Question 15 (10 marks)

a. The work function is $W = hf_{\text{critical}}$, and f_{critical} = the horizontal intercept from the graph (4.4×10^{14} Hz).

$$W = \frac{6.6 \times 10^{34} \times 4.4 \times 10^{14}}{1.6 \times 10^{19}}$$ 1 mark

$= 1.82$ eV 1 mark

OR

$W = 4.14 \times 10^{-15} \times 4.4 \times 10^{14}$ 1 mark

$= 1.82$ eV 1 mark

b. In order for electrons to be ionised by a photon of a particular frequency, the photon energy and therefore frequency must be above a minimum value. In this case, the frequency must be above the critical value of 4.4×10^{14} Hz. 1 mark

Light of frequency 3.0×10^{14} Hz will not be ionised, so no electrons will be emitted. 1 mark

c. The largest wavelength corresponds to the smallest allowable frequency that causes electron emission.

smallest frequency $= 4.4 \times 10^{14}$ Hz

$$\text{largest wavelength} = \frac{\text{speed of light}}{\text{smallest frequency}} \times 10^{9}$$

$$= \frac{3.0 \times 10^{8}}{4.4 \times 10^{14}} \times 10^{9}$$ 1 mark

$= 682$ nm 1 mark

d. The increase in intensity will enable more photons of the same energy to strike the metal. More electrons will be emitted as a result, but their maximum energy will not increase compared to dimmer light. 1 mark

For this reason, Sal's statement is incorrect. 1 mark

A higher work function refers to light requiring a greater energy and therefore frequency to be used to release electrons from the metal. The frequencies between 1×10^{14} and 4×10^{14} Hz, which currently are below the minimum frequency required, will have energies that remain too low for the higher work function. 1 mark

For this reason, Jenna's statement is incorrect. 1 mark