AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.1.1 ATOMIC STRUCTURE, SYMBOLS, RELATIVE ATOMIC MASS, CHARGE AND ISOTOPES (PACK 4)

SCORE	PERCENTAGE
/202	%

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Q1.

(a) 4

1

(b) 9

1

[2]

Q2.

(a) covalent

1

(b) (i) liquid

1

(ii) fluorine

accept F / F_2

*do **not** accept fluoride*

1

(c) (i) should fluoride ions be added to drinking water?

1

(ii) any **one** from:

- not enough reliable/valid evidence
- may be other factors involved
- it is an opinion / choice / belief / ethics issue
- it can't be scientifically investigated

allow can't do an experiment

ignore test

mark independently of (c) (i)

1

[5]

Q3.

(a) (i) gives out a <u>large amount</u> of energy

1

<u>only</u> water produced / product is non polluting (owtte)

allow it does not harm the environment

1

(ii) does not explode / burst into flames owtte

ignore will not react

1

(iii) hydrogen absorbed and released much faster

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allow more efficient
allow can store a larger amount

1

(b) (i) B

1

(ii) a lithium atom loses an electron

1

(iii) C

1

(c) reversible

1

(d) (i) much smaller

1

(ii) surface area

1

[10]

Q4.

(a) (i) made up of one sort of atom
accept it is in the periodic table
or
has its own symbol

1

(ii) nitrogen / N / N_2 **or** oxygen / O / O_2
*do **not** accept argon **or** helium*
*do **not** accept oxide*

1

(b) (i) compound

1

carbon

1

(ii) bond

1

[5]

Q5.

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

- they are positive / cations
- they are H^+
- opposite charges attract
ignore atom

1

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(ii) potassium is more reactive (or reverse)

assume 'it' refers to hydrogen

allow potassium reacts <u>with</u> water

*allow potassium is very reactive **or** most reactive metal / element*

allow hydrogen gains electrons more easily / is reduced more easily

accept potassium is higher up the reactivity series

1

(b) 6 **and** 2

accept correct multiples and fractions

1

(c) (i) the reaction / it is reversible **or** a description of a reversible reaction

allow 'it is an equilibrium'

allow reversible symbol drawn correctly

allow 'the reverse / back reaction'

1

(ii) **lithium nitride**

assume that 'it' or if they do not specify means lithium nitride

assume lithium / lithium nitrate refers to lithium nitride

- hydrogen is bonded / held / absorbed / has formed a compound / reacted with lithium nitride

1

plus **one** of:

- does not explode / cause a fire
- is not free / less hydrogen
- is not under pressure
- does not leak
- is only released slowly

1

- compound of hydrogen with lithium nitride / product is (more) stable / less reactive / less chance of a reaction

accept converse for hydrogen as below

assume that gas / hydrogen means gas in the cylinder

- *hydrogen (in cylinder) / gas is not bonded / held absorbed / in a compound / reacted with lithium nitride*

1

*plus **one** of:*

- *can explode / cause a fire*
- *is free*
- *is under pressure*

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- *can leak*
- *releases quickly*

1

(d) (i) loss of an electron **or** loses electrons

do not accept any ref. to oxygen

1

(ii) full outer shell of 8 electrons on circle

need not be paired

can be ×, dot or e

*do **not** accept if extra electrons added to inner shell*

1

[10]

Q6.

(a) CH_4

4 should be below halfway up H / tail of 4 below the dotted line

1

(b) molecule

1

(c) covalent

1

[3]

Q7.

(a) gives out (heat)

1

(b) D

1

(c) L

1

(d) magnesium chloride

1

[4]

Q8.

(a) N_2O

1

(b) 13.8 to 14

gains full marks without working

if answer incorrect

*13 gains **1** mark*

or

*14/101 × 100 gains **1** mark*

2

[3]

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Q9.

(a) electric current / electricity

1

plus **one** from:

- is passed through <u>ionic</u> compound / substance / electrolyte
- passed through molten/aqueous <u>compound</u> / <u>substance</u>

  must be linked to electricity

  allow liquid compound / substance

  *do **not** allow solution / liquid alone*
- causing decomposition

  accept split up / breakdown / breaking up owtte

  ignore separated

  accept elements are formed

  ignore new substances form

1

(b) hydrogen

accept H_2

*do **not** accept H / H^2*

1

(c) one electron from each atom

accept each carbon is bonded to three other carbon atoms leaving one (unbonded) electron owtte

1

is delocalised / free (to move)

must be linked to electrons

*answers of delocalised / free electrons only, gains **1** mark*

*accept each carbon is bonded to three other carbon atoms leaving delocalised / free electrons = **2** marks*

***maximum 1** mark if graphite described as a metal / giant ionic lattice*

1

[5]

Q10.

