Mark Schemes

Edexcel GCE
Chemistry (9080/8080)

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Edexcel

Success through qualifications

CONTENTS

NOTES on the using the mark schemes

1. The symbol / implies alternative answers to the same mark.
2. The use of ( ) implies the section of the answer is not necessary to score the mark.
3. The mark in [ ] is the total mark for the section.
4. 'Ignore' means that this answer is not worth a mark but does not negate an additional correct response
5. In any paper the penalty for an answer with an inappropriate number of significant figures is 1 mark per paper. Unless stated otherwise, numerical answers are expected to 3 sig. figs. but 2-4 are allowed.
6. The penalty for omission of hydrogens from a structure when a 'full' structural formula is requested is 1 mark per paper.
7. Marks for conditions are consequential on a correct reagent.

UNIT C1

MARK SCHEME

JANUARY 2002

1 **(a)** **(i)** fizzing/ effervescence
metal <u>disappears</u> /gets smaller
floats / moves around on surface
melts/ turns into ball
any 2
do not allow 'dissolves' [2]

(ii) $2Na + 2H_2O \rightarrow 2NaOH + H_2$
species **(1)** balance **(1)** [2]

(b) amount Na = 3.0/23 = 0.13 mol **(1)**
amount H_2 = 0.065 mol **(1)**
vol H_2 = 0.065 x 24 dm^3 = 1. 6 (dm^3) (allow 1.56, 1.57 or 1.565)
(1)
answers consequential on equation in (a)(ii)
If units quoted and are wrong final mark lost [3]

Total 7 marks

2 **(a)** **(i)** Number of protons + number of neutrons **(1)** [1]

(ii) (weighted) average / mean mass of **one atom (1)**
relative to one twelfth the mass of carbon-12 (atom) / on a
scale in which ^{12}C = 12 **(1)** [2]

(iii) **atoms** with same atomic no/ same no of protons/ same element
(1)
but different numbers of neutrons / mass number **(1)** [2]

(b) (24 x 0.7860) + (25 x 0.1011) + (26 x 0.1129) **(1)**
= 24.33 **(1)** [2]

Total 7 marks

3 **(a)** (Heat) energy / enthalpy change needed/required per mole **(1)**
to remove an electron **(1)**
from an atom of magnesium in the gas phase **(1)**
For three marks to be awarded there must be some reference
to magnesium in the written answer or in an equation. [3]

(b) (i) Two/big jumps show three/new/different shells present **(1)**
2 electrons with lowest I.E.in outer shell / first two electrons in outer shell / idea of order of removal **(1)**
then 8 then 2 / shows it is 2.8.2 **(1)**
Reference to s and p type electrons loses final mark because data does not show this.
The use of orbital/sub shell rather than shell should be penalised once only. **[3]**

(c) (i) $1s^2 2s^2 2p^6 3s^2$ **(1)** **[1]**

(ii) Same number of electrons (in all magnesium isotopes) **(1)**
outer electron structure determines chemical properties **(1)** **[2]**
Total 9 marks

4 (a) (i) $NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$ **(1)**
or
$2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$ **(1)** **[1]**

(b) (i) add silver nitrate (solution) / correct formula $AgNO_3$ (aq) **(1)**
white ppt / solid **(1)**
soluble in dilute ammonia /ammonia solution **(1)**
or
add lead nitrate/ethanoate (solution) **(1)**
white ppt. **(1)**
soluble in hot water **(1)**
Any feasible correct chemical method can score the marks here **[3]**

(ii) dissociates /reacts /ionises /changes into ions (as it dissolves) **(1)**
forming H^+ ions / H_3O^+ ions/ donates a proton to water. This makes the solution an acid **(1)** **[2]**

(c) (i) damp litmus paper **(1)** bleached **(1)**
or
damp starch-iodide paper **(1)** goes blue **(1)**
Displacement acceptable **[2]**

(ii) [+4] [-1] **(1)**
[+2] [-1] [0] **(1)**
positive charge not essential **[2]**

