AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.6.1 RATE OF REACTION (PACK 2)

SCORE	PERCENTAGE
/239	%

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Q1.

(a) any **two** from:

- effervescence / bubbles / fizzing
  allow gas / hydrogen is given off
  allow volume of gas
  allow magnesium floats

- magnesium disappears / dissolves
  allow change in mass of magnesium

- heat given off / exothermic
  allow temperature change
  *do **not** accept temperature decreases*

- change in pH
  *do **not** accept pH decreases*

2

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance.

0 marks
No relevant content.

Level 1 (1-2 marks)
A simple plan without reference to changing any variable but should include an attempt at measuring rate **or** an attempt at fair testing

Level 2 (3-4 marks)
A plan including change of concentration / 'volume' of acid **and** should include an attempt at measuring rate **and / or** an attempt at fair testing

Level 3 (5-6 marks)
A workable plan including change of concentration **and** measurement of rate **and** fair testing

Examples of chemistry points made in the response could include:

Plan:

- add magnesium to acid
- time reaction / 'count bubbles' / measure volume of gas
- change concentration / 'volume' of acid

Control Variables:

- amount / mass / length / same 'size' of magnesium
- volume / amount of acid

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6

[8]

Q2.

(a) (i) 10

1

(ii) OH^-

1

(b) (i) air

1

(ii) particles move faster

1

particles collide more often

1

(iii) catalyst(s)

1

(c) liquid

1

[7]

Q3.

(a) oxygen **and** water

both needed for mark
allow hydrogen oxide for water
in any order
ignore formulae

1

(b) (i) best fit line, omitting point at 10s

straight line drawn through all correct points

1

(ii) circle around point at 10 s

allow any indication

1

(iii) 7.5

allow ecf from candidate's line

1

(iv) increases (with time)

accept goes from 0 to 12.5

1

(c) (i) higher

1

(ii) more concentrated

1

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(d) (i) share

1

(ii) covalent

1

(iii) simple molecules

1

(e) Water has a boiling point of 100°C

1

Water has a melting point lower than room temperature

1

[12]

Q4.

(a) gives out energy **or** heat

1

(b) (i) *accept qualified answers in terms of volume of gas related to time*

fast initially

1

slows down

1

reaction stops

accept reaction is now very slow

1

(b) (ii) 21

1

(iii) 84

*correct answer with or without working = **2** marks*
*allow ecf from (b)(ii) correctly calculated for **2** marks*
*allow evidence of 21/25 **or** (b)(ii)/25 for **1** mark*

2

(c) because they / particles have more energy / move faster

ignore particles move more / vibrate

1

(and so) particles collide more often / more frequently **or** particles more likely to collide

ignore collide faster
ignore more collisions

1

(and) more of the collisions are successful **or** particles collide with more energy / harder **or** more of the particles have the activation energy

accept more successful collisions

1

[10]

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Q5.

(a) 118

1

(b) it loses / transfers electrons

it = Au / gold atom

1

three electrons

*sharing / covalency = max **1** mark*

1

(c) (i) O_2

1

2 CO and **2** CO_2
or
correct balancing of equation from O

accept correct multiples / fractions throughout

1

(ii) *reference to incorrect bonding = **1** mark max*

because carbon dioxide is simple molecular / small molecules

1

there are *intermolecular* forces (between the molecules)

allow intermolecular bonds

1

so a small amount of energy needed (to separate molecules) **or** (*intermolecular forces*) are weak

1

(d) any **three** from:

- gold is the only catalyst for some reactions
- catalysts are not used up
- improves speed of reaction

  reduces amount of energy **or** process needs low(er) temperature

  *if no mark awarded, allow catalyst reduce costs (of the process) for **1** mark*

- only small quantities (of catalyst) needed

3

[11]

Q6.

(a) (i) the temperature at start

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ignore reference to bubbles / heat

1

the temperature at end

*(measure) the temperature rise / change = **2** marks*

*(measure) the temperature **1** mark*

1

(ii) temperature would increase

allow it gets hot(ter) / warm(er) or heat given off

allow energy released / transferred

1

(b) any **one** from:

- volume of acid
  allow amount
  allow liquid
- temperature of acid
- size of magnesium ribbon
  allow volume / mass / amount
- surface area of magnesium
  ignore size of test tube and reference to water

1

(c) (i) (Test tube) B

1

(ii) produces bubbles faster

accept more bubbles

or

faster rate of reaction

allow most reactive

1

(d) The particles move faster

1

The particles collide more often

1

[8]

Q7.

