

MARK SCHEME

GCSE

CHEMISTRY

AQA - TRIPLE SCIENCE

C6 - TEST 6

RATE OF REACTION

Advanced

Mark schemes

1.

(a) any **two** from:

- temperature (of the HCl)
- mass or length of the magnesium
- surface area of the magnesium
- volume of HCl

2

(b) (i) (a greater concentration has) more particles per unit volume

allow particles are closer together

1

therefore more collisions per unit time **or** more frequent collisions.

1

(ii) particles move faster

allow particles have more (kinetic) energy

1

therefore more collisions per unit time **or** more frequent collisions

1

collisions more energetic (therefore more collisions have energy greater than the activation energy) **or** more productive collisions

1

(c) (i) add (a few drops) of indicator to the acid in the conical flask

allow any named indicator

1

add NaOH (from the burette) until the indicator changes colour **or** add the NaOH dropwise

candidate does not have to state a colour change but penalise an incorrect colour change.

1

repeat the titration

1

calculate the **average** volume of NaOH **or** repeat until concordant results are obtained

1

(ii) **moles of NaOH**

$0.10 \times 0.0272 = 0.00272$ moles

correct answer with or without working gains 3 marks

1

Concentration of HCl

$$0.00272 / 0.005 = 0.544$$

allow ecf from mp1 to mp2

1

correct number of significant figures

1

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2.

(a) any **two** from:

- heat water / make steam / boil water **or** heat / steam used in stage 1 or from stage 3
- carbon dioxide from stage 3 used in stage 7 /to make urea
- nitrogen and / or hydrogen recycled
- ammonia and / or carbon dioxide recycled

allow unreacted material / gas recycled from stage 5 (to 4)

allow unreacted material / gas recycled from stage 8 (to 7)

NB: if neither of the last two points are awarded unreacted material recycled = 1 mark

2

(b) (i) increase yield

because (forward) reaction is exothermic

ignore references to rate

1

allow because (forward) reaction gives out heat

1

(ii) increase yield

ignore references to rate

1

because more (gaseous) reactant molecules than (gaseous) product molecules

accept because greater volume on the left than the right

1

(c) 76.9 - 77

correct answer gains 2 marks with or without working

allow 77 **or** 76.923...

allow 76 **or** 0.77 **or** 0.76923 for 1 mark

if answer incorrect allow 1 mark for **either**

$$\frac{60}{\text{attempt at total } M_r \text{ of all reactants}} \times 100$$

or

$$\frac{\text{attempt at total } M_r \text{ of area}}{78} \times 100$$

2

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3.

(a) 2.61 / range 2.5 to 2.7

correct answer with **or** without **or** with wrong working gains 2 marks

(accept answers between 2.5 and 2.7)

if answer incorrect moles of salicylic acid = $2/138 = 0.0145$ moles

ie $2/138$ **or** 0.0145 gains 1 mark

or

$(180/138) \times 2$ gains 1 mark

or

1 g $\rightarrow 180/138 = (1.304 \text{ g})$ gains 1 mark

(**not** 1.304g alone)

2

(b) 42.1 range 40.7 to 42.3

accept correct answer with **or** without **or** with wrong working for 2 marks

ecf ie $(1.1 / \text{their answer from (a)}) \times 100$ correctly calculated gains 2 marks

if answer incorrect percentage yield = $1.1 / 2.61 \times 100$ gains 1 mark

if they do not have an answer to part (a)

or

they choose not to use their answer then:

- yield = $(1.1 / 2.5) \times 100$ (1)

- = 44

accept 44 for 2 marks with no working

2

(c) any **one** from:

- errors in weighing
- some (of the aspirin) lost
*do **not** allow 'lost as a gas'*
- not all of the reactant may have been converted to product
eg reaction didn't go to completion
allow loss of some reactants
- the reaction is reversible
accept other products / chemicals
- side reactions
ignore waste products
- reactants impure
- not heated for long enough
- not hot enough for reaction to take place

1

(d) any **one** from:

- use lower temperature
- use less fuel / energy
ignore references to use of catalyst
- produce product faster **or** speed up reaction
- more product produced in a given time (owtte)
- increased productivity
- lowers activation energy

1

[6]

4.

