GCE MARKING SCHEME

SUMMER 2016

CHEMISTRY - CH2 (LEGACY)
1092-01

INTRODUCTION

This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

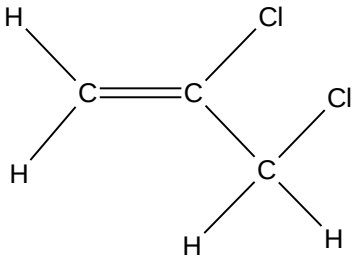
WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

GCE CHEMISTRY - CH2 (LEGACY)

SUMMER 2016 MARK SCHEME

SECTION A

1. White precipitate [1]

2. 

[1]

3. (a) Pair of shared electrons, one from each atom [1]

   (b) The difference in electronegativity between aluminium and oxygen is greater than between aluminium and chlorine [1]

4. (a) sodium aluminium magnesium silicon chlorine [1]

   (b) chlorine sodium magnesium aluminium silicon [1]

5. $C_{10}H_{22} \rightarrow C_2H_4 + C_8H_{18}$

   (or alternatives that produce more than one ethene) [1]

6. Acidified (potassium) dichromate(VI) [1]

7. Difference in solubility = 0.29 (1)

   Volume of solution = 0.11 / 0.29 = 0.38 (dm^3) (1) [2]

   Do not accept 0.4 (dm^3)

Total Section A [10]

SECTION B

8. (a) Ethanol can form hydrogen bonds with water molecules [1]

(b) Steam OR water and phosphoric acid (1)

55-80 atm pressure and 200-400°C (1) [2]

(c) (i) Peak at 650-800 cm^{-1} (due to C—Cl bond) in chloroethane will be gone [1]

(ii) I. Breaking of bond with one electron from the bond pair going to each atom/group [1]

II. $C_2H_5\bullet$ + HCl [1]

III. Fractional distillation [1]

(iii) I. Dissolved in ethanol or anhydrous (1)

Heat (1) - accept temperature up to 150°C [2]

II. Elimination [1]

III. Planar / bond angles of 120° (1)

σ bonds between C—H (1)

Sideways overlap of p-orbitals on two carbon atoms (1)

Double bond is π and σ (1)

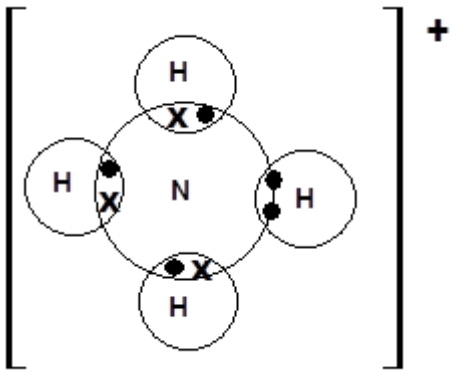
[Single <u>covalent</u> bonds between C—H and double bond between C=C worth 1 mark]

[MAX 3]

QWC *Legibility of text, accuracy of spelling, punctuation and grammar, clarity of meaning* [1]

Total [14]

9. (a) (i)



[1]

(ii) 109(.5) ° [1]

(iii) Trigonal pyramidal OR diagram (1)

3 bond pairs and one lone pair (1)

Electron pairs repel each other to be as far apart as possible / lone pair repels more than the bonded pair (1) [3]

(b) Oxidation state of nitrogen goes from -3 to +2 so it is oxidised (1)

Oxidation state of oxygen goes from 0 to -2 so it is reduced (1) [2]

Award (1) if all oxidation states for nitrogen and oxygen given correctly

(c) (i) Potassium ions = lilac

Calcium ions = brick red [1]

(ii) $3CaCO_3 + 2H_3PO_4 \rightarrow (1)Ca_3(PO_4)_2 + 3CO_2 + 3H_2O$ [1]

(iii) Moles of $CO_2 = 92.2 / (24 \times 1000) = 3.84 \times 10^{-3}$ mol (1)

Mass $CaCO_3 = 3.84 \times 10^{-3} \times 100.1 = 0.3846$ g (1)

Percentage by mass = 0.3846 / 1.202 × 100 = 32.0 (%) (1)

1 mark for correct answer (or ecf answer) given to three significant figures

If no working shown allow 1 mark for answer given to three significant figures between 31.7% and 32.3%

[4]

Total [13]

10. (a) (i) Hexanoic acid has the higher boiling temperature (reason must be given to award this mark) (1)

(Both molecules have the same amount of hydrogen bonding between molecules) but hexanoic acid has more van der Waals forces between its molecules (1) [2]

(ii) Propanoic acid has the greater solubility (reason must be given to award this mark) (1)

