AQA A-Level Chemistry

Rate equations mark scheme · goes with “Rate equations” · whiteboardchemistry.com/revision/aqa-a-level-chemistry/exam-questions

Mark schemes

Rate equations · 10 questions

Q1 · June 2017 · Paper 3 · Q27 · [1 mark]

Answer: **B**

Q2 · June 2018 · Paper 3 · Q12 · [1 mark]

Answer: **C**

Q3 · June 2018 · Paper 3 · Q13 · [1 mark]

Answer: **D**

Q4 · June 2019 · Paper 3 · Q10 · [1 mark]

Answer: **C**

Q5 · June 2025 · Paper 2 · Q9 · [11 marks]

09.1

(The silver halide) product is a precipitate / insoluble

[1 mark]

09.2

Any 1 of these

Start timer at the same point of addition

View the cross from the same distance

Light level

Same swirling / agitation

Same person observing 'disappearance of cross’

[1 mark]

09.3

3.08×10^{-3}

Allow 0.003075 or 3.075×10^{-3} or 0.00308

[1 mark]

09.4

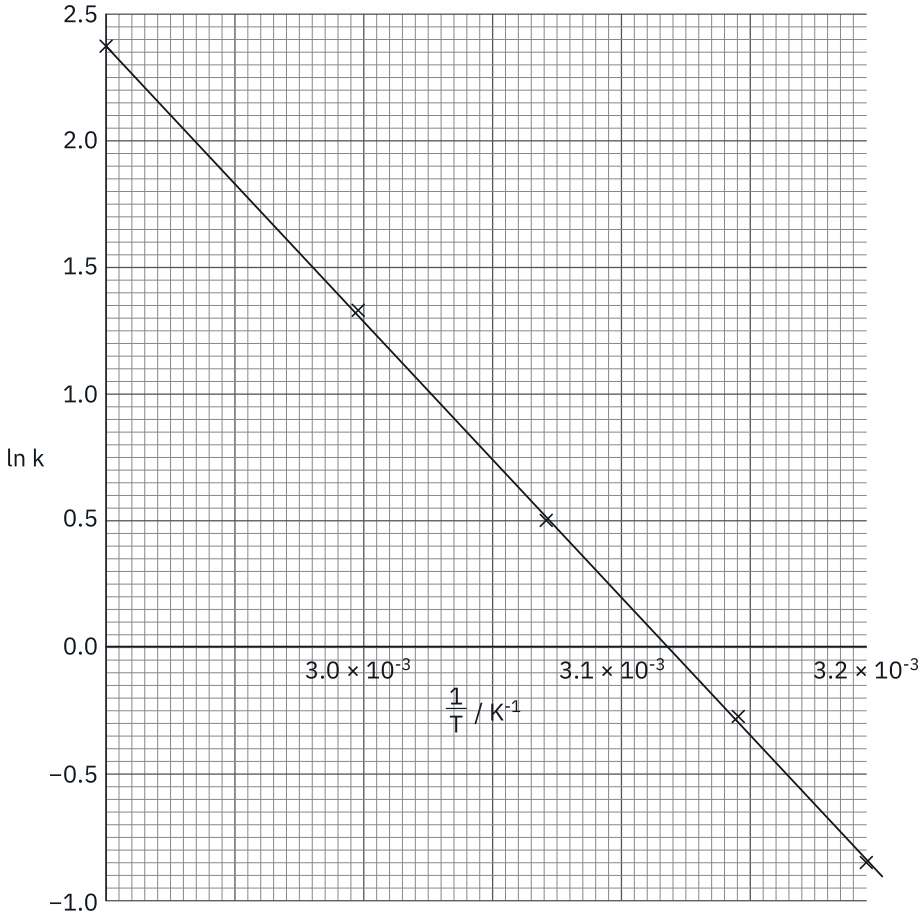
M1 Appropriate x axis scale used

M2 All 4 points given in table 2 plotted correctly and suitable straight line drawn

M3 $-\frac{(E_a)}{(R)}$ = calculated gradient (between -10469 and -10830)

M4 E_a = - M3 × 8.31 (J mol^{-1})

M5 $E_a = \frac{M4}{1000}$ (between 87 and 90)



