Mark schemes

1

(a) any **one** from:

- there was a flame
- energy was given out
- a new substance was formed
- the magnesium turned into a (white) powder

answers must be from the figure

1

(b) Magnesium oxide

1

(c) The reaction has a high activation energy

1

(d) 9

1

(e) They have a high surface area to volume ratio

1

(f) any **one** from:

- Better coverage
- More protection from the Sun's ultraviolet rays

1

(g) any **one** from:

- Potential cell damage to the body
- Harmful effects on the environment

1

(h) indication of $\frac{1}{1.6} = 0.625$

and

use of indices $10^{-9} - 10^{-6} = 10^{3}$

Both steps must be seen to score first mark

1

$0.625 \times 1000 = 625$ (times bigger)

1

[9]

2

(a) **B**

1

(b) **D**

1

(c) **E**

1

(d) **C**

1

(e) 92.5 × 6 **and**
7× 7.5

1

$\frac{607.5}{100}$

1

6.075

1

6.08

1

*allow 6.08 with no working shown for **4** marks*

[8]

3 (a) 13 (protons)

The answers must be in the correct order.

*if no other marks awarded, award **1** mark if number of protons and electrons are equal*

1

14 (neutrons)

1

13 (electrons)

1

(b) has three electrons in outer energy level / shell

allow electronic structure is 2.8.3

1

(c) **Level 3 (5–6 marks):**
A detailed and coherent comparison is given, which demonstrates a broad knowledge and understanding of the key scientific ideas. The response makes logical links between the points raised and uses sufficient examples to support these links.

Level 2 (3–4 marks):
A description is given which demonstrates a reasonable knowledge and understanding of the key scientific ideas. Comparisons are made but may not be fully articulated and / or precise.

Level 1 (1–2 marks):
Simple statements are made which demonstrate a basic knowledge of some of the relevant ideas. The response may fail to make comparisons between the points raised.

0 marks:
No relevant content.

Indicative content

Physical
Transition elements
- high melting points
- high densities
- strong
- hard

Group 1
- low melting points
- low densities
- soft

Chemical
Transition elements
- low reactivity / react slowly (with water or oxygen)
- used as catalysts
- ions with different charges
- coloured compounds

Group 1
- very reactive / react (quickly) with water / non-metals
- not used as catalysts
- white / colourless compounds
- only forms a +1 ion

6

[10]

4 (a) any **one** from:

- heat
- stir

1

(b) filter

accept use a centrifuge

accept leave longer (to settle)

1

(c) any **one** from:

- wear safety spectacles
- wear an apron

1

(d) evaporation at **A**

1

condensation at **B**

1

(e) 100

1

[6]

5 (a) The forces between iodine molecules are stronger

1

(b) anything in range +30 to +120

1

(c) Brown

1

(d) $2\ I^- + Cl_2 \rightarrow I_2 + 2\ Cl^-$

1

(e) It contains ions which can move

1

(f) hydrogen iodine

1

[6]

6 (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) + (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 + (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 then Br–Br
- C–Cl bond stronger that 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]

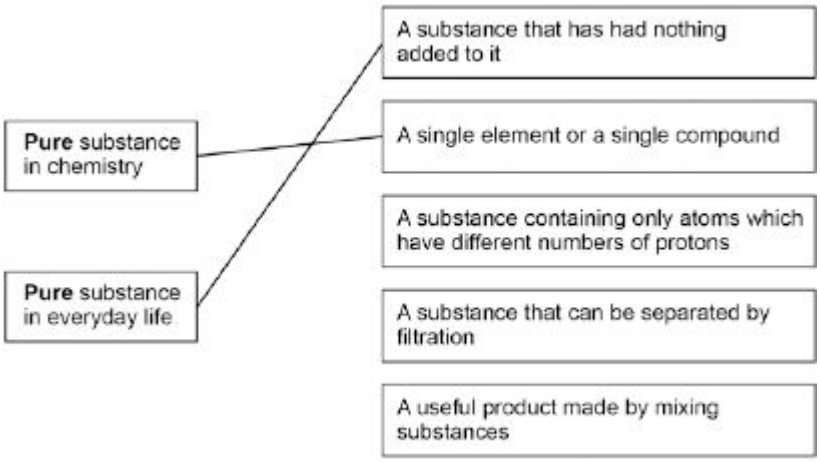
7 (a) Air

2

Steel

1

(b)



Allow **1** mark for the correct meanings linked to context but incorrect way around

1

(c) Damp litmus paper turns white

1

(d) Iron(III)

1

[6]

8

(a) 50

1

(b) 5%

1

(c) any **two** from:

- cost (9 carat is cheaper)
- pure gold is soft
  or
  24 carat gold is soft
  or
  9 carat gold is harder
  allow 9 carat gold is stronger
  allow gold is an alloy in 9 carat gold
- can change the colour

