1 Photons of wavelength 290 nm are incident on a metal plate. The work function of the metal is 4.1 eV

What is the maximum kinetic energy of the emitted electrons?

$hf = \phi + E_{k\,max}$

$4.287\text{eV} - 4.1 = 0.19\text{eV}$

A 0.19 eV

B 4.3 eV

C 6.9 eV

D 8.4 eV

(Total 1 mark)

2 When light of a certain frequency greater than the threshold frequency of a metal is directed at the metal, photoelectrons are emitted from the surface.
The power of the light incident on the metal surface is doubled.

Which row shows the effect on the maximum kinetic energy and the number of photoelectrons emitted per second?

	Maximum kinetic energy	**Number of photoelectrons emitted per second**	
A	remains unchanged	remains unchanged	
B	doubles	remains unchanged	
C	remains unchanged	doubles	
D	doubles	doubles	

(Total 1 mark)

now twice as many photons of the same energy.

3 (i) Calculate the longest wavelength of electromagnetic radiation that will cause photoelectric emission at a clean lithium surface.

work function for lithium $\varphi = 4.6 \times 10^{-19}$ J

$hf = \phi \Rightarrow \frac{\phi}{h} = f = 6.94 \times 10^{14}$ Hz

$c = f\lambda \Rightarrow \lambda =$

Longest wavelength = 4.3×10^{-7} m

(3)

(ii) Calculate maximum kinetic energy of the electrons emitted when electromagnetic radiation of frequency 8.5×10^{14} Hz is incident on the surface.

$hf - 4.6 \times 10^{-19} = E_{k\,max}$

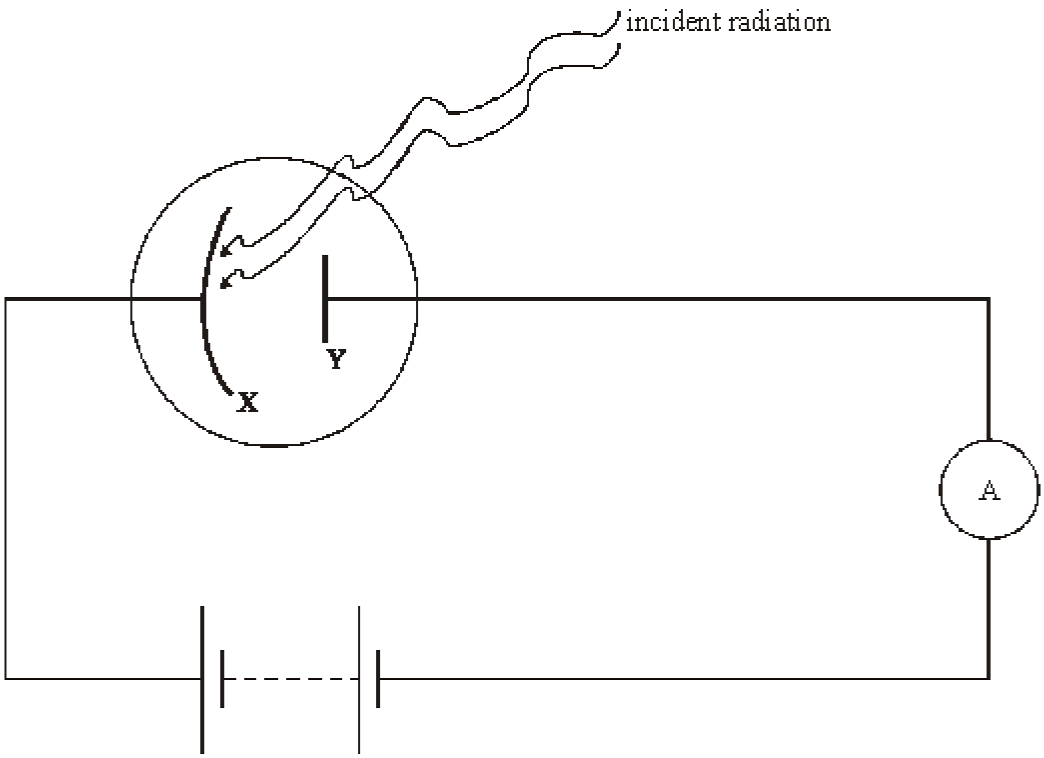
1.04×10^{-14}

Maximum energy = 1.0×10^{-14} J 2sf

(3)

(Total 6 marks)

4 In the apparatus shown, monochromatic ultraviolet radiation is incident on the surface of metal **X**. Photoelectrons are emitted from **X** and are collected at electrode **Y**.



(a) Calculate the work function of **X**, given that each photon in the incident radiation has 3.2×10^{-19} J of energy.

The maximum kinetic energy possessed by a single photoelectron is 2.1×10^{-19} J.

$hf - \phi = E_{kmax} \Rightarrow hf - E_{kmax} = \phi$

$\phi = 1.1 \times 10^{-19}$ J

(3)

(b) The source of the incident radiation is replaced with a new source. The wavelength of the radiation from the new source is half the wavelength of the original radiation.

Calculate the maximum kinetic energy of the emitted photoelectrons.

$\frac{\lambda}{2} \Rightarrow f \times 2 \therefore \Rightarrow hf \times 2$

$2 \times 3.2 \times 10^{-19} - 1.1 \times 10^{-19}$

$= 5.3 \times 10^{-19}$ J

(3)

(Total 6 marks)

Mark schemes

1 **A**

[1]

2 **C**

[1]

3 (i) recognition that work function = hf_0 or hc/λ_0 **(1)**

rearrangement or correct substitution of values **(1)**

4.3×10^{-7} m **(1)**

(ii) Einstein's equation seen or used **(1)**

work function subtracted from energy of incident photon **(1)**

$1.0(1) \times 10^{-19}$ J **(1)**

[6]

4 (a) (use of $hf = \phi + E_k$ gives) $3.2 \times 10^{-19} = \phi + 2.1 \times 10^{-19}$
$\phi = 1.1 \times 10^{-19}$ **(1)** J **(1)**

3

(b) incident energy of each photon is doubled
$6.4 \times 10^{-19} = 1.1 \times 10^{-19} + E_k$
$E_k = 5.3 \times 10^{-19}$ J **(1)**

3

[6]