

M1.(a) line goes up before it goes down 1

energy given out correctly labelled 1

activation energy labelled correctly 1

(b) electrostatic force of attraction between shared pair of negatively charged electrons 1

and both positively charged nuclei 1

(c) bonds formed = $348 + 4(412) + 2(276) = 2548$ kJ / mol 1

bonds broken – bonds formed = $612 + 4(412) + (\text{Br-Br}) - 2548 = 95$ kJ / mol 1

Alternative approach without using C-H bonds

For step 1 allow = $348 + 2(276) = 900$ kJ / mol

Then for step 2 allow $612 + (\text{Br-Br}) - 900 = 95$ kJ / mol

193 (kJ / mol) 1

accept (+)193 (kJ / mol) with no working shown for 3 marks

-193(kJ / mol) scores 2 marks

allow ecf from step 1 and step 2

(d) **Level 3 (5–6 marks):**

A detailed and coherent explanation is given, which demonstrates a broad understanding of the key scientific ideas. The response makes logical links between the points raised and uses sufficient examples to support these links. A conclusion is reached.

Level 2 (3–4 marks):

An explanation is given which demonstrates a reasonable understanding of the key scientific ideas. A conclusion may be reached but the logic used may not be clear or linked to bond energies.

Level 1 (1–2 marks):

Simple statements are made which demonstrate a basic understanding of some of the relevant ideas. The response may fail to make logical links between the points raised.

0 marks:

No relevant content.

Indicative content

Size and strength

- chlorine atoms have fewer electron energy levels / shells
- chlorine atoms form stronger bonds
- Cl–Cl bond stronger than Br–Br
- C–Cl bond stronger than C–Br

Energies required

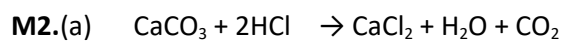
- more energy required to break bonds with chlorine
- more energy given out when making bonds with chlorine
- overall energy change depends on sizes of energy changes

Conclusions

- if C–Cl bond changes more, then less exothermic
- if C–Cl bond changes more then more exothermic
- can't tell how overall energy change will differ as do not know which changes more.

6

[14]



2

allow 1 mark for correct formulae

(b) sensible scales, using at least half the grid for the points

1

all points correct

± ½ small square

allow 1 mark if 8 or 9 of the points are correct

2

best fit line

1

(c) steeper line to left of original

1

line finishes at same overall volume of gas collected

1

(d) acid particles used up

allow marble / reactant used up

1

so concentration decreases

allow surface area of marble decreases

1

so less frequent collisions / fewer collisions per second

do **not** accept fewer collisions unqualified

1

so rate decreases / reaction slows down

1

(e) mass lost of 2.2 (g)

1

time taken of
270 s

allow values in range 265 – 270

1

$$\frac{2.2}{270} = 0.00814814$$

allow ecf for values given for mass and time

1

0.00815 (g / s)

or

8.15×10^{-3}

allow **1** mark for correct calculation of value to 3 sig figs

accept 0.00815 or 8.15×10^{-3} with no working shown for **4** marks

1

(f) correct tangent

1

eg 0.35 / 50

1

0.007

allow values in range of 0.0065 – 0.0075

1

7×10^{-3}

1

accept 7×10^{-3} with no working shown for 4 marks

[20]

M3.(a) both water vapour and ethanol will condense

allow steam for water vapour

allow they both become liquids

allow ethane condenses at a lower temperature

allow some of the steam hasn't reacted

allow it is a reversible reaction / equilibrium

1

(b) amount will decrease

1

because the equilibrium will move to the left

1

(c) more ethanol will be produced

1

because system moves to least / fewer molecules

1

[5]

M4.(a) (i) any **two** from:

ignore any conclusion drawn referring to data below 7.5 nm or above 20 nm

- *100% of (type 1 and type 2) bacteria are killed with a particle size of 7.5 to 8.5 nm*
accept nanoparticles in the range of 7.5 to 8.5 nm are most effective at killing (type 1 and type 2) bacteria
- *as the size increases (beyond 8.5 nm), nanoparticles are less effective at killing (type 1 and type 2) bacteria*
- *type 1 shows a linear relationship **or** type 2 is non-linear*
- *type 1 bacteria more susceptible than type 2 (at all sizes of nanoparticles shown on the graph)*
allow type 2 bacteria are harder to kill

2

- (ii) (yes) because you could confirm the pattern that has been observed
allow would reduce the effect of anomalous points / random errors
allow would give better line of best fit
ignore references to reliability / precision / accuracy / reproducibility / repeatability / validity

or

(no) because trend / *conclusion* is already clear

1

(b) magnesium loses electron(s)

1

oxygen gains electron(s)

1

two electrons (per atom)

1

gives full outer shells (of electrons) **or** *eight electrons in highest energy level*
*reference to incorrect particles **or** incorrect bonding **or** incorrect structure = max 3*

1

or

(electrostatic) attraction between ions **or** forms ionic bonds
accept noble gas structure

[7]

M5.(a) weaker bonds

allow (other substances) react with the silicon dioxide

or

fewer bonds

ignore weaker / fewer forces

or

disruption to lattice

do **not** accept reference to intermolecular forces / bonds

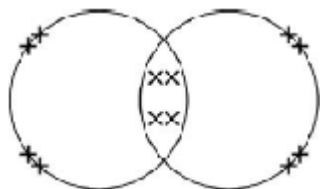
1

(b) (i) Na₂O

do **not** accept brackets or charges in the formula

1

(ii)



electrons can be shown as dots, crosses, e or any combination

2 bonding pairs

accept 4 electrons within the overlap

1

2 lone pairs on each oxygen

accept 4 non-bonding electrons on each oxygen

1

(c) lattice / regular pattern / layers / giant structure / close-packed arrangement

1

(of) positive ions **or** (of) atoms

1

(with) delocalised / free electrons

reference to incorrect particles **or** incorrect bonding **or** incorrect structure = max 2

1

[7]