2

[4]

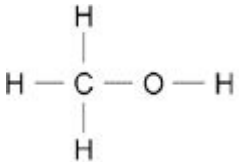
9

(a) Propanol

1

(b) Butanol has the highest boiling point

1

(c) 

1

(d) ethene + water (→ ethanol)

allow answers in either order

allow steam for water

1

(e) goes back to reactor

allow is recycled

1

(f) air contains oxygen

1

which oxidises ethanol

allow ethanol reacted with oxygen

1

to produce ethanoic acid

1

[8]

10 (a) C_5H_{12}

1

(b) Alkanes

1

(c) (3) CO_2

1

(4) H_2O

1

*allow for **1** mark*

4 CO_2 + 3 H_2O

(d) contains hydrogen and carbon

1

(hydrogen and carbon) <u>only</u>

1

(e) *(diesel)*

produces more oxides of nitrogen

allow converse answers in terms of petrol

1

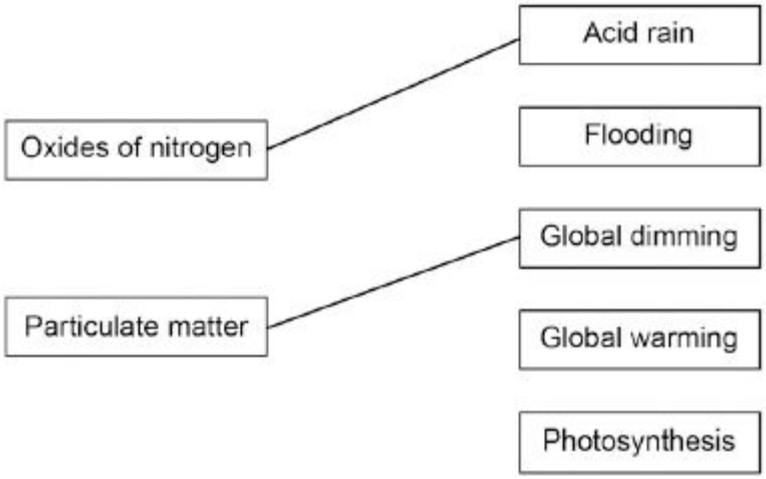
produces (more) particulate matter

1

produces less carbon dioxide

1

(f)



2

[11]

11 (a) filtration
or
by passing through filter beds to remove solids

1

sterilisation to kill microbes

allow chlorine / ozone allow ultraviolet light

1

(b) water needs more / different processes

1

because it contains any **two** from:

- more organic matter
- more microbes
- toxic chemicals or detergents

2

(c) *(as part of glassware attached to bung)*
salt solution in (conical) flask

allow suitable alternative equipment, eg boiling tube

1

(at end of delivery tube)
pure water in test tube which must not be sealed

allow suitable alternative equipment, eg, beaker, condenser

1

heat source (to heat container holding salt solution)

1

*if no other mark obtained allow for **1** mark suitable equipment drawn as part of glassware attached to bung **and** at end of delivery tube*

(d) determine boiling point

1

should be at a fixed temperature 100°C

allow should be 100°C

allow if impure will boil at a temperature over 100°C

1

(e) high energy requirement

1

[11]

12 (a) $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

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]

13 (a) both water <u>vapour</u> 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]

14 (a) (i) neutrons

this order only

1

electrons

1

protons

1

(ii) box on the left ticked

1

(b) (i) effervescence / bubbling / fizzing / bubbles of gas

*do **not** accept just gas alone*

1

magnesium gets smaller / disappears

allow magnesium dissolves

*allow gets hotter **or** steam produced*

ignore references to magnesium moving and floating / sinking and incorrectly named gases.

1

(ii) 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)
There are simple statements of some of the steps in a procedure for obtaining magnesium chloride.

Level 2 (3−4 marks)
There is a description of a laboratory procedure for obtaining magnesium chloride from dilute hydrochloric acid and magnesium.

The answer must include a way of ensuring the hydrochloric acid is fully reacted **or** a method of obtaining magnesium chloride crystals.

Level 3 (5−6 marks)
There is a well organised description of a laboratory procedure for obtaining magnesium chloride that can be followed by another person.

The answer must include a way of ensuring the hydrochloric acid is fully reacted **and** a method of obtaining magnesium chloride crystals.

examples of the points made in the response:
- hydrochloric acid in beaker (or similar)
- add small pieces of magnesium ribbon
- until magnesium is in excess or until no more effervescence occurs *
- filter using filter paper and funnel
- filter excess magnesium
- pour solution into evaporating basin / dish
- heat using Bunsen burner
- leave to crystallise / leave for water to evaporate / boil off water
- decant solution
- pat dry (using filter paper).

