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GCE MARKING SCHEME

CHEMISTRY
AS/Advanced

JANUARY 2013

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GCE CHEMISTRY - CH2

JANUARY 2013 MARK SCHEME

SECTION A

Q.1 Calcium – Bones, teeth, muscle contraction.
Magnesium – chlorophyll, activation of ATP. (Both for 1 mark) [1]

Q.2 4,4-dimethylpentan-1-ol (1) [1]

Q.3 (a) Ability of atom to attract electrons in a covalent bond towards itself. [1]

(b) δ- F-Cl δ+ δ+ At-Cl δ- Both needed for mark [1]

Q.4 CH_2 (Accept H_2C) [1]

Q.5 (a) C [1]

(b) B [1]

Q.6 Both O_2 and O_3 have oxidation states of zero (1) No change in oxidation state (1) [2]

Q.7 Reversible change in properties when conditions change. [1]

Total Section A [10]

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SECTION B

Q.8 (a) (i) $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ (state symbols not required) [1]

(ii) white precipitate [1]

(b) (i) apple-green / yellow-green (no credit for 'green') [1]

(ii) Reagents – silver nitrate (1)
Observation – white precipitate (1)
Must have correct reagent to get observation [2]

(c) Mass produced by cooling 1 dm^3 = 358-312 = 46 g (1)
Mass produced by 200 cm^3 = 46 x 200 ÷1000 = 9.2 g (1) [2]

(d) M_r of anhydrous $BaCl_2$ = 208 (1)
Water content = 36 so *x* =2 (1) [2]

(e) (i) $BaCO_3 + 2HCl \rightarrow BaCl_2 + H_2O + CO_2$ [1]

(ii) I. Moles = 50 x 0.50 ÷ 1000 (1) = 0.025 moles (1) [2]

II. Filtration [1]

III. Moles $BaCl_2$ = moles HCl ÷ 2 = 0.0125 mol (1)

Mass hydrated $BaCl_2$ = 0.0125 x 244 = 3.05 g (1) [2]

Total [15]

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Q.9 (a) (i) ultraviolet / sunlight [1]

(ii) A species with an unpaired electron. [1]

(b) $CH_4 + Cl\bullet \rightarrow CH_3\bullet + HCl$ (1)
$CH_3\bullet + Cl_2 \rightarrow CH_3Cl + Cl\bullet$ (1) [2]

(c) (i) Two $CH_3\bullet$ radicals combine (in a termination reaction). [1]

(ii) 24.3 ÷ 12 = 2.025 for C 4.1 ÷ 1.01 = 4.059 H 71.6 ÷ 35.5 = 2.017 Cl (1)
CH_2Cl (1) [2]

(d) (i) Nucleophilic substitution [1]

(ii) Methanol has hydrogen bonding between molecules (1)
Chloromethane has van der Waals forces / dipole-dipole forces between molecules (1)
Hydrogen bonding is stronger than Van der Waals/dipole-dipole (1) [3]

(iii) Acidified potassium dichromate / acidified potassium manganate(VII) (1)
Heat /warm (1) (Need correct reagent to gain heat mark) [2]

(e) Compounds **B** and **C** are stable enough to reach the ozone layer OR Compound **D** would not reach the ozone layer as it would decompose in the lower atmosphere. (1)

(The C-Cl forms) Cl• which will decompose the ozone. (1)

Compound **A** does not contain chlorine, (so it cannot form Cl•) / Compound A has a lower RODP (1)

[3]

Total [16]

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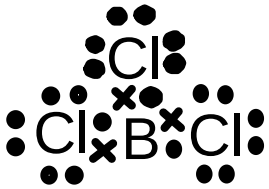
Q.10 (a)

- BCl_3 is trigonal planar or clear diagram.
- NCl_3 is pyramidal or clear diagram.
- BCl_3 has 3 bonded pairs
- NCl_3 has 3 bonded pairs
- NCl_3 has a lone pair
- BCl_3 has no lone pair
- Electron pairs repel to be as far from each other as possible / position of minimum repulsion.
- Lone pairs repel more than bonded pairs.

