AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.2.1 CHEMICAL BONDS: IONIC, COVALENT AND METALLIC (PACK 4)

SCORE	PERCENTAGE
/118	%

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Q1.

(a) $Mg + 2H^+ \rightarrow Mg^{2+} + H_2$

* reactants correct in every detail
* products correct in every detail

if the spectator ions are sown then (1) mark should be credited but only if they are shown correctly on both sides e.g.
$Mg + 2H^+ + 2Cl^- \rightarrow Mg^{2+} + 2Cl^- + H_2$

2

(b) 24 (parts) of magnesium → 2 (parts)

1

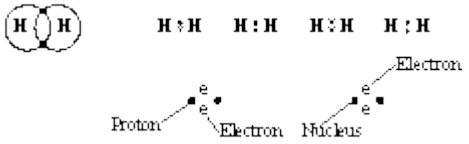
of hydrogen **or** equally clear working (so) 6 grams/g (are needed)

1

unit required

(c) (i) two (and no more) atoms shown to be sharing their single electrons examples

do not credit if anything which contradicts the impression that these are hydrogen atoms



1

(ii) (single) covalent (bond)

1

(d) $\frac{2}{34}$ (×100) = 6 (just 6 is worth (1) mark)

1

$\frac{2}{32} \times 100 = 6$ *or similar is (0)*

do not credit 5.8823529 and the like

1

[8]

Q2.

(a)

both correct in each row

electron ...– (1)

allow negative

1

1 0

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allow neutral or none

1

proton .....+ (1)

allow positive

1

(b) (i) protons...electrons

both correct in correct order

1

(ii) protons....neutrons

both correct in either order

1

(c) (i) sodium fluoride

do not credit sodium fluorine

1

NaF

must be correct in every detail

do not credit NAF and the like

1

(ii) ionic

accept ion (bonding)

do not credit ironic ***or*** *iron (bonding)*

1

(iii) electron transferred from sodium to fluorine

accept electron transferred from metal to non-metal

either positive sodium ion and negative fluoride ion

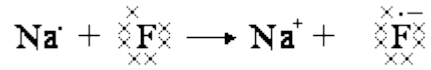
or *correctly identified by the symbols Na+ and F- accept 'positive sodium ion and negative fluorine ion'*

1

or attracted because have opposite charge(s)

or (atoms/ions) form an (ionic) lattice or (atoms/ions) form a crystal

e.g.



or both marks may be gained by a suitable dot and cross diagram

1

[10]

Q3.

(i) two

or 2

1

(ii) magnesium **and** chloride

either order

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not *positive / negative*
do not credit'chlorine'
accept Mg^{++} ***and*** Cl^{-}
do not credit just Mg and Cl^{-}
accept cation(s) ***and*** *anion(s)*

1

(iii) 2

1

(iv) electrons

accept charges

1

(v) any **three** from

- (is a) giant structure/lattice structure
- crystalline / hard
  accept just 'crystals(s)'
- high melting point / solid
- high boiling point
- conductor (of electricity) when dissolved **in** water
  or *conductor (of electricity) when ions are free to move*
- conductor (of electricity) when molten
- soluble in water

3

[7]

Q4.

(a) (i) rings of 2, 8 and 3 electrons

credit 2, 8, 3 pay particular attention to the outer shell in diagrams

1

(ii) rings of 2, 8 and 7 electrons

credit 2, 8, 7 pay particular attention to the outer shell in diagrams

1

(b) (i)

labels not required on atoms
charges need to be shown on ions
reference to outer shell is required otherwise a maximum of two marks

structure of atoms/ions marks

(ring of 2, 8, 1 for sodium) **or** the outer shell of sodium only contains 1 electron

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credit 2, 8, 1 ***or*** *an ion 2, 8* ***or*** *two circles and 1 electron in outer shell*

1

(ring of 2, 6 for oxygen) **or** outer shell only contains 6 electrons

credit 2, 6 ***or*** *an ion 2, 8* ***or*** *two circles*

1

transfer of electrons mark

two sodiums needed to supply two outer electrons to oxygen to complete the (one oxygen's) outer shell

award maximum of two marks if a covalent structure is given

credit two rings of electrons for sodium showing outer electrons transferring to outer shell of one oxygen for three marks

do not accept diagrams showing overlapping rings for third mark

1

(ii) loses an electron

credit atoms lose electrons ***or*** *oxygen takes the electron*
ignore oil rig

1

[6]

Q5.