*Student may choose to use a named indicator until it turns a neutral colour, record the number of pieces of magnesium added then repeat without the indicator.

6

[12]

15 (a) (i) Proton

1

(ii) Neutron

1

(b) In order of increasing atomic number

1

(c) (i) 9

1

(ii) Gas

1

(d) (i) gains (one) electron

1

(to gain a) full outer energy level **or** noble gas configuration

allow because it has seven outer electrons

1

(ii) add sodium hydroxide (solution)

*allow ammonia (solution) **or** ammonium hydroxide **or** any other soluble hydroxide **or** flame test*

1

(forms a) blue precipitate

second mark dependent on suitable reagent being added

allow blue–green / blue / green if flame test given

1

[9]

16 (a) gold

1

(b) atom (s)

1

(c) (i) protons

any order

allow proton

1

neutrons

allow neutron

1

(ii) 3 / three

1

(d) (i) Al

ignore any numbers / charges

1

(ii) any **two** from:

- limited resource
- expensive in terms of energy / mining
- effects on the environment, such as, landfill, atmospheric pollution, quarrying

allow uses a lot of energy to extract.

2

(e) resistant to corrosion

1

does not react (with water or food)

*allow **one** mark for low density with a suitable reason given*

1

[10]

17 (a) (i) protons

allow "protons or electrons", but do not allow "protons and electrons"

1

(ii) protons plus / and neutrons

1

(b) (because the relative electrical charges are) −(1) for an electron and +(1) for a proton

allow electrons are negative and protons are positive

1

and the number of electrons is equal to the number of protons

if no other mark awarded, allow 1 mark for the charges cancel out

1

(c) (the electronic structure of) fluorine is 2,7 and chlorine is 2,8,7

allow diagrams for the first marking point

1

(so fluorine and chlorine are in the same group) because they have the same number of or 7 electrons in their highest energy level or outer shell

if no other mark awarded, allow 1 mark for have the same / similar properties

1

(d) S

1

(e) (i) ions

1

(ii) molecules

1

[9]

18 (a) 1

must be in this order

1

very small

accept negligible, 1 / 2000

allow zero

1

(b) The mass number

1

(c) C

1

(d) (i) 2

1

(ii) 3

1

(e) (i) 28

1

(ii) 42.9

accept ecf from (e)(i)

accept 42 - 43

1

(f) (i) 0.9

1

(ii) any **one** from:

- accurate
- sensitive
- rapid
- small sample.

1

[10]

19 (a) because this lithium atom has

3 protons

1

and 4 neutrons

1

mass number is total of neutrons and protons

accept protons and neutrons have a mass of 1

accept number of neutrons = 7 - 3(protons)

ignore mass of electron is negligible

1

(b) grams

accept g

1

^{12}C

allow carbon-12 ***or*** *C-12*

ignore hydrogen ***or*** *H*

1

(c) any **three** from:

max ***2*** *if no numbers given*

numbers if given must be correct

- both have 8 protons

  accept same number of protons
- ^{18}O has 10 neutrons
- ^{16}O has 8 neutrons

  accept different number of neutrons or ^{18}O *has two more neutrons for* ***1*** *mark*
- both have 8 electrons.

  accept same number of electrons

3

[8]

20 (a) (i) Neutron (top label)

1

Electron (bottom label)

1

(ii) 13

1

(iii) electrons

1

(b) (i) compound

1

hydrogen

1

bond

1

(ii) C_4H_{10}

1

[8]

21 (a) Sulfur dioxide causes acid rain.

1

(b) red / orange / yellow

do ***not*** *accept any other colours*

1

because sulfur dioxide (when in solution) is an acid

1

(c) (there are) weak forces (of attraction)

*do **not** accept any reference to covalent bonds breaking*

1

between the molecules

*do **not** accept any other particles*

1

(these) take little energy to overcome

award third mark only if first mark given

1

(d) 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 on page 5 and apply a 'best-fit' approach to the marking.

0 marks
No relevant content

Level 1 (1 – 2 marks)
A relevant comment is made about the data.

Level 2 (3 – 4 marks)
Relevant comparisons have been made, and an attempt made at a conclusion.

