

2. This question is about a sodium street lamp

- (a) $1s^2, 2s^2, 2p^6, 3s^1$ 1
- (b) $3s$ 1
- (c) (i) Energy = $6.626 \times 10^{-34} \text{ J s} \times 2.998 \times 10^8 \text{ m s}^{-1} / 589 \times 10^{-9} \text{ m}$
 $= 3.37 \times 10^{-19} \text{ J (atom}^{-1}\text{)}$ 1
- (ii) Energy per mole = $3.37 \times 10^{-19} \text{ J} \times 6.02 \times 10^{23} \text{ mol}^{-1}$
 $= 2.03 \times 10^5 \text{ J mol}^{-1}$
 $= 203 \text{ kJ mol}^{-1}$ 1
- Allow ECF from (c)(i)*
- (d) one Zero infinity the constant k 1
- (e) Energy change = $I.E. (nd) - I.E. (3p)$
Note this answer is negative as energy is given out. Award one mark for the expression: Energy change = $I.E. (3p) - I.E. (nd)$ 2
- (f) (i) Intercept = 0.00245 nm^{-1} (*Allow values from 0.00243-0.0247 nm^{-1}*)
 $I.E. (3p) = 6.626 \times 10^{-34} \text{ J s} \times 2.998 \times 10^8 \text{ m s}^{-1} \times 2.45 \times 10^6 \text{ m}^{-1}$
 $= 4.87 \times 10^{-19} \text{ J (atom}^{-1}\text{)}$ 1
- (ii) Ionisation energy of sodium = $I.E. (3p) + \Delta E (3s \rightarrow 3p)$
 $I.E. (3p) = 4.87 \times 10^{-19} \text{ J (atom}^{-1}\text{)} \times 6.02 \times 10^{23} \text{ mol}^{-1}$
 $= 293 \text{ kJ mol}^{-1}$
Ionisation energy of sodium = $293 \text{ kJ mol}^{-1} + 203 \text{ kJ mol}^{-1}$ 1
 $= 496 \text{ kJ mol}^{-1}$
Allow ECF from (c)(ii) or (f)(i), as long as they have shown that these two quantities must be added together, and both in the units of kJ mol^{-1}

Question Total 9