(a) (i) sodium..... positive **or +**

both *required*

1

chloride... negative **or –**

both *required*

do not credit chlorine

1

(ii) ions not free (to move) in solid crystal / lattice

ions are free to move when sodium chloride is molten

1

or ions are mobile

do not credit when ions are molten

allow 'particles' for ions (1) mark

do not credit electrons etc

1

(iii) dissolved in water

or *in aqueous solution*

accept in solution

accept in water

or *when a gas/ vapour* ***or*** *solid it will not*

1

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(b) (i) 40

1

(ii) (total) number of protons **and** neutrons (in the nucleus)

1

(c) (i) $2Ca + O_2 \text{ -+ } 2CaO$

accept any 2n : n : 2n ratio
do not credit if any other change has been made

1

(ii) any **two** from

electron(s) is / are lost

from the outer shell / orbit / ring
***or** from the shell furthest the nucleus*
***or** from the 4th shell*

two / both (electrons are lost)
accept two electrons are lost for (2)marks
accept both electrons are lost from the atom for (1) mark

2

[10]

Q6.

(a) (i) ammonia and hydrogen chloride

both required either order
accept formulae if correct in every detail

1

(ii) ammonium chloride / NH_4Cl

do not credit ammonia chloride

1

(iii) the fumes / gases / are poisonous / toxic

***or** ammonia and hydrogen chloride are poisonous / toxic / lethal*
accept just ammonia is poisonous / toxic
accept just hydrogen chloride is poisonous / toxic
accept vapour is poisonous / toxic
do not credit just fumes are dangerous
***or** harmful*

1

(iv) nitrogen

do not credit N/N_2

1

hydrogen

do not credit H/H_2

1

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molecule

do not credit compound ***or*** *mole*

1

covalent

accept single / molecular

1

(b) (i) proton

neutron

electron

either *all three correct*

or *one or two correct*

however do not credit a response which is repeated

2

(ii) protons and neutrons

both required in either order

1

[10]

Q7.

(a) positive

for 1 mark

1

(b) any reference to loss of electrons

for 1 mark

reference to charge being +2 (in (a)) **or** to loss of 2 electrons (in (b))

for 1 mark

2

[3]

Q8.

(a) *Idea that*

the electrons do not belong to specific atoms/delocalised electrons

[credit if done on appropriate diagram]

metal atoms form positive ions

the attraction which exists between particles with opposite charges, holds the metal together

no specific bonds exist between adjacent atoms/ions

atoms/ions can slide over each other so allowing metals to bend

each for 1 mark

5

(b) some electrons in the structure are delocalised/free to move

for 1 mark

these free electrons carry the electric current

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for 1 mark

from left to right across the period, atoms of elements have more free electrons

gains 1 mark

but from left to right across the period, atoms of elements have more free electrons because they have more electrons in the outer shells

gains 2 marks

4

[9]

Q9.

(a) covalent bonds

for 1 mark

1

(b) any reference to shared electrons

gains 1 mark

but idea that bond is shared pair of electrons

gains 2 marks

2

[3]

Q10.

(a) (i) A calcium hydroxide/limewater/$Ca(OH)_2$ *not CaOH*

(ii) B calcium oxide/Quicklime/CaO

(iii) C hydrogen/H_2 *(accept correct formulae)/* not H_2/H

each for 1 mark

3

(b) (i) *idea that*
electrons are lost (by the calcium atom)

gains1 mark

but two electrons are lost (by the calcium atom)/lose outer electrons to get full shell

gains 2 marks

calcium ions are 2+

for 1 mark

(ii) electrons are gained (by the oxygen atom)

gains 1 mark

but two electrons are gained (by the oxygen atom)/gain electrons to get full outer shell

gains 2 marks

oxygen ions are 2–

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for 1 mark

6

(b) (i)(ii) needs:
electron loss/gain
number (2)
charge (+/–)

(c) *idea that*
they are held together by many/strong forces/bonds
a lot of energy/high temperature is required to break these forces/bonds
each for 1 mark

2

[11]

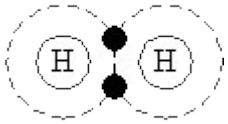
Q11.