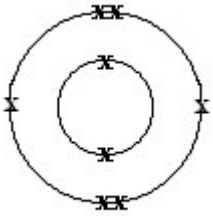
(a) $2Mg + O_2 \rightarrow 2MgO$

accept correct multiples / fractions

1

(b)

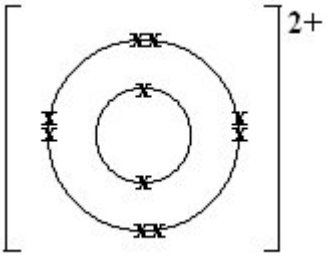
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electrons do not need to be paired
accept dots / circles / e instead of crosses
*do **not** allow 2.6 without diagram*

1

(c)



electrons do not need to be paired
allow without bracket s/ must have the charge
accept dots / circles / e instead of crosses
ignore extra empty outer shells
ignore nucleus
*do **not** allow $[2.8]^{2+}$ without diagram*

1

(d) oppositely charged (ions / atoms)

allow positive and negative(ions / atoms)

1

(they) attract

must be in correct context
accept held by electrostatic forces
ignore ionic bonding
***maximum 1** if they refer to intermolecular forces / attractions / covalent bonds*

1

(e) magnesium chloride

accept $MgCl_2$ (if correctly written)

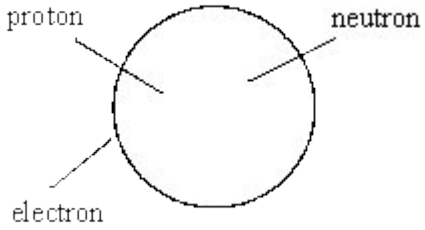
1

[6]

Q11.

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(a) (i)



*all three correct **2** marks*
*one correct **1** mark*

2

(ii) 14

1

(b) A

1

[4]

Q12.

(a) (i) small **or** few atoms thick **or** size in the range 1–100 nanometres
owtte

1

(ii) sensible idea of passing through smaller gaps owtte
*eg can pass through skin / pores / cells **or** more easily absorbed*

1

(b) any **two** from:

- good at absorbing UV light / radiation
- spread more easily
- cover better
- save money / use less
- transparent
- less chance of getting skin cancer **or** stops skin cancer
ignore more effective alone

2

(c) toxic to (cells / specific cells)
*allow harm / damage / kill **or** cause cancer*

1

[5]

Q13.

(a) 157
*correct answer with **or** without working*

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*(2 × 19 + 119) for **1** mark only*
*allow (119 + 19 =) 138 for **1** mark only*
ignore units

2

(b) 24.2

accept answers in the range 24 to 24.2038.....
ignore incorrect rounding after correct answer
*25 only without working gains **1** mark **or***
*38/157 × 100 gains **1** mark **or***
*(19/157 × 100 =) 12 to 12.1 gains **1** mark*
allow error carried forward from part(a)
*38/(a) × 100 gains **2** marks if calculated correctly*
*(19/138 × 100 =) 13.8 gains **1** mark*

2

(c) 0.29

accept answers in the range 0.28 to 0.3
allow error carried forward from part (b)
(b)/100 × 1.2 correctly calculated
ignore units

1

(d) an electron

allow electrons
*allow electron shared / lost for **1** mark*
apply list principle for additional particles

1

is gained owtte

must be linked to electron
accept can hold / take in if in correct context
*eg it can hold another electron (in its outer shell) = **2** marks*
*it can take an electron (from another atom) = **2** marks*
ignore reference to fluoride ions
*incorrect number of electrons gained does **not** gain the second mark*

1

[7]

Q14.

(a) 2.8.3 on diagram as Xs / dots

or e

*accept paired **or** unpaired*

1

(b) any **two** from:

- electrons in highest energy level **or** electrons in outer shell
- electrons are delocalised **or** sea of electrons

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- electrons are free **or** electrons move around / flow
- electrons carry charge / current
  ignore carry electricity

2

[3]

Q15.

(a) made of one sort of atom

accept it is in the periodic table
accept it only has lithium atoms

1

(b) nucleus labelled correctly

1

electron labelled correctly

1

[3]

Q16.

(a) water (molecules) contain two hydrogen atoms and one oxygen atom

*all water molecules have the formula H_2O for **2** marks*
*water molecules contain hydrogen and oxygen (atoms) for **1** mark*
*water is H_2O for **1** mark*

2

(b) atom A has no <u>neutrons</u> / atom B has one <u>neutron</u>

allow different numbers of <u>neutrons</u>

1

[3]

Q17.

