

Rate of Reaction

Mark Scheme 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.6 Rate + Extent Chemical Change
Sub-Topic	Rate of Reaction
Difficulty Level	Gold Level
Booklet	Mark Scheme 1

Time Allowed: 55 minutes

Score: /55

Percentage: /100

Grade Boundaries:

M1.(a)	x axis scale correct	1
	y axis scale correct	1
	all points plotted correctly $\pm \frac{1}{2}$ small square	1
	curve correct, omitting the anomalous point	1
(b)	relative formula mass of $\text{NH}_4\text{NO}_3 = 14 + (4 \times 1) + 14 + (3 \times 16) = 80$	1
	mass of ammonium nitrate in 1 dm^3 at $20^\circ\text{C} = 190 \times 10 = 1\,900 \text{ g}$	1
	number of moles of ammonium nitrate in $1\,900 \text{ g} = 1\,900 / 80 = 23.75 \text{ mol}$	1
(c)	small beads would dissolve slower than fine powder	1
	because the surface area of the bead is less than fine powder	1
(d)	increasing the temperature at equilibrium will reduce the amount of ammonia produced	1

because the reaction is exothermic

1

increasing the pressure at equilibrium will increase the amount of ammonia produced

1

because the equilibrium will shift towards the smaller number of molecules in the equation (which is ammonia)

1

[13]

M2.(a) left hand: (conical) flask

*do **not** accept round bottomed
flask or container which is not a flask*

1

right hand: beaker / trough

accept plastic box

1

(b) (i) 157

1

(ii) all calcium carbonate used up **or** reaction stopped

*do **not** accept all acid used up*

1

(c) (i) 0.007(272727...)

*correct answer with or without working gains **2** marks
if answer incorrect, allow (0.32 / 44) for **1** mark*

2

- (ii) 0.007(272727...)
allow ecf from (c)(i)

1

- (iii) ($M_r = \text{mass} / \text{moles} = 1 / 0.00727\dots = 137.5$ or 138
allow ecf from (c)(ii)
if use 0.00943 moles then = 106
if use 0.007 allow 143 (142.857)

1

- (iv) $(138) - 60 (= 78)$
23 / 85

1

$$(78 / 2) = 39$$

1

potassium

sodium / rubidium

identity of metal ecf on A_r , but **must** be Group 1

If no working max 1 mark

1

- (d) (i) (relative atomic mass) would decrease

1

because the mass lost greater

1

so moles carbon dioxide larger **or** moles metal carbonate greater

1

- (ii) no change

1

because the acid (already) in excess

1

so the amount carbon dioxide lost is the same

1

[17]

M3.(a) the forward and backward reactions occur

allow reversible

1

at (exactly) the same rate

1

in a closed system

*allow therefore the concentrations / amounts of the reactants
and products remain the same*

1

- (b) (i) increasing the temperature would lower the yield of ethanol **or** the
(position of) equilibrium moves to the left

*if student has stated that increasing the temperature
increases the yield then award 0 marks*

1

since the backwards reaction is endothermic **or** the forward reaction is
exothermic

1

- (ii) increasing the pressure would increase the yield of ethanol **or** the
(position of) equilibrium moves to the right

*if student has stated that increasing the pressure decreases
the yield then award 0 marks*

1

because the position (of equilibrium) moves in the direction of the lower number of moles (of gas)

2 (moles / molecules / volumes / particles) on lhs / 1 (mole / molecule / volume / particle) on rhs

1

(c) (a catalyst) provides an alternative pathway

1

with lower activation energy

or

(a catalyst) lowers the activation energy (1)

so less energy is needed to react **or** more particles react (1)

1

[9]

M4.(a) (s) (aq) (aq) (g)

must be in this order

2 marks if all four correct

1 mark if 2 or 3 correct

2

(b) (i) 55

ignore units

1

(ii) 54

allow ecf from (b)(i)

1

(iii) 0.92

correct answer with or without working gains 2 marks

ecf from volume in (b)(i)

accept 2 d.p. up to calculator value

if answer incorrect, allow rate = (b)(i) / 60 for 1 mark

2

- (c) (i) circle round point at (48,22)

1

- (ii) problem (1) and explanation (1)

*explanation **must** give lower volume of gas or slower reaction*

ignore human error unless qualified

problem with bung

e.g. bung not placed in firmly / quickly enough

so gas lost

or

problem with reagent

e.g. acid was diluted **or** acid not replaced

so reaction slower

or

problem with temperature

e.g. temperature was lower than recorded temperature

so reaction slower

or

problem with measurement

e.g. length of magnesium less than 8 cm **or** timed for less than a minute

so less gas produced

2

- (d) repeat the experiment (several times)

1

because anomalous results could be excluded

1

and then the mean can be determined / calculated

accept suggestion of alteration to method, which is explained as to why it would reduce the error, for 3 marks (e.g. place the magnesium in a container within the flask (1) so it can be tipped into the acid once the bung is in place (1). This will prevent anomalous results or gas loss (1))
ignore idea of more accurate gas syringe
ignore shorter time intervals

1

- (e) (i) use clean magnesium **or** use magnesium without oxide coating

1

compare results

1

- (ii) **either**

measure the temperature of the acid before (adding magnesium)

1

and after adding magnesium

or

place the conical flask in a water bath (at 40 °C) (1)

compare results (1)

1

[16]