

- M1.** (a) propyl methanoate;
- $$\text{HCOOC}_3\text{H}_7 + \text{OH}^- \rightarrow \text{HCOO}^- + \text{C}_3\text{H}_7\text{OH}$$
- 1
- OR
- $$\text{HCOOC}_3\text{H}_7 + \text{NaOH} \rightarrow \text{HCOONa} + \text{C}_3\text{H}_7\text{OH};$$
- 1
- (b) order wrt A = 1;
- 1
- order wrt NaOH = 1;
- 1
- Initial rate in Exp 4 = 2.4×10^{-3} ;
- 1
- (c) (i) $r(\text{ate}) = k[\text{A}]$
- OR
- $$r(\text{ate}) = k[\text{A}][\text{NaOH}]^0;$$
- (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)
- 1
- (ii) $k = \frac{9.0 \times 10^{-3}}{0.02}$;
- 1
- = 0.45;
- 1
- s^{-1} ;
- 1
- (iii) (large) excess of OH^- or $[\text{OH}^-]$ is large/high;
- 1

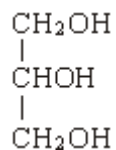
[OH⁻] is (effectively) constant

OR

[A] is the limiting factor (Q of L mark)

1

(d) (i)



1

propan(e)-1,2,3-triol

OR

1,2,3-propan(e)triol

OR

Glycerol;

1

(ii) $\text{CH}_3(\text{CH}_2)_{16}\text{COONa}$ or $\text{C}_{17}\text{H}_{35}\text{COONa}$ or $\text{C}_{18}\text{H}_{35}\text{O}_2\text{Na}$;
(ignore 3 in front of formula but not if indicating trimer)

1

(not just anion and penalise Na shown as covalently bonded) soap -
allow with detergent but not detergent alone;

1

[15]

M2.C

[1]

M3.D

[1]

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

Units: mol⁻¹ dm³ 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

(d) pH = -log₁₀ [H⁺] **(1)**

= 1.25

[H⁺] = 0.056**(2)** **(1)**

∴ rate = (4.44 × 10⁻⁴) × (1.50) × (0.0562)

= 3.75 × 10⁻⁵ **(1)** (mol dm³ s⁻¹)

(3.7 — 3.8)

Can score all 3 conseq on k from part (b)

3

[10]

M6. (a) (i) Experiment 2 2.60 × 10⁻³

1

Experiment 3 0.60 × 10⁻²

1

Experiment 4 11.4 × 10⁻²

1

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

1

= 49.7

(Allow 49.8 and 50)

1

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

1

(b) No change

1

[7]

M7. (a) (i) Experiment 2: $0.4(0) \times 10^{-3}$ (1)
Experiment 3: 0.15 (1)
Experiment 4: 0.28 (1)

(ii) $k = \frac{4.8 \times 10^{-3}}{(0.20)^2 \times (0.30)} = 0.4(0) \text{ mol}^{-2} \text{ dm}^6 \text{ s}^{-1}$

(1) (1) (1)

6

(b) (change in) temperature (1)

1

[7]

M8.C

[1]

M9. (a) (i) 2 (1)

(ii) 0 (1)

2

(b) (i) Value of k : $k = \frac{\text{rate}}{[\text{NO}]^2[\text{O}_2]} = \frac{6.5 \times 10^{-4}}{(5.012 \times 10^{-2})^2 (2.0 \times 10^{-2})} = 13$

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

(ii) $\text{rate} = 13 (6.5 \times 10^{-2})^2 (3.4 \times 10^{-2})$
 $= 1.9 \times 10^{-3} \quad (\text{mol dm}^{-3} \text{s}^{-1})$ (1)

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

4

[6]

M10. (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 =) $k [\text{A}]^2$ (1)

Allow conseq on c(i)

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

conseq on rate equation

4

[6]

Organic points

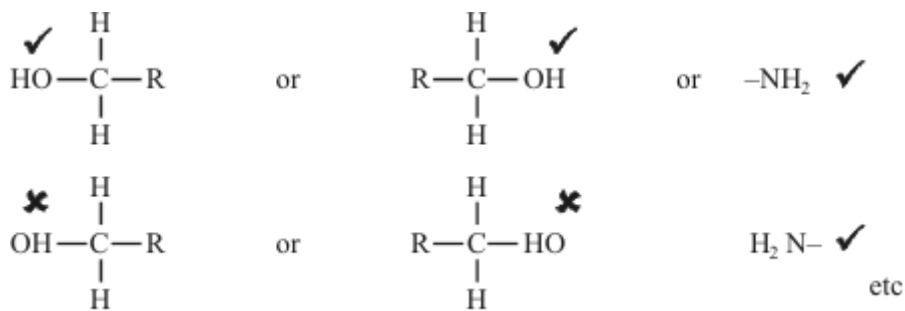
(1) Curly arrows: must show movement of a pair of electrons,
 i.e. from bond to atom or from lp to atom / space

e.g.



(2) Structures

penalise sticks (i.e. $\begin{array}{c} | \\ -\text{C}- \\ | \end{array}$) once per paper



Penalise once per paper

allow CH_3- or $-\text{CH}_3$ or $\begin{array}{c} \text{CH}_3 \\ | \end{array}$ or CH_3
or $\text{H}_3\text{C}-$