

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 [1]
- (b) A [1]
- (c) B [1]
- (d) D [1]
- (e) E [1]
- (f) A and D [1]

[Total: 6]

- 2 (a) (i) two atoms per molecule [1]
- (ii) 7e in outer shell or level / same number of outer electrons / need to gain one electron [1]
- (iii) different number of energy levels / different number of electrons [1]
- (iv)

halogen	solid, liquid or gas at room temperature	colour
chlorine	gas	yellow / yellow green / green
bromine	liquid	<u>brown</u> / red- <u>brown</u> / orange- <u>brown</u> not: red / orange
iodine	solid	black / grey / silver-grey / purple / violet NOT: blue-black

NOTE: one mark for each vertical column [2]

- (b) correct formula, AsF₃ [1]
 3nbs and 1bp around all 3 fluorine atoms [1]
 3bps and 1nbp around arsenic atom [1]
- (c) (increased) light increases / causes forward reaction / light causes AgCl reacts with CuCl [1]
 (increased) light increases the amount of silver (and so darkens glass) [1]
 decrease in light reverses reaction / uses up silver / silver reacts (and so reduces darkness)[1]

[Total: 11]

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- 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
- (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)
 not balanced = (1) only
- any four of:
- coke burns to form carbon dioxide / $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- this reacts with more carbon to form carbon monoxide / $\text{C} + \text{CO}_2 \rightarrow 2\text{CO}$
- calcium carbonate decomposes to form calcium oxide and carbon dioxide / $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
- 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** $\text{CaCO}_3 + \text{SiO}_2 \rightarrow \text{CaSiO}_3 + \text{CO}_2$
- 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]

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- (b) (i) greenhouse effect / CO₂ is a greenhouse gas [1]
 global warming / ice caps melting / suitable example [1]
- (ii) burning or combustion of charcoal produces carbon dioxide [1]
 trees use carbon dioxide (in photosynthesis) [1]
- (iii) cathode reaction $\text{Fe}^{3+} + 3\text{e} \rightarrow \text{Fe}$ [1]
 anode reaction $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}$ [2]
 not balanced = (1) only

[Total: 13]

- 5 (a) because they have more than one oxidation state or valency / form ions with different charges [1]
 there are two iron oxides (iron(III) oxide and iron(II) oxide) / iron forms Fe²⁺ and Fe³⁺ compounds / iron forms iron(II) and iron(III) compounds [1]
- (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]
- (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 AgNO₃ needed is $170 \times 0.2 \times 0.1 = 3.4\text{g}$ [2]
NOTE: if answer given is 34 they have omitted 0.1
ALLOW: (1) ecf
 (iii) number of moles of AgNO₃ used = $0.02 \times 0.2 = 0.004$ [1]
 number of moles of Ag₂CrO₄ formed = 0.002 [1]
 mass of one mole of Ag₂CrO₄ = 332g
 mass of Ag₂CrO₄ formed = 0.664g [1]
NOTE: use ecf when appropriate

[Total: 11]

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- 6 (a) (i) $\text{Cu}(\text{OH})_2 \rightarrow \text{CuO} + \text{H}_2\text{O}$ [1]
(ii) 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) Mn [1]
(ii) (solution) becomes colourless / decolourises
NOT: clear [1]
- [Total: 8]**
- 7 (a) (i) contains only carbon, hydrogen and oxygen [1]
hydrogen (atom) to oxygen (atom) ratio is 2:1 [1]
ALLOW: C:H:O as 1:2:1 or $\text{C}_n(\text{H}_2\text{O})_n$
- (ii) condensation [1]
polymerisation [1]
- (b) (i) cells / micro-organisms / plants / animals / metabolic reactions [1]
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 [1]
correct reason based on group $\text{C}_{17}\text{H}_{35}$ / all C–C bonds / no C = C bonds [1]

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- (iii) salt / carboxylate / alkanoate [1]
(making) soap [1]
ACCEPT: detergent / washing
- (e) at least one correct amide linkage –CONH– [1]
continuation shown at both ends of chain [1]
diagram showing three (different) amino acid residues [1]

[Total: 18]