(a) mixture is cooled / cooling

1

so ammonia / it condenses

or

so ammonia <u>turns into</u> a liquid (but nitrogen and hydrogen remain as gases)

1

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(b) (i) exothermic reaction

accept reverse reaction is endothermic

or

equilibrium / reaction moves in the direction which raises the temperature

ignore answers based on rate or collisions

1

(ii) they / particles / molecules move faster **or** have more (kinetic) energy

allow atoms instead of particles

ignore particles move more / vibrate

*do **not** accept electrons (max1)*

1

any **one** from:

- particles / molecules collide more often / more frequently / more likely to collide

  ignore collide faster

  ignore more collisions

- more of the collisions are successful **or** particles collide with more energy / harder **or** more of the particles have the activation energy

  accept more successful collisions

1

(iii) more molecules / particles / moles / volumes on LHS (of equation than RHS)

accept 4 molecules / particles / moles / volumes on LHS and 2 molecules / particles / moles / volumes on RHS

or

greater volume on LHS (than RHS)

or

equilibrium / reaction moves in the direction which reduces the pressure / volume

accept converse

1

(iv) cost

or

difficulty in containing such a high pressure

allow risk of explosion

ignore dangerous

1

(c) (i) 60

1

(ii) 2.4(2857….)

*correct answer gains **3** marks with or without working*

accept any answer that rounds to 2.4

ignore units

if answer is incorrect look for evidence of correct working to a

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*maximum of **2** marks.*
moles of N_2 = 2/28 = (0.0714)
moles of ammonia = 2 × 0.0714 = (0.1428)
mass of ammonia = 0.1428 × 17 = (2.4276)
or
28 → 34
1g →34/28
2g →2.4… …..

3

(d) (i) 15

1

(ii) unreacted gases are recycled
allow unreacted gases are reused

1

rate (of production) is fast
accept production is continuous
ignore compromise between rate and yield

1

[14]

Q8.

(a) (i) increase

1

(ii) energy is given out to the surroundings

1

(b) (i) NO
allow 2NO
ignore nitrogen oxide
*do **not** allow equations*

1

(ii) harmful / poisonous (owtte)
allow dangerous
ignore reference to pollution / global warming
*do **not** accept references to ozone layer*

1

(c) a catalyst can speed up a chemical reaction

1

different reactions need different catalysts

1

(d) (i) smaller
accept less / tiny / very small
allow 10^{-9}
*do **not** allow small unless qualified*

1

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(ii) reduce cost (owtte) **or**

ignore references to energy

save resources / raw materials (owtte)

1

[8]

Q9.

(a) gives out heat / energy

allow release / loses

allow the products have less energy

or

energy / heat transferred to the surroundings

ignore temperature rises

allow more energy given out in forming bonds than taken in to break bonds

1

(b) (i) speed up the reaction (owtte)

accept changes the rate

accept lowers activation energy

accept increases <u>successful</u> collisions

accept allows reaction to take place at a lower temperature

1

(ii) nitrogen (N_2) / oxygen (O_2) / products are safe **or** not harmful / pollutant / toxic / dangerous / damaging

ignore releases nitrogen / oxygen unless qualified

or

(harmful) nitrogen monoxide / NO is not released into the air.

accept prevents / less acid rain

ignore greenhouse gas / ozone layer

1

(iii) 2 and 2

accept correct multiples or fractions

1

(iv) idea of catalyst not being used up

allow not changed by reaction

ignore catalyst does not take part

ignore catalyst not used in the reaction

1

(v) idea of different reactions (require different catalysts)

accept catalysts work for specific reactions

allow different gases

1

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(c) • smaller / very small / or any indication of very small / 1–100 nanometres / a few (hundred) atoms

ignore just small

ignore size of the converter

1

• big(ger) surface area

1

• less (catalyst) needed / small amount of catalyst needed

1

[9]

Q10.

use a more concentrated solution of sulfuric acid

1

grind the phosphate rock into a powder before adding the acid

1

increase the temperature of the sulfuric acid

1

[3]

Q11.

