UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the May/June 2010 question paper

for the guidance of teachers

0620 CHEMISTRY

0620/33 Paper 33 (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.

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1 In **(a)**, **(b)** and **(c)**, descriptions of chemical properties need not be detailed. If more than one answer is given in each section, mark the **first** one and ignore anything subsequent unless it contradicts what they have already written. No marks for reversing physical and chemical properties.

(a) properties should focus on a group 1 metal and not just metals in general

PHYSICAL soft / can be cut (with a knife) / low density / light / low melting point / (good) conductor (heat or electricity) / shiny (when freshly cut) / malleable / ductile / tarnishes [1]

CHEMICAL react with water (**not** steam) / (very) reactive / forms salts with halogens / react vigorously with acids (**ignore** concentration) / forms an alkaline or basic oxide / fixed oxidation state or oxidation number or valency of +1 / has one valency or outer shell electron
not forms ionic compounds on its own. [1]

(b) properties should focus on a transition metal

PHYSICAL hard / high density / dense / high mp or bp / (good) conductor (heat or electricity) / strong / malleable / ductile / silver or grey or lustrous or shiny solid [1]

CHEMICAL more than one oxidation state or valency (**accept** many oxides) / forms coloured compounds or ions (**not** coloured on its own) / forms complex ions / behave as a catalyst / less reactive than group 1 [1]

(c) PHYSICAL colourless gas / yellow gas [1]
not diatomic molecules

CHEMICAL most reactive halogen / **very** reactive / forms **ionic** fluorides / bonds with metals / form **covalent** fluorides / bonds with non-metals / powerful oxidant / gains one electron (to be stable) / fixed oxidation state or valency of –1
allow decolourised when reacts with alkene) / forms F^- ions / forms acidic oxides / forms an acid when reacted with hydrogen / hydride is acidic [1]
not bleaching agent

2 **(a)** **(i)** enzymes are proteins / come from living organisms / biological (catalysts) [1]
not enzymes are living or natural

(ii) carbohydrates have 2H:1O ratio [1]
contain elements of water [1]

contain water = [1]
unless they state that carbohydrates contain water, this response scores 2 or 0

(b) correct -O- linkage [1]
cond same correct monomer (this mark is lost if 2 different boxes are shown) [1]
cond continuation (i.e. bonds at **both** ends) [1]

(c) **(i)** (concentration or amount or mass etc.) of starch decreases (with time) [1]
(concentration etc.) of starch becomes zero / all starch gone [1]
colour (intensity) indicates how much starch is present (can be inferred) [1]

(ii) enzyme denatured / destroyed [1]
not enzymes killed / don't work / saliva denatured

3 (a) (i) red brown or orange to colourless [1]
not just bromine decolourised
yellow (**not** dark) / white solid / precipitate / goes cloudy [1]
brown to yellow with no mention of solid/precipitate scores = [1]

(ii) $Br_2 + Na_2S \rightarrow 2NaBr + S$ [1]

(iii) look for two comments
sulfide (ion) / sulfur (ion) loses electrons [1]
not sodium sulfide
bromine accepts them [1]

(b) (i) oxidation [1]
not redox

(ii) hydrogen / H_2
not H [1]

(iii) iron(II) hydroxide / ferrous hydroxide [1]

(iv) $4Fe(OH)_2 + O_2 + 2H_2O \rightarrow 4Fe(OH)_3$ [1]

(v) oxidation number or state or valency increases / electron loss / Fe^{2+} to Fe^{3+} [1]
not gains oxygen

(vi) sacrificial protection **or** zinc is sacrificed /
zinc corrodes not iron **or** zinc corrodes therefore iron doesn't /
not just zinc rusts
zinc is oxidised in preference to iron /
zinc reacts with oxygen and water in preference to iron /
zinc more reactive or electropositive than iron /
zinc forms ions more readily than iron **or** zinc loses electrons more readily than iron /
electrons move on to iron /
iron is cathode **or** zinc is anode /
any **three** [3]

4 **(a)** **(i)** same molecular formula / same number of C and H atoms [1]
different structural formula or structure [1]
same compound = [1]

(ii) correct **formula** of but-2-ene / methylpropene / methyl cyclopropane [1]

(iii) bromine / bromine water / aqueous bromine [1]
brown to colourless **not** clear [1]
stays brown [1]
brom**ide** loses the first mark only

OR alkaline potassium manganate(VII) [1]
from purple/pink to green/brown [1]
stays purple [1]

OR acidic potassium manganate(VII) [1]
from purple/pink to colourless **not** clear [1]
stays purple [1]