(i) 160 ignore units

(2 × 56) + (3 × 16) for **1** mark

2

(ii) 70

$\frac{2 \times 56}{160} (\times 100)$ *for **1** mark*

allow ecf from part (i)

2

(iii) 700

allow ecf from part (ii)

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1

[5]

Q18.

(a) carbon

accept C

1

(b) protons

1

[2]

Q19.

(a) 100

ignore units
*40 + 12 + (3 × 16) for **1** mark*

1

(b) 40

*(**ecf** from part (a) can get **2** marks)*

$\frac{40}{\text{their (a)}} \times 100$ *for **1** mark*

1

(c) 0.5

*(**ecf** from part (b) can get **2** marks)*

$1.25 \times \left(\frac{\text{their (b)}}{100}\right)$ ***or** other correct working for **1** mark*

2

(d) gas produced **or** carbon dioxide / CO_2 produced

1

[7]

Q20.

(a) react with oxygen / oxidise / burn in oxygen / burning / combustion **or** tungsten to tungsten oxide **or** makes an oxide

key idea is oxidation
ignore breaking ignore fire / flames / exothermic
ignore react with air

1

(b) it is (very) unreactive / not reactive / inert / does not react with tungsten **or** it is a noble gas **or** it is in group 0 or 8 or 18

*do **not** accept unreactive / inert metal **or** argon is not very reactive*

1

full outer shell (of electrons) / 8 electrons in outer shell

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1

does not need to gain / lose / swap / transfer / share electrons **or** does not need to form bonds

does not bond ionically / covalently

1

[4]

Q21.

(a) M_r (SiO_2) = 60

if M_r incorrect ecf for max 2

1

60 g SiO_2 → 28 g Si

*correct answer for **3** marks*

1

2.14 g SiO_2 → 1 g Si

allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2

a unit is not required but an incorrect unit loses the third mark

OR M_r (SiO_2) = 60 (1)

moles if silicon needed = $\frac{1}{28}$ = 0.0357

mass of SiO_2 needed = 0.0357 × 60 (1)

= 2.14 g (1)

allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2

OR M_r (SiO_2) = 60 (1)

mass SiO_2 = 1 × $\left(\frac{60}{28}\right)$ (1)

= 2.14 g (1)

allow 2, 2.1, 2.4 (or anything rounding to 2.14), 2.16 or 2.2

3

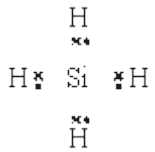
(b) (i) $MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l)$

*penalise incorrect symbols correctly balanced equation for **1** mark state symbols for **1** mark*

allow correct multiples / fractions

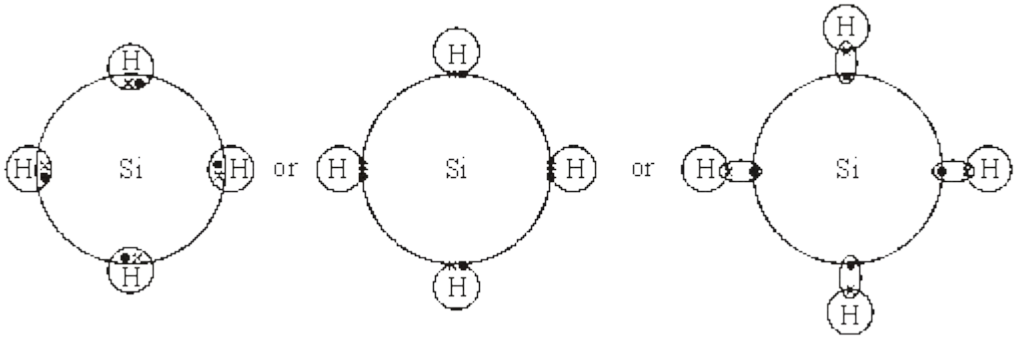
2

(ii)



or

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ignore inner shell electrons of silicon
allow correct drawings without symbols
must clearly indicate four shared pairs of electrons with one electron from each atom

(iii) **Si** **H**

$\frac{1.4}{28}$ $\frac{0.15}{1}$

1

= 0.05 = 0.15

1

1 3

for whole number ratio can be implied

1

SiH_3

accept H_3Si ***or*** *any correct formula with 1:3 ratio*
if in step 1 they get either of ratios incorrect they lose first 2 marks but can be ecf for 3rd and 4th mark
evidence of mass / A_r ***1*** *mark*
proportions of each ***1*** *mark*
whole number ratio ***1*** *mark*
correct formula ***1*** *mark*

1

(iv) **C**

accept c

1

(c) any **four** from:

- giant structure / macromolecule / lattice / giant molecule
  allow giant molecular / giant atomic structure
- each silicon atom joined to four other atoms
  (or diagram)
- covalent bonds
- bonds are strong **or** large amount of energy needed to break bonds
  accept hard to break bonds
- large number of bonds to be <u>broken</u>

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*mention of giant **ionic** structure **or** intermolecular forces **or** intermolecular bonds max **1** mark*

*diamond **or** carbon discussion max **3** marks unless clearly linked to silicon*

4

[15]

Q22.

