**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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

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


**(b)** A         simple distillation                                  [1]


**(c)** D         chromatography                                  [1]


**(d)** E         filtration                                      [1]


**(e)** C         evaporation                                    [1]


**(f)** B         <u>fractional</u> 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 <u>layers, lattice or rows</u> of <u>ions/cations</u> [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 $\rightarrow$ 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]**