(d) (hydrogen) iodide is more easily oxidized / loses electrons more easily than (hydrogen) chloride **(1)**
because larger (than chloride) **(1)**
Could argue from the reducing power of the iodide /chloride for the first mark **[2]**
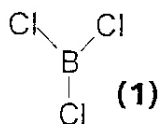**Total 12 marks**

5 (a)

(1)
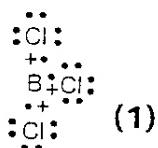
Must show all the outer electrons around the chlorine
Do not have to be • and + /   **[1]**

(b) (i)

(1)   **[1]**

(ii) The (three) bonding (electron) pairs **(1)**
repel as far apart as possible / position of minimum repulsion
(1) *not stand alone*
not just equal repulsion   **[2]**

(c) (i) Power (of an atom) to attract (the pair of) electrons **(1)**
in a covalent bond / bonding pair **(1)**   **[2]**

(ii) Bonds arranged symmetrically /molecule symmetrical /bond
polarities directional/ are vectors **(1)**
Bond polarities cancel **(1)**
Could be shown as a diagram

Note:
*The answer to (b) is consequential on the answer to (a) in the
following situation*
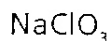*If the candidate puts a lone pair of electrons on the boron*
*   • the shape mark can be given for a clear, 3-D diagram of a
      molecule with the same shape as ammonia*
*   • the explanation will need to refer to both bond and lone
      pairs of electrons*   **[2]**

Total 8 marks

6 (a)

Na	Cl 33.3/35.5	O	
21.6/23		45.1/16	**(1)**
= 0.939	= 0.938	= 2.82	
	÷ by smallest		**(1)**
1	1	3	

$NaClO_3$
*Could argue from formula and calculate back to shown
percentages for full marks.*   **[2]**

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(b) (i) $3OCl^- \rightarrow 2Cl^- + ClO_3^-$
species **(1)** balance **(1)**
Fully balanced molecular equation score 1 mark only
Ignore spectator sodium ions in ionic equation if on both sides **[2]**

(ii) Identification of oxidation states **(1)** +1 +5 -1
Identification of an oxidation reaction **(1)** +1 to +5
Identification of a reduction reaction **(1)** +1 to -1
Disproportionation because (Cl in) OCl^- both oxidised or
reduced **(1)**
Final mark can be awarded for a simple definition of
disproportionation related to chlorine.
n.b. reference to a single atom of chlorine not acceptable. **[4]**

(c) (i) $Cl_2 + 2e^- \rightarrow 2Cl^-$ **(1)** ⎫ **[1]**
⎪ or multiples / negative charge
⎬ on e not required
(ii) $2Br^- \rightarrow Br_2 + 2e^-$ **(1)** ⎭ **[1]**

Total 10 marks

7 (a) (i)

	Na	Mg	Al	Si	P	S	Cl	Ar
m.p./°C:	98	650	660	1410	44	119	-101	-189
structural type	giant /metallic			giant (covalent)/ macromol-ecular	Simple /simple molecular / molecular (covalent)			(mon)atomic /single atoms

2 marks for four correct answers; 1 mark for three correct **[2]**

(b) Na largest atom / ion / cation
or
Na^+ smallest charge on ion/ or comparison of the charges on the
three ions **(1)**

Sodium has one / fewer delocalised electron others have more
or
Sodium has one / fewer electrons in metallic bond per atom,
others have more **(1)**

melting point low because weaker (metallic) bonding **(1)**
The final mark is for the relation of the bonding to the melting
point **[3]**

(c) (i) Weak van der Waals' forces because Ar atoms have few electrons
or
Very weak / weakest van der Waals' forces between Ar atoms **(1)** [1]

(ii) S_8 has stronger van der Waals' forces than P_4 **(1)**
Because it has more electrons/bigger molecules (NOT mass) **(1)**
Explanation of van der Waals' forces rather than name acceptable [2]

Total 8 marks

8 (a) (i) Ca <u>brick</u> red or orange red, Ba (apple) green **(1) each** [2]

(ii) electrons excited / promoted **(1)**   = up, down & out
fall to lower energy level / orbital **(1)**
give out energy in the visible region / in form of light **(1)** [3]

