Question Number	Answer		Mark
17(a)	Electron moves to a higher energy level Then drops back (down, releasing a photon) (MP1 allow electron is excited. MP2 allow electron is de-excited) (MP2 allow returns to ground state)	**(1)** **(1)**	**2**
17(b)(i)	Use of $v = f\lambda$ with $v = 3.00 \times 10^8$ m s^{-1} Use of $E = hf$ Conversion from J to eV Photon energy = 5.7 eV <u>Example of calculation</u> $v = f\lambda$, f = 3.00×10^8 m s^{-1} / 218×10^{-9} m = 1.38×10^{15} Hz $E = hf = 6.63 \times 10^{-34}$ Js $\times$ 1.38×10^{15} Hz = 9.12×10^{-19} J E (in eV) = 9.12×10^{-19} J / 1.60×10^{-19} J eV^{-1} = 5.70 eV	**(1)** **(1)** **(1)** **(1)**	**4**
17(b)(ii)	(Differences between) energy levels are discrete **Or** only certain jumps/transitions are possible No difference of 5.7 eV, so not possible (for this photon to be produced) (MP2 – allow comment consistent with their calculated value from b(i))	**(1)** **(1)**	**2**
17(c)(i)	Use of $hf = \Phi + \frac{1}{2} mv^2_{max}$ Use of $E_k = \frac{1}{2} mv^2$ with $m = 9.11 \times 10^{-31}$ kg Maximum possible speed = 1.5×10^6 m s^{-1} <u>Example of calculation</u> $E_k = hf - \Phi = 1.63 \times 10^{-18}$ J – 5.89×10^{-19} J = 1.04×10^{-18} J $E_k = \frac{1}{2} mv^2$, $v = \sqrt{\frac{1.04 \times 10^{-18}\text{ J}}{0.5 \times 9.11 \times 10^{-31}\text{kg}}} = 1.5 \times 10^6$ m s^{-1}	**(1)** **(1)** **(1)**	**3**
17(c)(ii)	**MAX 2** from: • There is a minimum/threshold frequency for electron release • Electrons are released instantaneously • (Changing) intensity does not affect KE/speed/release of an electron **MAX 2** from: • The energy of a photon increases as frequency increases • Photon energy has to be greater than the work function • Each photon only interacts with one electron	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**3**
	Total for question 17		**14**