MARK SCHEME for the October/November 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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1 (a) C and F  
(b) A  
(c) B  
(d) D  
(e) E  
(f) A and D  

[Total: 6]

2 (a) (i) two atoms per molecule  
(ii) 7e in outer shell or level / same number of outer electrons / need to gain one electron  
(iii) different number of energy levels / different number of electrons  
(iv) halogen | solid, liquid or gas at room temperature | colour  
--- | --- | ---  
chlorine | gas | yellow / yellow green / green  
bromine | liquid | brown / red-brown / orange-brown  
not: red / orange  
iodine | solid | black / grey / silver-grey / purple / violet  
NOT: blue-black  

NOTE: one mark for each vertical column  

(b) correct formula, AsF$_3$  
3nbps and 1bp around all 3 fluorine atoms  
3bps and 1nbp around arsenic atom  

(c) (increased) light increases / causes forward reaction / light causes AgCl reacts with CuCl  
(increased) light increases the amount of silver (and so darkens glass)  
decrease in light reverses reaction / uses up silver / silver reacts (and so reduces darkness)  

[Total: 11]
3 (a) (i) the (forward) reaction is endothermic [1]
(ii) none [1]
volume of reactants and products the same [1]
ACCEPT: number of moles or molecules [1]
(iii) the reaction (between oxygen and nitric oxide) is exothermic [1]
high temperatures push equilibrium to left / high temperatures decrease yield of products / low temperatures favour forward reaction [1]
(iv) \(4\text{NO}_2 + \text{O}_2 + 2\text{H}_2\text{O} \rightarrow 4\text{HNO}_3\) [2]
not balanced = (1) only
(v) (cost of) high amount of electricity / energy [1]
(b) (i) contains more nitrogen [1]
(ii) photosynthesis [1]
chlorophyll is catalyst / chlorophyll absorbs light [1]
carbon dioxide and water react [1]
to make glucose / carbohydrates / starch / sugar / named sugar [1]
[Total: 13]

4 (a) Any one of:
\[\text{Fe}_2\text{O}_3 + 3\text{C} \rightarrow 2\text{Fe} + 3\text{CO}\]
\[2\text{Fe}_2\text{O}_3 + 3\text{C} \rightarrow 4\text{Fe} + 3\text{CO}_2\]
\[\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2\]
for correct equation (2) [1]
not balanced = (1) only
any four of:
coke burns to form carbon dioxide / \(\text{C} + \text{O}_2 \rightarrow \text{CO}_2\) [1]
this reacts with more carbon to form carbon monoxide / \(\text{C} + \text{CO}_2 \rightarrow 2\text{CO}\) [1]
calcium carbonate decomposes to form calcium oxide and carbon dioxide / \(\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2\) [1]
calcium oxide / calcium carbonate reacts with silica / silicon oxide / silicon(IV) oxide (in ore) to form calcium silicate / slag / \(\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3\) or \(\text{CaCO}_3 + \text{SiO}_2 \rightarrow \text{CaSiO}_3 + \text{CO}_2\) [1]
the reaction between carbon and oxygen is exothermic / produces heat / coke is used as a fuel / the slag floats on the (molten) iron / the slag and molten iron can be run off separately [6]
5 (a) because they have more than one oxidation state or valency / form ions with different charges
there are two iron oxides (iron(III) oxide and iron(II) oxide) / iron forms $\text{Fe}^{2+}$ and $\text{Fe}^{3+}$ compounds / iron forms iron(II) and iron(III) compounds [1]

5 (b) (i) to remove the precipitate / remove the silver(I) chromate(VI) / remove the residue [1]
(ii) to remove soluble impurities / remove named soluble salt e.g. potassium nitrate / remove reactants [1]
(iii) to dry solid / to remove water [1]

5 (c) (i) need one mole of potassium chromate(VI) for two moles of silver(I) nitrate / correct references to mole ratio [1]
(ii) mass of $\text{AgNO}_3$ needed is $170 \times 0.2 \times 0.1 = 3.4g$
NOTE: if answer given is 34 they have omitted 0.1
ALLOW: (1) ecf [2]
(iii) number of moles of $\text{AgNO}_3$ used = $0.02 \times 0.2 = 0.004$
number of moles of $\text{Ag}_2\text{CrO}_4$ formed = 0.002 [1]
mass of one mole of $\text{Ag}_2\text{CrO}_4 = 332g$
mass of $\text{Ag}_2\text{CrO}_4$ formed = 0.664g
NOTE: use ecf when appropriate [1]
6 (a) (i) \( \text{Cu(OH)}_2 \rightarrow \text{CuO} + \text{H}_2\text{O} \) [1]

(ii) \( \text{Rb} \) [1]

(b) (i) electron loss [1]

(ii) because they can accept electrons [1]

(c) (i) copper and mercury [1]

(ii) add copper / mercury / metal to (named) acid and no reaction / no bubbles / no hydrogen [1]

(d) (i) \( \text{Mn} \) [1]

(ii) (solution) becomes colourless / decolourises

NOT: clear [1]

[Total: 8]

7 (a) (i) contains only carbon, hydrogen and oxygen hydrogen (atom) to oxygen (atom) ratio is 2:1 [1]

ALLOW: \( \text{C:H:O as 1:2:1 or C}_n(\text{H}_2\text{O})_n \) [1]

(ii) condensation polymerisation [1]

(b) (i) cells / micro-organisms / plants / animals / metabolic reactions obtaining energy from food / glucose / nutrients [1]

(ii) \( 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2 \) [2]

allow: \( \text{C}_2\text{H}_6\text{O} \) for \( \text{C}_2\text{H}_5\text{OH} \)

not balanced = (1) only

(iii) to prevent aerobic respiration / to get anaerobic respiration / to prevent ethanoic acid / lactic acid / carboxylic acids being formed / to prevent oxidation of ethanol [1]

(c) displayed formula of methyl butanoate [2]

NOTE: all bonds must be shown

NOTE: award (1) if error in alkyl groups but correct displayed structure of \(-\text{COO}-\)

(d) (i) alcohol, e.g. glycerol, circled [1]

ALLOW: if only part of glycerol molecule is circled as long as it involves an OH group

(ii) saturated correct reason based on group \( \text{C}_{17}\text{H}_{35} / \text{all C–C bonds} / \text{no C = C bonds} \) [1]
(iii) salt / carboxylate / alkanoate
    (making) soap
    ACCEPT: detergent / washing

(e) at least one correct amide linkage –CONH–
    continuation shown at both ends of chain
    diagram showing three (different) amino acid residues

[Total: 18]