Quiz (Arrhenius Equation Experiment)

Consider the following reaction:

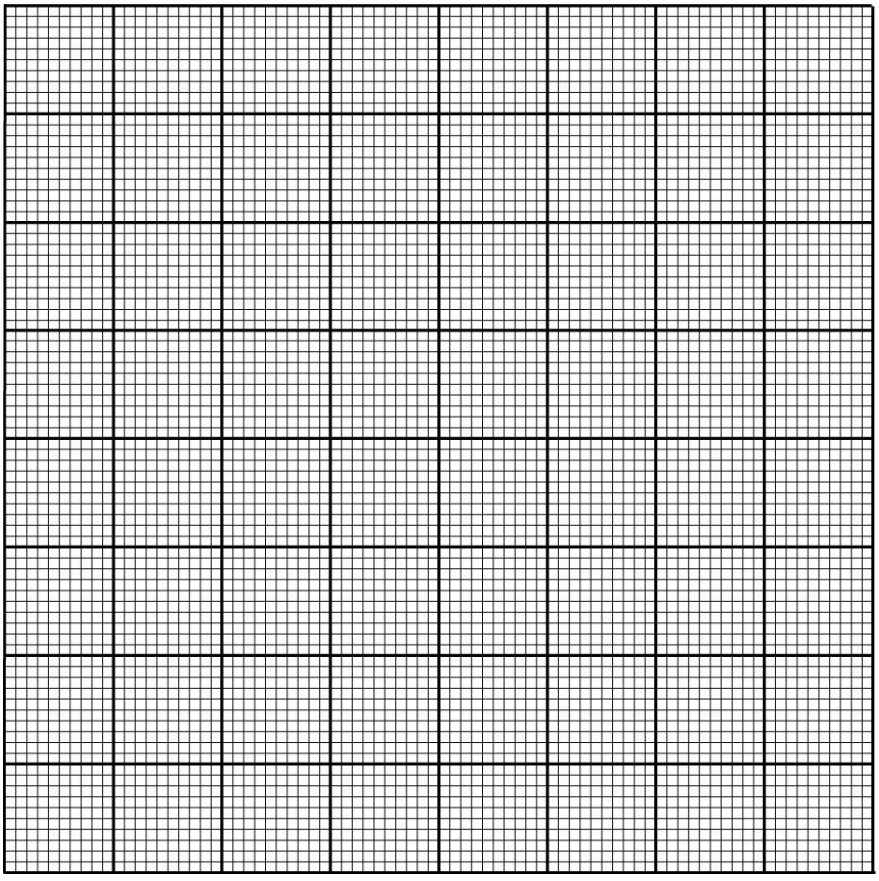
$A(aq) + B(aq) \longrightarrow C(aq) + D(aq)$

As $C(aq)$ is coloured, the rate of reaction can be determined by measuring the time for the colour change of the reaction mixture. The following table shows the results of a series of experiments:

Experiment	Temperature (°C)	Time for colour change (s)
1	8	42.0
2	30	18.6
3	35	15.8
4	40	12.9

(a) Define the term 'activation energy'.

(b) By plotting a graph, determine the activation energy of the reaction.
(Given: $R = 8.31\ J\ K^{-1}\ mol^{-1}$)



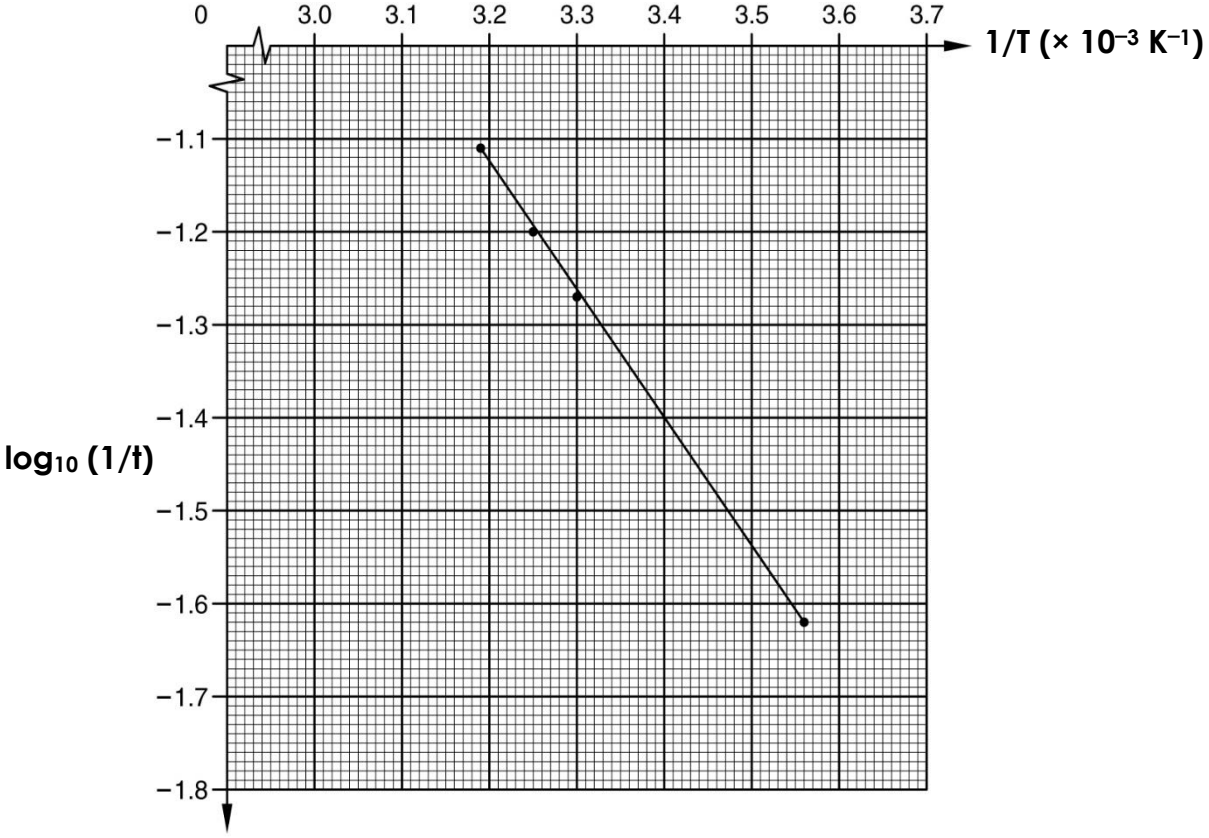
(c) Comment the following statement:
'When the temperature increases, the rate of reaction increases because the activation energy of a reaction is lowered.'

Suggested Answer

(a) Activation energy is the minimum energy required for the reaction to occur.

(b)

Experiment	1	2	3	4
1/T (× 10^{-3} K^{-1})	3.56	3.30	3.25	3.19
$\log_{10}$ (1/t)	−1.62	−1.27	−1.20	−1.11



Slope of the graph = $-\frac{E_a}{2.3R} = -\frac{-1.11-(-1.62)}{3.19\times10^{-3}-3.56\times10^{-3}} = -1378$

E_a = (1378 × 2.3 × 8.31) J mol^{-1} = 26.3 kJ mol^{-1}

(c) The statement is incorrect. When the temperature increases, the rate of reaction increases because the number of particles having energy equal to or greater than the activation energy increases.