(a) particles move faster

accept molecules / atoms / ions instead of particles

or

particles have more energy

ignore move / vibrate more

1

so they collide more often / frequently

allow particles collide harder / with more force

ignore collide quicker

or

more of the collisions are successful / have the activation energy

ignore collide more / more collisions

1

(b) any **one** from:

• increase surface area (of the rock)

accept crush / powder the rock

• increase the concentration (of the acid)

ignore increase the pressure / temperature

• add a catalyst

• stir / mix the mixture

1

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[3]

Q12.

(a) goes up

1

(b) (i) B

1

(ii) A

1

(iii) a catalyst

1

activation energy

1

(c) (i) eg (ensures) complete reaction

allow spread heat / energy

or even heating

allow mixes properly or mix them together or to get correct temperature

ignore dissolves

1

(ii) lid (on beaker)

accept cover beaker

or

insulate (beaker) / use a plastic cup

1

[7]

Q13.

(a) energy released from making (new) bonds is greater than the energy needed to break (existing) bonds

accept the energy needed to break (existing) bonds is less than the energy released in making (new) bonds

*do **not** accept energy needed to make bonds*

1

(b) (i) energy / heat of products less than energy of reactants

accept products are lower than reactants

***or** reactants higher than products*

accept more energy / heat given out than taken in

***or** less energy / heat taken in than given out*

accept energy / heat is given out / lost (to the surroundings)

allow produce heat

ignore produce energy

accept ΔH is negative

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or *energy change / **A** is negative*
or B *is less than* ***C***

1

(ii) **B** is (very) high / large
*it = **B***
*ignore energy change **C** is high*

1

(iii) *it = MnO_2*

(MnO_2) catalyst (is added)
accept it is a catalyst

or reaction catalysed (by MnO_2)
*do **not** accept MgO / magnesium oxide*

1

which lowers activation energy
accept provides alternative / lower energy pathway

or which lowers (energy change) **B**
if hydrogen peroxide is given as a catalyst instead of MnO_2 penalise once only in question

1

(c) any **two** from:

- (chemicals) not mixed / stirred
- heat / energy lost (from apparatus)
- (apparatus) not insulated **or** no lid
- low amount / mass / not enough MnO_2 **or** low concentration H_2O_2
- thermometer read incorrectly
ignore other experimental error

2

[7]

Q14.

(a) (i) mix (owtte)
accept to allow more collisions / helps particles to collide (owtte)
idea of more efficient heat transfer
*do **not** allow heat is a catalyst*

1

(ii) higher **and** more

1

powder **and** big

1

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concentrated **and** more

1

(b) electrons

1

(c) H^+

1

[6]

Q15.

(a) (i) 0.2

*correct answer gains **2** marks with or without working*
accept answer in table
*if answer incorrect 5/25 gains **1** mark*

2

(ii) any **one** from:

- wider range of temperatures (owtte)
- (repeat at the same temperature) to improve accuracy / reliability
  allow to make it reliable / accurate
- reveal anomalous results (owtte)
  allow to eliminate random / human errors / to check results owtte
- so you can get an average / better average
  ignore to make it a fair test / to get better results
  ignore precision and validity

1

(b) any **two** from:

allow atoms / molecules / they instead of particles throughout

- particles gain energy / have more energy
  ignore increases particles activation energy
- particles move faster
  ignore move more / vibrate more
- particles collide more
- more of the particles have the activation energy **or** more of the collisions are successful (owtte)
  ignore increases / decreases activation energy

or
particles <u>collide</u> with more force / harder / more energy
allow more successful collisions
*alone for **1** mark*

2

[5]

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Q16.

(a) the glow stick is brighter (owtte)

*accept glow stick is less bright **at low temperatures** (owtte)*
ignore references to rate / particles

1

(b) gave out light for less time

accept use of figures from table for comparison
allow reference to speed / rate eg quicker / faster reaction

1

(c) the particles will collide more often

1

the particles will move faster

1

the particles will have more energy

1

(d) any **one** from:

repeat

allow more glow sticks

measure brightness eg use light meter

more temperatures **or** wider range

improve precision

1

[6]

Q17.

