

6. This question is about a supernova

$$\begin{aligned}
 \text{(a) } E &= -R_H Z^2 / n^2 \\
 &= -2.179 \times 10^{-18} \times 1/4 \\
 &= -5.45 \times 10^{-19} \text{ J} \qquad \qquad \qquad \text{(1)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b) } E &= -5.45 \times 10^{-19} - (-2.179 \times 10^{-18}) \\
 &= 1.63 \times 10^{-18} \text{ J} \qquad \qquad \qquad \text{(1)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(c) I.E.} &= 0 - (-2.179 \times 10^{-18} \times 4/1) \\
 &= 8.72 \times 10^{-18} \text{ J} \qquad \qquad \qquad \text{(1)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(d) } f &= 1.63 \times 10^{-18} / 6.626 \times 10^{-34} \\
 &= 2.47 \times 10^{15} \text{ Hz} \qquad \qquad \qquad \text{(1)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(e) } ?E &= -R_H Z^2 (1/n_2^2 - 1/n_1^2) \\
 &= -2.179 \times 10^{-18} \times 64 \times (1/4 - 1) \\
 &= 1.05 \times 10^{-16} \text{ J} \\
 f &= ?E/h = 1.05 \times 10^{-16} / 6.626 \times 10^{-34} \\
 &= 1.58 \times 10^{17} \text{ Hz} \qquad \qquad \qquad \text{(3)}
 \end{aligned}$$

lose 1 mark for using $Z=7$

(gives $?E = 8.01 \times 10^{-17} \text{ Hz}$, $f = 1.58 \times 10^{17} \text{ Hz}$)

$$\begin{aligned}
 \text{(f) } ?E &= hf = 6.626 \times 10^{-34} \times 2.471 \times 10^{17} \\
 &= 1.64 \times 10^{-16} \text{ Hz} \qquad \qquad \qquad \text{(1)}
 \end{aligned}$$

$$\begin{aligned}
 ?E &= -R_H Z^2 (1/n_2^2 - 1/n_1^2) \\
 &= -R_H Z^2 (-3/4)
 \end{aligned}$$

$$\begin{aligned}
 Z &= \sqrt{4/3 \times ?E/R_H} \\
 &= \sqrt{4/3 \times 1.63 \times 10^{-16} / 2.179 \times 10^{-18}} \\
 &= 10 \text{ The element is Neon} \qquad \qquad \qquad \text{(1)}
 \end{aligned}$$

Total 9