First two points and any other 4 for (1) each up to 6 max [6]

- *QWC: selection of a form and style of writing appropriate to purpose and to complexity of subject matter.[1]*
-
- *QWC: legibility of text, accuracy of spelling, punctuation and grammar, clarity of meaning.[1]* [2]

(b)



accept crosses and dots exchanged (1)

Electron deficient: outer shell of boron has less than 8 electrons / is not full.(1) [2]

(c) NH_3 can form hydrogen bonds with water molecules (so it dissolves) (1)
NCl_3 cannot form hydrogen bonding. (1) [2]

(d)

- Covalent has a pair of shared electrons one from each atom (1)
- Coordinate has a pair of shared electrons both electrons from same atom (1)

[2]

Total [14]

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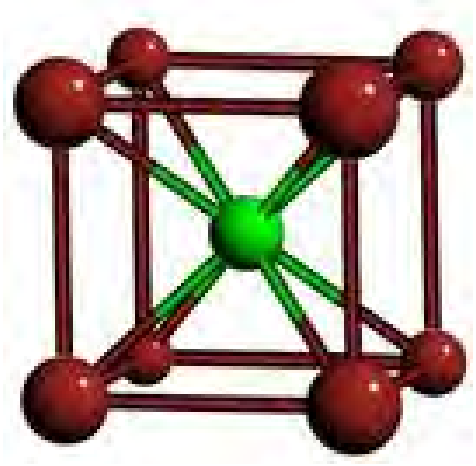
Q.11 (a) (i)



Clear 8 coordination number (1)
Labels of both Cl^- and Cs^+ (either way round) (1) [2]

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

(b) (i) Any three from the following for (1) each up to 3 max – can gain these from labelled diagram

- Layers of carbon atoms.
- Hexagons of carbon atoms / each carbon bonded to three others.
- Weak forces between layers.
- Delocalised electrons above and below plane. [3]

QWC: organisation of information clearly and coherently; use of specialist vocabulary where appropriate. [1]

(ii) Delocalised electrons in graphite can move to carry a current (1)
Diamond has no delocalised electrons (1) [2]

(iii) Van der Waals forces between molecules need to be broken to form iodine gas (1)

Covalent bonds need to be broken to form a gas from diamond/graphite (1)

Van der Waals forces are much weaker than covalent bonds (1)
[3]

Total [12]

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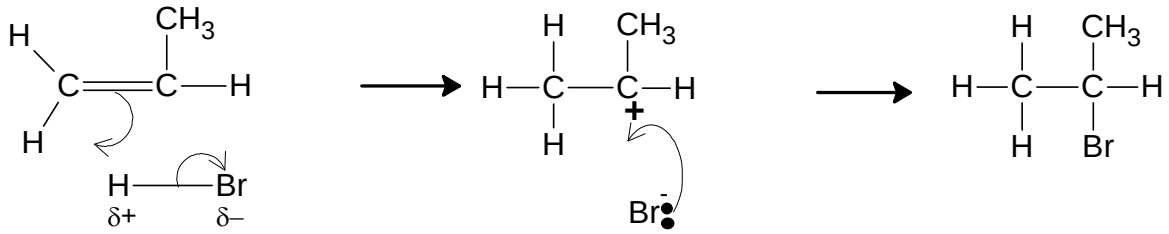
Q.12 (a) (i) Molecules with different numbers of carbon atoms have different boiling points. [1]

(ii) Any suitable reaction, e.g. $C_{10}H_{22} \rightarrow C_4H_8 + C_6H_{14}$ [1]

(b) (i) Turns from orange to colourless (no credit for 'red') [1]

(ii) (1) for arrows in first diagram; (1) for arrow in second diagram; (1) for all charges.



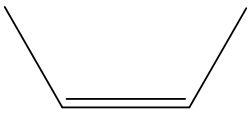
[3]

(iii) Ethanol OR Alcohol solution / Heat - both required [1]

(c) (i) Restricted rotation about double bond in but-2-ene but not butane (1)

2 groups attached to each carbon of the double bond are different in but-2-ene but in propene one carbon has the same two groups attached (1) [2]

(ii)



Accept any valid representation [1]

(d) (i) Steam, phosphoric acid catalyst, (1) 300°C, 70 atm pressure (1) [2]

(ii) Butan-2-ol will have IR absorptions at 2500-3550 cm^{-1} / 1000 – 1300 cm^{-1} and butene will not
OR
But-2-ene will have an IR absorption at 1620-1720 and butan-2-ol will not [1]

Total [13]

Total Section B [70]

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