

## **MARK SCHEME for the October/November 2013 series**

### **0620 CHEMISTRY**

**0620/31**

Paper 3 (Extended Theory), maximum raw mark 80

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Page 2	Mark Scheme	Syllabus	Paper
	IGCSE – October/November 2013	0620	31

- 1 (a) uranium / plutonium / thorium [1]
- (b) graphite / carbon [1]
- (c) platinum / titanium / mercury / gold [1]  
**NOT:** carbon / graphite
- (d) helium [1]
- (e) nitrogen / phosphorus [1]
- (f) argon [1]  
**ACCEPT:** any ion 2 + 8 + 8 e.g. K<sup>+</sup> etc.
- (g) tellurium [1]  
**ACCEPT:** correct symbol
- [Total: 7]**
- 2 (a) Any three of:  
iron is harder  
iron has higher density  
**ACCEPT:** heavier **or** potassium lighter  
iron has higher mp **or** bp  
iron has higher tensile strength **or** stronger  
iron has magnetic properties [3]  
**NOTE:** has to be comparison, e.g. iron is hard (0) but iron is harder (1)  
**NOT:** appearance e.g. shiny  
**ACCEPT:** comparative statements relating to potassium
- (b) potassium hydrogen (1) and potassium hydroxide (1)  
zinc hydrogen (1) and zinc oxide (1)  
copper no reaction (1) [5]
- [Total: 8]**

Page 3	Mark Scheme	Syllabus	Paper
	IGCSE – October/November 2013	0620	31

- 3 (a) (i) fractional distillation [1]  
(liquid) air [1]
- (ii) cracking / heat in presence of catalyst [1]  
of alkane / petroleum [1]  
to give an alkene and hydrogen [1]
- OR:** electrolysis (1)  
named electrolyte (1)  
hydrogen at cathode (1)
- OR:** from methane (1)  
react water / steam (1)  
heat catalyst (1)  
only **ACCEPT:** water with methane **or** electrolysis
- (b) (i) the pair with both graphs correct is C [1]  
**NOTE:** mark (b)(ii) independent of (b)(i)
- (ii) high pressure favours side with lower volume / fewer moles [1]  
this is RHS / product / ammonia [1]  
%NH<sub>3</sub> / yield increases as pressure increases [1]
- the forward reaction is exothermic [1]  
exothermic reactions favoured by low temperatures [1]  
%NH<sub>3</sub> / yield decreases as temperature increases [1]  
**ACCEPT:** reverse arguments
- (iii) increases reaction rate [1]  
**ACCEPT:** reduces activation energy [1]  
**OR:** decreases the amount of energy particles need to react  
**OR:** economic rate at lower temperature so higher yield
- [Total: 14]**
- 4 (a) (i) (mass at t = 0) – (mass at t = 5) [1]  
**NOTE:** must have mass at t = 5 not final mass
- (ii) fastest at origin  
slowing down between origin and flat section gradient = 0  
where gradient = 0  
**three** of above in approximately the correct positions [2]
- (iii) 3 correct comments about gradient = [2]  
2 correct comments about gradient = [1]  
1 correct comment about gradient = [0] [2]
- (b) start at origin and smaller gradient [1]  
same final mass just approximate rather than exact [1]

Page 4	Mark Scheme	Syllabus	Paper
	IGCSE – October/November 2013	0620	31

- (c) (i) smaller surface area [1]  
lower collision rate [1]
- (ii) molecules have more energy [1]  
collide more frequently / more molecules have enough energy to react [1]
- (d) number of moles of HCl in 40 cm<sup>3</sup> of hydrochloric acid, [1]  
concentration 2.0 mol / dm<sup>3</sup> = 0.04 × 2.0 = 0.08 [1]  
maximum number of moles of CO<sub>2</sub> formed = 0.04 [1]  
mass of one mole of CO<sub>2</sub> = 44 g [1]  
maximum mass of CO<sub>2</sub> lost = 0.04 × 44 = 1.76 g [1]

[Total: 15]

- 5 (a) (i) have same molecular formula / both are C<sub>5</sub>H<sub>12</sub> [1]  
they have different structural formulae / different structures [1]
- (ii) CH<sub>3</sub>-CH<sub>2</sub>-CH=CH-CH<sub>3</sub> / any other correct isomer [1]
- (b) (i) CH<sub>2</sub>-(Br)-CH<sub>2</sub>Br [1]  
**NOT:** C<sub>2</sub>H<sub>4</sub>Br<sub>2</sub>  
dibromoethane [1]  
**NOTE:** numbers not required but if given must be 1, 2
- (ii) CH<sub>3</sub>-CH<sub>2</sub>-CH<sub>3</sub> [1]  
**NOT:** C<sub>3</sub>H<sub>8</sub>  
propane [1]
- (iii) CH<sub>3</sub>-CH<sub>2</sub>-CH<sub>2</sub>-CH<sub>2</sub>-OH / CH<sub>3</sub>-CH<sub>2</sub>-CH(OH)-CH<sub>3</sub> [1]  
butanol [1]  
numbers not required but if given must be correct and match formula
- (c) (i) CH<sub>3</sub>-CH=CH-CH<sub>2</sub>-CH<sub>3</sub> [1]  
CH<sub>3</sub>-CH=CH-CH<sub>3</sub> [1]
- (ii) pink / purple [1]  
colourless [1]  
**NOT:** clear
- (d) -CH<sub>2</sub>-CH(CN)-CH<sub>2</sub>-CH(CN)- [1]  
correct repeat unit CH<sub>2</sub>-CH(CN) [1]  
**COND:** at least 2 units in diagram [1]  
continuation [1]

[Total:16]

Page 5	Mark Scheme	Syllabus	Paper
	IGCSE – October/November 2013	0620	31

- 6 (a) (i) (attractive force between) positive ions [1]  
and (negative) electrons [1]  
opposite charges attract ONLY [1]  
electrostatic attraction ONLY [1]
- (ii) lattice / rows / layers of lead ions / cations / positive ions [1]  
**NOT:** atoms / protons / nuclei [1]  
can slide past each other / the bonds are non-directional [1]
- (b) (i) anhydrous cobalt chloride becomes hydrated [1]  
**ACCEPT:** hydrous [1]
- (ii) carbon dioxide is acidic [1]  
sodium hydroxide and calcium oxide are bases / alkalis [1]
- (iii) Any two of: [2]  
water, calcium carbonate and sodium carbonate [2]  
**ACCEPT:** sodium bicarbonate [2]
- (c) number of moles of CO<sub>2</sub> formed = 2.112 / 44 = 0.048 [1]  
number of moles of H<sub>2</sub>O formed = 0.432 / 18 = 0.024 [1]
- x = 2 and y = 1 **NOT:** ecf from this line
- formula is 2PbCO<sub>3</sub>.Pb(OH)<sub>2</sub> / Pb(OH)<sub>2</sub>. 2PbCO<sub>3</sub> [1]
- [Total:12]**
- 7 (a) (i) hydrogen (atoms) replaced by (atoms) of a different element e.g. chlorine [1]  
**NOT:** substitute [1]
- (ii) light required [1]
- (b) exothermic reaction gives out energy [1]  
endothermic reaction absorbs [1]  
takes in energy [1]
- (c) bonds broken                      energy [1]  
C-H                                      +412  
C-Cl                                      +242  
total energy                            +654 [1]
- bonds formed                        energy  
C-Cl                                      -338  
H-Cl                                      -431  
total energy                            -769 [1]  
energy change                        -115 [1]  
negative sign indicates exothermic [1]

**[Total: 8]**