AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.1.1 ATOMIC STRUCTURE, SYMBOLS, RELATIVE ATOMIC MASS, CHARGE AND ISOTOPES (PACK 5)

SCORE	PERCENTAGE
/233	%

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Q1.

(i) same number of protons and electrons

accept equal numbers of protons and electrons

*do **not** accept they are neutral*

1

(ii) same element

accept all atoms are potassium

1

same number of protons

accept same atomic number

accept they all have 19+

1

different number of neutrons

accept different mass numbers

*do **not** accept different atomic masses*

1

[4]

Q2.

(a) (i) H_2SO_4 **or** red (acidic) pH < 7

accept names of compounds

accept correct use of acidic

1

NaOH **or** purple (alkaline) pH > 7

*alkaline and neutral without any mention of pH for **1** mark only*

1

NaCl **or** green (neutral) pH 7

*ignore high **or** low pH*

1

(ii) hydrogen (ion)

accept proton

accept hydroxonium ion

1

H^+

accept H_3O^+ for hydroxonium ion

1

(b) (i) neutralisation

1

(ii) NaOH + HCl

ignore state symbols

1

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$NaCl + H_2O$

ignore state symbols

*maximum of **1** mark if incorrectly balanced*

1

(c) (i) sodium – 2 . 8 . 1

accept 2.8.1 written

1

chlorine – 2 . 8 . 7

accept 2.8.7 written

1

(ii) ion(s)

1

(iii) attraction between oppositely charged particles (ions)

accept attraction between + and – particles (ions)

accept electrostatic attraction

1

(d) chloride ions lose electrons to form chlorine

$Cl^- - e^- \rightarrow Cl$

1

hydrogen ions gain electrons to form hydrogen

$H^+ + e^- \rightarrow H$

1

sodium hydroxide remains in solution

Na + and OH^- remain in solution to form sodium hydroxide

1

[15]

Q3.

(a) (i) B

1

(ii) D

1

(b) A and B – only one type of atom

1

C and D – more than one type of atom

accept element for atom

ignore the word 'mixture'

1

(chemically) bonded

accept (chemically) joined or similar idea of joined

1

[5]

Q4.

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(a) (i) proton

1

(ii) neutron

1

(iii) nucleus

1

(b) there are shells **or** energy levels **or** orbitals

do not accept ring

1

the maximum number of electrons
found in the first shell **or** energy level is 2

accept first shell is full with 2 electrons

1

[5]

Q5.

(i) 160

ignore units

1

(ii) 112

ignore units

1

(iii) 70

*do **not** carry forward errors*

1

[3]

Q6.

(a) (i) pair of electrons shared (for one covalent bond) or (shown in diagram)

1

complete bonding **or** electron configurations described **or** drawn

*if candidate states 'ionic' then maximum mark is **1***

1

(ii) transfer of one electron from sodium to chlorine

*accept diagrams **or** electron arrangements showing this transfer*

1

Na^+ and Cl^- formed

*if candidate states 'covalent' then maximum mark is **2***

1

opposite ions attract

'opposite' required if charges on ions not shown

1

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(b) each has 17 protons

accept same number of protons

1

each has 17 electrons

accept same number of electrons

1

18 and 20 neutrons or neutron numbers differ by 2

accept different number of neutrons

*for full marks must mention all numbers of particles otherwise maximum mark is **2***

1

[8]

Q7.

(a) 2 2 multiples of ½ allowed

for 1 mark

1

(b) (i) 2. 8. 1 and 2. 8. 7

gains 3 marks

1 mark for 2 electrons in each inner shell
1 mark for 8 electrons in each second shell
1 mark for 1 electron in sodium outer shell
and 7 in chlorine outer shell

3

(ii) sodium atom loses;
electron;
chlorine atom gains;
electron

for 1 mark each

inversion = 2 marks
lose negative charge = 1 mark

4

(c) (i) KCl (accept 2KCl)

for 1 mark

1

(ii) both have on electron in outer shell/same number of electrons/
lose same number of electrons in compound formation/
both lose one electron

for 1 mark

1

(d) 0 amps;
the ions;
cannot move in the solid
solid Na chloride does not conduct

for 1 mark each

3

(e) (i) water (H_2O)

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for 1 mark

1

(ii) (1) chlorine;
(2) hydrogen
for 1 mark

1

[15]

Q8.

