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 = $\frac{286.2 \times 0.1}{4}$ = 7.155 / 7.16 allow 7.15 / 7.2 based on 286 [1]

Q.5 enthalpy changes = –110 [1]

Q.6 $^{234}_{90}Th$ (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 = ∞
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 = ∞ (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}Cl - ^{37}Cl (1) $^{37}Cl_2^+$ (2) [2]

(ii) line drawn as m/z 72 (1)

ratio height 6 (1) allow ½ 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 = $CHCl_3$ (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 ΔH / 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 = 3.15×10^4 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) $2C(s) + 3H_2(g) + \frac{1}{2}O_2(g) \rightarrow C_2H_5OH(l)$ (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) $C_3H_7OH + 4\frac{1}{2}O_2 \rightarrow 3CO_2 + 4H_2O$ (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 $MgCO_3 = 0.008333 \times 84.3 = 0.702$ 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 = $40.3 / 84.3 \times 100 = 47.8\%$ (1) [2]

Total [14]

Section B Total [70]