(a) nucleus

1

electron

1

(b) correct number of electrons (12)

accept dots and circles

1

2.8.2

1

[4]

Q23.

(a) sodium
hydrogen
phosphorus
oxygen

***2** marks for all 4*
***1** mark for 2 or 3*
***0** marks for 0 or 1*

not symbols / formulae

2

(b) (i) gives out

gets hot(ter) / temperature rises (1)

1

heat / energy

independent mark

1

(ii) **Quality of written communication**

for clearly expressed ideas

1

take temperature of water at start

owtte

1

take temperature after adding soup powder

1

plus any **one** from:

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- using a thermometer
- mix / stir / shake etc
- in beaker / conical flask / test tube / plastic cup
- temperature will rise (indicates an exothermic reaction)

1

[8]

Q24.

(a) all electrons correct (inner shell need not be shown)

three bond pairs and two electrons anywhere else
can use dots, crosses or e's in any combination

1

(b) covalent

accept phonetic spelling
*do **not** accept convalent*

1

[2]

Q25.

(a) (i) all points plotted to ± $\frac{1}{2}$ square

1

sensible line of best fit extended

could be curve
*must **not** join dots, ie zig zag*
if they draw 2 lines then lose second mark,
but can still gain marks in (a)(ii)

1

(ii) as read from their graph ± ½ square

1

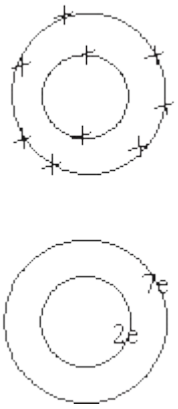
(iii) iodine **and** astatinel/I ² At/At ²

*must give **both** 1*

1

(b) (i)

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ignore symbol
ignore nucleus / lack of nucleus
accept dots / crosses etc / e / e^-
***not** 2.7 alone*

1

(ii) same number of electrons in **outer** shell **or**
seven electrons in **outer** shell (owtte)

accept missing one electron in outer shell / energy level / orbit
accept trying to gain one electron
accept they all form 1^- ions
*do **not** accept orbital / rings*

1

(c) (i) 8 electrons in outer shell **or** full outer shell / energy level

1

does not need to lose / gain / share electrons **or** don't need to form bonds

accept don't bond ionically or covalently
*they do not react is **not** enough*

1

(ii) fluorine atom is smaller / fewer shells (owtte) **or** outer shell closer to nucleus

accept answers argued in terms of iodine

1

more strongly attracted (to nucleus) **or** less shielding

accept holds electrons tighter (to the nucleus)

1

gains electron(s) more easily

accept easier to gain electrons

1

[11]

Q26.

(i) nucleus

1

(ii) they both have seven electrons in the outer shell

accept they both have the same

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number of electrons in the outer shell
both need one electron to make full outer shell

1

[2]

Q27.

(a) group seven/7VII
accept halogens

1

(b) (i) in light **bulbs**/lasers
accept any other specified use as an inert atmosphere e.g. (argon)
welding, storing explosives, fluorescent lights

1

(ii) 2.8.8/has a full/8 in/outer shell

1

electrons
accept does not need to share/gain/lose electrons

1

(c) (i) any one from:

disinfectant

bleaching agent

sterilising water/kills bacteria

manufacture of HCl

water treatment

1

not: *cleaning/in pools*
purification of water
kills germs
warfare
antiseptic

(ii) inner shells 2,8

1

outer shell 7

1

(iii) fluorine:
accept the converse reasons for chlorine

gains **one**/an electron easier/is more

strongly attracted

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not *more strongly held*

1

less shielding of nucleus by inner electron shells

1

less distance from (attraction of)

nucleus/less shells

1

[10]

Q28.

