UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

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.

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UNIVERSITY of CAMBRIDGE
International Examinations

1 **(a)** F **or** B diffusion / fractional distillation [1]

(b) A simple distillation [1]

(c) D chromatography [1]

(d) E filtration [1]

(e) C evaporation [1]

(f) B fractional distillation [1]

2 **(a)** **(i)** photosynthesis or a photochemical reaction [1]
not an example, question requires a process
not devices which convert light into electricity

(ii) cell [1]
accept battery
not generator

(b) **(i)** correct formula [1]

cond following marks conditional on correct formula
If covalent mark 1 only
correct charges [1]
6x and 2o around anion [1]
do **NOT** penalise for incorrect coding
ignore electrons around potassium

(ii) correct formula [1]

If ionic mark 1 only
cond
2 bp and 2 nbp around selenium [1]
1 bp and 3 nbp around both chlorine atoms [1]

(iii) the ionic compound
higher melting point / boiling point / less volatile
conducts when molten or aqueous, covalent compound does not
is soluble in water, covalent is not / ionic insoluble in organic solvents, covalent soluble in organic solvents
harder
any **two** [2]
note there has to be comparison between the ionic compound and the covalent compound
not density

(c) base [1]
not alkali
accepts a proton [2]
accepts hydrogen ion / H^+ **only** [1]
proton and H^+ [2]

3 **(a)** any four max 4
carbon forms carbon dioxide / carbon monoxide [1]
this is a gas it escapes / blown out / diffuses [1]
silicon forms silicon(IV) oxide / silica [1]
/ silicon(IV) oxide present in impure iron
silicon(IV) oxide reacts with calcium oxide to form slag **or** calcium silicate [1]
slag removed from surface [1]
accept skimmed, syphoned, poured off
not tapped max [4]
accept correct formula or equations
not calcium oxide reacts with silicon

(b) **(i)** any sensible suggestion – harder/stronger/can be tailored for a specific use/more resistant to corrosion [1]
not steel does not rust

(ii) mild steel – cars or any vehicle/bicycles/white goods/screws or nails/roof/bridges/tools/ buildings/ships/pipes/machinery etc. [1]

stainless steel – chemical plants/cooking utensils/jewellery/cutlery/surgical equipment/ kitchen sinks/pipes/etc. [1]

(c) **(i)** strong attractive forces / strong bonds / bonds hard to break / requires a lot of energy to break bonds [1]
not between ions, **not** between positive and negative ions,
not between electrons

between positive ions and (negative) electrons / opposite charges attract [1]

(ii) because the layers, lattice or rows of ions/cations [1]
accept sheets of ions
not atoms / molecules / protons / nuclei

can move / slip / slide past each other [1]

4 **(a)** **(i)** $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$ [2]
not balanced only [1]

(ii) **two** reagents from named metal(s) more reactive than zinc/carbon monoxide [2]
not hydrogen

(iii) they have different boiling points [1]
cadmium will distil first then zinc leaving lead/lead distilled last [1]

(b) for a high yield need low temperature [1]
then rate would be too slow or uneconomic [1]
a discussion of optimum temperature could score mark 1 and 2

presence of catalyst would increase rate (at same temperature) [1]
does not alter the yield (at that temperature) [1]
/ economic rate at lower temperature, therefore higher yield

higher pressure which would increase yield / rate [1]
yield high enough / high pressure expensive [1]
max [4]

accept reverse arguments
note increase yield ≡ position of equilibrium to right

5 **(a)** **(i)** $2Li + 2HI \rightarrow 2LiI + H_2$ [1]

(ii) zinc carbonate + hydriodic acid → zinc iodide + carbon dioxide + water [1]

(iii) $MgO + 2HI \rightarrow MgI_2 + H_2O$ [1]

(b) reaction 1 is redox / Li/2HI reaction [1]
cond reason either oxidation number/state / electron transfer [1]

(c) with hydriodic acid – iodine formed / goes <u>dark brown</u> / grey/black solid [1]

not purple vapour **not** purple/black solution

with hydrobromic acid – bromine formed / goes orange / yellow / brown / reddish brown / red / brown vapour [1]

note can accept brown for iodine provided bromine is different orange/brown etc.

(d) **(i)** the reaction is exothermic / reaction produces heat/energy [1]
all the sodium hydroxide used up/neutralised / reaction has stopped [1]

(ii) adding colder acid / no more heat produced [1]
if not given in **(d)(i)** any comments such as "reaction has stopped" can gain mark

(iii) 1.33 / 1.3 / 1.3333 (mol/dm^3) scores both marks [2]
not 1.34
for a correct method – $M_1 V_1$ / moles of NaOH = 0.02
with an incorrect answer **only** [1]

6 **(a)** **(i)** cracking / heat with catalyst [1]
to make butane [1]
butene reacts with steam/water / hydrated [1]
accept heat and catalyst for cracking but if specified: 450 to 800°C zeolites / aluminosilicates / silica / aluminium oxide/alumina / china / broken pot / porcelain / chromium oxide

(ii) glucose / sugar changed to alcohol / ethanol [2]
accept an unbalanced equation
(catalysed by) enzymes / yeast [1]

(b) butanoic acid [1]
CH_3-CH_2-CH_2-COOH [1]
hydrogen atoms omitted from ends of bonds, penalise once

(c) **(i)** ester [1]

(ii) $C_6H_{12}O_2$
ignore $CH_3COOC_4H_9$ [1]

(iii) correct structural formula of butyl ethanoate showing all bonds [2]

7 **(a)** metal A is magnesium [1]
cond most reactive or fastest reaction [1]

metal B is aluminium [1]
cond faster reaction after removal of oxide layer / it would give more hydrogen / aluminium more reactive than zinc [1]

metal C is zinc [1]
zinc least reactive [1]
NOTE MAX [5]
If you encounter different reasoning which is correct, please award the appropriate marks.

(b) for magnesium and zinc same <u>volume</u> of hydrogen [1]

because both have valency of 2 / 1 mole of metal gives 1 mole of hydrogen / 1 mole of metal reacts with 2 moles of acid [1]

bigger volume for aluminium because its valency is 3 / 1 mole of metal gives 1.5 moles of hydrogen / 1 mole of metal reacts with 3 moles of acid [1]

If you encounter different reasoning which is correct, please award the appropriate marks.

accept balanced equations
accept ionic charges as alternative to valency

8 **(a)** addition – polymer only product / only one product [1]
accept monomer has C=C
accept monomer and polymer have same empirical formula
accept no loss of material in polymerisation
not only one monomer

condensation – polymer and water / small molecule formed [1]

(b) $-CH_2 - CCl_2-$
repeat unit correct [1]
COND continuation [1]

(c) $CH_2=CHOOCCH_3$ [1]

(d) $-OC(CH_2)_4CONH(CH_2)_6NH-$
COND amide correct linkage [1]
correct repeat units [1]
continuation [1]
not NH_2 **or** COOH endings

[Total: 80]