(b) $2Ba(NO_3)_2 \rightarrow 2BaO + 4NO_2 + O_2$ **(2)**
species **(1)** balance **(1)** [2]

(c) (i) ability (of a cation) to distort / change shape of **(1)**
the electron cloud around an anion **(1)** [2]

(ii) Size /radius /ionic radius **(1)** charge **(1)** [2]

(iii) Mg^{2+} / magnesium **ion** smaller than Ba^{2+} / barium **ion**
or
Mg^{2+} has higher change density **(1)**

Polarising power increases / Mg^{2+} able to polarise the nitrate ion more effectively than Ba^{2+} **(1)**
this weakens the bonds in the nitrate / bonds in nitrate more easily broken **(1)** [3]

Total 14 marks

PAPER TOTAL 75 MARKS

UNIT C2 :

MARK SCHEME

JANUARY 2002

3 (a) (i) $2SO_2 + O_2 \rightleftharpoons 2SO_3$ **(1)** [1]

(ii) vanadium(V) oxide / vanadium V oxide / V_2O_5 / vanadium
pentoxide **(1)**
400-500 °C / 673-773 K **(1)**
2-5 atm **(1)**
n.b. any stated number or range within the above ranges [3]

(iii) Any one use
production of fertilizers, detergents, dyes, paints,
pharmaceuticals, rayon
(in) car batteries, pickling metal **(1)** [1]

(b) (i) bauxite **(1)** [1]

(ii) $Al^{3+} + 3e^- \rightarrow Al$ **(1)**
$2O^{2-} \rightarrow O_2 + 4e^-$ **(1)** [2]

(iii) Graphite /carbon **(1)** [1]

(iv) electricity / power / energy / fuel **(1)** [1]

(v) conserves resources of ores or bauxite **(1)**
uses less energy/power/electricity/fuel (than extraction) /
conserves energy resources **(1)** [2]

(vi) e.g. aeroplanes, cans, power cables, window frames, car bodies,
car engine blocks, foil, bicycle frames, kitchen utensils **(1)** [1]

Total 13 marks

4 (a) (i) Equilibrium shifts to left / lower yield **(1)** must be clear not
implied
more (gas) molecules on right **(1)** [2]

(ii) Equilibrium shifts to left / lower yield **(1)** *must be clear not
implied*
forward reaction exothermic / shift to endothermic direction /
moves to absorb heat / rate of reverse reaction increases more
than rate of forward reaction **(1)** [2]

)

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(b) (i) Increased rate **(1)**
Molecules closer together / less space between molecules / higher concentration / same number of molecules in less space **(1)**
more collisions / collide more frequently **(1)** [3]

(ii) Increased rate **(1)**
More molecules /collisions have (at least) the activation energy **(1)**
More of the collisions successful / more of the collisions lead to reaction **(1)** [3]

(c) (i) Platinum (plus rhodium) / Pt (Rh) **(1)** [1]

(ii) Alternative route **(1)**
With lower activation energy **(1)** *this mark is consequential on previous mark*
Increase in rate because there are more successful collisions **(1)** [3]

(iii) Increased surface area / more active sites **(1)** [1]

Total 15 marks

5 (a) (i) e.g.
$CH_3CHBrCH_2CH_3 + KOH \rightarrow CH_2=CHCH_2CH_3 + KBr + H_2O$
Or
$CH_3CHBrCH_2CH_3 + KOH \rightarrow CH_3CH=CHCH_3 + KBr + H_2O$
(1)
allow ionic equation with OH⁻ and Br⁻ [1]

(ii) Elimination **(1)** [1]

(b) (i) brown / red-brown / orange / red-orange / yellow to colourless / fades / decolourises / gets paler **(1)** [1]

(ii)

(1)
2,3-dibromobutane **(1)** *accept 3-bromobutan-2-ol if correct structure drawn for hydroxy product* [2]

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(c) (i)