(i) convection currents

accept a suitable description of convection currents

1

move the Earth's plates

accept a suitable description of 'movement' of Earth's plates

1

at plate boundary one plate or a slab of rock can be pushed down forming magma/molten rock

accept at subduction zones magma/molten rock is formed – deconstructive boundary

1

magma/molten rock rising and cooling at the Earth's surface reforms as part of the plate

accept magma/molten rock rising and cooling at the Earth's surface forms igneous rock – constructive boundary

accept Earth's crust or lithosphere for Earth's surface

1

(ii) isotopes are atoms of the same element

do not accept that isotopes have the same atomic number but a different atomic mass

1

19/the same number of protons

1

19/the same number of electrons

do ***not*** *penalise for incorrect*

1

20 and 21 neutrons/different numbers of neutrons

arithmetic if concept is correct

1

[8]

Q29.

160

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ignore units if answer incorrect then (2 × 56) + (3 × 16)
or
*112 + 48 for **one** mark*

[2]

Q30.

(a) calcium atom loses two electrons

accept diagrams with correct labelling

1

(each) fluorine atom gains one electron

*accept two electrons transfer from a calcium atom to the two fluorine atoms for these first **two** marks*

1

forming full (outer) shells of electrons

*accept forming full (outer) energy levels **or** noble gas electronic structures*

*do **not** accept stable unless qualified*

1

giving the ions Ca^{2+} and F^{-}

1

attraction between ions of opposite charges

accept electrostatic attraction between ions

*if candidate mentions sharing **or** pairing of electrons then no credit*

*if explanation is entirely correct but they state this is called covalent bonding, the maximum mark is **four***

1

(b) atoms of the same element

1

atomic number is same

accept each contains 92 or same number of protons

1

mass numbers differ **or** each has a different number of neutrons

1

one has 146 neutrons the other has 143 neutrons

*accept one has three more **or** less neutrons than the other*

1

(c) (i) 349

1

(ii) 349g UF_2 produces 235g U [1]

first mark can be awarded if answer is incorrect

answer = 117.5

1

[12]

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Q31.

(a) (i) **all** correct **two** marks **one or two** correct **one** mark

electron
proton
neutron

2

(ii) (argon has) a full outer shell (of electrons)

accept energy level for shell

accept does not lose or gain electrons

*do **not** accept does not form bonds **or** react **or** is a noble **or** inert gas*

1

(b) <u>oxygen</u> would react (with metal)

accept oxygen is reactive

*do **not** accept metal would react (neutral)*

1

metal would burn

*accept metal would be 'destroyed' **or** metal oxide formed **or** metal is oxidised*

*do **not** accept it would explode **or** would not last long*

accept filament for metal

1

[5]

Q32.

(a) made of atoms which contain the same number of protons

accept made of only one type of atom

accept cannot be broken down into anything simpler by chemical means

1

(b) non-metals

1

metals

1

(c) sodium

1

<u>too</u> reactive (with water **or** air)

*accept has a low melting point **or** will melt **or** not strong **or** will explode **or** will burn*

*do **not** accept dangerous (neutral)*

*do **not** accept iron as rusting **or** copper **or** sodium as expensive (neutral)*

*do **not** accept not a good conductor of heat*

1

[5]

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Q33.

(a) (i) low density

accept floats (on water)

1

(ii) forms an alkaline solution with water

*accept <u>alkali</u> (metal) **or** basic*

*do **not** accept group 1 metal*

1

(b) 3 **or** three (protons)

1

3 **or** three (electrons)

1

4 **or** four (neutrons)

1

[5]

Q34.

(a) (i) number

1

periods

1

groups

1

(ii) some elements (**or** metals) had not been isolated

*accept some elements (**or** metals) had not been discovered (found)*

*do **not** accept matching properties*

*do **not** accept some elements were not known*

1

(b) (i) He **or** Ne **or** Ar

*accept Kr **or** Xe **or** Rn*

accept correct names

1

(ii) arrangement of electrons correct

accept He 2
Ne 2 . 8
Ar 2 . 8 . 8

arrangement of electrons must match

correct answer if given in (i)

*do **not** accept other elements*

1

(iii) (all) have one electron in the outer shell **or** energy level

*accept (all) have same number of electron(s) in the outer shell **or** energy level*

accept all have to lose one electron

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*do **not** accept all in same group*

1

(iv) K Na Li

accept names

accept correct indication of order of reactivity

1

(v) H_2

*do **not** accept H*

1

correctly balanced → 2 + 1

must have H_2 correct to get balancing mark

1

[10]

Q35.

(a) fractional distillation

1

boiling point or use

1

(b) (i) mixture: compounds **or** elements **or** substances together but not chemically combined

ignore references to separation

1

compound: (different) elements **or** different atoms together and chemically combined

ignore references to separation

1

(ii) element: contains only one type of atom

accept made of atoms which contain the same number of protons

1

compound: contains different types of atom chemically combined

'chemically combined' not needed here if already stated in (b)(i)

1

[6]

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