(a) (i) 14 electrons =
gets 1 mark

2.8.4 =
gets 2 marks

2

(ii) outer shell electrons

1

(iii) same number of electrons in outer shell

1

(b) (1) shiny
conducts electricity

(2) oxide neutralises alkalis
covalent bonds

4

[8]

Q9.

(a) 40 + 12 + (3 × 16) = 100
each for 1 mark

2

(b) M_r of CaO = 56
for 1 mark

mass required = 60 × 100/56
for 2 marks

= 107.1
for 1 mark

4

(c) (i) calcium hydroxide

1

(ii) solid

1

[8]

Q10.

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(a) a substance which contains one type of atom
or a substance that cannot be **broken down**
into anything simpler

for 1 mark

1

(b) more than one element/more than one type of atom
combined/join together/bonded

for 1 mark each

2

[3]

Q11.

(a) (i) same number of shells/2 full shells/3 shells/same number
of energy levels

any 1 for 1 mark

increasing number of electrons/different number of electrons/
number of electrons same as group
number
(if electrons not specifically mentioned assume they are referring to electrons)

any 1 for 1 mark

2

(ii) all have 7 electrons in outer shell/same number in outer shell/
each has one electron missing from outer shell
each can accept one electron

any 1 for 1 mark

number of shells/energy levels increases
increasing number of electrons

any 1 for 1 mark

2

(b) (i) increases down group/decreases up

for 1 mark

1

(ii) down group atoms get bigger/larger/have more shells/
more energy levels

for 1 mark

electrons further away from nucleus/more
shielding down group

for 1 mark

outer electron more easily lost/less
firmly held

for 1 mark

3

(c) H^+ or has positive ions/one electron in outer shell/can lose
one electron/H^+ ions discharged at negative electrode (max 2)
covalent bonds or compounds/forms diatomic mols. or example/

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ability to form H^- ions/non-conductor/
low Mt.Pt or low B.P. (max 2)

(overall max 3)

3

[11]

Q12.

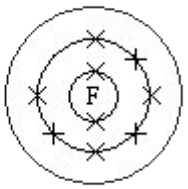
(a) 2, 8, 8, 1

for 1 mark

1

(b)

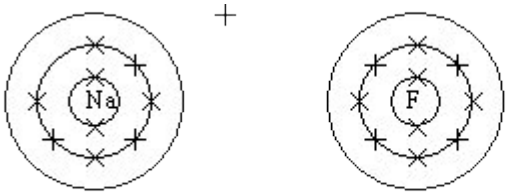
(i)



for 1 mark

Ignore symbol in middle but structure must be drawn NOT 2,7

(ii)



(1) for charges

(1) for each structure

If covalent; can score mark for changes but not for diagram
Arrow showing electron transfer from metal atom to non-metal atom = 2 marks
If the ions are not identified then cannot score mark for changes

4

[5]

Q13.

(a) 4 HCl / $2H_2O$, allow multiples **or** fractions if whole equation balances

for 1 mark

1

(b) germanium tetrachloride + water = germanium oxide + hydrochloric acid
If symbol equation given it must be correctly balanced
Allow germanium

for 1 mark

1

(c) to purify the germanium oxide/remove impurities/give in
pure product/to make pure germanium

for 1 mark

1

ensure complete reaction/reaction does not give a good yield

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not to increase efficiency/to purify germanium

for 1 mark

1

(d) (i) remove oxygen/addition of hydrogen/gain up electrons allow remove oxygen molecules

(ii) GeO_2 = 73 + (2 × 16) = 105
mass of germanium = 525 × (73/105)
= 365 g
(or alternative methods)
apply consequential marking

for 1 mark each

3

(e) (i) germanium is shiny/lustrous
conducts a small amount of electricity *
germanium oxide reacts with hydrochloric acid
(and) metal oxides react with acid
metal oxides are basic
metal oxides are reduced by hydrogen
Information must be taken from the passage.
Apply the list principle if more than three answers are given.
Assume the word 'it' refers to the metal.

any 3 for 1 mark each

3

(ii) germanium is brittle
germanium tetrachloride is a (volatile) liquid
made of molecules
germanium tetrachloride has covalent bonding or when two non-metals react they have covalent bonding
$GaC1_4$/the salt of germanium undergiven hydrolysis/reacts with water
germanium is not a good conductor of electricity*
* conductivity mark can only be given once

any 3 for 1 mark each

3

[13]

Q14.

