



- 4 (a) With reference to the photoelectric effect, explain the meaning of the term *threshold frequency*.

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[2]

- (b) Light is incident on a metal surface so that it emits electrons. The variation with the frequency f of the incident light of the maximum kinetic energy E_{\max} of the electrons is shown in Fig. 4.1.

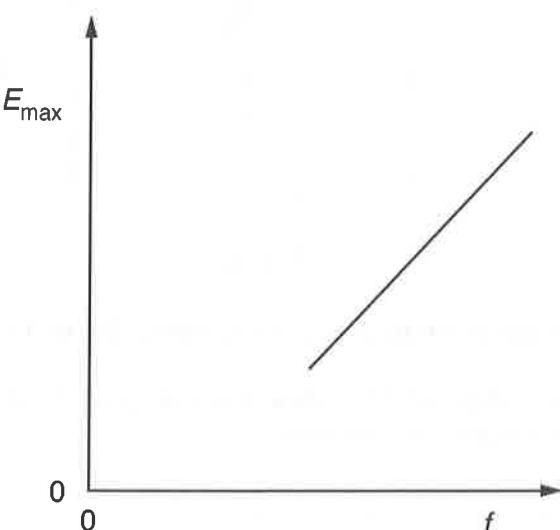


Fig. 4.1

- (i) On Fig. 4.1, label the threshold frequency f_0 . [1]
- (ii) State the significance of the gradient of the line. [1]
- (iii) On Fig. 4.1, draw a second line for a different metal surface with a greater work function energy. [1]

- (c) Europium is a metal with a work function energy of 2.5 eV.

- (i) Light of wavelength 490 nm is incident on the europium surface.

Calculate the maximum speed of the emitted electrons.

$$\text{speed} = \dots \text{ms}^{-1} \quad [4]$$





- (ii) The europium is placed on a gold-leaf electroscope as illustrated in Fig. 4.2.

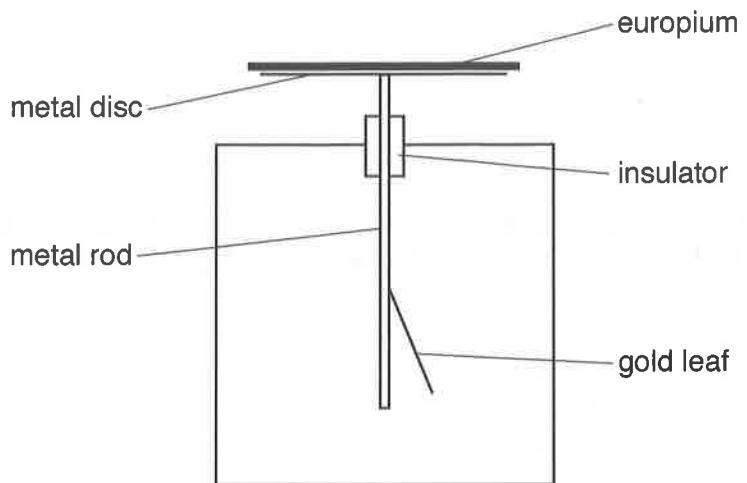


Fig. 4.2

1. When the europium is charged negatively, the leaf rises.

Explain why the leaf falls when the europium is illuminated with blue light but not when illuminated with red light.

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[1]

2. When the europium is charged positively, the leaf rises.

Explain why the leaf will not fall no matter what wavelength of light is used to illuminate the surface of the europium.

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[2]

[Total: 12]