Level 3 (5 – 6 marks)
Relevant, detailed comparisons made and a justified conclusion given.

examples of the points made in the response

effectiveness

- W removes the most sulfur dioxide
- D removes the least sulfur dioxide

material used

- Both W and D use calcium carbonate
- Calcium carbonate is obtained by quarrying which will create scars on landscape / destroy habitats
- D requires thermal decomposition, this requires energy
- D produces carbon dioxide which may cause global warming / climate change
- S uses sea water, this is readily available / cheap

waste materials

- W product can be sold / is useful
- W makes carbon dioxide which may cause global warming / climate change
- D waste fill landfill sites
- S returned to sea / may pollute sea / easy to dispose of

6

[12]

22 (a) (i) an electron

1

(ii) a neutron

1

(iii) 11

1

(iv) boron

1

(b) (i) GH_3

1

(ii) covalent

1

[6]

23 (a) (i) Na

allow sodium / phonetic spelling

if more than one answer is given apply list principle

1

(ii) Fe

allow iron / phonetic spelling

if more than one answer is given apply list principle

1

(iii) Na **or** S

allow sodium or sulfur / sulphur / phonetic spelling

if more than one answer is given apply list principle

1

(iv) S

allow sulfur / sulphur / phonetic spelling

if more than one answer is given apply list principle

1

(v) Na

allow sodium / phonetic spelling

if more than one answer is given apply list principle

1

(b) (i) any **three** from:

- effervescence / fizzing **or** bubbles **or** gas produced

  *do **not** allow incorrectly named gas*
- sodium melts **or** turns into a ball
- sodium moves (on the surface)
- steam / mist / vapour is produced

  ignore heat / temperature / flame / spark
- sodium gets smaller / disappears

  allow dissolves
- colour of indicator is darker / more intense near the sodium

  Must be linked to near the sodium.

3

(ii) hydroxide **or** OH^-

allow OH without a charge

*do **not** allow OH^+*

1

(c)

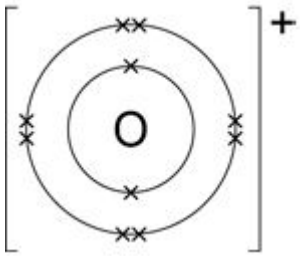


diagram showing electron configuration of ion is 2,8

1

charge on ion is +

Bracket not necessary

$[2,8]^+$ is worth 1 mark as there is no diagram

1

[11]

24 (a) (i) points correctly plotted (± ½ small square)

*four points = **2** marks*

*three points = **1** mark*

Max 2

straight line of best fit using full range of points from 0,0

1

(ii) any **one** from:

must explain why the point is below the line

- the solution may not have been properly stirred
- the electrodes may have been a larger distance apart
- the drop of sodium chloride may have been a smaller volume / smaller

allow not enough sodium chloride added

allow smaller amount of sodium chloride

*do **not** allow too few drops added*

ignore the student may have misread the conductivity meter

1

(iii) any **one** from:

- the volume of pure water

  allow amount
- the concentration (of the solutions added)
- the volume (of the drops) of solution added

  ignore number of drops
- the distance between the electrodes
- the same electrodes **or** electrodes made of the same material
- same depth **or** surface area of electrodes in the water
- constant power supply

  ignore current
- stirred

1

(b) (i) because (pure) water is covalent / molecular (simple) **or** contains molecules

1

therefore (pure) water has no free / mobile electrons **or** ions

*molecules do not have a charge **or** molecules do not contain ions*
*gains **2** marks*

1

(ii) because there are ions in sodium chloride

*allow Na^+ and / or Cl^-(ions) **or** ionic bonding.*
Ignore particles other than ions for MP1.

1

which can move **or** carry the current / charge

MP2 must be linked to ions only.

1

(iii) Hydrogen

allow H_2 / H

1

[10]

25 (a) (i) a proton

1

(ii) nucleus

1

(iii) 12

order must be correct

1

4

1

(b) (i) 5 / five (%)

1

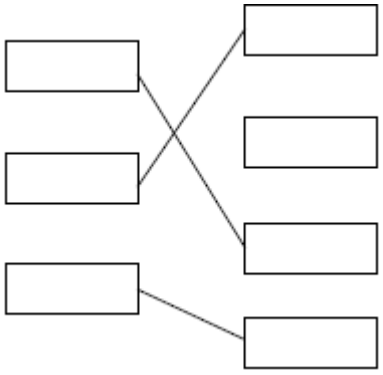
(ii) Carbon dioxide > global warming

1

Sulfur dioxide > acid rain

1

Water > no pollution



1

[8]

26 (a) (i) 14

1

(ii) isotope

1

(iii) (very) small

accept smaller / tiny / (very) little

1

(b) (i) C

1

(ii) NH_3

1

(c) (i) nitric (acid)

1

(ii) indicator

1

(iii) crystallisation **or** evaporation

*allow by heating **or** cooling **or** leave (on windowsill)*

do not accept freezing

1

(iv) any **one** from:

- grass grows faster
- grass grows taller **or** thicker

allow grass grows better / greener

1

(d) potassium (atom) loses (an electron)

*reference to incorrect bonding or particle = max **3***

1

chlorine (atom) gains (an electron)

ignore references to full outer shells

1

1 (electron)

1

electron

1

[13]

