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.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.
1 (a) (i) named noble gas
   accept: any noble gas
   accept: symbol [1]

   (ii) $\text{H}_2\text{O} / \text{CO}_2$
   not: names not: equations [1]

(b) (i) oxygen and nitrogen (in air) (react) at high temperature
   accept: in engines / lightning not: in exhausts [1]

   (ii) fossil fuels / fuels which contain sulfur
   accept: named fossil fuel such as coal / oil / natural gas
   burn / combust [1]

   (iii) any two from:

(c) (i) oxygen reacts with copper 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$^3$ note: units required [1]

2 (a) $^{39}_{19}\text{K}$
   positive charge + [1]

   $^{65}_{30}\text{Zn}$ [1]

   $^{16}_{8}\text{O}$
   charge 2– [1]

   $^{70}_{31}\text{Ga}$ [1]

(b) number of $p$ = number of $e$ [1]

   number of $p$ > number of $e$ [1]

   number of $p$ < number of $e$ [1]
3 (a) (i) complete combustion / combustion in excess oxygen of fuels containing carbon / fossil fuels / hydrocarbon (fuels) produce carbon dioxide / increase percentage of CO₂ in atmosphere (ii) living things / cells / plants / animals / humans / micro-organisms (oxidise / react with) oxygen and food / foodstuff / named foodstuff / carbohydrate / sugar / glucose produces carbon dioxide (b) (i) glucose or starch or carbohydrate oxygen (ii) light / sunlight / sun / UV chlorophyll accept: chloroplast

4 (a) (i) first reaction volume / moles / molecules of reactants and products are different second reaction volume / moles / molecules of reactants and products are the same (ii) first reaction (forward) reaction is endothermic second reaction (forward) reaction is exothermic (b) (i) C₈H₁₈ → 2C₄H₈ + H₂ (ii) 2H⁺ + 2e → H₂ or 2H₃O⁺ + 2e → H₂ + 2H₂O accept: –2e on right hand side accept: e⁻ note: not balanced = 1 (iii) chlorine / Cl₂ / cond: water treatment / solvents / plastics / PVC / bleach / disinfectants / HCl / kill bacteria / sterilising water / chlorination of water / swimming pools / pesticides / herbicides / insecticides / germicides / pharmaceuticals sodium hydroxide / NaOH cond: making soap / degreasing / making paper / detergents / bio-diesel / paint stripper / clearing drains / alumina from bauxite / oven cleaner / bleach
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:
chlorine
hydrogen chloride
carbon monoxide [2]

(b) (i) \( \text{CH}_3—\text{CH} = \text{CH}_2 \)

*note: can be fully or semi-displayed, \( \text{C} = \text{C} \) must be shown* [1]

(ii) correct repeat unit

\( —\text{CH(C}_6\text{H}_5)—\text{CH}_2— \)

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]
7 (a) (i) \[ \text{CH}_3\text{COOCH}_2\text{CH}_3 / \text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_3 / \text{CH}_3\text{COOC}_{2}\text{H}_5 / \text{CH}_3\text{CO}_2\text{C}_2\text{H}_5 / \text{C}_2\text{H}_5\text{OOCCH}_3 / \text{CH}_3\text{CH}_2\text{OOCCH}_3 \] \text{not: } –\text{OCO}– \text{ linkage}  
\text{note: } \text{formulae can be displayed or semi-displayed}  
\text{note: } \text{penalise sticks (i.e. any missing atoms)}  

(ii) butyl methanoate

(b) (i) fats / vegetable oils / triglycerides / lipids

(ii) two correct ester linkages, e.g. –\text{OOC} / –\text{O}_2\text{C} and –\text{COO} / –\text{CO}_2  
contents of the ‘boxes’ being \text{C}_6\text{H}_4 and \text{C}_2\text{H}_4 or \text{CH}_2\text{CH}_2  
continuation bonds at both ends

(c) (i) to make colourless / invisible (spots)  
visible / coloured / seen / position made clear / indicate

(ii) ____ distance travelled by sample ____ = \text{R}_f  
distance travelled by solvent (front)

(iii) sample 1 \text{R}_f = 0.20 \text{ to } 0.24 \text{ tartaric (acid)}  
sample 2 \text{R}_f = 0.44 \text{ to } 0.48 \text{ malic (acid)}

8 (a) (i) \text{(the number of particles which is equal to the number of atoms in) } 12 \text{g of carbon 12}  
or \text{the mass in grams which contains the Avogadro’s constant number of particles}  
or \text{Avogadro’s constant or } 6 \text{ to } 6.023 \times 10^{23} \text{ of atoms / ions / molecules / electrons / particles}  
or \text{(the amount of substance which has a mass equal to) its relative formula mass / relative atomic mass / relative molecular mass in grams}  
or \text{(the amount of substance which has a volume equal to) } 24 \text{ dm}^3 \text{ of a gas at RTP}

(ii) \text{(Avogadro’s constant is the) number of particles / atoms / ions / molecules in one mole of a substance}  
or \text{the number of carbon atoms in } 12 \text{g of C(12).}  
or \text{the number of particles / molecules in } 24 \text{ dm}^3 \text{ of a gas at RTP}  
or 6 \text{ to } 6.023 \times 10^{23} \text{ (particles / atoms / ions / molecules / electrons)}

(b) \text{CH}_4 \text{ and SO}_2

\[ 2/16 = 1/8 \text{ or } 0.125 \text{ moles of } \text{CH}_4 \text{ AND } 8/64 = 1/8 \text{ or } 0.125 \text{ moles of SO}_2 \]
(c)  

(i) \[
4.8/40 = 0.12 \text{ moles of Ca} \\
3.6/18 = 0.2 \text{ moles of H}_2\text{O both correct}
\]

(ii) Ca is in excess (no mark) (because 0.12 moles of Ca need 0.24 moles / 4.32 g of H\(_2\)O to react
there is not enough / there are 0.2 moles / 3.6 g of H\(_2\)O
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
there is more than that / there are 0.12 moles / 4.8 g of Ca
or
Ca is in excess (no mark) because the mole ratio Ca:H\(_2\)O is 3:5 / mass ratio 4:3
which is bigger than the required mole ratio of 1:2 / mass ratio 10:9
or
Ca is in excess (no mark) because the mole ratio H\(_2\)O:Ca is 5:3 / mass ratio 3:4
which is smaller than the required mole ratio of 2:1 / mass ratio 9:10

(iii) \[
0.02 \times 40 = 0.8 \text{ (g)}
\]