M1 data plotted covers at least half the x axis

M3 $-\frac{(E_a)}{(R)} = -\frac{(2.38)}{(2.25 \times 10^{-4})} = -10578$

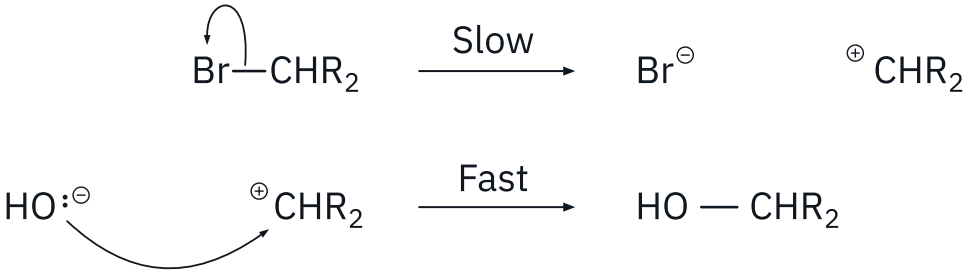
M4 $E_a = 10578 \times 8.31$ (J mol^{-1}) = 87903

M5 E_a = 87.9 kJ mol^{-1}

[5 marks]

09.5

Option B



[1 mark]

09.6

M1 (Br more electronegative than C so) Br is δ- and C is δ+ (and so the C–Br bond breaks when heated)

M2 (Lone pair of electrons on) HO^- attacks/attracted to C^+ (after C–Br bond breaks)

OR

δ+C (in C–Br bond) attracts / susceptible to attack by (lone pair of electrons on oxygen of) HO^-

[2 marks]

Q6 · June 2025 · Paper 3 · Q2 · [15 marks]

02.1

Any 3

- temperature
- amount/volume of starch
- total volume / volume of reaction mixture
- (constant) stirring/agitation
- same person observing colour change / same shade of colour when timing stopped

ALLOW concentration/mass of starch

IGNORE same stopwatch

IGNORE concs/vols/amounts of thiosulfate &

other reagents

IGNORE references to (same) apparatus

IGNORE same person unqualified

[3 marks]

02.2

M1 1st / one for H_2O_2 AND 1st / one for I^- AND zero / 0 for H^+

M2 Doubling $[I^-]$ halves the time

M3 (Use experiments 3 and 4) because $[H^+]$ and $[H_2O_2]$ stay the same OR because only $[I^-]$ changes

M2 is independent of M1

M2 ALLOW doubling $[I^-]$ doubles the rate

ALLOW M2 AND M3 for when $[I^-]$ doubles and

$[H^+]$ and $[H_2O_2]$ stay the same the time halves / rate doubles

ALLOW any correct explanation based on two

experiments and orders wrt H_2O_2 and/or H^+

[3 marks]

02.3

M1 rate = k $[H_2O_2]$ $[I^-]$

M2 mol^{-1} dm^3 s^{-1}

M1 ALLOW rate = k $[H_2O_2]^1$ $[I^-]^1$ $[H^+]^0$

ALLOW M1 independent of 02.2 if correct

but ECF from 02.2 for other answers

NOT ()

M2 dependent on a rate equation in M1

M2 ALLOW any order of mol dm s

M2 ALLOW if no answer to M1

[2 marks]

02.4

M1 (amount of $S_2O_3^{2-}$ = $\dfrac{(1.00 \times 10^{-3})}{((1.00)/(1000))}$

= 1.00×10^{-6} mol)

amount of I_2 = ½ × amount of $S_2O_3^{2-}$

= 5.00×10^{-7} mol

M2 $[I_2]$ = $\dfrac{(M1)}{((40)/(1000))}$

= 1.25×10^{-5} mol dm^{-3}

For M2, M1 must be an attempt at calculating amount of I_2

M3 rate = $\dfrac{(M2)}{(20)}$

= 6.25×10^{-7} (mol dm^{-3} s^{-1}) (= 3 marks)

(at least 2sf so ALLOW 6.3×10^{-7})

M3 if no M2 ALLOW mol of iodine from M1/20

e.g. $\dfrac{5 \times 10^{-7}}{20}$ = 2.5×10^{-8} (= 2 marks, M1 &

M3)

[3 marks]