(1 mark for each)
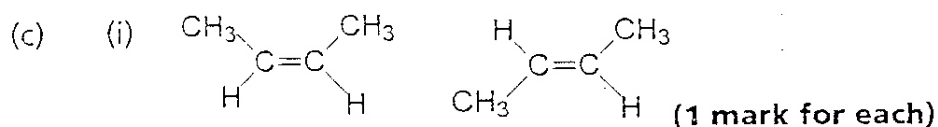
allow:
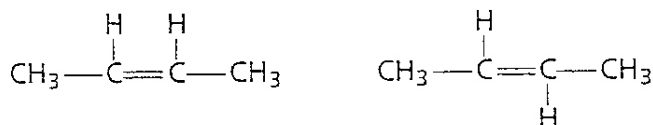
[2]

(ii) Restricted (or 'no') rotation about double bond /
2 different groups at each end of double bond **(1)**
geometrical / cis-trans **(1)**   [2]

Total 9 marks

6 (a) (i) **Enthalpy/heat change** for formation of **1 mole** of a
compound **(1)**
from its **elements (1)**
in their **standard states** / or stated temperature of 298K
(25°C) and 1 atm (or suitable unit) **(1)**   [3]

(ii) = -60.4 - (52.3-36.2) **(1)**
      = -76.5 (kJ mol⁻¹) **(1)**   [2]

(iii) negative sign means reaction exothermic/gives out heat**(1)**
if no answer given to part (ii) must give general explanation
that negative means exothermic and positive means
endothermic reaction   [1]

(b) Energy in = (612 + 366) = 978 **(1)**
Energy out = 348 + 412 + 276 = 1036 **(1)**
Energy change = 978 − 1036 = -58 **(1)** consequential

*If candidates choose to include the four C-H bonds the above
figures are 2626, 2684 and -58*   [3]

(c) **Average** values from many compounds used in bond
enthalpies **(1)**
Actual values for these compounds probably slightly different
/ or, calculation in (a) (ii) uses real / actual / experimental
/standard/ values **(1)**
n.b. do not accept arguments based on error   [2]

) **Total 11 marks**

11

7   (a)   (i) $2H_2 + O_2 \rightarrow 2H_2O$
                  formulae **(1)** balancing **(1)**

     (ii) $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$
            formulae **(1)** balancing **(1)**   **[4]**

     (b) H_2 gives more heat per gram or more heat per £ / ethanol gives
            less **(1)**
            H_2 cheaper / ethanol more expensive **(1)**

            H_2 is gas and so difficult to store/transport because it needs to
            be under pressure or needs a strong container **(1)**
            Ethanol liquid needs no special storage conditions **(1)**

            H_2 gives only water which is not a pollutant **(1)**
            ethanol gives CO_2 which is a greenhouse gas / leads to global
            warming **(1)**

            Ethanol can be a renewable resource – *needs to be qualified*
            (1)
            e.g made from sugar or made by fermentation
            Full marks can only be obtained for an answer that
            includes a clear discussion of the advantages and   Max
            disadvantages of both types of fuels   **[5]**

                                                            Total 9 marks

                                                    PAPER TOTAL 75 MARKS

UNIT C3B (6243B)

MARK SCHEME

JANUARY 2002

1 (a) (i) potassium / K^+ **(1)**
not K [1]

(ii) oxygen / O_2 **(1)**
KNO_3 / $KClO_3$ / $KMnO_4$ / KO_2 **(1)** [2]

(b) (i) carbon dioxide / CO_2 **(1)**
hydrogen / H^+ / H_3O^+ **(1)** [2]

(ii) barium sulphate / $BaSO_4$ **(1)**
sulphuric acid / H_2SO_4 **(1)** [2]

(c) Yellow / orange / brown **(1)**
to colourless / decolourised **(1)**

steamy fumes / steamy vapour / misty fumes **(1)**
litmus turns red **(1)** *if candidates then go on to say the litmus
is bleached score zero for litmus test*

orange **(1)** to green **(1)** [6]

Total 13 marks

2 (a) (i) carbon dioxide / gas evolved **(1)**
escapes from flask / lost **(1)** [2]

