AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.1.1 ATOMIC STRUCTURE, SYMBOLS, RELATIVE ATOMIC MASS, CHARGE AND ISOTOPES (PACK 2)

SCORE	PERCENTAGE
/298	%

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Q1.

(a) (i) atomic weights

allow atomic masses

1

(ii) proton

allow proton number

1

(b) (i) F/fluorine

allow F_2

1

(ii) any **one** from:

- copper has a higher density
- copper is stronger
- copper is harder
- copper is less reactive

allow named property

ignore colour, conductivity, melting point and boiling point

allow converse for potassium

1

(iii) relative distance from nucleus

allow more / fewer energy levels / shells or larger / smaller atom

1

relative attraction to nucleus

allow more / less shielding

1

relative ease of gain or loss of electron

1

opposite explanation of ease of gain or loss of electron for other group

1

max 3 marks if 'outer' not mentioned

[8]

Q2.

(a) (i) neutrons

this order only

1

electrons

1

protons

1

(ii) box on the left ticked

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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]

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Q3.

(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]

Q4.

(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

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(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]

Q5.

(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]

Q6.

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(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]

Q7.

(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

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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]

Q8.

(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]

Q9.

(a) Sulfur dioxide causes acid rain.

1

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(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

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- 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]

Q10.

(a) (i) an electron

1

(ii) a neutron

1

(iii) 11

1

(iv) boron

1

(b) (i) GH_3

1

(ii) covalent

1

[6]

Q11.

(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:

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- 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)

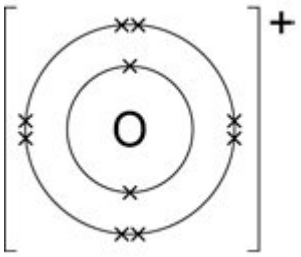


diagram showing electron configuration of ion is 2,8

1

charge on ion is +
Bracket not necessary
$[2,8]^+$ is worth 1 mark as there is no diagram

1

[11]

Q12.

(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*

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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]

Q13.

(a) (i) a proton

1

(ii) nucleus

1

(iii) 12
order must be correct

1

4

1

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

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1

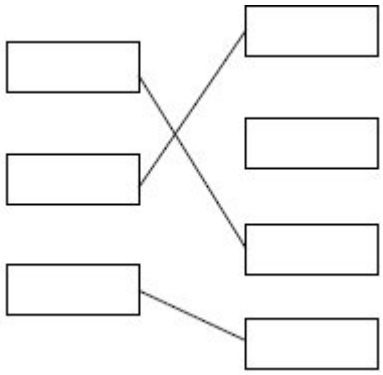
(ii) Carbon dioxide > global warming

1

Sulfur dioxide > acid rain

1

Water > no pollution



1

[8]

Q14.

(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

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(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]

Q15.

(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

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or

(electrostatic) attraction between ions **or** forms ionic bonds

accept noble gas structure

[7]

Q16.

(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*

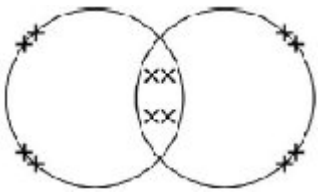
1

(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]

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Q17.

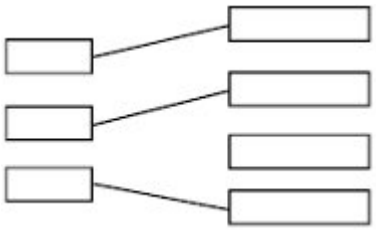
(a) (i) nucleus

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]

Q18.

(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*

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allow they are noble gases
ignore they are in group 0

1

[5]

Q19.

(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]

Q20.

(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

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(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]

Q21.

(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)

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- 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]

Q22.

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

giant structure / lattice
ignore many bonds

1

made up of <u>positive</u> ions surrounded by delocalized / free electrons
allow <u>positive</u> 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 <u>very</u> small

or

1-100 nanometres **or** a few(hundred) atoms
accept tiny / really small / a <u>lot</u> 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 <u>non-bonded</u> electron from each atom

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accept electron(s) <u>moving through the structure / nanotube</u>
allow electron(s) carry / form / pass current / charge

1

[7]

Q23.

(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

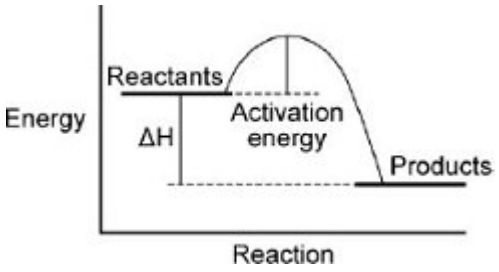
(c) (i) −184kJ / mol

*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*

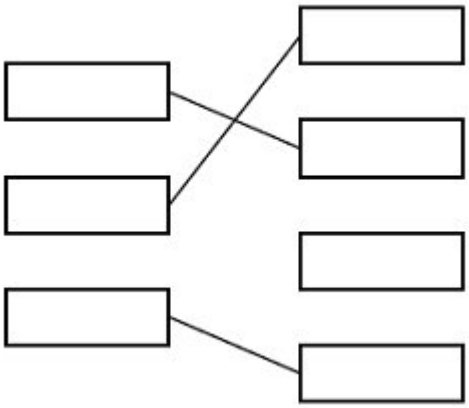
1

[10]

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Q24.

(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]

Q25.

(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

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

1

[5]

Q26.

(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]

Q27.

(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

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*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]

Q28.

(a) has simple / small molecules

accept molecular covalent

1

the <u>intermolecular</u> forces / <u>intermolecular</u> bonds (are weak)

*do **not** accept <u>weak</u> covalent bonds **or** reference to incorrect bonding*

1

only need a small amount of <u>energy</u> to be overcome

accept only need a small amount of <u>energy</u> 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

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accept same atomic number
numbers if given must be correct

- ^{2}H has one neutron
- ^{1}H 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]

Q29.

(a) +1/+

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

1

electron

allow phonetic spelling

1

(b) (i) elements

1

(ii) non-metal

1

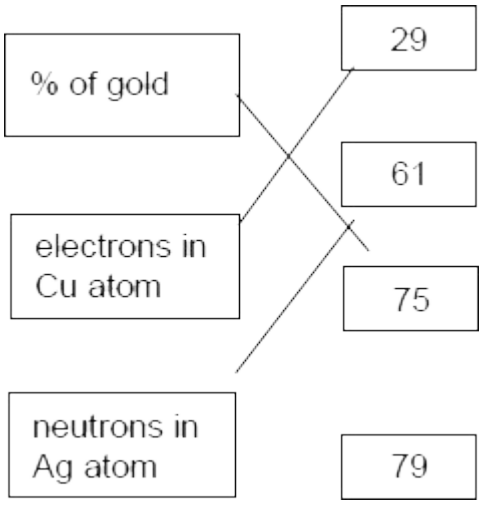
(c) soft

1

an alloy

1

(d)



***one** mark for each correct link*

extra lines lose the mark

3

[9]

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Q30.

(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]

Q31.

(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

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must be names
accept hydrogen oxide
allow steam

1

[6]

Q32.

(a) electron

1

(b) (i) 5

1

(ii) boron
accept B

1

(c) (i) 11

1

(ii) neutrons

1

[5]

Q33.

(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

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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]

Q34.

(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 only one electron ***or*** *become +1 ions*
allow this mark if no letters given in boxes

1

[6]

Q35.

(a) 6

1

oxygen

1

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

1

the presence of a catalyst

1

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(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]

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