4.1 EXAM QUESTIONS MS

1. (a) Increased surface area **(1)**
more collisions **(1)** 2

(b) (i) Experiment 2 = $9{\cdot}6 \times 10^{-4}$ **(1)**
Experiment 3 = 0·010 **(1)**
Experiment 4 = $8{\cdot}1 \times 10^{-4}$ **(1)**
Experiment 5 = 0·035 **(1)**

(ii) $k = \frac{1.2\times10^{-4}}{(0\cdot020)(0\cdot020)^2}$ **(1)** = 15 **(1)** $mol^{-2}\ dm^6\ s^{-1}$ **(1)** 7

[9]

2. (a) order wrt A = 1; 1
order wrt NaOH = 1; 1
Initial rate in Exp 4 = 2.4×10^{-3}; 1

(b) (i) r(ate) = k[A]
OR
r(ate) = k[A][NaOH]^0; 1
(penalise missing [ ] but mark on)
(penalise missing [ ] once per paper)
(if wrong order, allow only units mark conseq on their rate eqs)
(penalise k_a or k_w etc)

(ii) $k = \frac{9.0\times10^{-3}}{0.02}$; 1
= 0.45; 1
s^{-1}; 1

(iii) (large) excess of OH^- or $[OH^-]$ is large/high; 1
$[OH^-]$ is (effectively) constant
OR
[A] is the limiting factor *(Q of L mark)* 1

[9]

3. (a) Power (or index or shown as *x* in $[\ ]^x$) of concentration term (in rate equation) **(1)** 1

(b) 2 **(1)** 1

(c) (i) *Order with respect to **A**:* 2 **(1)**

*Order with respect to **B***: 0 **(1)**

(ii) *Rate equation:* (rate =) k $[A]^2$ **(1)**

Allow conseq on c(i)

Units for rate constant: mol^{-1} dm^3 s^{-1} **(1)** 4

conseq on rate equation

[6]

4. (a) *Order with respect to **A*** 1 **(1)**
*Order with respect to **B*** 1 **(1)**
*Order with respect to **C*** 2 **(1)** 3

(b) *Value of k* $K = \frac{8.0 \times 10^{-5}}{(0.1)(0.2)(0.2)^2} = 0.1$

(1) **(1)**

Units of k mol^{-3} dm^9 s^{-1} **(1)**

Initial rate 1.0×10^{-5} (mol dm^{-3} s^{-1})

(1) 4

(c) increases **(1)** 1

[8]

5. (a)

Substances **added** to an excess of zinc and 100 cm^3 of 0.2 M hydrochloric acid	Volume of hydrogen/cm^3	Effect on initial rate of reaction
100cm^3 water	***240 (1)***	***decreased (1)***
l0g zinc	***240 (1)***	***no change (1)***
50 cm^3 0.2 M hydrochloric acid	***360 (1)***	***no change (1)***

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(b) *Order with respect to A* 1 **(1)**

Order with respect to B 1 **(1)**

Initial rate 2.8×10^{-5} (mol dm^{-3} s^{-1}) **(1)**

either via $k = 1.56 \times 10^{-3}$ (1)

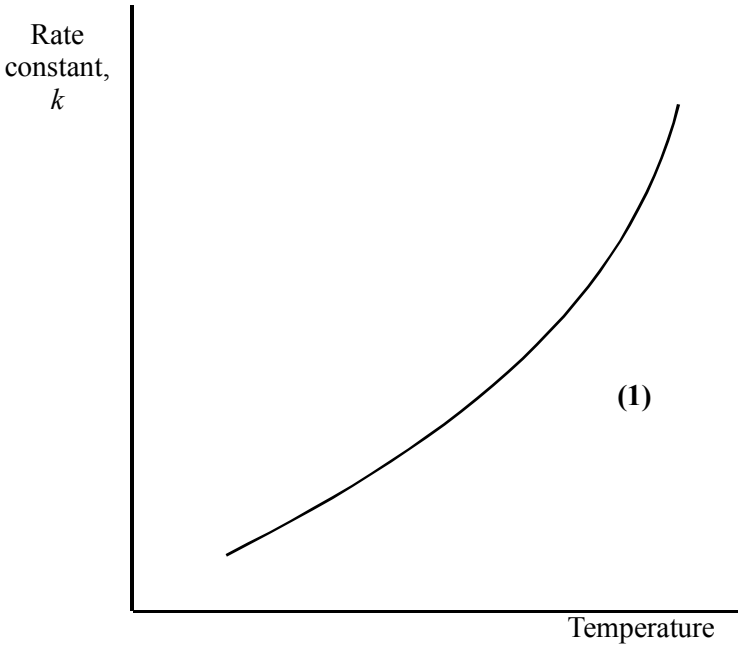
or via table eg expts 2 $\rightarrow$ 4: rate $\times \frac{1}{2} \times \frac{3}{4} = \times \frac{3}{8}$ (1) 4