(ii) reaction (is fast at first then) slows down / gives off less CO_2 per
minute **(1)**
when line is horizontal the reaction has finished /
after 6 or 7 minutes the reaction has finished /
when 1 g of CO_2 lost the reaction has finished **(1)** [2]

(b) Experiment 2   steeper than 1 and same mass loss **(1)**
Experiment 3   less steep than 1 and same mass loss /
                reaction incomplete **(1)**
Experiment 4   steeper than 1 and horizontal at twice
                mass loss **(1)** [3]

(c) (i) 50.0 cm³ of 0.1 mol dm⁻³ HCl = 50 x 1/1000 mols
= 5 x 10⁻² **(1)**

5 x 10⁻² mol of HCl react with $\underline{5 \times 10^{-2}}$ **(1)** mol of $CaCO_3$
                                      2
= 2.5 x 10⁻² x 100 g
= 2.5 g **(1)** *units must be shown*
Consequential step by step [3]

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(ii) Suggested mass at least twice mass calculated in (c)(i)
e.g. 5 g **(1)** twice as much needed for experiment 4 **(1)**
If mass is larger than answer to (c)(i) and a reference to an
excess being needed score 1 mark
Consequential on previous answer.   **[2]**

Total 12 marks

3 (a)   diagram 1   (heating under) reflux **(1)**
diagram 2   distillation **(1)**   **[2]**

(b) (i)   reaction is slow / time needed for reaction to reach completion
(1)   **[1]**

(ii)   condenses vapours and returns liquid to flask / vapour turns to
liquid and returns to flask**(1)**
(it allows reaction at boiling point of reactants) without loss /
escape of material/reactants
prevents loss/escape of materials/reactants/products **(1)**   **[2]**

(c)   heat the mixture (slowly) **(1)**
collect only fraction/distillate **(1)**
produced at 102 °C / around 102 °C / between 100 -104 °C / at
the boiling temperature of the 1-bromobutane **(1)**
Need to make clear that only distillate at this temperature is
collected for second mark   **[3]**

(d) (i) $\underline{3.1}$ **(1)** x 100 = 43.1% **(1)** Allow 2-4 significant figures
7.2   **[2]**

(ii)   two reasons from:
side reactions **(1)**
reaction incomplete **(1)**   **max**
product lost in purification / transfers **(1)**   **[2]**

Total 12 marks

4 (a) (i) $\underline{0.25}$ = 0.00258 / 2.58 x 10^{3} / 0.0026 / 0.002577 **(1)**   **[1]**
97

(ii)   0.00258 / *same number of moles as calculated in (i)* **(1)**

0.00258 x $\underline{1000}$ **(1)** = 0.110 (mol dm^{3}) **(1)** *units not required*
23.45
consequential on (i) possible answers 0.11, 0.110, 0.1111   **[3]**

(b) $\dfrac{2 \times 0.01 \times 100}{0.25} = 8\%$ **(1)**

but allow $\dfrac{0.01 \times 100}{0.25} = 4\%$ **[1]**

(c)

W	Weighing	must be evidence of two weighings at some point in the process **(1)**
P	Preparation	Rinsing out one piece of relevant apparatus correctly **(1)**
D	Dissolve	Dissolve in water in beaker / volumetric flask **(1)**
R	Rinse	Rinse beaker and add washing to volumetric flask / rinse funnel (if solid straight to volumetric flask) **(1)**
V	Volumetric flask	Volumetric / standard / graduated flask **(1)** DO NOT AWARD IF CANDIDATE USES VOLUMETRIC FLASK TO MEASURE OUT 250 cm³
M	250 cm³	Making up to mark / exactly 250 cm³ of solution **(1)**
S	Shake	Shake / invert / mix final solution **(1)** *n.b. this is at end*

Max 5 marks

C   concentration $= \dfrac{\text{mass of sulphamic acid}}{97 \text{ (or } M_r)} \times \dfrac{1000}{250}$ **(1)**

H   Safety
(solution of) acid is corrosive and appropriate safety precaution
e.g. wear eye protection and/or gloves **(1)**   **[8]**

Total 13 marks

PAPER TOTAL 50 MARKS