

## **MARK SCHEME for the May/June 2013 series**

### **0620 CHEMISTRY**

**0620/32**

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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- 1 (a) (i) named noble gas [1]  
**accept:** any noble gas  
**accept:** symbol
- (ii) H<sub>2</sub>O / CO<sub>2</sub> [1]  
**not:** names **not:** equations
- (b) (i) oxygen and nitrogen (in air) (react) [1]  
at high temperature [1]  
**accept:** in engines / lightning **not:** in exhausts
- (ii) fossil fuels / fuels which contain sulfur [1]  
**accept:** named fossil fuel such as coal / oil / natural gas  
burn / combust [1]
- (iii) any two from:  
damage buildings / soil acidification / leaching from soil / soil nutrients become  
unavailable / kill microbes / acidify lakes / kill fish / damage trees / reduction in plant  
growth / crop loss [2]
- (c) (i) oxygen reacts with copper [1]  
to form copper oxide (which is black) [1]
- (ii) measure volume at room temperature / gas has different volumes at different  
temperatures / volume of gas depends on temperature / hot gas has higher volume /  
heat causes expansion (of gases) / ORA [1]
- (iii) no oxygen left **or** all the oxygen has reacted (with copper) [1]
- (iv) 39–40 cm<sup>3</sup> **note:** units required [1]
- 2 (a) B  ${}_{19}^{39}\text{K}$  [1]  
positive charge + [1]
- C  ${}_{30}^{65}\text{Zn}$  [1]
- D  ${}_{8}^{16}\text{O}$  [1]  
charge 2– [1]
- E  ${}_{31}^{70}\text{Ga}$  [1]
- (b) number of p = number of e [1]  
number of p > number of e [1]  
number of p < number of e [1]

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- 3 (a) (i) complete combustion / combustion in excess oxygen [1]  
of fuels containing carbon / fossil fuels / hydrocarbon (fuels) [1]  
produce carbon dioxide / increase percentage of CO<sub>2</sub> in atmosphere [1]
- (ii) living things / cells / plants / animals / humans / micro-organisms [1]  
(oxidise / react with) oxygen **and** food / foodstuff / named foodstuff / carbohydrate /  
sugar / glucose [1]  
produces carbon dioxide [1]
- (b) (i) glucose **or** starch **or** carbohydrate [1]  
oxygen [1]
- (ii) light / sunlight / sun / UV [1]  
chlorophyll **accept:** chloroplast [1]
- 4 (a) (i) **first reaction**  
volume / moles / molecules of reactants and products are different [1]  
**second reaction**  
volume / moles / molecules of reactants and products are the same [1]
- (ii) first reaction (forward) reaction is endothermic [1]  
second reaction (forward) reaction is exothermic [1]
- (b) (i)  $C_8H_{18} \rightarrow 2C_4H_8 + H_2$  [1]
- (ii)  $2H^+ + 2e \rightarrow H_2$  [2]  
or  $2H_3O^+ + 2e \rightarrow H_2 + 2H_2O$   
**accept:**  $-2e$  on right hand side **accept:**  $e^-$   
**note:** not balanced = 1
- (iii) chlorine / Cl<sub>2</sub> / [1]  
**cond:** water treatment / solvents / plastics / PVC / bleach / disinfectants / HCl / kill  
bacteria / sterilising water / chlorination of water / swimming pools / pesticides /  
herbicides / insecticides / germicides / pharmaceuticals [1]  
sodium hydroxide/NaOH [1]  
**cond:** making soap / degreasing / making paper / detergents / bio-diesel / paint stripper /  
clearing drains / alumina from bauxite / oven cleaner / bleach [1]

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- 5 (a) (i) does not decay **or** non-biodegradable **or** flexible **or** bendable **or** easily moulded **or** low density / light / lightweight **or** waterproof / insoluble in water **or** does not corrode **or** durable [1]
- (ii) any two from: [2]  
 chlorine  
 hydrogen chloride  
 carbon monoxide
- (b) (i)  $\text{CH}_3\text{—CH} = \text{CH}_2$  [1]  
**note:** can be fully or semi-displayed, C = C must be shown
- (ii) correct repeat unit [1]  
 $\text{—CH}(\text{C}_6\text{H}_5)\text{—CH}_2\text{—}$   
 continuation shown [1]
- (c) glucose two products (polymer and water) / condensation (polymerisation) / (small) molecules removed [1]  
 phenylethene one product (polymer) / addition (polymerisation) [1]
- 6 (a) (i) ions cannot move / no free ions in solid state [1]  
 ions can move / free ions in liquid state [1]  
**note:** ions can only move in liquid state = 2
- (ii) reduce melting point / reduce energy costs / better conductor when dissolved in cryolite [1]
- (iii) burns in oxygen / reacts with oxygen / oxidised by oxygen / forms carbon dioxide / forms carbon monoxide [1]
- (iv) high melting point / inert / unreactive [1]
- (b) protective / unreactive / resists / prevents corrosion / non-porous (layer) [1]  
 of (aluminium) oxide [1]
- (c) (i) good conductor (of electricity) [1]  
 low density / light / lightweight [1]
- (ii) steel core (increased) strength / prevent sagging / to increase separation of pylons / support [1]

