



# **GCE MARKING SCHEME**

**CHEMISTRY  
AS/Advanced**

**SUMMER 2014**

**GCE CHEMISTRY - CH1**  
**SUMMER 2014 MARK SCHEME**

**SECTION A**

- Q.1**  $1s^2 2s^2 2p^6 3s^2 3p^6$  [1]
- Q.2** carbon-12 /  $^{12}\text{C}$  [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)  $\text{mass} = \frac{286.2 \times 0.1}{4} = 7.155 / 7.16$  allow 7.15 / 7.2 based on 286 [1]
- Q.5** enthalpy changes =  $-110$  [1]
- Q.6**  $^{234}_{90}\text{Th}$  (1)  $^{234}_{91}\text{Pa}$  (1) (award 1 mark for 2 correct symbols) [2]
- Q.7** portion to right of  $E_{a1}$  labelled as molecules that react / shaded [1]  
 $E_{a2}$  marked, at lower energy than  $E_{a1}$ , 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  
allow decrease charge on charged plates [1]
- (b) (i) 1+ (1)  
 $^{37}\text{Cl} - ^{37}\text{Cl}$  (1)                       $^{37}\text{Cl}_2^+$  (2) [2]
- (ii) line drawn as m/z 72 (1)  
ratio height 6 (1)                      allow  $\frac{1}{2}$  square tolerance [2]
- (c) (i) % H = 0.84 (1)  
C : H : Cl = 10.04 / 12 : 0.84 / 1.01 : 89.12 / 35.5 (1)  
= 0.84 : 0.83 : 2.51 = 1 : 1 : 3 empirical formula =  $\text{CHCl}_3$  (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  $\text{N}_2\text{H}_4 = 14000/32.04 = 437.0$  (1)  
this produces  $437.0 \times 3 = 1311$  moles of gas (1)  
volume =  $1311 \times 24 = 3.15 \times 10^4 \text{ dm}^3$  (1) [minimum 2 sf] [3]
- (ii) (large volume of) gas produced [1]
- (d) (i) an acid is a proton /  $\text{H}^+$  donor [1]
- (ii)  $\rightarrow \text{NO}_2^- + \text{H}_3\text{O}^+$  [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)  $2\text{C}(\text{s}) + 3\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{C}_2\text{H}_5\text{OH}(\text{l})$  (state symbols needed) [1]  
 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)  $\text{C}_3\text{H}_7\text{OH} + 4\frac{1}{2}\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$  (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  $\text{CO}_2$ ) /  $\text{CO}_2$  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)  $\text{MgCO}_3 + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$  (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  $\text{CO}_2 = 200 \text{ cm}^3$  (1)  
 moles  $\text{CO}_2 = 200 / 24000 = 0.008333 = \text{moles MgCO}_3$  (1)  
 [minimum 2 sf] [2]
- (ii) mass  $\text{MgCO}_3 = 0.008333 \times 84.3 = 0.702 \text{ g}$  (1)  
 $\% \text{MgCO}_3 = \frac{0.702}{0.889} \times 100 = 79.0\% / 79\%$  [2]
- (e) carbon dioxide is soluble in water / reacts with water (1)  
 volume collected less therefore % / moles of  $\text{MgCO}_3$  less (1) [2]
- (f) use of 40.3 and 84.3 (1)  
 atom economy =  $40.3 / 84.3 \times 100 = 47.8\%$  (1) [2]

**Total [14]**

**Section B Total [70]**