CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

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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CAMBRIDGE
International Examinations

1 (a) (i) named noble gas [1]
accept: any noble gas
accept: symbol

(ii) H_2O / CO_2 [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) <u>oxygen</u> 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** <u>all</u> the oxygen has reacted (with copper) [1]

(iv) 39–40 cm^3 **note:** units required [1]

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

C $^{65}_{30}Zn$ [1]

D $^{16}_{8}O$ [1]
charge 2– [1]

E $^{70}_{31}Ga$ [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 [1]

of fuels containing carbon / fossil fuels / hydrocarbon (fuels) [1]

produce carbon dioxide / increase percentage of CO_2 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_2 / [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]

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)** CH_3—$CH = CH_2$ [1]
note: can be fully or semi-displayed, C = C must be shown

(ii) correct repeat unit [1]
$–CH(C_6H_5)–CH_2–$

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)** $CH_3COOCH_2CH_3$ / $CH_3CO_2CH_2CH_3$ / $CH_3COOC_2H_5$ / $CH_3CO_2C_2H_5$ / $C_2H_5OOCCH_3$ / $CH_3CH_2OOCCH_3$ **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 / $–O_2C$ and –COO / $–CO_2$ [1]

contents of the 'boxes' being C_6H_4 and C_2H_4 or CH_2CH_2 [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) 12 g 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 × 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 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 12 g of C(12).
or
the number of particles / molecules in 24 dm^3 of a gas at RTP
or
6 to 6.023 × 10^{23} (particles / atoms / ions / molecules / electrons) [1]

(b) CH_4 **and** SO_2 [1]

2/16 = 1/8 or 0.125 moles of CH_4 **AND** 8/64 = 1/8 or 0.125 moles of SO_2 [1]

(c) (i) 4.8/40 = 0.12 moles of Ca
3.6/18 = 0.2 moles of H_2O **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_2O to react [1]
there is not enough / there are 0.2 moles / 3.6 g of H_2O [1]
or
Ca is in excess **(no mark)** (because 0.2 moles / 3.6 g of water will react with) 0.1moles/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_2O 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_2O: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]