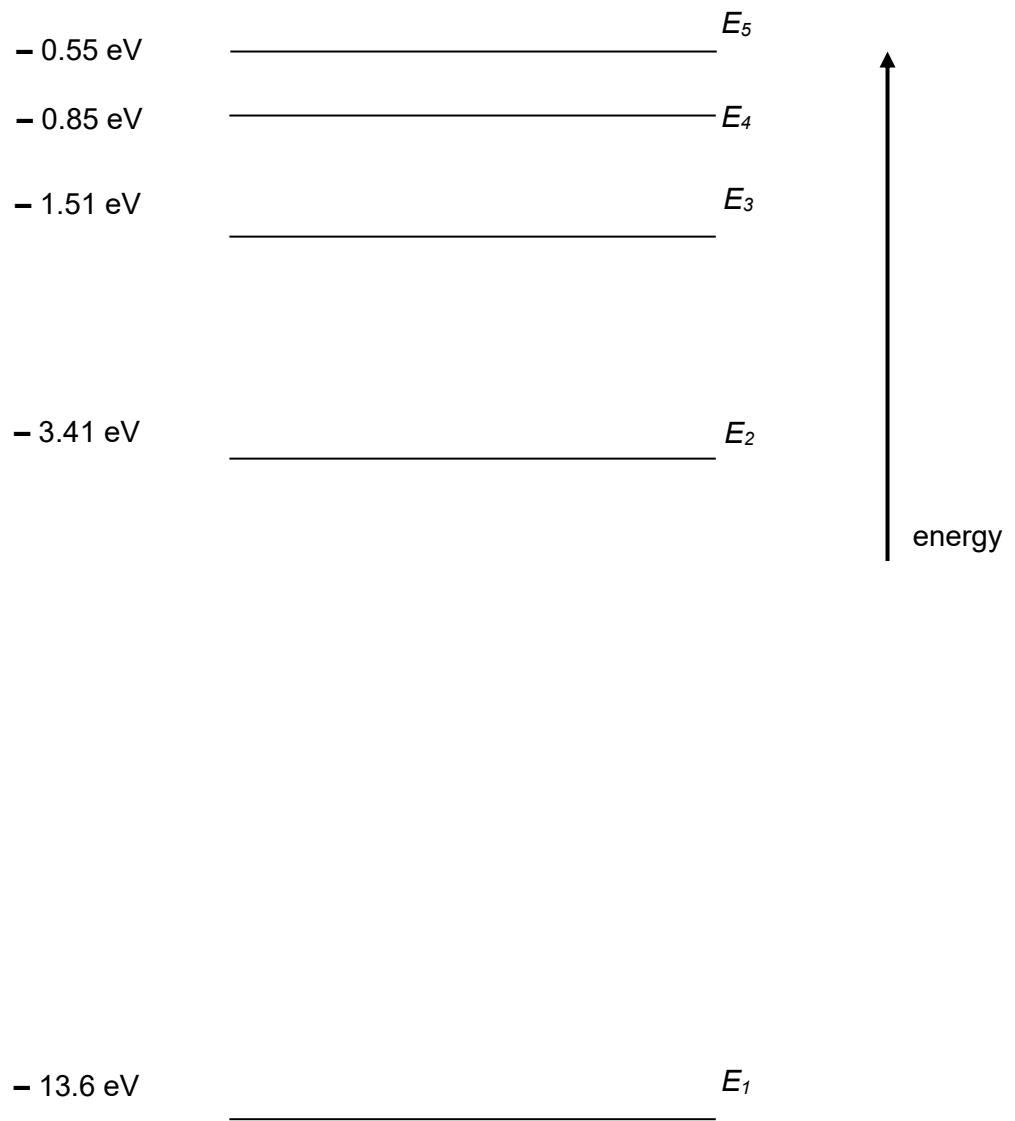


Fig. 6.1 (not to scale)

(i) On Fig 6.1, draw an arrow to show a transition that results in the emission of electromagnetic wave of the shortest wavelength. [1]

(ii) A line spectrum is produced from the electron energy levels shown in Fig. 6.1.

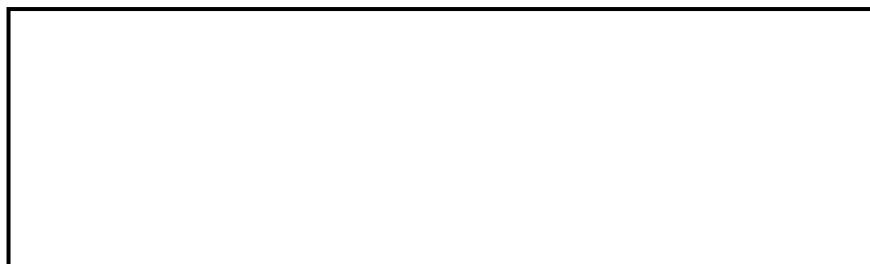
1. Determine the shortest wavelength of photon in this spectrum,

$$\text{wavelength} = \dots \text{m} [2]$$

2. state the number of lines that lie in this spectrum,

$$\text{number} = \dots [1]$$

3. sketch the line spectrum formed by the three shortest wavelength in Fig. 6.2.