(a) same number of (gaseous) molecules / moles / volume on both sides of the equation

allow particles for molecules
*do **not** accept atoms*
ignore amount

1

(b) (forward) reaction is exothermic

accept reverse answer

1

(c) any **three** from:

- particles gain energy
- particles move faster

  allow particles collide faster / quicker
  ignore move more / vibrate more
- particles collide more **or** more collisions

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- more of the collisions are successful **or**
  more of the particles have the activation energy **or**
  particles collide with more force / energy

3

(d) any **two** from:

- more product (obtained in shorter time)
  accept better yield (of product)

- less fuel needed
  accept less energy / heat / electricity needed

  or

  lower fuel costs
  ignore cheaper unqualified

- less pollution caused by burning fuels

  or

  less specified type of pollution caused by producing heat / burning fuels
  *allow correct specified pollutants caused by burning fossil fuels eg CO_2 / greenhouse gases **or** correct effect of burning fossil fuels eg global warming*
  accept thermal / heat pollution

- using less fuel conserves resources
  accept sustainable
  accept fossil fuels are non-renewable

2

[7]

Q18.

(a) (i) increase

1

(ii) high melting point

1

(b) (i) decreases

1

increases

1

(ii) it gives the particles more energy

1

it makes the particles move faster

1

[6]

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Q19.

(a) (i) increase (owtte) **or** gets hotter

ignore gives out heat / takes in heat

1

(ii) any **two** from:

- bonds are strong
  accept hard to break
- a lot of energy needed to break bonds
  allow heat for energy
- all atoms are joined by (covalent bonds
  accept forms lattice
- a large number of bonds would need to be broken
  *reference to ionic / metallic = **1** mark*
  *intermolecular forces /forces between molecules = max **1** mark*
  ignore electrostatic
  *many strong bonds need to be broken = **2** marks*
  accept 'double bonds' as equivalent to bonds

2

(b) any **two** from:

- particles have more energy
  ignore more vibrations
- particles move faster
  ignore move more
- particles collide more often **or**
  more collisions
  accept answers such as hit / bump
- more particles / particle collisions
  have the activation energy
  or
  more of the particles / particle collisions have
  enough energy to react
  or
  collisions are more energetic / harder (owtte)
  or
  more of the collisions are successful
  *if electrons rather than particles stated then max **1** mark*
  *there are more collisions and more of the collisions are successful = **2** marks*
  *accept more collisions per second / unit of time for **2** marks*
  *accept 'more successful collisions' for **1** mark*

2

[5]

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Q20.

(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) × 2 gains **1** mark*
or
*1 g → 180/138 = (1.304 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 / their answer from (a)) × 100 correctly calculated gains **2** marks*

*if answer incorrect percentage yield = 1.1 / 2.61 × 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) × 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

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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]

Q21.

(a) (i) a continuous straight line missing anomalous point
allow a line which does not start at zero / origin

1

(ii) any **two** sensible errors eg

- timing errors and / or example(*)
- measurement errors and / or example(*)
- apparatus errors and / or example(*)
- human / experimental / random error and / or example or 'did not do it right'(*)
  *(*)could be two from **same** category eg two timing errors – watch not started at the same time plus difficulty in deciding when the cross has disappeared.*
- temperature fluctuation
- anomalous point
  accept outlier / wrong result
- results not recorded correctly
- plotting error
- rate calculated incorrectly
  ignore 'not repeated'
  *ignore systematic / zero error / weighing error **or** error unqualified*

2

(b) (i) straight line

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or

as concentration increases the rate goes up **or** converse

accept numerical example

accept positive correlation

accept same gradient

ignore 'most points near / on line of best fit'

1

(ii) more collisions

accept greater chance of collisions

accept collide more successfully

accept alternative versions of collide eg 'bump / hit'

ignore references to energy / speed of particles / surface area

1

more particles (in each volume of solution)(i.e. an attempt at defining concentration)

accept 'particles are closer together'

allow ions / atoms / molecules for particles ignore reactants

*accept greater frequency of collisions **or** greater number of collisions per second for **2** marks*

1

[6]

Q22.

