MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

0620 CHEMISTRY

0620/33   Paper 3 (Extended Theory), maximum raw mark 80

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.

Cambridge is publishing the mark schemes for the May/June 2011 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

1   **(i)**   Rb / Sr   [1]

     (ii)   I   [1]

     (iii)   Fe   [1]

     (iv)   P   [1]

     (v)   Si   [1]

2   **(a)**   **(i)**   no reaction   [1]

$Fe + Sn^{2+} \rightarrow Fe^{2+} + Sn$ / $2Fe + 3Sn^{2+} \rightarrow 2Fe^{3+} + 3Sn$ [2]
for realising that there would be a reaction shown by an attempt to write an
equation e.g. writing Fe_2Sn etc. allow [1]

no reaction   [1]

     (ii)   tin oxide, nitrogen dioxide (accept nitrogen(IV) oxide/dinitrogen tetroxide), oxygen
All three for two   [2]
accept correct formulae

any two correct products   [1]

   (b)   **(i)**   tin   [1]

     (ii) $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ [2]
not balanced allow [1]

     (iii)   sulfuric acid   [1]

   (c)   zinc is more reactive than iron/steel   [1]
      tin is less reactive than iron/steel   [1]

zinc corrodes/reacts/loses electrons/is oxidised/is anodic/provides sacrificial protection/
forms positive ions (in preference to iron or steel) ORA
allow iron is cathodic for this mark.   [1]

Iron/steel corrodes/reacts/rusts/loses electrons/is oxidised/is anodic/forms positive ions (in
preference to tin). ORA
allow tin is cathodic for this mark   [1]

3 (a) (i) <u>concentration</u> of thiosulfate is proportional to volume of thiosulfate solution added (when total volume is same in all experiments) / <u>concentration</u> of acid always the same   [2]

for comments based on amount / to make experiments fair / comparable allow [1]

(ii) 240 s   [1]

(iii) decreases/reaction slower   [1]
because concentration of thiosulfate decreases   [1]
frequency/chances/rate of collisions decreases   [1]

one mark can be scored for less/smaller amount/smaller volume of thiosulfate / less collisions

(b) rate increases with temperature (or at 42 °C) ORA   [1]

particles/molecules/ions move faster or gain energy / ORA   [1]
(don't accept reactants or atoms)

more collisions / ORA   [1]

(last mark is for qualification of the collisions) i.e.
greater frequency / more per unit time/more often /greater chance/more likely/more collision rate/more effective/more successful/more with activation energy / ORA   [1]

4 **One** redox equation   [1]
accept $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$
$Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$
$C + O_2 \rightarrow CO_2$
$CO_2 + C \rightarrow 2CO$

one acid/base equation   [1]
$CaO + SiO_2 \rightarrow CaSiO_3$
or $CaCO_3 + SiO_2 \rightarrow CaSiO_3 + CO_2$

three more equations or comments   [3]
carbon <u>burns</u> to form carbon dioxide
this reaction is <u>exothermic</u> or <u>produces heat</u>
carbon dioxide is <u>reduced</u> to carbon monoxide
carbon monoxide <u>reduces</u> hematite to iron
carbon <u>reduces</u> hematite to iron
limestone removes silica <u>which is an impurity</u>
to form slag <u>which is a waste product</u>
limestone <u>decomposes or</u> symbol/word equation

5 **(a)** $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ / $Zn + 2H^+ \rightarrow Zn^{2+} + H_2$ [2]

marks are for correct reactants [1] correct products [1]
If ionic equation is given don't penalise SO_4^{2-} spectator ions on both sides

(b) (exothermic because) a cell produces (electrical) energy/electricity [1]

the next two marks score for

electrons are lost **AND** gained / oxidation no. or state/valency **both** increases and decreases
/ two correct half equations i.e. $Zn \rightarrow Zn^{2+} + 2e^-$ and $2H^+ + 2e^- \rightarrow H_2$ [2]

(c) zinc [1]
cond it is the more reactive metal / it supplies electrons / it forms ions more readily than iron
[1]

