5 The diagram below shows an X-ray tube used for the production of X rays. The potential difference between the cathode and anode is 90 kV.

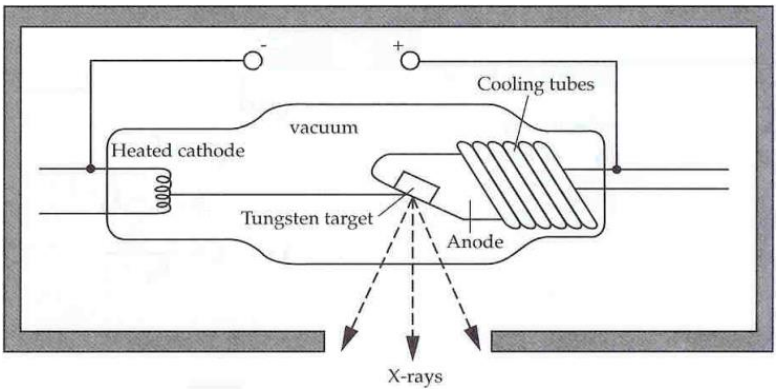

Fig. 5.1

The target is made of tungsten. The energy levels of tungsten for the three lowest electron shells are given in Fig 5.2.

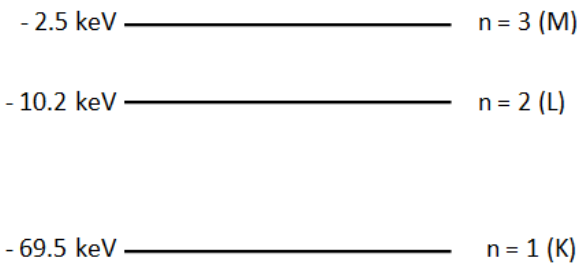

Fig. 5.2

(a) **(i)** X-ray photons of specific wavelengths are emitted from these atoms when they are excited by collisions with electrons.

Explain why the emitted photons have specific wavelengths.

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……...

……. [2]

(ii) Calculate the shortest characteristic wavelength that will be observed in the X ray spectrum produced by the tungsten target.

wavelength = ……..……. m [2]

(b) When the potential difference between the cathode and anode i.e. tube voltage is set to 80 kV and then 100 kV. The X-ray spectra for the two voltages are shown in Fig. 5.2.

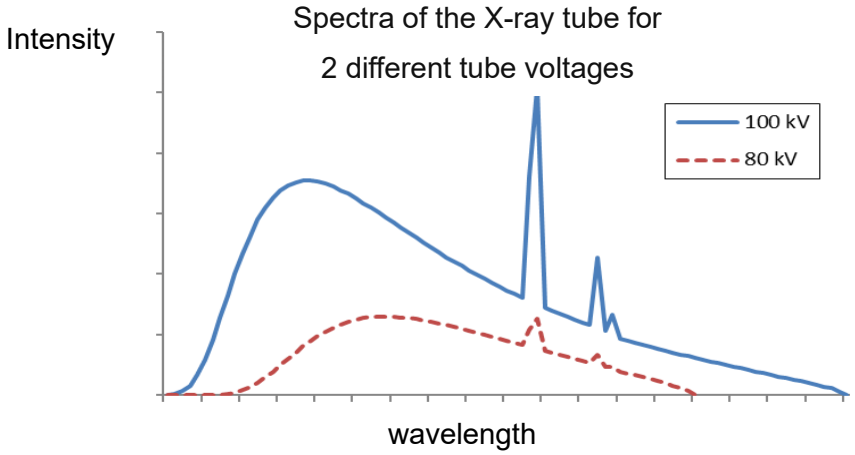

Fig. 5.3

Explain the similarities and differences of the X-ray spectra in Fig 5.3.

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……. [3]

(c) State what is meant by the wave–particle duality of electrons. Give one example of each type of behaviour.

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……...

……. [3]