(a) (bonds broken) = 1370 (kJ)

1

(bonds made) = 1856 (kJ)

1

change in energy = (–) 486

ecf

ignore sign

*correct answer with **or** without working = **3** marks*

1

(b) energy released from forming new bonds is greater than the energy needed to break existing bonds

allow the energy needed to break bonds is less than the energy released in forming bonds

*do **not** accept energy needed to form bonds*

1

(c) (i) energy barrier needs to be overcome

or

activation energy supplied / needed

*allow energy needed to start reaction **or** energy needed to break bonds*

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accept high activation energy

1

(ii) lowers activation energy(*)

or

provides lower energy pathway / route(*)

*(*)**2** mark answers*

*allow provides alternative pathway **or** platinum / it is a catalyst for **1** mark*

2

[7]

Q23.

(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

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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

Q24.

(a) (i) (phosphoric) acid

allow phosphoric acid

1

(ii) hydrogen

1

(b) (i) faster / quicker / speeds it up (owtte)

allow answers based on activation energy

ignore helps it to react

1

(ii) most of the starting materials end up as useful products

1

(iii) H_2O

*allow HOH **or** OH_2*

1

[5]

Q25.

(a) any **two** from:

- increases

  owtte allow 'goes up'

- until reaches maximum / levels off

  owtte

- quickly at first

  owtte

- then more slowly / rate decreases

  allow reaction finished

  ignore rate increases

2

(b) use a more concentrated acid

list principle applies

use zinc powder

2

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[4]

Q26.

(a) (i) sulfuric

accept H_2SO_4
accept sulphuric
allow phonetic spellings

1

(ii) $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$

***1** mark for reactants*
***1** mark for products*
ignore state symbols
*max **1** mark for incorrect balancing*

2

(b) any **two** from:

- particles gain energy **or** particles have more energy
  allow have more activation energy
- particles move faster
  allow they collide faster / quicker
  ignore move / vibrate more
- collide more often
  allow more collisions
- collide more energetically
- more of the collisions are successful
  or more particles have the activation energy
  ***NB** more successful collisions alone = **1** mark*
  *if particles are identified as electrons = max **1** mark*

2

[5]

Q27.

(a) (i) energy / heat of products less than energy of reactants

owtte
allow products are lower than reactants
allow more energy / heat given out than taken in
allow methanol is lower
allow converse
allow energy / heat is given out / lost allow ΔH is negative

1

(ii) lowers / less activation energy

owtte
allow lowers energy needed for reaction
***or** it lowers the peak/ maximum*

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*do **not** allow just 'lowers the energy'*

1

(b) (i) bonds broken: (2 × 435) + 498 = 1368

allow: (8 × 435) + 498 = 3978

1

bonds made: (2 × 805) + (2 × 464) = 2538

allow: (6 × 435) + (2 × 805) + (2 × 464) = 5148

1

energy change: 1368 – 2538 = (–)1170

allow: 3978 – 5148 = (–)1170

ignore sign

allow ecf

*correct answer (1170) = **3** marks*

1

(ii) energy released forming new bonds is greater than energy needed to break existing bonds owtte

allow converse

*do **not** accept energy needed to form new bonds greater than energy needed to break existing bonds*

1

[6]

Q28.

(a) (i) accurate plotting of points ($\pm \frac{1}{2}$ square)

***2** marks for all points*
***1** mark for 3 or 4 points*

2

sensible smooth curve

reasonable attempt
*do **not** accept double lines **or** dot to dot*

1

(ii) accurately read from <u>their</u> graph to $\pm \frac{1}{2}$ square

1

(b) (i) (as temperature increases) rate <u>increases</u>

accept speeds up, gets faster, gets quicker
accept higher speed
*do **not** accept gets bigger / higher unqualified*
*do **not** accept answers about time on its own*

1

(ii) **Quality of Written Communication**

The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written

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communication should be considered in crediting points in the mark scheme.

maximum 2 marks if ideas not expressed well

any **three** from:

for converse maximum 2 marks

particles have more energy

higher kinetic energy

particles move faster

*do **not** accept move more or vibrate more*

3

more collisions

accept greater rate of collisions

more energetic / successful / harder collisions

more particles have activation energy

(c) concentration (of solutions) **or** volume (of solutions)

accept 'how much of'
accept references to intensity of colour
accept same endpoint
accept rate of stirring / shaking
*do **not** accept reference to solids **or** catalysts etc*
ignore containers
*do **not** accept pH*

1

[9]

Q29.