(b) heat / high temperature (temperature need not be stated, but if it is stated it must be 500ºC or above) [1]

catalyst (need not be named, but if they are named accept any metal oxide or zeolite / aluminosillicates / silicon dioxide) [1]
not nickel/platinum

(c) (1,2)dibromobutane [1]
if numbers given must be correct
butane [1]
butanol [1]
accept butan-1-ol or butan-2-ol **not** but-1-ol / but-1-anol / buthanol

5 **(a)** fractional [1]
distillation [1]

(b) **(i)** O=O / oxygen(–)oxygen / H–H / hydrogen(–)hydrogen [1]

(ii) O-H / oxygen(–)hydrogen / OH / bond between hydrogen and oxygen [1]
not H-O-H

(iii) endothermic. [1]

(c) **(i)** no pollution / no CO / no CO_2 / no oxides of nitrogen / only produces steam or water / no greenhouse gases / no global warming [1]
does not use up fossil fuels / water is not a finite resource / water is a renewable source of energy / hydrogen is renewable / available from electrolysis of water [1]

(ii) obtaining hydrogen from water requires fossil fuels / storage problems / transport problems / limited range of vehicles available / gaseous nature means only produces small amount of energy per unit volume / methane as a source of steam reforming is finite / lack of distribution network [1]
not expensive / anything regarding safety / flammability / explosiveness

6 (a) (i) Tl_2S [1]

(ii) $TlCl_3$ [1]

(b) filter / centrifuge / decant
wash the precipitate
dry the solid / heat the solid (in oven) / press between filter paper [3]

all three stated but not in correct order = [2]
two out of three stated in any order = [1]

(c) (i) silver chloride / silver bromide [1]
photography / cameras / films / photo chromic lenses / sunglasses [1]

(ii) increase distance between lamp and paper **or** put lamp far away /
put a screen **or** translucent **or** semi-opaque material between them /
use a less powerful **or** low voltage **or** dim lamp /
lower the temperature
any **two** [2]

(d) (i) thalium sulfate + ammonia + water [1]

(ii) $2TlOH + H_2SO_4 \rightarrow Tl_2SO_4 + 2H_2O$ [2]
not balanced = [1]
incorrect formula = [0]

(iii) green precipitate **or** solid (ignore shades of green but not bluey green etc.) [1]
$Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2$ **accept** multiples [1]

7 (a) sodium is expensive / difficult to obtain sodium (from sodium chloride) / problems getting electricity / hard to extract sodium / high energy costs in extraction of sodium [1]

(b) (i) reduce temperature / reduce melting point (to 900/1000°C) temperature need not be stated, but if it is stated it must be within the range
better conductivity / solid aluminium oxide does not conduct
aluminium oxide is insoluble in water any **two** [2]

(ii) $2O^{2-} \rightarrow O_2 + 4e^-$ [2] or [0]

(iii) they burn (away) / react with oxygen / form carbon dioxide [1]

(c) hydrogen formed / aluminium above hydrogen in reactivity series / H^+ discharged in preference to Al^{3+} / aluminium is more reactive than hydrogen [1]
aluminium more reactive than carbon / carbon cannot reduce aluminium oxide /
aluminium is higher than carbon in the reactivity series / carbon doesn't reduce
aluminium oxide / carbon doesn't displace aluminium [1]
comparison is essential for mark

8 (a) (i) accept all metals excluding Group I (lithium is acceptable) [1]
not lead **accept** silver

(ii) M nitrite / nitrate(III) [1]
not nitride

(b) (i) exothermic [1]
not reverse reaction is endothermic as the question asks about the forward reaction
cond forward reaction favoured by low temperature / reverse reaction favoured by high temperature [1]
second mark only scores if exothermic is correct.

(ii) position of equilibrium to right / forwards / more products / more N_2O_4 / lighter colour [1]
because this side has smaller volume / fewer moles [1]

(c) if the final answer is between 86–89% award all 4
if the final answer is between 66–67% award 3 marks (M_r of 32 must have been used)
for all other answers marks can be awarded using the mark scheme as below and applying ecf if necessary

number of moles of O_2 formed = 0.16/24 = 0.0067/0.00667 or 1/150
number of moles of $Pb(NO_3)_2$ in the sample = 0.0133/0.013 or 1/75
mass of one mole of $Pb(NO_3)_2$ = 331 g
mass of lead(II) nitrate in the sample = 4.4(1) g
percentage of lead(II) nitrate in sample = 88.3% (**allow** 88–89) [4]

mark **ecf** in this question but **not** to simple integers
if mass of lead(II) nitrate > 5.00 only marks 1 and 2 available
If divides by 32 (not 24) only last 3 marks can score consequentially