(c) (i) *Calculation* $k = \frac{7.5 \times 10^{-3}}{(0.25)^2 (0.50)^2}$ **(1)** = 0.48 **(1)**

Units $\frac{\text{mol dm}^{-3}\text{s}^{-1}}{(\text{mol dm}^{-3})^2(\text{mol dm}^{-3})^2} = \text{mol}^{-3}\ \text{dm}^9\ \text{s}^-$

^{1} **(1)**

(ii)



(1)

4

[14]

6. (a) exp2 4.0×10^{-3} 1

exp3 0.45×10^{-5} 1

exp4 9.0×10^{-3} 1

(b) $\frac{1.8 \times 10^{-5}}{(3.0 \times 10^{-3})^2 (1.0 \times 10^{-3}}$ 1

2000 1

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

[6]

7. (a) (i) 2 **(1)**

(ii) 0 **(1)** 2

(b) (i) *Value of k*: $k = \frac{\text{rate}}{[NO]^2[O_2]} = \frac{6.5\times10^{-4}}{(5.012\times10^{-2})^2(2.0\times10^{-2})} = 13$

Units of k: $mol^{-2}\ dm^6\ s^{-1}$ **(1)**

(ii) rate = $13\ (6.5\times10^{-2})^2\ (3.4\times10^{-2})$

$= 1.9\times10^{-3}$ $(mol\ dm^{-3}\ s^{-1})$ **(1)** 4

If k wrong, the mark in (ii) may be gained conseq for their k × 1.437 × 10^{-4}

[6]

8. (a) (i) Experiment 2: $0.4(0)\times10^{-3}$ **(1)**
Experiment 3: 0.15 **(1)**
Experiment 4: 0.28 **(1)**

(ii) $k = \frac{4.8\times10^{-3}}{(0.20)^2\times(0.30)} = 0.4(0)\ mol^{-2}\ dm^6\ s^{-1}$

(1) **(1)** **(1)** 6

(b) (change in) <u>temperature</u> **(1)** 1

[7]

9. (a) (i) (Experiment 1 → 2) [A] doubled, ([B] constant,)
<u>rate</u> doubled **(1)**
stated or shown numerically

(ii) 2 **(1)**
or shown as ... $[B]^2$ 2

(b) (i) $k = \frac{9.30\times10^{-5}}{(0.75)^2\times(1.50)} = 1.1(0)\times10^{-4}$

(1) **(1)**

units of k: $mol^{-2}\ dm^6\ s^{-1}$ **(1)**

(ii) rate = $(1.10\times10^{-4})\times(0.20)^2\times(0.10)$
$= 4.4(1)\times10^{-7}\ (mol\ dm^{-3}\ s^{-1})$

(1) for the answer
Ignore units
Conseq on (i)
Upside down expression for k scores zero in (i) for 9073
but rate = 9073 × $(0.2)^2$ × (0.1) = 36(.3)
conseq scores (1) in (ii)

4

[6]

10. (a) (i)

Expt	Initial [**A**]/mol dm^{-3}	Initial [**B**]/mol dm^{-3}	Initial rate/mol $dm^{-3}s^{-1}$
1	0.30	0.30	1.5×10^{-2}
2	**0.60 (1) (0.58 to 0.63)**	0.60	6.0×10^{-2}
3	0.45	**1.20 (1) (1.17 to 1.25)**	9.0×10^{-2}
4	0.90	0.60	**9.0×10^{-2} (1) (8.6 to 9.2 $\times 10^{-2}$)**

(ii) $K = \frac{\text{rate}}{[A][B]} = \frac{1.5 \times 10^{-2}}{0.3 \times 0.3}$ **(1)** $= 0.16\dot{6}$ **(1)** (or 0.17 or $0.1\dot{6}$)

(1) **(1)**

units: $mol^{-1}\ dm^3\ s^{-1}$ **(1)** 6

(b) surface area more (than doubled) **(1)**
many more collisions **(1)** 2

[8]

11. (a) 2 **(1)**

0 **(1)**

rate = $k[J]^2$ **(1)** 3

(b) $k = \frac{4 \times 10^{-4}}{(2 \times 10^{-2})^2 (5 \times 10^{-2})}$ **(1)** = 20 **(1)** 3

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

(c) rate = k [ ]^n $\therefore [\ ]^n = \frac{\text{rate}}{k}$

units: $\frac{mol\,dm^{-3}\,s^{-1}}{s^{-1}} = mol\ dm^{-3}$ $\therefore n = 1$ **(2)**

greater/increase **(1)** 3

[9]