4.1 test ms

1. (a) (i) Rate = k[X][Y]^2 **(2)**

(ii) 3 **(1)**

(iii) 8 **(1)**   4

(b) (i) *Overall order of reaction*   2 **(1)**

Explanation   doubling both [A] and [B] leads to Rate × 4 **(1)**

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

Explanation   doubling [A] at constant [B] also leads to rate × 4 **(1)**

(iii) Rate = k[A]^2 **(1)**

(iv) $k = \dfrac{Rate}{[A]^2} = \dfrac{3.5\times10^{-4}}{(0.2)^2}$ **(1)**

$= 8.75 \times 10^{-3}$ dm^3 mol^{-1} s^{-1} **(1)**   7

[11]

2. (a) $k = rate/[CH_3CH_2COOCH_3][H^+]$ or

$= \dfrac{1\cdot15\times10^{-4}}{(0.150)(0.555)}$ 1

$= 1.38 \times 10^{-3}$ to 1.4×10^{-3} 1

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

(b) ans = rate constant × (½ × 0.150) × (½ × 0.555)   1
ignore units

= rate constant × 0.0208
2.88×10^{-5} (1.38×10^{-3} gives 2.87×10^{-5})
Allow 2.87 – 2.91 × 10^{-5} (1.4 × 10^{-3} gives 2.91 × 10^{-5})

[4]

3. (a) order with respect to **P** is 2   1
order with respect to **Q** is 1   1

(b) (i) rate = k**[R][S]**^{2} (if wrong expression, no further marks)   1
rate = $(4.2 \times 10^{-4}) \times 0.16 \times 0.84^2$ 1
$= 4.7 \times 10^{-5}$ (mol dm^{-3} s^{-1})   ignore units even if wrong   1

(ii) $k = \dfrac{rate}{[R][S]^2} = \dfrac{8.1\times10^{-5}}{0.76\times0.98^2}$ 1

$= 1.1 \times 10^{-4}$ *   1

(iii) T_1 1
*If calculated value for $k > 4.2 \times 10^{-4}$, then answer to (iii) is T_2

[8]

4. (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

             $= 49.7$ 1

              (Allow 49.8 and 50)

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

   (b)   No change   1

            [7]

5. (a) *Order with respect to iodine*: 0 **(1)**

       Overall order: 2 **(1)**   2

   (b) *Rate constant*: $k = \dfrac{2 \times 10^{-5}}{(1.5) \times (3 \times 10^{-2})} = 4.4(4) \times 10^{-4}$ **(1)**

       Units: $\text{mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$ **(1)**   3

   (c) Appears in rate equation **(1)**

           OR implied by mention of concentration or order

       does not appear in (stoichiometric / overall) equation (1)   2

            [7]

6. (a) (i) change in concentration / amount / mass / volume / (partial) pressure per unit time / per s **(1)**   1

       (ii) constant of (proportionality) in the rate equation **(1)**

            allow reference to *k* in rate equation   1

       (iii) sum of

            dependent on 2nd mark or reference to 'orders' **(1)**

            powers in rate equation **(1)**

            allow reference to annotated rate equation   2

(b)   (i)   (H_2) – 1 **(1)**

eg rate trebles as [H_2] trebles **not** rate doubles as [H_2] doubles **(1)**

(I_2) – 1 **(1)**

eg rate doubles as [I_2] doubles **(1)**

mark these points independently
allow 1 mark for orders if not clear that both are first order   4

   (ii)   rate = k[H_2][I_2] **(1)**

must be [H2] not [H]
allow e.c.f from (b)(i)
allow mark for correct answer for (b)(ii), even if (b)(i) wrong   1

   (iii)   rearrange correctly **(1)**

correct substitution and correct consequential answer **(1)**

correct units ($mol^{-1} dm^3 s^{-1}$) **(1)**

allow e.c.f. from (b)(ii)
allow e.c.f. for incorrect arrangement   3

(c) 4×10^{-6} **(1)**
allow e.c.f. from (b)(ii) and (b)(iii)
could be worked by ratio from values in table or from rate equation   1

[13]