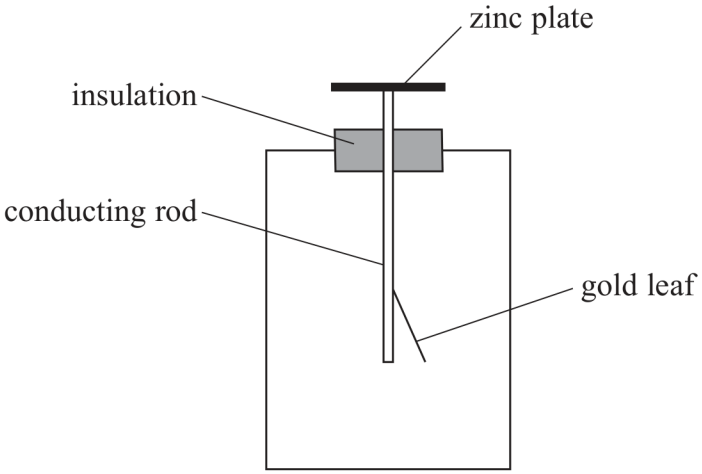
14 A gold leaf electroscope is used to demonstrate the photoelectric effect. When the zinc plate of the electroscope is given a negative charge, the conducting rod and gold leaf also become negatively charged. The gold leaf deflects away from the metal stem as shown. The deflection of the gold leaf depends on the amount of charge on the zinc plate and the conducting rod.



A beam of ultraviolet radiation is incident on the zinc plate. The gold leaf immediately begins to fall back to the conducting rod.

(a) Explain why this observation cannot be explained by the wave model of electromagnetic radiation.

(2)

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(b) Photons of ultraviolet radiation with an energy of 9.3×10^{-19} J are directed towards the zinc plate.

(i) Calculate the maximum speed with which electrons are released from the plate.

work function of zinc = 4.3 eV

(4)

Maximum speed of electrons = ...

(ii) A student suggests that a greater maximum speed of electrons could have been achieved if both:

– a metal with a lower work function than zinc was used
– ultraviolet radiation with a greater wavelength was used.

Discuss the student's suggestion.

(3)

(Total for Question 14 = 9 marks)