02.5

(observer) reaction time / time taken to stop timer (is more significant) / hard to determine 'end point' / colour change not instantaneous

IGNORE 'human error' unqualified

[1 mark]

02.6

2.5 (%)

NOT 2.55

[1 mark]

02.7

M1 increase the time (and so reduces percentage uncertainty)

M2 use a greater concentration/amount of thiosulfate

ALLOW greater volume of thiosulfate

ALLOW lower temperature

IGNORE use of colorimeter

IGNORE references to starch

IGNORE references to repeats / averages

NOT lower/greater total volume / adding water /

lower/greater concentrations of reactants

[2 marks]

Q7 · June 2025 · Paper 3 · Q4 · [9 marks]

04.1

$$(K_c =) \frac{([Fe^{2+}]^2\,[I_2])}{([Fe^{3+}]^2\,[I^-]^2)}$$

IGNORE state symbols

NOT ()

[1 mark]

04.2

M1 (dilution and cooling) stops the reaction OR reduces rate

M2 during the titration no more iodide formed OR during the titration the equilibrium will not shift

M1 ALLOW concentrations/amounts stay constant

M2 NOT iodide concentration remains constant during titration

[2 marks]

04.3

M1 initial amount of Fe^{3+} = $\frac{(50 \times 0.015 \times 2)}{(1000)}$ = 1.5×10^{-3} mol

AND

initial amount of I^- = $\frac{(50 \times 0.015)}{(1000)}$ = 7.5×10^{-4} mol

M2 amount of I^- reacted = M1 I^- – 3 x 10^{-4}

M3 for equilibrium amounts in mol

Fe^{3+} = (M1 Fe^{3+} – M2) AND

Fe^{2+} = M2 AND

I_2 = ($\frac{(M2)}{(2)}$)

M4 equilibrium concentrations in mol dm^{-3}

$[I^-]$ = 3 x 10^{-3} AND

$[Fe^{3+}]$ = $\frac{(M3\ Fe^{3+})}{(0.1)}$ AND

$[Fe^{2+}]$ = $\frac{(M3Fe^{2+})}{(0.1)}$ AND

$[I_2]$ = $\frac{(M3\ I_2)}{(0.1)}$

M5 K_c = $\frac{((M4\ Fe^{2+})^2 \times M4\ I_2)}{((M4\ Fe^{3+})^2 \times (M4\ I^-)^2)}$

M6 units = $mol^{-1}\ dm^3$

M2 = 4.5×10^{-4} mol

M3 Fe^{3+} = 1.05×10^{-3} / 0.00105 mol

Fe^{2+} = 4.5×10^{-4} / 0.00045 mol

I_2 = 2.25×10^{-4} / 0.000225 mol

M4 $[I^-]$ = 3×10^{-3} / 0.003 mol dm^{-3}

$[Fe^{3+}]$ = 1.05×10^{-2} / 0.015 mol dm^{-3}

$[Fe^{2+}]$ = 4.5×10^{-3} / 0.0045 mol dm^{-3}

$[I_2]$ = 2.25×10^{-3} / 0.00225 mol dm^{-3}

M5 $\frac{((4.5 \times 10^{-3})^2 \times 2.25 \times 10^{-3})}{((1.05 \times 10^{-2})^2 \times (3 \times 10^{-3})^2)}$ *= 45.9*

(45.9 = 5 marks)

If wrong K_c expression then ECF from 4.1

M6 Correct units scores irrespective of anything else; otherwise units should match K_c expression used in M5; if K_c expression not used in M5, then ECF from 4.1

459 = M1, M2, M3 & M5 if mole not concs used

562.5 = M2 to M5 if M1 Fe^{3+} = 7.5 x 10^{-4}

[6 marks]

Q8 · November 2020 · Paper 3 · Q33 · [1 mark]

Answer: **D**

Q9 · June 2023 · Paper 2 · Q2 · [5 marks]

(a) M1 Relative rate = 1.00

M2 [B] = 0.16

M3 Relative rate = 1.35

[3 marks]

(b) M1 Step 2

M2 (By the end of step 2) 1 × H^+ and 2 × B have been used

Allow slowest step

[2 marks]

Q10 · November 2020 · Paper 3 · Q12 · [1 mark]

Answer: **B**

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