(a) fewer product molecules than reactant molecules (owtte) **or**

accept forward reaction produces fewer molecules

accept left hand side for reactants and right hand side for products

3 reactant molecules and 1 product

or 3 volumes of gas becomes 1 volume of gas

accept high pressure favours the side with fewer molecules

ignore references to reaction rate

1

(b) any **three** from:

- low temperature gives best yield
*accept add heat as increased temperature **or** 'less' as poor yield*
or high temperature gives poor yield
- because the reaction is exothermic
accept reverse argument if clearly expressed
- reaction too slow at low temperature
or reaction faster at high temperature
accept add heat and reaction goes faster
- temperature used gives a reasonable yield
at a fast rate / compromise explained
*allow get less product but it takes less time
for 2 marks*

3

[4]

5.

(a) because sulfur / S (forms)

1

(which) is solid / insoluble / a precipitate / a suspension

1

(b) any **two** from:

- volume of sodium thiosulfate
ignore amount of sodium thiosulfate
- volume of (hydrochloric) acid
ignore amount of (hydrochloric) acid
- concentration of sodium thiosulfate
- concentration of (hydrochloric) acid
*if no other mark, allow 1 mark for same cross **or** same flask **or**
unspecified volume **or** unspecified concentration
ignore same person
do **not** accept references to temperature*

2

(c) rate increases

1

because particles move faster

accept particles have more energy

1

so frequency of collisions increases

*accept particles are more likely to collide **or** more chance of
collisions*

ignore more collisions

1

more particles / collisions have energy greater than (or equal to) the activation energy

1

- (d) cool
accept refrigerate or method to decrease temperature
or
decrease the temperature (of the solutions)

1

[9]

6.

- (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

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7.

(a) 2NH_3

*allow NH_3 with incorrect or missing balancing for 1 mark
allow multiples*

2

(b) (i) 200

1

(ii) rate of reaction (too) slow

allow converse

ignore references to yield / cost

1

(iii) 400

1

(iv) lower yield

allow converse

accept shifts equilibrium to left

allow favours the backward reaction

allow favours side with more (gaseous) molecules

allow lower rate

1

(c) (gases) cooled

it = ammonia

1

ammonia liquefied

accept ammonia condensed

accept ammonia cooled below boiling point for 2 marks

1

[8]

- 8.** (a) (i) 25 °C 1
- (ii) (fractional) distillation 1
- (b) (i) (fertile) land is used to grow fuel crops **or** crops are grown for fuel **or** farmers get a better price for crops for fuel **or** crops for biofuels take up space
ignore biofuels are made from food or plants 1
- less food grown **or** food prices rise **or** less (fertile) land to grow food 1
- (ii) (crops / plants) take in carbon dioxide (while growing / during photosynthesis) 1
- so the CO₂ given out was previously taken in
*do **not** accept burning biofuels does not release CO₂ or releases less CO₂ unqualified*
if no other mark awarded, a statement of "carbon neutral" scores 1 mark 1

- (c) Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking Guidance and apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1–2 marks)

At least one statement about the effect of a condition on either rate **or** yield.

Level 2 (3–4 marks)

Correct statements about the effect of at least one condition on rate **and** yield.

Level 3 (5–6 marks)

Correct statements about the effect of at least one condition on rate and yield **and** at least one correct statement about compromise conditions.

Examples of the points made in the response

Temperature

- a higher temperature gives a lower yield
- a higher temperature gives a faster rate

Pressure

- a higher pressure gives a higher yield
- increase in yield gets less as pressure increases
- a higher pressure gives a faster rate
- increase in rate increases as pressure increases

Catalyst

- using a catalyst speeds up reaction
- catalysts allow a lower temperature to be used and so save energy / reduce energy costs

Compromise

- a higher pressure gives a greater yield but increases costs / (safety) risks
- a high pressure gives a faster rate but increases costs / risks
- a high temperature makes reaction faster but reduces yield
- a catalyst makes reaction faster so a lower temperature can be used which will increase the yield

6

[12]