(a) elements: aluminium, copper,
compounds: pure water, sodium chloride,
mixture: beer, milk

2/3 correct gains 1 mark
4/5 correct gains 2 marks
all correct gains 3 marks

3

(b) metals: can be hammered into shape,
good conductor of electricity, shiny
non metals: brittle, dull, poor conductors of electricity

2/3 correct gains 1 mark
4/5 correct gains 2 marks
all correct gains 3 marks

3

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[6]

Q15.

(a) potassium, hydrogen,
carbon, oxygen,
chlorine <u>or</u> iodine

3 correct gains 1 mark
4 correct gains 2 marks
all correct gains 3 marks
(deduct 1 mark for each incorrect answer)

3

(b) potassium (K)

for 1 mark

1

[4]

Q16.

(a) potassium / K

for 1 mark

1

(b) carbon dioxide / CO_2

for 1 mark

1

(c) losing
electrons
gaining
electrons

for 1 mark each

4

(d) (i) power supply, (not mains)
beaker containing solution,
(inert) electrodes and circuit
ammeter or bulb/
(or see bubbling etc. at electrodes written by drawing)

for 1 mark each

4

(ii) reading on ammeter/bulb lights / (solution) conducts (electricity)
bubbling / gas produced
hydrogen produced
chlorine / oxygen produced
ions move
to electrodes (must be linked to ions move)
negative ions move to the positive electrode
<u>and/or</u> positive ions move to the negative electrode
negative ions lose electrons
<u>and/or</u> positive ions gain electrons

any 3 for 1 mark each

3

[13]

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Q17.

(a) covalent/description of covalent

for 1 mark

1

(b) forces/bonds between the molecules/particles (<u>not</u> atoms) are weak

for 1 mark each

2

(c) non-flammable so it will not burn etc.
extremely unreactive so it will not react with materials in the transformer,
does not conduct electricity so it can insulate the transformer
gas so it has freedom to move and insulate whole area

for 1 mark each

3

[6]

Q18.

electron
nucleus
neutron

each for 1 mark

[3]

Q19.

56
74

each for 1 mark

[2]

Q20.

(a) light / caloric (heat)

for 1 mark

1

(b) (i) lime (calcium oxide) / magnesia (magnesium oxide)
barytes (barium sulphate) /argilla (aluminium oxide) /
silex(silicon dioxide)

for 1 mark

1

(ii) Lavoisier / he could not break it down into anything simpler
by chemical methods of the time

for 1 mark

1

[3]

Q21.

(a) plot correct (2 segments)

for 1 mark

1

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(b) nitrogen + hydrogen ⇌ ammonia
or N_2 H_2 NH_3
all correct for 1 mark

1

(c) largest area labelled nitrogen or shaded
for 1 mark

1

(d) (i) nitrogen

1

oxygen

hydrogen

1

three correct for 2 marks
two correct for 1 mark

(ii) potassium chloride
for 1 mark

1

(e) (i) $NH_4NO_3 = 14 + (4 \times 1) + 14 + (3 \times 16) = 80$
for one mark

1

(ii) ecf (error carried forward from part (i))
look for 28 / 80 for first mark
gains 1 mark

but 35% (% sign not needed)

special case of (14 / 80 × 100 = 17.5%) gains 1 mark
gains 2 marks

2

[9]

Q22.

(i) B **or** 2, 8, 1
for one mark

1

(ii) A **or** 2, 8
for one mark

1

[2]

Q23.