27 (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

<u>two</u> 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]

28 (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*

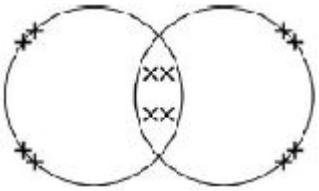
1

(b) (i) Na_2O

*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]

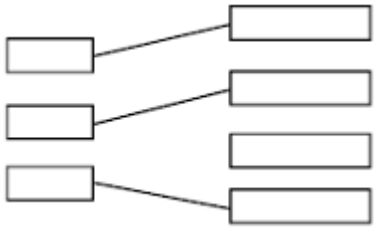
29 (a) (i) nucleus

1

(ii) an energy level (shell)

1

(b)



3

(c) 2 / two(%)

1

(d) (i) 10 / ten

1

(ii) (group) 0

accept noble gases
ignore (group) 8

1

[8]

30 (a) hydrogen has one proton whereas helium has two protons

accept numbers for words
accept hydrogen only has one proton
ignore references to groups

1

hydrogen has one electron whereas helium has two electrons

accept hydrogen only has one electron
allow helium has a full outer shell (of electrons)

1

hydrogen has no neutrons **or** helium has two neutrons

*if no other mark awarded, allow helium has more electrons / protons / neutrons for **1** mark*

1

(b) (i) 2 electrons on first shell **and**

8 electrons on outer shell

1

(ii) they have a stable arrangement of electrons

accept they have full outer energy level / shell of electrons
*do **not** accept they have the same number of electrons in their outer energy level / shell*
allow they are noble gases
ignore they are in group 0

1

[5]

31 (a) proton 1

ignore ±

1

electron very small owtte

allow zero

allow values from 1 / 1800 to 1 / 2000 ***or*** *0.0005 – 0.00055*

1

(b) 8

1

16

1

(c) (i) Isotopes

1

(ii) $^{18}_{8}O$

1

(d) (i) compound

1

(ii) H-O-H

1

(iii) covalent

1

(iv) sharing

1

[10]

32 (a) Will kelp last longer than coal as an energy source?

1

(b) any **two** from:

- cannot be determined by experiment

  allow can't predict how long kelp / coal will last

  allow more testing needed

- based on opinion

- ethical **or** environmental **or** economic reason

  allow could damage ecosystem allow reference to cost

2

(c) (i) 7

1

(ii) sodium (atom) loses (electron) **and** iodine (atom) gains (an electron)

*reference to incorrect bonding **or** incorrectly named particle = max **2***

any or all marks can be obtained from a labelled diagram

ignore inner shell electrons if shown

1

1 electron

1

(electrostatic) attraction **or** forms ionic bond(s)

1

(iii) ions can move (in the solution)

1

(iv) $2\,I^- \rightarrow \mathbf{I_2} + \mathbf{2}\,e^-$

1

(v) hydrogen is formed

1

because sodium is more reactive (than hydrogen)

1

[11]

33 (a) (i) nucleus

1

(ii) neutron

1

(iii) electron

1

(b) (i) 12

1

(ii) 24

1

(c) any **four** from:

*sharing / covalent / metallic = max **3***

- magnesium (atom) reacts with **two** iodine (atoms)
- magnesium (atom) loses electrons
- **2** electrons (from each atom)
- Iodine (atom) gains electron(s)
- **1** electron or an electron (to each atom)
- iodide ion formed

  allow iodine ion
- iodide has negative charge / is a negative ion / particle

  allow iodine

  ignore I^{2-}
- magnesium ion formed
- magnesium has positive charge
- oppositely charged ions attract
- a giant structure / lattice is formed

  *allow **1** mark for unqualified reference to ion formation or ionic bonding*

4

[9]

34 (a) *reference to incorrect bonding **or** incorrect structure **or** incorrect particles = max **3***

giant structure / lattice

ignore many bonds

1

made up of positive ions surrounded by delocalized / free electrons

allow positive ions surrounded by a sea of electons

1

with strong bonds / attractions

allow hard to break for strong

1

so a lot of energy is needed to break these bonds / attractions / forces

ignore high temperature

ignore heat

1

(b) (i) that they are very small

or

1-100 nanometres **or** a few(hundred) atoms

accept tiny / really small / a lot smaller / any indication of very small eg. microscopic, smaller than the eye can see

ignore incorrect numerical values if very small is given

1

(ii) delocalised / free electrons

allow sea of electrons

1

one non-bonded electron from each atom

accept electron(s) moving through the structure / nanotube

allow electron(s) carry / form / pass current / charge

1

[7]

35 (a) neutron(s)

answers can be in either order

1

proton(s)

