TOPIC 11 TEST MS

1. (a) (i) propyl methanoate

must be correct spelling

1

(ii) rate = k[X][OH^-]

allow $HCOOCH_2CH_2CH_3$ (or close) for X

allow ( ) but penalise missing minus

1

(iii) $k = \frac{8.5 \times 10^{-6}}{(0.024)(0.035)}$

In (a)(iii), if wrong orders allow

mark is for insertion of numbers in correct expression for k

If expression for k is upside down, only score units conseq to their expression

1

= 0.10(12) 2sf minimum

1 for conseq answer

1

$mol^{-1}\ dm^3\ s^{-1}$

1 for conseq units

any order

1

(iv) $2.1(3) \times 10^{-5}$

or $2.1(2) \times 10^{-5}$ ignore units

allow 2 sf

NB If wrong check the orders in part (a)(iii) and allow (a)(iv) if conseq to wrong k

See * below

1

(v) 1.3×10^{-4} (1.28×10^{-4})

allow (1.26×10^{-4}) to (1.3×10^{-4}) *ignore units*

allow 2 sf

NB If wrong check the orders in part (a)(iii) and allow (a)(iv) if conseq to wrong k

See ** below

1

For example, if orders given are 1st in X and second in OH$^-$
[The mark in a(ii) and also first mark in a(iii) have already been lost]

So allow mark * in (iv) for rate = their k × $(0.012)(0.0175)^2$ = their k ×(3.7×10^{-6})
(allow answer to 2sf)
** in (v) for rate = their k × $(0.012)(0.105)^2$ = their k ×(1.32×10^{-4})
(allow answer to 2sf)

The numbers will of course vary for different orders.

(vi) Lowered

if wrong, no further mark

1

fewer particles/collisions have energy > E_a
OR
fewer have sufficient (activation) energy (to react)

not just fewer successful collisions

1

(b) Step 2

1

(this step with previous) involves one mol/molecule/particle
A and two Bs

or 1:2 ratio or same amounts (of reactants) as in rate equation

if wrong, no further mark

1

[11]

2. (a) (i) Experiment 2 2.60×10^{-3}

1

Experiment 3 0.60×10^{-2}

1

Experiment 4 11.4×10^{-2}

1

(ii) $k = \dfrac{10.4 \times 10^{-3}}{(4.80 \times 10^{-2})(6.60 \times 10^{-2})^2}$

1

= 49.7

(Allow 49.8 and 50)

1

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

1

(b) No change

1

[7]

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

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

(b) (i) *Value of k*: $k = \frac{\text{rate}}{[NO]^2[O_2]} = \frac{6.5 \times 10^{-4}}{(5.012 \times 10^{-2})^2 (2.0 \times 10^{-2})} = 13$

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

(ii) rate = 13 $(6.5 \times 10^{-2})^2$ (3.4×10^{-2})
= 1.9×10^{-3} $(mol\ dm^{-3}\ s^{-1})$ **(1)**
If k wrong, the mark in (ii) may be gained conseq for their k × 1.437 × 10^{-4}

4

[6]

4. (a) 2 or two or second

1

(b) $k = \frac{1.24 \times 10^{-4}}{(4.40)(0.82)}$

mark is for insertion of numbers into a correctly rearranged rate equ, k = etc
if upside down, (or use of I_2 data) score only units mark

1

= 3.44 × 10^{-5} (min 3sfs)

1

$mol^{-1}\ dm^3\ s^{-1}$
any order

1

(c) no change or no effect or stays the same or 1.24×10^{-4}

1

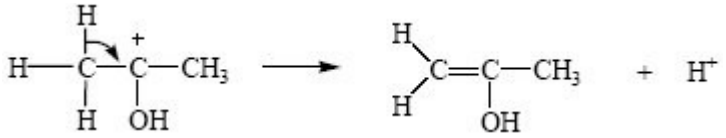
(d) 1 or 2 or 1 and 2
if wrong no further mark but mark on from no answer

1

rate equ doesn't involve I_2 or only step which includes 2 species in rate equ

1

(e)



any second arrow loses the mark

1

[8]

5. (a) $K_p = \frac{P_{SO_2} \times P_{Cl_2}}{P_{SO_2Cl_2}}$ **(1)**

1

(b) 0.25 + 0.75 + 0.75 = 1.75 **(1) (1)**

2

(c) (i) *p* = Total pressure × mol fraction **(1)**

(ii) *Partial of SO_2Cl_2*: $125 \times \frac{0.25}{1.75}$ = 17.9 kPa **(1)**

Partial pressure of Cl_2: $125 \times \frac{0.75}{1.75}$ = 53.6 kPa **(1) (1)**

5

(d) $K_p = \frac{53.6 \times 53.6}{17.9}$ **(1)** = 161 **(1)** kPa **(1)**

3

(e) *Effect on K_p*: increase **(1)**
Explanation: increase T sends equilibrium in endothermic direction **(1)**

2

(f) no effect **(1)**

1

Notes

(a) If K_p has [ ] lose mark in (a) but allow full marks in (d)

If K_p wrong/upside down etc, allow max 2 in (d) for substitution of numbers **(1)** and consequential units **(1)**

(b) Mark for moles of SO_2Cl_2 can be scored in part (c) (ii) if not gained in (b)

1.75 get **(2)**

If moles of SO_2Cl_2 = 1, this is a Chemical Error, hence a 2 mark penalty

- If total moles given in (b) = 1.75, this scores [2] in (b); but if the no moles of SO_2Cl_2 = 1 in (c)(ii), lose both marks in (c)(ii) for pp of SO_2Cl_2 = (1/1.75) × 125, i.e. the 2 mark penalty is in (c)(ii).
- If total moles given in (b) = 2.5, score zero in (b), but can gain full marks in (c)(ii) consequentially, i.e. the 2 mark penalty is in (b).
- If moles of SO_2Cl_2 = 1 and total in (b) does not equal 2.5, still lose both in (b) but can get all 4 conseq in (c)(ii) for 1/x etc and 0.75/x etc

(c) (i) Allow "Total pressure = sum of partial pressures" for **(1)** or $p_A = x_A \times p_{tot}$

(ii) First mark is for mole fraction.
If either number in either mole fraction is not consequential on (b), then lose both marks for that partial p.

(d) If pCl_2 is not equal to pSO_2 or any number used in K_p is not conseq on (c)(ii), allow units only

SIG FIGS; must be 3 sig figs in (b) but then allow 2 sig figs in (c) and (d); (ignore extra figs) but penalise incorrect rounding

(e) If effect wrong, no marks for explanation.
If effect missing, e.g. answer states “equm shifts to right”, mark on.
In the explanation, the word “endothermic” (or its equivalent) is essential.

[14]

6. B

[1]

7. C

[1]

8. C

[1]

9. B

[1]