Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Rate Equations

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Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Mark Schemes

Q1.

Stage 1: Complete table and draws graph:

Rate constant k/s^{-1}	ln k	Temperature /k	$\frac{1}{T}$
6.13×10^{-5}	**−9.7(0)**	700	**1.43×10^{-3}**
2.75×10^{-4}	**−8.2(0)**	727	**1.38×10^{-3}**
8.25×10^{-4}	**−7.1(0)**	746	**1.34×10^{-3}**
8.23×10^{-3}	**−4.8(0)**	793	**1.26×10^{-4}**

Extended response question

M1 *Calculates (four) values of* $\frac{1}{T}$ **1**

M2 *Calculates (four) values of ln k* **1**

M3 *Plots points on graph* **1**

M4 *Draws line of best fit.* **1**

Stage 2: Calculates gradient:

M5 working = $\frac{\Delta y}{\Delta x}$ (such as $\frac{-6.9}{0.24 \div 1000}$ **OR** $\frac{-5.5}{0.19 \div 1000}$

Stage 2 *can only be accessed if the table has been completed correctly and a straight line graph is drawn.* **1**

M6 answer = -2.88×10^4

Correct answer with or without working scores M5 and M6. **1**

Stage 3: Calculates E_a:

M7 (recognises that gradient = $-2.88 \times 10^4 \propto \frac{-Eact}{R}$)

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$E_a = 2.88 \times 10^4 \times 8.314$)

Stage 3 *can only be accessed if the student has correctly calculated a gradient from their line graph.*

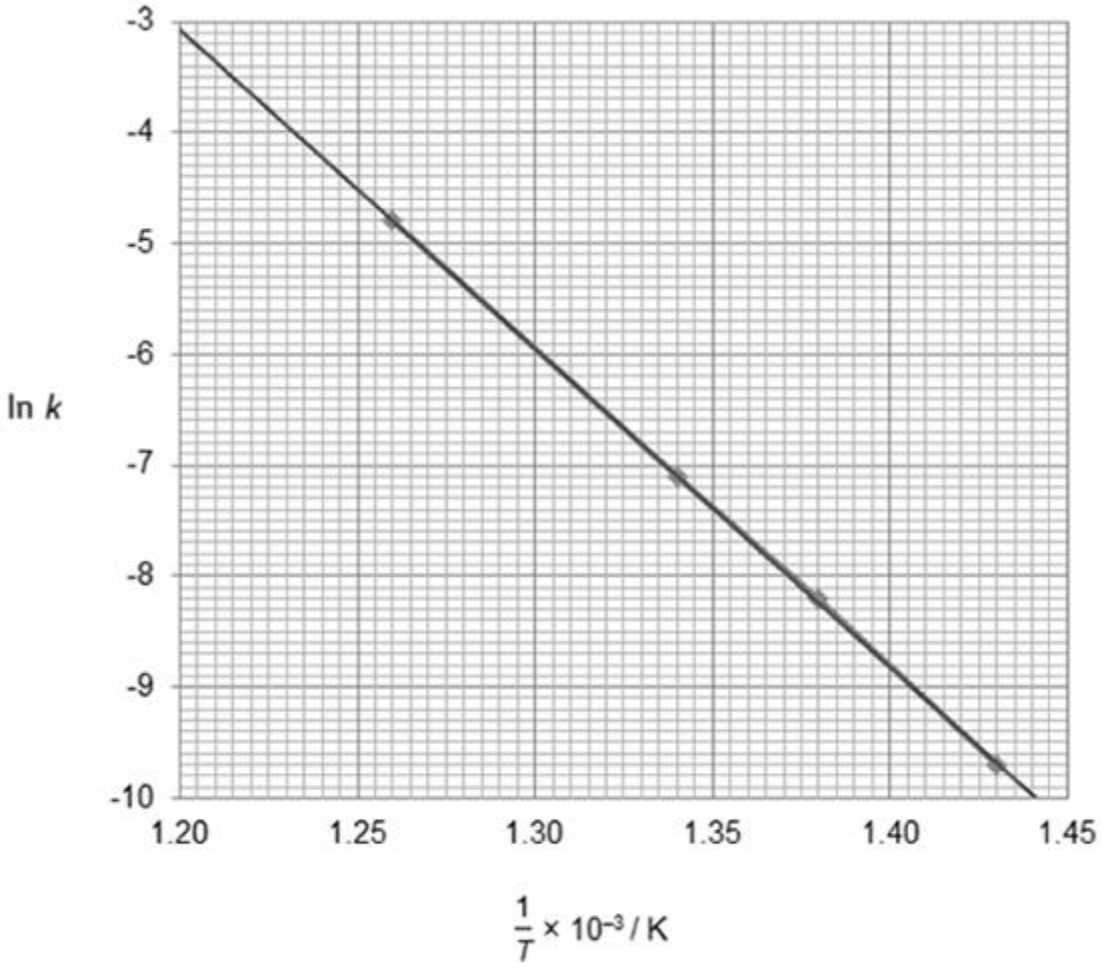
1

M8 (÷1,000 =) E_a = 239 kJ mol^{-1}

Correct answer with or without working scores M7 and M8.

Answer to correct number of significant figure (3 sf).

1



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Q2.

(a) Consider experiments 1 and 2: [B constant]

[A] increases × 3: rate increases by 3^2 therefore 2nd order with respect to A

1

Consider experiments 2 and 3:

[A] increases × 2: rate should increase × 2^2 but only increases × 2

Therefore, halving [B] halves rate and so 1st order with respect to B

1

Rate equation: rate = $k[A]^2[B]$

1

(b) rate = k $[C]^2[D]$ therefore k = rate / $[C]^2[D]$

1

$$k = \frac{7.2\times10^{-4}}{(1.9\times10^{-2})^2 \times (3.5\times10^{-2})} = 57.0$$

Allow consequential marking on incorrect transcription

1

$mol^{-2}\ dm^{+6}\ s^{-1}$

Any order

1

(c) rate = $57.0 \times (3.6 \times 10^{-2})^2 \times 5.4 \times 10^{-2} = 3.99 \times 10^{-3}$ (mol dm^{-3} s^{-1})

OR

Their $k \times (3.6 \times 10^{-2})^2 \times 5.4 \times 10^{-2}$

1

(d) Reaction occurs when molecules have $E \geq E_a$

1

Doubling T by 10 °C causes <u>many</u> more molecules to have this E

1

Whereas doubling [**E**] only doubles the number with this E

1

(e) $E_a = RT(\ln A - \ln k) / 1000$

Mark is for rearrangement of equation and factor of 1000 used correctly to convert J into kJ

1

$E_a = 8.31 \times 300\ (23.97 - (-5.03)) / 1000 = 72.3$ (kJ mol^{-1})

1

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