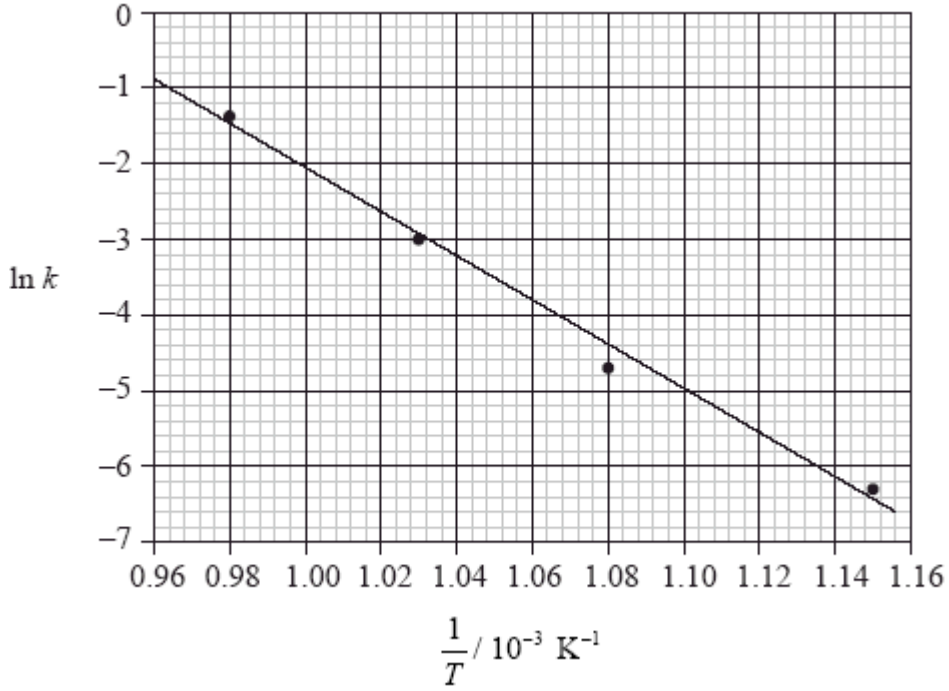
IB Chemistry II 16.2 P2 Practice

1. Consider the following graph of ln *k* against $\frac{1}{T}$ (temperature in Kelvin) for the second order decomposition of N_2O into N_2 and O.

$$N_2O \rightarrow N_2 + O$$



$\frac{1}{T} / 10^{-3}\ K^{-1}$

(a) State how the rate constant, *k* varies with temperature, *T*.

(1)

(b) Determine the activation energy, E_a, for this reaction.

(3)

(c) The rate expression for this reaction is rate = $k\,[N_2O]^2$ and the rate constant is 0.244 $dm^3\ mol^{-1}\ s^{-1}$ at 750 °C.

A sample of N_2O of concentration 0.200 mol dm^{-3} is allowed to decompose. Calculate the rate when 10 % of the N_2O has reacted.

(2)

(Total 6 marks)

(a) k increases with increase in T / k decreases with decrease in T; 1

Do not allow answers giving just the Arrhenius equation or involving ln k relationships.

(b) gradient = $-E_a/R$;

-30000 (K) = $-E_a/R$;

Allow value in range –28800–31300 (K).

E_a =(30000 × 8.31=) 2.49×10^5 J mol^{-1} /249 kJ mol^{-1}; 3

Allow value in range 240–260 kJ mol^{-1}.

*Allow **[3]** for correct final answer.*

(c) $0.9 \times 0.200 = 0.180$ (mol dm^{-3});

rate = $(0.244 \times (0.180)^2 =) 7.91 \times 10^{-3}$ mol dm^{-3} s^{-1}; 2

*Award **[2]** for correct final answer.*

*Award **[1 max]** for either 9.76×10^{-3} mol dm^{-3} s^{-1} or 9.76×10^{-5} mol dm^{-3} s^{-1}.*

[6]