1

(b) same number (17) protons **or** same number electrons

if candidate chooses to quote numbers, they must be correct

1

different numbers of neutrons (^{35}Cl has 18 and ^{37}Cl has 20)

1

(c) (i) −184kJ / mol

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

*allow **2** marks for 184 kJ / mol*

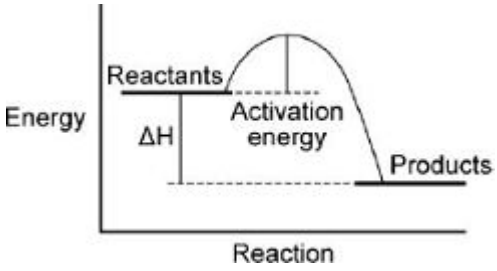
*If answer incorrect award up to **2** marks for any two of the steps below:*

- *bonds broken: (436 + 242) = 678 (kJ)*
- *bonds formed: (2 × 431) = 862 (kJ)*
- *bonds broken − bonds formed*

allow ecf for arithmetical errors

3

(ii)



the reactants and the products at the correct level

ignore labels on the axes

1

ΔH correctly labelled

allow −538 if in correct place

1

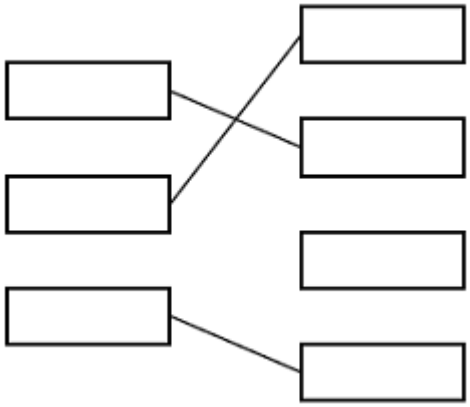
E_a correctly labelled

*correctly labelled endothermic reaction gains max. **2** marks*

1

[10]

36 (a)



one mark for each substance linked correctly to its description

*do **not** accept more than one line from each substance*

3

(b) 0 / zero / none / no charge

1

electron

1

(c) (i) nucleus

1

(ii) atomic number

1

(iii) mass number

1

[8]

37 (a) (i) 2.8.3

any sensible symbol can be used to represent an electron

1

(ii) proton(s) **and** neutron(s)

both needed for the mark

1

(iii) number of protons is equal to number of electrons

allow positive and negative charges cancel out

allow same amount of protons and electrons

1

(b) (i) **2** Al + $Fe_2 O_3$ → **2** Fe + $Al_2 O_3$

equation must be balanced

1

(ii) aluminium is more reactive (than iron)

it = aluminium

accept converse

accept aluminium displaces iron

accept aluminium is higher in the reactivity series (than iron)

1

[5]

38 (a) 1 / one

1

(b) (i) protons

1

(ii) neutrons

1

(iii) 7

1

(c) (i) losing

1

(ii) a positive

1

(iii) electrostatic

1

(d) high melting points

1

strong bonds

1

(e) (i) 58.5

1

(ii) mole

1

(f) very small (particles) **or**

ignore tiny / small / smaller / microscopic etc.

1-100nm in size **or**

(particle with a) few hundred atoms

1

[12]

39

(a) (alloy) atoms / ions / particles not in layers

accept layers are distorted

accept different (size) particles / atoms

1

so, (alloy) layers / atoms / ions / particles can't slide

*if no other mark awarded allow (an alloy) is a mixture of metals for **1** mark*

1

(b) diamonds have a giant covalent structure

1

diamonds have strong bonds between carbon atoms

1

(c) (i) a compound

1

(ii) CH_4

1

(iii) covalent

1

(d) methane has a low boiling point
or boiling point less than 20°C molecules

1

because it has small molecules

accept it has forces between molecules

*accept weak forces between molecules for **2** marks*

1

[9]

40

(a) has simple / small molecules

accept molecular covalent

1

the intermolecular forces / intermolecular bonds (are weak)

*do **not** accept weak covalent bonds **or** reference to incorrect bonding*

1

only need a small amount of energy to be overcome

accept only need a small amount of energy to separate the molecules

*if no other mark awarded, allow it has a low boiling point for **1** mark*

1

(b) (i) any pH value from 0 to 6.9

1

(ii) hydrogen

allow H^+

ignore H / H_2 / H^-

1

(c) any **three** from:

- same number of protons

  accept same atomic number
  numbers if given must be correct

- ^2H has one neutron

- ^1H has no neutrons

  *accept different mass number **or** different number of neutrons for **1** mark*

  ignore relative atomic mass

- same number of electrons

  numbers if given must be correct

3

[8]

