- Calculate the energy (in J) and the wavelength (in nm) expected for an emission associated with an electronic transition from $n = 4$ to $n = 2$ in the Be^{3+} ion. **Marks 3**

Be^{3+} has one electron and so the equation below can be used with Z = 4 to calculate the orbital energies, $E_n = -Z^2 E_R\left(\frac{1}{n^2}\right)$

The energies of the n = 4 and n = 2 levels are therefore,

$$E_{n=4} = -(4)^2 E_R\left(\frac{1}{4^2}\right) = E_R \quad \text{and} \quad E_{n=2} = -(4)^2 E_R\left(\frac{1}{2^2}\right) = 4E_R$$

The energy associated with emission from n = 4 to n = 2 is the difference between the energy of these two levels:

$$\Delta E = E_{n=2} - E_{n=4} = 4E_R - E_R = 3E_R = 3 \times (2.18 \times 10^{-18}) = 6.54 \times 10^{-18}\ \text{J}$$

The energy is related to the wavelength, λ, by $E = \frac{hc}{\lambda}$:

$$\lambda = \frac{hc}{E} = \frac{(6.634\times10^{-34})\times(2.998\times10^{8})}{6.54\times10^{-18}} = 3.04\times10^{-8}\ \text{m} = 30.4\,\text{nm}$$

Energy: **6.54×10^{-18} J**	Wavelength: **3.04×10^{-8} m or 30.4 nm**

- What two properties do electrons in atoms have which lead to discrete energy levels? Explain your answer. **2**

All particles have wave-like properties with momentum given by $mv = \frac{h}{\lambda}$.

The wavelengths that are possible for an electron are limited because the electron has restricted motion due to its attraction to the positive nucleus.

- What is the % transmission of a sample measured in an atomic absorption spectrometer to have an absorbance of 0.5? **2**

The absorbance, A, is related to the intensity of the incident light, I_0, and the transmitted light, I, by $A = -\log_{10}\left(\frac{I}{I_0}\right)$

If A = 0.5, then the fraction transmitted is $\frac{I}{I_0} = 10^{-0.5} = 0.3$ **or 30%**

Answer: **30%**