B carbon monoxide

1

CO

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accept carbon oxide
*do **not** credit carbon dioxide*
*do **not** credit if any superscripts **or** subscripts used but accept C_1O_1,*
accept OC
*do **not** credit if obviously lower case*

1

C water

1

H_2O

accept hydrogen oxide

do not accept hydrogen hydroxide
*do **not** credit if obviously lower case **or** if 2 not subscript*
*do **not** accept HOH*
accept OH_2

1

D ammonia

1

NH_3

do not accept ammonium
*do **not** credit if obviously lower case, **or** if 3 not subscript*
*accept nitrogen hydride **or** hydrogen nitride*
*do **not** accept hydrogen nitrate **or** nitrite*
allow H_3N

1

[6]

Q24.

(a) oxygen

Ignore any numbers
accept hydrogen oxide / steam

1

water

1

(b) catalyst

1

[3]

Q25.

(a) 9 protons /Proton Number 9

mass / atomic number is neutral

1

10 neutrons

1

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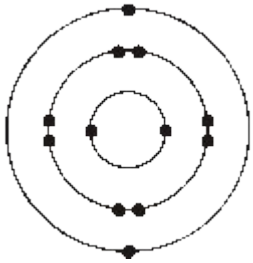
electron arrangement 2,7 / 9 electrons

incorrect configurations neutral

*if no points scored, allow 1 mark for nucleus surrounded by electrons **or** nucleus contains neutrons and protons*

1

(b)



Mark is for 2,8,2 arrangements.
accept electrons anywhere in correct orbit

1

[4]

Q26.

(a) **A** – electron

1

B – nucleus

1

C – proton

1

D – neutron

1

(b) Group 1 / alkali metals

1

has one electron in outer shell

accept 3 protons / 3 electrons / atomic number 3
therefore lithium (so Group 1 / alkali metals)

1

(c) lithium

accept Li

1

[7]

Q27.

(i) 4 **and** 1

both answers must be correct

1

(ii) 53.5

if incorrect relative formula mass
allow 1 mark for correct working

accept e.c.f. from c(i) for 2 marks

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2

[3]

Q28.

(a) proton + (1)

both required

neutron 1

both required

electron – (1)

both required

3

(b) 2.8.3

accept words or diagram to this effect

1

(c) (i) 24

1

(ii) 52

1

(d) any **one** of

- gains one or more electrons

  accept gains an electron

- becomes an anion

  do not credit becomes an ion

- becomes a <u>negative</u> ion

1

(e) sodium ions have a (single) positive charge <u>and</u> chloride ions have a (single) negative charge

do not credit 'chlorine ions' but

allow this error to be carried forward

1

ions with opposite charge are attracted (to each other)

***or** the positive ions and the negative ions are attracted (to each other)*

***or** the sodium ions and the chloride ions are attracted (to each other)*

1

(positive and negative) ions are arranged alternatively (in each direction **or** dimension)

***or** ions with the same charge are repelled (by each other) no mark for just ionic bonds*

1

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[10]

Q29.

(a)

both correct in each row

electron ...– (1)

allow negative

1

1 0

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

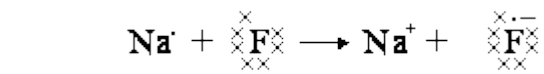
***or** correctly identified by the symbols Na+ and F- accept 'positive sodium ion and negative fluorine ion'*

1

or attracted because have opposite charge(s)

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

e.g.



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

1

[10]

Q30.

(i) two

or 2

1

(ii) magnesium **and** chloride

either order

***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]

Q31.

NOTE

In this question and throughout the Paper, if the name of a chemical is asked for, then the formula is acceptable only if it is correct in every detail. If the name is correct and the candidate has tried to be 'helpful' by giving, in addition, an incorrect version of the formula, then this is acceptable provided it does not lead to ambiguity.

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(i) nitric (acid)

accept $HN0_3$

1

(ii) sulphuric (acid)

accept H_2SO_4

1

(iii) heat given out

***or** temperature rise*

***or** energy given out*

***or** steam*

do not credit just 'use a thermometer'

do not credit just 'change in temperature'

1

(iv) neutralisation

accept neutralise

accept neutral

*accept formation of salt **or** water*

do not credit exothermic

1

[4]

Q32.

(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

*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

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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]

Q33.

(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

(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

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(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]

Q34.

(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

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

1

covalent
accept single / molecular

1

(b) (i) proton

neutron

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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]

Q35.

(a) compound

1

(b) oxide

1

[2]

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