41 (a) +1/+

*do **not** accept 1 without the +*

1

electron

allow phonetic spelling

1

(b) (i) elements

1

(ii) non-metal

1

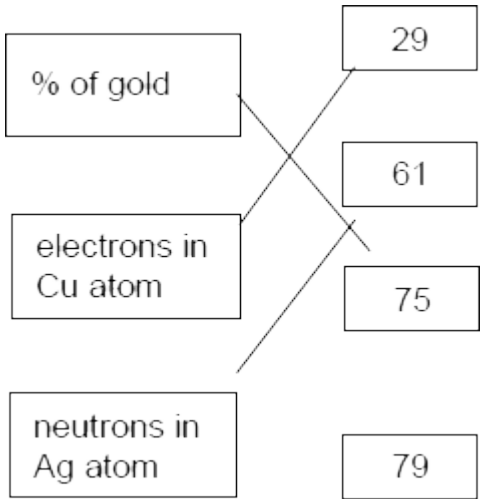
(c) soft

1

an alloy

1

(d)



one *mark for each correct link*

extra lines lose the mark

3

[9]

42 (a) 2,4

allow electrons in any position on correct shells

1

(b) (electron) 79

1

neutron

allow phonetic spelling

1

118

1

(c) (i) 16 **and** 9

in this order

1

(ii) any **two** from:

ignore reasons about colour / lustre / corrosion / rarity

- (100% / pure) gold is soft
  allow layers can slide in pure gold
- (alloyed) to make the metal hard(er)
  ignore just 'the ring is an alloy'
  allow (alloyed) to stop the layers sliding
  allow (alloyed) to make the metal strong
- gold is expensive **or** alloy is less expensive

2

[7]

43 (a) NN linked to element

1

OCO linked to compound

1

(b) electron

1

nucleus

must be correct order

1

(c) (reacts with) oxygen

1

to produce water

must be names
accept hydrogen oxide
allow steam

1

[6]

44 (a) electron

1

(b) (i) 5

1

(ii) boron

accept B

1

(c) (i) 11

1

(ii) neutrons

1

[5]

45 (a) (i) *mention of molecules / intermolecular / ionic / covalent =* ***max 2***

atoms / positive ions

1

any **two** from:

- (atoms / positive ions) in regular pattern / lattice / layer / giant structure (or diagram)
- delocalised electrons
  accept electrons move within / through the structure
  allow free (moving) electrons
  allow sea of electrons
- (atoms / positive ions) held together by strong / electrostatic attractions
  allow strong (metallic) bonds

2

(ii) delocalised electrons
accept electrons move within / through the structure
allow free electrons

1

(b) (i) smaller / very small
accept converse
accept 1 - 100 nanometres in size
accept a few hundred atoms
accept larger surface area ***or***
large surface area for their size

1

(ii) nanoparticles / more can fit into (tiny) gaps
allow nanosize particles have large(r) surface area

1

[6]

46 (a) (i) nucleus

1

(ii) protons

1

(b) protons / + / positive

electrons / – / negative

*both words needed in any order for **1** mark*

1

(c) nitrogen

allow N or N_2

1

(d) B **and** C

*both letters needed in any order for **1** mark*
*allow Li **and** Na*

1

(both) have one electron **or** same number of electrons in the outer energy level / shell

*allow both are in Group **1***
allow both are alkali metals
*allow both can lose <u>only</u> one electron **or** become +1 ions*
allow this mark if no letters given in boxes

1

[6]

47 (a) 6

1

oxygen

1

(b) (i) heating the hydrocarbon to a high temperature

1

the presence of a catalyst

1

(ii) all bonds correct

four C—H bonds**and**

one C=C bond

1

(iii) water

accept hydrogen oxide/steam
allow H_2O

1

(c) (i) carbon dioxide

allow CO_2

1

(ii) by filtering/decanting/centrifuging (to remove yeast)

ignore sieving

1

(fractional) distillation (to separate ethanol from water)

accept a description of (fractional) distillation

1

[9]

48 (a) protons **(and)** neutrons

*both needed for **1** mark*

ignore p / + and n / 0

*do **not** accept electrons*

1

(b) because the number of protons is equal to the number of electrons

allow protons and electrons balance / cancel out

allow positive / + and negative / - balance / cancel out

1

(c) *it = atom A*

because atom A has a full highest energy level **or** full outer shell

*allow all the shells are full **or** no incomplete shell*

or because atom A has a stable arrangement of electrons

allow because atom A is in Group 0 / a noble gas

1

(d) (atom) B / lithium / Li **(and)**

(atom) C / sodium / Na

*both needed for **1** mark*

1

because they have the same number/one outer electron(s)

linked to answer for first mark

accept because both need to lose one / an electron

allow because (atoms) B and C are in Group 1 / the same group / are alkali metals

1

[5]

49 (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

(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]

50 (a) 79

1

79

1

(b) hundred

1

(c) (i) electron(s)

