Question Number	Answer		Mark
15(a)	Use of $v = f\lambda$ using $v = 3.00 \times 10^8$ (ms^{-1}) Use of $E = hf$ Converts from J to eV Photon energy of source B = 4.43 (eV) (Can achieve MP1 and MP2 together if correctly using $E = hc/\lambda$) (Units are in brackets, as this is a "show that" question, where the units have already been given in the question) (For a "show that" question, the answer needs to be given to at least one more significant figure than that given in the question, so an answer of 4.4eV would not score MP4 unless it is shown to a greater number of significant figures beforehand) (A fully correct reverse calculation, showing that with a 4.4eV energy, the radiation would have a wavelength of 283nm can score a maximum of 3 marks) <u>Example of calculation</u> $v = f\lambda$ so $f = (3.00 \times 10^8\ ms^{-1}) / (280 \times 10^{-9}\ m) = 1.07 \times 10^{15}$ Hz $E = hf$, so $E = (6.63 \times 10^{-34}\ Js) \times (1.07 \times 10^{15}\ Hz) = 7.09 \times 10^{-19}$ J in eV, this is $(7.09 \times 10^{-19}\ J) / (1.60 \times 10^{-19}\ J\ eV^{-1}) = 4.43$ eV	(1) (1) (1) (1)	**4**

***15(b)**

This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning. Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning. The following table shows how the marks should be awarded for indicative content.

IC points	IC mark	Max linkage mark	Max final mark
6	4	2	6
5	3	2	5
4	3	1	4
3	2	1	3
2	2	0	2
1	1	0	1
0	0	0	0

The following table shows how the marks should be awarded for structure and lines of reasoning**.**

	Number of marks awarded for structure of answer and sustained line of reasoning
Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout	2
Answer is partially structured with some linkages and lines of reasoning	1
Answer has no linkages between points and is unstructured	0

Indicative content

- Frequency of source A is less than the threshold frequency for either metal.
  Or frequency of source B is less than the threshold frequency for copper but is greater than the threshold frequency for zinc.
- (Photon) energy of source A is less than the work function for either metal
- (Photon) energy of source B is less than the work function for copper but is greater than the work function for zinc.
- Work function of zinc must be between 2.0 eV and 4.4 eV
  Or work function of copper must be greater than 4.4 eV
- Intensity is (linked to) the number of photons per second
- Each photon releases one electron (so greater intensity leads to greater number of electrons per second)

6

Total for question 15 **10**