(d) replace zinc with magnesium
replace iron with copper
use (more) concentrated <u>sulfuric</u> acid
accept use a <u>more</u> concentrated acid / a <u>more</u> concentrated solution

any **two** [2]

6 **(a)** **(i)** rate at which methanol formed by forward reaction [1]
   equals rate it is reacting in back reaction [1]
   rate of forward reaction equals rate of back reaction allow [1]

   (ii) low/lower/decreased temperature [1]
   high/higher/increased pressure [1]
   Explanations not needed but if they are given they must be correct
   IGNORE values of temperature and pressure

   (iii) high pressure can be used / lower pressure due to expense or safety [1]
   cannot use a low temperature as rate would be too slow the rate would not be economic [1]

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

   (ii) soap/sodium stearate or any acceptable salt/glycerol [1]

   (iii) burning both fuels forms carbon [1]

   growing plants to make biodiesel removes carbon dioxide
   from atmosphere [1]

(c) **(i)** correct SF of an octane [1]

   (ii) add bromine (water)/bromine in an organic solvent [1]
   result octane remains brown/orange/yellow/red [1]
   result octane goes colourless/decolourises [1]
   not clear/discolours
   colour of reagent must be shown somewhere for [3] otherwise max [2]
   accept equivalent test using $KMnO_4$ in acid or alkali

7 (a) 3 bp and 1nbp around phosphorus   [1]
       1 bp and 3nbp around each chlorine   [1]

(b) (i) $PCl_3 + 3H_2O \rightarrow 3HCl + H_3PO_3$ [1]

   (ii) acid solutions same concentration   [1]
        measure pH/pH paper/Universal indicator   [1]
        hydrochloric acid lower pH   [1]

        colours of Universal indicator can be given as red<orange<yellow
        ignore precise pH values as long as HCl is lower than H_3PO_3

        OR Acid solutions same concentration   [1]
        add magnesium or any named metal above Hydrogen in reactivity series but not above magnesium
        calcium carbonate or any insoluble carbonate   [1]
        hydrochloric acid react faster/shorter time   [1]

        OR acid solutions same concentration   [1]
        measure electrical conductivity   [1]
        hydrochloric acid better conductor/bulb brighter   [1]

        OR acid solutions same concentration   [1]
        add sodium thiosulphate   [1]
        hydrochloric acid forms precipitate faster/less time   [1]

  (iii) sodium hydroxide/sodium carbonate   [1]
        titration **cond** on correct reagent   [1]
        second mark scores for mention of titration /burette/pipette/indicator.
        experimental detail not required

        any named soluble calcium salt e.g. calcium chloride/nitrate/hydroxide   [1]

        precipitation/filter/decant/centrifuge   [1]

8 (a) (i) (to avoid) carbon monoxide formation/so complete combustion occurs/avoid incomplete combustion So that CO_2 is produced   [1]

CO does not dissolve/react with alkali   [1]

(ii) CO_2 is acidic   [1]

(iii) volume of gaseous hydrocarbon 20 cm^3
volume of oxygen used = 90 cm^3 [1]
volume of carbon dioxide formed = 60 cm^3 [1]

no mark for 20 cm^3 of hydrocarbon.

(iv) $2C_3H_6(g)/2CxHy(g) + 9O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$ [1]

OR … $C_3H_6(g) + 9/2O_2(g) \rightarrow 3CO_2(g) + 3H_2O(l)$

C_3H_6 [1]

C_3H_6 can be given in the equation for the second mark

(b) (i) correct structural or displayed formula of another chlorobutane / dichlorobutane / polychlorobutane   [1]

(ii) light / 200 °C / lead tetraethyl   [1]

(iii) cracking is the decomposition/breaking down of an alkane/hydrocarbon/petroleum   [1]
heat/high temperature / Temperature between 450 °C to 800 °C
OR catalyst / named catalyst   [1]
to give a simpler alkane and alkene   [1]

word equation or equation as example   [1]

to make polymers / to increase petrol fraction / organic chemicals/petrochemicals / hydrogen   [1]
any **four**