# GCE MARKING SCHEME

## CHEMISTRY
## AS/Advanced

## SUMMER 2014

## GCE CHEMISTRY - CH1

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### SECTION A

**Q.1** $1s^2 2s^2 2p^6 3s^2 3p^6$ [1]

**Q.2** carbon-12 / $^{12}C$ [1]

**Q.3** any example e.g. [1]
iron for Haber process / manufacture of ammonia
vanadium(V) oxide in Contact process / manufacture of sulfuric acid
platinum / palladium / rhodium in catalytic converters / to remove toxic gases from exhaust fumes
nickel in hydrogenation of alkenes / unsaturated oils

**Q.4** (a) $M_r = 286.2$ allow 286 [1]

(b) mass = $\dfrac{286.2 \times 0.1}{4}$ = 7.155 / 7.16 allow 7.15 / 7.2 based on 286 [1]

**Q.5** enthalpy changes = –110 [1]

**Q.6** $^{234}_{90}Th$ (1) $^{234}_{91}Pa$ (1) (award 1 mark for 2 correct symbols) [2]

**Q.7** portion to right of $Ea_1$ labelled as molecules that react / shaded [1]

$Ea_2$ marked, at lower energy than $Ea_1$, and portion to right labelled as molecules that react / shaded [1]

**Section A Total [10]**

## SECTION B

**Q.8** (a) same number of protons and electrons (1)

0, 1 and 2 neutrons (1) [2]

(b) (i) 3 energy levels between n = 2 and n = $\infty$
becoming closer together
first gap must be < that between n = 1 and n = 2 [1]

(ii) any arrow pointing upwards (1)

from n = 1 to n = $\infty$ (1) [2]

(c) (i) visible [1]

(ii) (not correct because) Balmer series corresponds to energy transitions involving n = 2 (1)

for ionisation energy need Lyman series / energy transitions involving n = 1 (1) [2]

(d) (i) $Q(g) \rightarrow Q^{+}(g) + e$ / accept any symbol [1]

(ii) Group 6 [1]

(iii) In T there is more shielding (1)

The outer electron is further from the nucleus (1)

The increase in shielding outweighs the increase in nuclear charge / there is less effective nuclear charge (1) [3]

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

**Total [14]**

| | | | | |
|---|---|---|---|---|
| **Q.9** | (a) | (i) | line drawn that is deflected less by magnetic field | [1] |
| | | (ii) | increase strength of the magnetic field<br>allow decrease charge on charged plates | [1] |
| | (b) | (i) | 1+ (1)<br>$^{37}Cl$ - $^{37}Cl$ (1) $\quad$ $^{37}Cl_2^+$ (2) | [2] |
| | | (ii) | line drawn as m/z 72 (1)<br>ratio height 6 (1) $\quad$ allow ½ square tolerance | [2] |
| | (c) | (i) | % H = 0.84 (1)<br>C : H : Cl = 10.04 / 12 : 0.84/ 1.01 : 89.12 / 35.5 (1)<br>= 0.84 : 0.83 : 2.51 = 1 : 1 : 3 empirical formula = $CHCl_3$ (1) | [3] |
| | | (ii) | the relative molecular mass / $M_r$ / molar mass | [1] |
| | | (iii) | right hand / largest / heaviest m/z peak from mass spectrum | [1] |

**Total [11]**

**Q.10** (a) (a reaction in which) the rate of the forward reaction is equal to the rate of the backward reaction [1]

(b) goes darker / more brown (1)

because the (forward) reaction has a +ve $\Delta H$ / is endothermic (1)

goes paler / less brown (1)

because there are more moles / molecules on RHS (1)

no change (because catalysts do not affect the position of an equilibrium) (1) [5]

(c) (i) moles $N_2H_4$ = 14000/32.04 = 437.0 (1)

this produces 437.0 × 3 = 1311 moles of gas (1)

volume = 1311 × 24 = $3.15 \times 10^4$ $dm^3$ (1) [minimum 2 sf] [3]

(ii) (large volume of) gas produced [1]

(d) (i) an acid is a proton / $H^+$ donor [1]

(ii) $\rightarrow NO_2^- + H_3O^+$ [1]

(iii) sulfuric acid is behaving as the acid / nitric acid is behaving as a base (1)

as it donates a proton / as it accepts a proton (1) [2]

**Total [14]**

**Q.11** (a) (i) $2C(s) + 3H_2(g) + ½O_2(g) \rightarrow C_2H_5OH(l)$ (state symbols needed)

C(s) allowed as C(gr) or C(graphite) [1]

(ii) (if these elements were reacted together) other products would form/ carbon does not react with hydrogen **and** oxygen under standard conditions [1]

(b) (i) energy = $100 \times 4.2 \times 54 = 22680$ [1]

(ii) moles ethanol = 0.81/46 = 0.0176 (1)

energy change = $\frac{22.68}{0.0176}$ $\Delta H = -1290$ (1)

–ve sign and correct to 3 sf (1) [3]

(c) internet value numerically larger (1)

heat losses / incomplete combustion / thermal capacity of calorimeter ignored (1) no credit for energy loss [2]

(d) (i) $C_3H_7OH + 4½O_2 \rightarrow 3CO_2 + 4H_2O$ (ignore state symbols) [1]

(ii) negative enthalpy change means energy in bonds broken is less than that in bonds made [1]

(iii) more bonds broken and made in propanol and therefore more energy released [1]

(e) any 4 from:

both conserve carbon / non-renewable fuel sources / fossil fuels / use renewable sources

(these gas / liquid) suitable for different uses e.g. ethanol to fuel cars

atom economy gasification is less (some C lost as $CO_2$) / $CO_2$ produced in gasification is a greenhouse gas

CO is toxic

gasification at high temperature / enzymes need low temperature

enzyme approach therefore saves fuel / gasification needs more energy [4]

3 max if any reference to destruction of ozone layer

*QWC* [2]
The candidate has selected a form and style of writing that is appropriate to purpose and complexity of the subject matter (1)

Answer has suitable structure (1)

**Total [17]**

**Q.12** (a) to increase rate of reaction / to increase surface area [1]

(b) $MgCO_3 + 2HCl \rightarrow MgCl_2 + CO_2 + H_2O$ (ignore state symbols) [1]

(c) rate starts fast and gradually slows (1)

because concentration becomes less so fewer collisions (per unit time) / less frequent collisions / lower probability of collisions (1)

at time = 17/18 min rate = 0 (1) [3]

(d) all the solid would all have disappeared / if more carbonate is added further effervescence is seen [1]

(e) (i) volume $CO_2$ = 200 $cm^3$ (1)

moles $CO_2$ = 200 / 24000 = 0.008333 = moles $MgCO_3$ (1)
[minimum 2 sf] [2]

(ii) mass $MgCO_3$ = 0.008333 × 84.3 = 0.702 g (1)

% $MgCO_3$ = $\frac{0.702}{0.889} \times 100$ = 79.0% / 79% [2]

(e) carbon dioxide is soluble in water / reacts with water (1)

volume collected less therefore % / moles of $MgCO_3$ less (1) [2]

(f) use of 40.3 and 84.3 (1)

atom economy = 40.3 / 84.3 × 100 = 47.8% (1) [2]

**Total [14]**

**Section B Total [70]**