MARK SCHEME

GCSE

CHEMISTRY

AQA - TRIPLE SCIENCE

C6 - TEST 4

RATE OF REACTION

Intermediate

Mark schemes

1.

(a) sulfur

1

precipitate

allow solid

1

(b) any **one** from:
- (volumetric) pipette
- burette

1

(c) any **one** from:
- concentration of hydrochloric acid
- volume of hydrochloric acid
- volume of sodium thiosulfate solution
- temperature (of solution)
- darkness of cross

allow same cross

- same stirring / swirling

1

(d) 7 points plotted correctly

allow tolerance of ± half a small square

*allow 5 or 6 points plotted correctly for **1** mark*

2

line of best fit

must avoid anomalous point

1

(e) repeatable

*do **not** accept reproducible*

1

(f) discard any anomalous results

1

calculate a mean

1

(g) **conclusion:**
the higher the concentration, the higher the rate of reaction

1

explanation:
(at higher concentrations) there are more particles in a fixed volume

1

(therefore the) collisions are more frequent

1

allow converse

(h) 120 (s)

1

0.18 / 120

allow 0.0015

1

= 1.5×10^{-3} (g / s)

*an answer of 9×10^{-2} scores **2** marks*

*allow an answer of 0.09 for **1** mark*

1

*an answer of 1.5×10^{-3} (g / s) scores **3** marks*

[16]

2. (a) time from when the heating is started until

1

the limewater turns cloudy / milky

1

(b) (i) the temperature was not high enough

accept the copper carbonate had not started to decompose / react

accept it takes time to heat up the copper carbonate

1

the bubbles of gas were air

accept no carbon dioxide produced

1

(ii) the copper carbonate was decomposing / reacting

accept the temperature was high enough to cause decomposition / a reaction

1

so carbon dioxide was produced

allow correct word / symbol equation

1

(iii) copper oxide was produced

allow correct word / symbol equation

1

because the copper carbonate had <u>completely</u> decomposed / reacted

ignore all of the carbon dioxide had been given off

1

[8]

3. (a) sensible line of best fit which goes through or close to all the points **except** the anomalous point

allow wobbly / short double lines

± ½ square

1

(b) loss of gas / loss of CO_2

idea of gas produced / formed

1

(c) 7

1

(d) (i) steeper line from around the same starting point and left of the points

*allow crosses if they are fully correct for **1** mark*

1

levelling off at 99

accept short level line at 99

± ½ square

1

(ii) any **three** from:

- particles / molecules / atoms/ ions have more energy

  allow given / gain / get energy

- move faster

  ignore move about more

  ignore vibrate more / faster

- collide more often

  or more chance of collisions

  or bump into each other more

  ignore collide quicker / faster

- collide with more force / energy

  or more particles have the activation energy

  or more collisions result in reaction

  or more collisions are successful

3

4. (a) 6

accept 5.8 – 6

1

(b) hydrochloric acid used up / reacted / combined / **or** fewer particles (of hydrochloric acid) **or** fewer hydrogen ions owtte

accept reactants used up
*accept less calcium carbonate **or** smaller surface area of calcium carbonate*
accept lower concentration / less crowded
*do **not** accept atoms / molecules*
ignore references to energy
*do **not** accept references to atoms or molecules*

1

fewer collisions owtte

independent mark

1

(c) steeper curve initially

independent marks

1

levels out at same volume

- *must indicate levelling out*
- *if line goes higher than 66 do **not** award this mark*
- *diagonal line only = 0 marks*
- *if steeper initially and then crosses the line and finishes correctly, then loses one*

1

[5]

5. (a) (i) ***must** be chemical symbol*

Ca

1

C

$CaCO_3$= 2 marks

1

O not O_2

1

(ii) carbon dioxide

***must** be name*

1

(b) (i) *points all correct 2 marks*
one point incorrect 1 mark
two points incorrect 0 marks

2

suitable line -narrow neat single curve

not dot to dot

1

(ii) reaction with X forms less gas
***must** include X or Y*
*do **not** penalise for H_2/O_2 if (a) (ii) already penalised*
*do **not** accept is finished in less time **or** slower/faster reaction **or** lower on graph*

1

(iii) any two from:

- concentration (of acid) decreases/less reacting particles/molecules
  ***not** acid/$CaCO_3$ runs out/is used up*
- surface area of calcium carbonate decreases
  ***not** strength of acid decreases*
- less collisions between reacting particles
  ***not** smaller (amount of) $CaCO_3$*

2

[10]

6. (a) increase concentration of acid;
increase surface area of solid
or grind up the solid;
add a catalyst
any two for 1 mark each

2

(b) 1;
it is the one that makes the gas fastest (steeper curve etc)
(second part is dependant on first)
for 1 mark each

2

(c) (i) faster after one minute, slower after 2 minutes
for 1 mark

1

(ii) the reactants get used up;
so concentration decreases/less chance of collision
for 1 mark each

2

[7]

7. (i) A = air
B = natural gas
for 1 mark each

2

(ii) nitrogen
both for 1 mark

1

(iii) catalyst / speed up reaction
for 1 mark

1

(iv) recycle unreacted gases / save money
for 1 mark

1

[5]

8. Factor 1

heating the solution / heat / increasing temperature / candidates can gain one mark here for the idea of the water evaporating faster with increased heat (so heating the reactants faster).

particles (of fat and sodium hydroxide) move faster (not vibration / not just move more) / more kinetic energy

collide more often / more collisions

have more energy when they collide / more successful collisions

Factor 2

concentrated (solution of alkali)

more (sodium hydroxide) particles (in a given volume) particles closer/ more crowded etc.

more collisions / greater chance of successful collisions
each for 1 mark

Possible alternative answer

size of fat pieces / small pieces of fat

have larger surface area

more collisions / greater chance of collisions

[7]

9. (a) NO_2 / $2NO_{2(g)}$ / Nitrogen dioxide
for one mark

1

(b) particles of gas move / they move

reject spread out
particles move randomly / mix / go between air molecules / diffusion
any two for 1 mark each

2

(c) faster reaction / more surface area (*not* smaller pieces)
for one mark

1

(d) (i) **either** lower temperature / particles move slower
fewer collisions (owtte) / less energetic collisions / owtte
or acid diluted (owtte)
fewer collisions (owtte)
for 1 mark each

2

(ii) alkali neutralises the acid / stops the reaction
or water will only slow the reaction not stop it
either for 1 mark

1

[7]

10. (a) as a catalyst
accept to speed up the reaction (equilibrium)

1

(b) nitrogen + hydrogen $\rightleftharpoons$ ammonia
$N_2 + H_2 \rightleftharpoons NH_3$
accept mixed formula / word equations
ignore balancing

1

(c) (i) the reaction is reversible / an equilibrium
accept that ammonia can break down again into nitrogen and hydrogen
accept reaction goes both ways
*do **not** accept some nitrogen and hydrogen do not react*

1

(ii) (the gases are cooled)

no marks as given in the diagram
accept correct formulae NH_3, N_2 H_2

1

ammonia removed as a liquid

*accept ammonia liquefies **or** condenses*

nitrogen and hydrogen are recycled

accept nitrogen and hydrogen are put back through the converter
accept 'other gases' only if ammonia identified for first mark

1

[5]