7 A simplified representation of the 5 lowest energy levels of the outermost electron in the sodium atom is shown in Fig. 7.1.

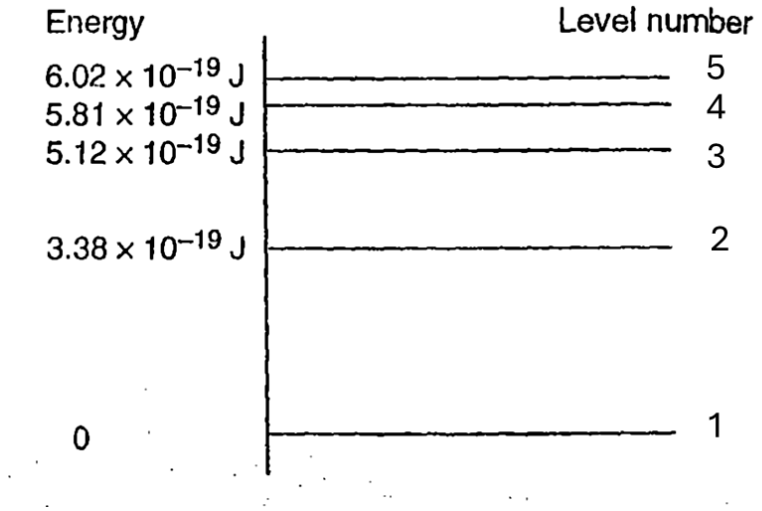

Fig. 7.1

(a) Considering transitions between only these levels,

(i) state the spectral emission transition that has the longest wavelength (give your answers in terms of level numbers),

level …….. to …….. [1]

(ii) state the number of emission lines that might be produced by transitions among these levels.

number of spectral emission lines …….. [1]

(iii) Cool sodium vapour at low pressure is bombarded with electrons of kinetic energy *E*.

Determine the number of emission transitions observed if *E* has the value 3.6 eV. Show your reasoning clearly.

number of observed transitions …… [3]

(b) State the number of absorption lines that might be visible to the human eye, if the sodium atoms are initially at Level 1. Show your working clearly.

number of visible absorption lines …….. [2]

When electrons bombard heavier metals, the range of spectral lines detected could be very different. Fig. 7.2 shows a spectral graph of relative intensity against frequency of x-ray detected, conducted using two different accelerating voltages, V_1 and V_2 (not labelled).

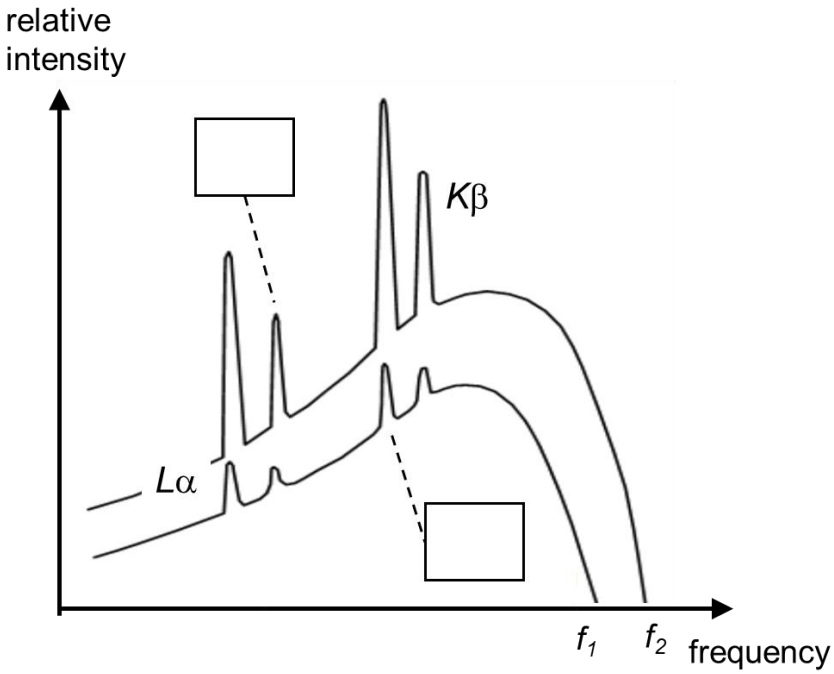

Fig. 7.2

(c) Fill in the boxes in Fig. 7.2 with appropriate notations for the characteristic lines. [1]

(d) Explain briefly for the observation of characteristic peak K_β in Fig. 7.2.

……..……..

……..……..

……..……..

……..…… [2]

(e) Explain briefly for the observation of two distinct continuous spectra in Fig. 7.2, when experiments using two different accelerating voltages, V_1 and V_2 are conducted, where V_2 is larger than V_1.

……..……..

……..……..

……..……..

……..…… [2]

(f) Explain briefly for the observation of characteristic peaks at the same frequency regardless of the voltages.

……..……..

……..……..

……..……..

……..…… [2]