	Marks
• Explain in terms of their electronic configurations and ionisation energies why the alkali metals (Group 1) are powerful *reducing* agents.	**2**

Ionisation energies increase across a period in the periodic table because the increasing nuclear charge holds the electrons more tightly. Hence, in any period, the Group I element is the one that most easily loses its electron (from the *s* subshell). This electron is then available to reduce another species.

• The half-life for the first order decomposition of $N_2O_5(g)$ is 6.00×10^4 s at 20 °C. Calculate the rate constant, k, at this temperature.	**3**

For a first-order reaction, the half-life, $t_{1/2}$, is related to the rate constant, k, by:

$$t_{1/2} = \frac{\ln 2}{k} = \frac{\ln 2}{(6.00\times10^4\ \text{s}^{-1})} = 1.16 \times 10^{-5}\ \text{s}^{-1}$$

$k = 1.16 \times 10^{-5}\ \text{s}^{-1}$

What percentage of the N_2O_5 molecules will have reacted after one hour?

For a first-order reaction:

$$\ln[N_2O_5] = \ln[N_2O_5]_0 - kt \quad \text{or} \quad \frac{\ln[N_2O_5]}{\ln[N_2O_5]_0} = -kt$$

Hence for t = 1 hour = (60 × 60) s = 3600 s,

$$\frac{\ln[N_2O_5]}{\ln[N_2O_5]_0} = -(1.16 \times 10^{-5}\ \text{s}^{-1}) \times (3600\ \text{s}) = 0.0418$$

$$\frac{[N_2O_5]}{[N_2O_5]_0} = 0.959 \text{ or } 95.9\% \text{ remains.}$$

The amount that has reacted is (100.0 – 95.9) = 4.1 %

ANSWER: **4.1%**