1

(ii) three

1

(d) changes rate of reaction

accept lowers activation energy

or

speeds up / slows down reaction

accept reduces costs

1

(e) (i) melt

1

(ii) crosslinking

allow answers on diagram

or

(covalent) bonds between polymers / chains

allow bonds between layers
*do **not** allow intermolecular*

1

[8]

51 (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]

52 (a) because calcium is +2 and hydroxide is –1

accept to balance the charges

or

to make the compound neutral (in terms of charges)

allow calcium needs to lose 2 electrons and hydroxide needs to gain one electron

1

(b) particles of size 1-100 nm

allow clear comparison to 'normal' size particles

or particles with a few hundred atoms / ions

or particles with a high surface area (to volume ratio)

or as different properties to 'normal' size particles of the same substance

1

(c) **M_r** CaO = 56
and

M_r $Ca(OH)_2$= 74

1

2/56 (x74) **or** 0.036 (x74)
or
allow ecf from step 1

74/56 (x2) **or** 1.3(214…) (x2)

1

2.6(428…) in range 2.6 to 2.96
*correct answer with or without working gains **3** marks*
allow ecf carried through from step 1
ignore final rounding to 3

1

[5]

53 (a) causes dust pollution

1

increases traffic

1

(b) (i) it is soft
accept the layers of atoms can slide over each other
ignore other properties

1

(ii) contains chromium / nickel
allow contains other <u>metals</u>

1

(c) (i) an element

1

(ii) hard

1

(iii) is resistant to corrosion

1

[7]

54 (a) (i) B

1

(ii) A

1

(iii) C

1

(b) D and E

1

(c) electron

1

[5]

55 (a) gases

1

white

1

solid

1

ammonium chloride

1

(b) reversible

allow phonetic spelling
allow goes both / two / either way(s)

1

[5]

56 (a) (i) hydrochloric

1

(ii) insoluble

1

filtration

1

(iii) crystallisation

1

(b) any **four** from:

any reference to incorrect bonding = max 3

- calcium atom reacts with **2** chlorine atoms
- calcium atoms lose electrons

  accept calcium ion is formed
- lose **two** electrons

  accept calcium has a 2+ charge / calcium ion has a 2+ charge

  allow Ca^{2+}
- chlorine atoms **gain** electrons

  accept chloride ion formed
- gain one electron

  accept chlorine / chloride has a negative charge / is a negative ion/ is a negative particle

  allow Cl^-

  *if no other marks awarded allow ionic bonding **or** complete outer shell for **1** mark*

4

[8]

57

(a) less dense than air

1

(b) (i) water

accept hydrogen oxide

*do **not** accept hydrogen dioxide / hydro oxide*

1

(ii) unreactive

1

(c) atoms

1

(d) electron(s)

1

nucleus

1

[6]

58 (a) (i) removal of oxygen

*accept definition in terms of electrons **or** oxidation numbers*

ignore oxides

1

(ii) 2 (Cl_2)

allow correct multiples

1

(iii) no atoms are lost / made (during a chemical reaction)

or

the atoms are rearranged (during a chemical reaction)

accept because of (the law of) conservation of mass / matter

1

(b) (i) sodium is more reactive (than titanium)

*accept sodium is very reactive **or** titanium is less reactive*

*do **not** accept sodium is more reactive than argon*

1

(ii) any **one** from:

- sodium / titanium would react with oxygen / air

  accept air / oxygen is reactive

- sodium / titanium does not react with argon

  accept argon is unreactive / inert / a noble gas / in group O

1

(c) (i) all atoms are the same / it only contains one type of atom

accept all ions are the same

*do **not** accept only got one atom*

*do **not** accept all atoms are the same size*

ignore particles

1

(ii) two <u>different</u> / <u>types</u> atoms / elements / ions

accept more than one type of atom / ion / element

*do **not** accept different size*

1

bonded / joined together

accept definite proportions

*do **not** accept mixture*

1

[8]

59

(a) diagram **A**

1

(b) the atoms can slide over each other.

1

the atoms are in layers

1

(c) (i) sulfuric

1

(ii) bubbles are produced

1

the magnesium disappears

1

(iii) crystallisation

1

[7]

60

(a) (i) 65

*correct answer with or without working = **2** marks*
if answer incorrect
*evidence of (81 - 16) for **1** mark*
ignore units

2

(ii) zinc

accept error carried forward from (a)(i)
allow correct symbol
answer given should be element / metal closest to their answer
*do **not** allow compounds*

1

(b) (i) • it loses electrons

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

1

• three electrons

1

(ii) 8 electrons shown in second shell.

accept dots / crosses / mixture of dots and crosses / e

electrons do not need to be paired

*do **not** allow extra electrons in first shell*

1

[6]