(i) measure volume / mass of gas produced

1

in a certain time period

***1** mark is for a sensible way of measuring the amount of product produced and **1** mark is for the idea of timing*

e.g. measure volume of gas produced at regular time intervals
or time taken to fill a test tube with the gas
or collect a certain volume of gas

*(measuring the rate at which bubbles are produced e.g. number of bubbles in 30 seconds gains only **1** mark unless an enclosed system is used)*

or measure decrease in mass of flask and contents at regular time intervals

or time taken for the mass to decrease by certain amount

1

(ii) increases rate (owtte)

1

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(ii) change the concentration **or** add a catalyst **or** change the surface area **or** lower the temperature

*accept 'expose to sunlight' (owtte) **or** change the amount of water / powder / solution used*

ignore 'stirring'

1

[4]

Q30.

(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]

Q31.

(a) (i) yield increases

two marks are linked

1

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

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accept 7 → 4 moles or volumes
ignore more reactants
accept fewer particles on the right

1

(ii) increased (rate) / faster / speeds up etc
two marks are linked

1

more collisions **or** increased concentration **or** particles closer together
greater chance of more successful collisions

1

(b) heat / high temperatures
*do **not** accept burn it ignore cracking / catalyst*

1

[5]

Q32.

(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*

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- surface area of calcium carbonate decreases
  not *strength of acid decreases*
- less collisions between reacting particles
  not *smaller (amount of)* $CaCO_3$

2

[10]

Q33.

(a) (i) H_2O_2 reactant correct
ignore any state symbols

1

$H_2O + O_2$ products correct

1

$2H_2O_2 \rightarrow 2H_2O + O_2$ balanced
accept correct multiple

1

(ii) glowing splint

1

relights
accept 'bursts into flame'
*do **not** accept a lighted splint burns brighter **or** faster*

1

(b) unchanged
*accept **not** used up **or** left (behind)*

1

(c) (i) gas syringe **or** measuring cylinder **either** with scale drawn **or** labelled

1

the apparatus as drawn would work

1

(ii) correct plotting of points
one *mark to be deducted for each error*

2

best fit graph line drawn (single line drawn)

1

(iii) concentration of hydrogen peroxide decreases
accept less particles of hydrogen peroxide to collide
*do **not** accept hydrogen peroxide gets used up*

1

rate of reaction decreases
accept reaction gets slower

1

(iv) any two from:

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- temperature
- pressure
- division of catalyst **or** manganese oxide
  *do **not** accept any other factors*

2

[15]

Q34.

(a) (i) $Na_2S_2O_3(aq) + 2\ HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + S(s) + SO_2(g)$

1

(ii) (formation of) sulphur
*accept precipitate **or** solid produced*
*do **not** accept goes cloudy **or** milky*

1

(b) (i) heat ≡ temperature increased temperature increases (the rate of reaction)
or decreased temperature decreases rate of reaction
may be gained in part (ii) if stated and not implied

1

(ii) (these ideas may be given in (i))

particles have more kinetic energy
accept particles move faster

1

more collisions (so more reactions)
*more energetic collisions **two** marks*

1

[5]

Q35.

(a) exothermic (reaction)

1

(b) smaller lumps react faster
or larger lumps react slower
accept smaller lumps cause a more rapid rise in temperature
***or** vice versa*
*do **not** accept higher temperature*
***or** more heat unless linked to time*

1

smaller lumps have a larger surface (area) or larger lumps have a smaller surface (area)
more water can react at the same time
***or** so less water can react at the same time*

1

(c) heats up (too) rapidly
accept temperature (too) high

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1

burning the food **or** the hands

*accept danger of container exploding **or** splitting **or** food overheating*

do not accept reference to handling of powder

*do **not** accept a lot of powder needed **or** powder getting into food **or** too hot to eat **or** food would not cook properly **or** heat through properly*

1

[5]

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