Both can form hydrogen bonds with water molecules (1)

Hexanoic acid has more of the molecule that cannot hydrogen bond (1)

[3]

(b) (i) *E-isomer* *Z-isomer*

1 mark for correct isomers in any representation

Only award marks for skeletal representations of correct isomers

Award (1) for correct representations incorrectly identified

[2]

(ii) Any representation of pent-4-enoic acid

(also accept 3-methylbut-2-enoic acid) (1)

Cannot form *E-Z* isomers as one carbon of the double bond has two of the same group attached OR two hydrogen atoms attached (1) [2]

(c) (i) Orange to colourless [1]

(ii) I. Percentage hydrogen = 3.42% (1)

C: 25.44/12 = 2.12

H: 3.42/1.01 = 3.39

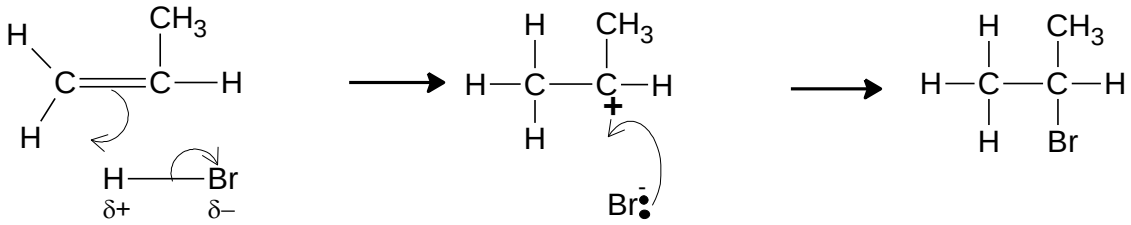
O: 3.39/16 = 0.212

Br: 67.75/79.9 = 0.848 (1)

Empirical formula = $C_{10}H_{16}O_1Br_4$ (1) [3]

II. 4 double bonds – empirical formula has only one oxygen atom but compound has —COOH group [1]

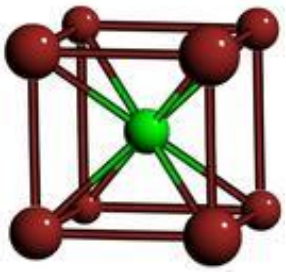
(iii) 1 mark for arrows in first diagram; 1 mark for arrow in second diagram; 1 mark for all charges



[3]

Total [17]

11. (a) (i)



1 mark for showing clear 8 coordination number (1)

Labels for both Cl^- and Cs^+ (either way round) (1) [2]

(ii) Cs^+ ion larger than Na^+ (so can have a larger coordination number) [1]

(b) Hydrogen bonding between molecules in HF but not HCl (1)

Hydrogen bonding stronger than van der Waals/forces in HCl (1) [2]

(c) Sodium metal conducts when solid (or liquid) (1)

Due to a mobile sea of delocalised electrons (1)

Sodium chloride conducts only when liquid/molten OR in solution (1)

As the ions can move (and carry a charge) (1) [4]

QWC *Selection of a form and style of writing appropriate to purpose and to complexity of subject matter* [1]

(d) (i) Refrigerants / aerosols / anaesthetics / fire retardants [1]

(ii) Ozone is broken down by (chlorine) radicals (1)

C—Cl bonds are weak enough to be broken by uv light in the upper atmosphere (1)

C—Br bonds are weaker so the molecule is broken down before reaching the ozone layer / upper atmosphere (1)

C—H or C—F are too strong to break so do not form radicals (1) [4]

QWC *Organisation of information clearly and coherently; use of specialist vocabulary where appropriate* [1]

Total [16]

12. (a) (i) To ensure **all** water had been removed [1]

(ii) Moles water = 1.658/18.02 = 0.092 (1)

x = 0.092 / 0.023 = 4 (1) [2]

(b) Moles acid at start = 0.104 × 25 /1000 = 0.0026

Therefore acid used = 0.0026 – 0.0016 = 0.0010 (1)

c = 0.0010 / 0.0010 = 1 (1) [2]

(c) Ion E = Cl^- (due to white precipitate) (1) - do not accept 'chlorine'

Moles precipitate = 3.243 / 143.5 = 0.0226 (1)

b = 0.0226 / 0.0113 = 2 (1)

ECF possible [0.0173 with AgBr; 0.0138 with AgI] [3]

(d) M_r due to D = 187 – 72 – 17 – 71 = 27 (1)

[Allow ECF from parts (a), (b) and (c)]

This is equivalent to 1 Al so ion D = Al^{3+} and a = 1 (1) [2]

Total [10]

Total Section B [70]