(a) correct representation of 1 atom of hydrogen e.g.



gains 1 mark

but correct representation of 1 molecule of hydrogen e.g. or H-H



gains 2 marks

2

(b) *idea that:*
hydrogen/metals form positive ions/lose electrons
gains 1 mark

but hydrogen and the metals form positive ions/lose electrons
gains 2 marks

hydrogen/non-metals form covalent bonds/share electrons
gains 1 mark

but hydrogen and the non-metals form covalent bonds/share electrons
gains 2 marks

4

[6]

Q12.

(a) (i) $2\ H_2 + O_2 \rightarrow 2\ H_2O$ (*allow* $H_2 + ½O_2 \rightarrow H_2O$)
both circled for 1 mark

1

(ii) $4\ A1 + 3\ O_2 \rightarrow 2\ A1_2O_3$

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all circled for 1 mark

1

(b) *idea that:*
must end up with the same number of atoms
otherwise matter is shown to be lost/gained
doesn't show correct amount of each element/compared

each for 1 mark

2

(c) *idea that:*
oxygen has 2 electrons short in outer shell) in words or
chlorine has 1 electron short in outer shell) indicated on diagram
(shared pair/covalent bond with) hydrogen
atom supplies **one** further electron*
(but do not allow hydrogen **gives away electron or **ionic bond**)*

for 1 mark each

3

[7]

Q13.

(a) (i) *idea that*

- two hydrogen atoms share one pair of electrons
- linked by a covalent bond
- each then has two outer electrons / a full outer shell / two
- electrons in the highest (occupied) energy level

(2 marks may be awarded for a correct electron diagram i.e. with electrons on boundary of or within marked area).

any two for 1 mark each

2

(ii) *idea that*

- helium atoms do not give / take / share electrons / react
- because the (outer) shell / orbit is full

or

- highest (occupied) energy level is full

(*but not just* "contains two electrons")

for 1 mark each

2

(b) *idea that*

- the (attractive) forces between molecules are weak

(*not* bonds between atoms)

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- so little energy is required / it is easy for molecules to escape from the liquid* / escape from other molecules*

(*allow* evaporate / change into a gas)

for 1 mark each

2

[6]

Q14.

(a) positive / + / 2

gains 1 mark

but 2^+ / ++ / +2

gains 2 marks

2

(b) *Ideas that:* 2
Ca^{2+}
Br^- *[Do not disqualify for "bromine" ions]*
Ions / They are in the ratio 1:2

any two for 1 mark each

2

[4]

Q15.

idea that

- contains nitrogen atoms
- contains hydrogen atoms
- atoms are chemically bonded NOT linked/joined
- ratio of one nitrogen to three hydrogen (atoms) formula of ammonia is NH_3

for 1 mark each

[4]

Q16.

(a)

	Calcium	Phosphorus	Fluorine
No of protons		15	
No of neutrons			10
No of electrons	20		

for 1 mark each

3

(b) (i) gain of electron(s)

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from (atoms) (of) calcium

for 1 mark

2

(ii) Ca^{+}

gains 1 mark

but superscript only Ca^{2+} / Ca^{++}

gains 2 marks

2

(c) atoms
electrons
molecule(s) not compound

each for 1 mark

3

(d) (i) *ideas that*

- ionic – strong forces between ions
- molecular – weak forces between molecules

each for 1 mark

2

(ii) *ideas that*

- ionic – ions/charged particles are free to move
- molecular -molecules do not carry a charge

each for 1 mark

2

[14]

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