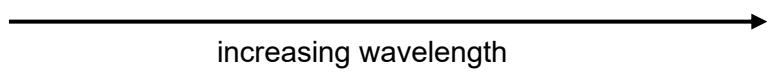


Fig. 6.2

[1]

- (d) The radiation emitted from transitions between levels shown in Fig. 6.1 is incident on the surface of a sheet of metal A as shown in Fig. 6.3.

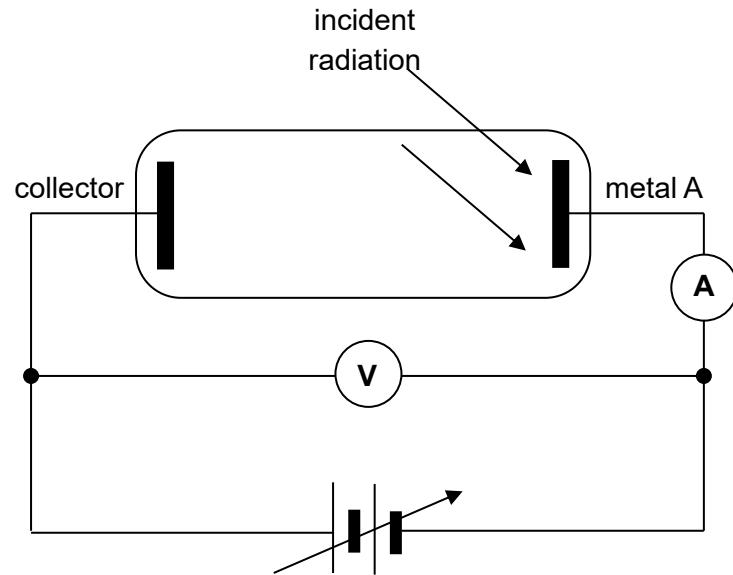


Fig. 6.3

The e.m.f. is varied and the corresponding readings on ammeter and voltmeter are plotted as shown in Fig. 6.4.

current / μA

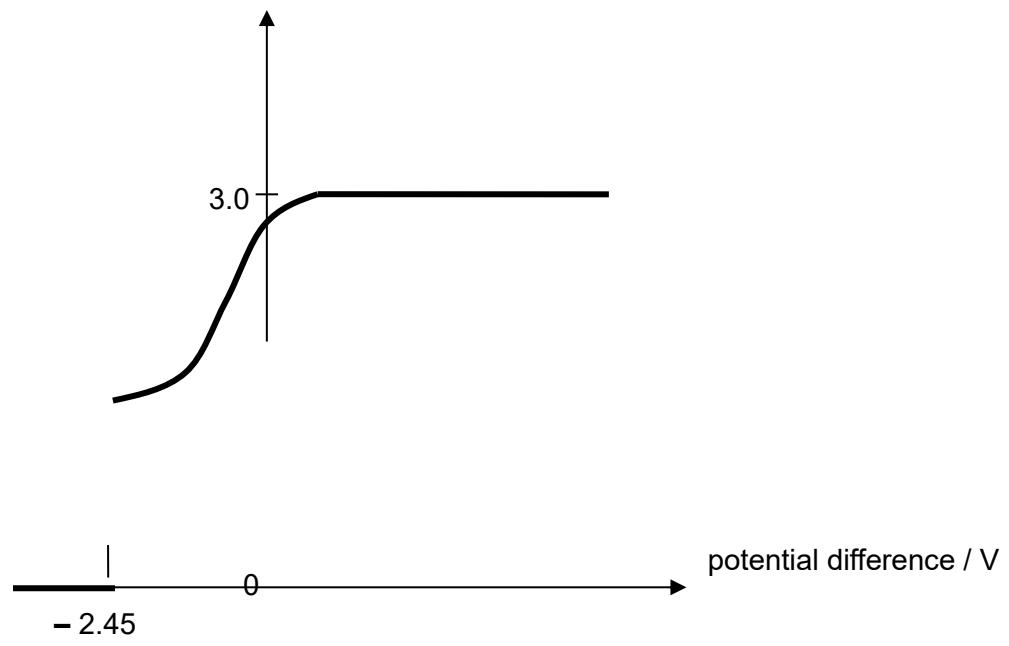


Fig. 6.4

- (i) Determine the work function energy of metal A.

work function energy = J [3]

- (ii) 1. This irradiation of metal A has a quantum yield of 9.2×10^{-7} . Quantum yield is defined as the ratio

$$\frac{\text{number of photoelectrons emitted per second}}{\text{number of photons incident per second}}.$$

Determine the number of photons incident per second on metal A.

number of photons incident per second = s^{-1} [2]

2. State a possible reason why the quantum yield is so much smaller than 1.

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..... [1]

(iii) Describe and explain the change on the graph in Fig. 6.4 when the following changes are made independently.

1. The unpolarised radiation was polarised before it is incident on metal A.

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[2]

2. Metal A was replaced with another metal with a lower work function energy.

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[2]

- (iv) By reference to the de Broglie equation, suggest whether light incident on the metal surface exerts a pressure on the surface.

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[2]

[Total: 20]