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- 7 (a) (i)  $\text{CH}_3\text{COOCH}_2\text{CH}_3$  /  $\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_3$  /  $\text{CH}_3\text{COOC}_2\text{H}_5$  /  $\text{CH}_3\text{CO}_2\text{C}_2\text{H}_5$  /  $\text{C}_2\text{H}_5\text{OOCCH}_3$  /  $\text{CH}_3\text{CH}_2\text{OOCCH}_3$  **not:** –OCO– linkage [1]  
**note:** formulae can be displayed or semi-displayed  
**note:** penalise sticks (i.e. any missing atoms)
- (ii) butyl methanoate [1]
- (b) (i) fats / vegetable oils / triglycerides / lipids [1]
- (ii) two correct ester linkages, e.g. –OOC / –O<sub>2</sub>C and –COO / –CO<sub>2</sub> [1]  
 contents of the ‘boxes’ being C<sub>6</sub>H<sub>4</sub> and C<sub>2</sub>H<sub>4</sub> or CH<sub>2</sub>CH<sub>2</sub> [1]  
 continuation bonds at **both** ends [1]
- (c) (i) to make colourless / invisible (spots) [1]  
 visible / coloured / seen / position made clear / indicate [1]
- (ii)  $\frac{\text{distance travelled by sample}}{\text{distance travelled by solvent (front)}} = R_f$  [1]
- (iii) sample 1  $R_f = 0.20$  to  $0.24$  tartaric (acid) [1]  
 sample 2  $R_f = 0.44$  to  $0.48$  malic (acid) [1]
- 8 (a) (i) (the number of particles which is equal to the number of atoms in) 12g of carbon 12  
**or**  
 the mass in grams which contains the Avogadro’s constant number of particles  
**or**  
 Avogadro’s constant **or**  $6$  to  $6.023 \times 10^{23}$  of atoms / ions / molecules / electrons / particles  
**or**  
 (the amount of substance which has a mass equal to) its relative formula mass / relative atomic mass / relative molecular mass in grams  
**or**  
 (the amount of substance which has a volume equal to)  $24 \text{ dm}^3$  of a gas at RTP [1]
- (ii) (Avogadro’s constant is the) number of particles / atoms / ions / molecules in one mole of a substance  
**or**  
 the number of carbon atoms in 12g of C(12).  
**or**  
 the number of particles / molecules in  $24 \text{ dm}^3$  of a gas at RTP  
**or**  
 $6$  to  $6.023 \times 10^{23}$  (particles / atoms / ions / molecules / electrons) [1]
- (b)  $\text{CH}_4$  and  $\text{SO}_2$  [1]  
 $2/16 = 1/8$  or  $0.125$  moles of  $\text{CH}_4$  **AND**  $8/64 = 1/8$  or  $0.125$  moles of  $\text{SO}_2$  [1]

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- (c) (i)  $4.8/40 = 0.12$  moles of Ca  
 $3.6/18 = 0.2$  moles of H<sub>2</sub>O **both** correct [1]
- (ii) Ca is in excess (**no mark**) (because 0.12 moles of Ca need) 0.24 moles / 4.32 g of H<sub>2</sub>O to react [1]  
there is not enough / there are 0.2 moles / 3.6 g of H<sub>2</sub>O [1]  
**or**  
Ca is in excess (**no mark**) (because 0.2 moles / 3.6 g of water will react with) 0.1 moles / 4.0 g of Ca [1]  
there is more than that / there are 0.12 moles / 4.8 g of Ca [1]  
**or**  
Ca is in excess (**no mark**) because the mole ratio Ca:H<sub>2</sub>O is 3:5 / mass ratio 4:3 [1]  
which is bigger than the required mole ratio of 1:2 / mass ratio 10:9 [1]  
**or**  
Ca is in excess (**no mark**) because the mole ratio H<sub>2</sub>O:Ca is 5:3 / mass ratio 3:4 [1]  
which is smaller than the required mole ratio of 2:1 / mass ratio 9:10 [1]
- (iii)  $0.02 \times 40 = 0.8$  (g) [1]