Rewarding Learning

ADVANCED
General Certificate of Education
2015

Chemistry

Assessment Unit A2 1

assessing

Periodic Trends and Further Organic, Physical and Inorganic Chemistry

[AC212]

FRIDAY 22 MAY, MORNING

MARK SCHEME

General Marking Instructions

Introduction

Mark schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what the examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The purpose of mark schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents the final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example where there is no absolute correct response – all teachers will be familiar with making such judgements.

Section A

	AVAILABLE MARKS
1 B	
2 D	
3 B	
4 C	
5 D	
6 C	
7 B	
8 D	
9 D	
10 D	
[2] for each correct answer [20]	20
Section A	**20**

Section B

AVAILABLE MARKS

11 **(a)** iodine
low bond energy [1]

(b) **(i)** energy is needed to separate the positive ions from the negative ions/(ionic) bonds being broken [1]

(ii) the size of the halide ions increase/the bond energies of the halogens get less [1]

(c) **(i)** +178 +590+1145+4912 +3×112 – 3×349 = ΔH + 4650

$\Delta H = +1464$ kJ mol^{-1} [3]

(ii) the reaction is (highly) endothermic [1]

(iii) size of charge on Ca ion increases, (hence greater attractive forces) [1]

(iv) $2CaCl \rightarrow Cl_2 + 2Ca$ $+ 2 \times 178 = +356$

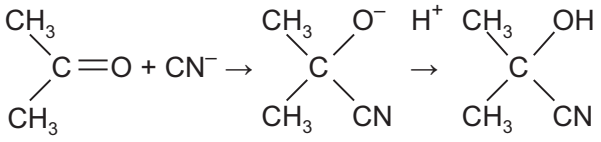
$Ca + Cl_2 \rightarrow CaCl_2$ -796

$2CaCl \rightarrow Ca + CaCl_2$ $-796 + 356 = -440$ kJ/kJ mol^{-1} [2]

(v) all the products and reactants are solids/very small change in entropy/no entropy change [1] 11

12 **(a)** 2-methylpropenoic acid [2]

(b) **(i)**



[3]

(ii) sodium hydroxide(aq)/potassium hydroxide(aq) [1]
(dil.) hydrochloric acid/(dil.) sulfuric acid [1] [2]

(iii) methanol [1]
concentrated/conc. sulfuric acid [1] [2]

(iv) esterification [1]

(c) **(i)** petroleum/North Sea gas [1]
Haber process [1] [2]

(ii) 3N–H + 4C–H = $3 \times 391 + 4 \times 413 = 1173 + 1652 = +2825$

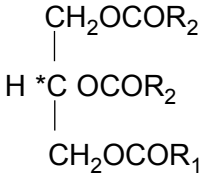
1C–H + 1C≡N + 3H—H = $1 \times 413 + 1 \times 887 + 3 \times 436 = -2608$

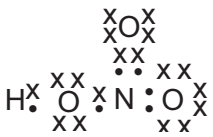
$= +217$ kJ/kJ mol^{-1} [3]

(iii) increase in the number of molecules/moles [1]
$\Delta G = \Delta H - T\Delta S = 217 \times 10^3 - T \times 125$

$T = 217\,000/125 = 1736$ K [2] [3]

					AVAILABLE MARKS
(d)	**(i)**	landfill sites use up empty quarries			
		or landfill sites once refilled are used	[1]		
		waste incineration creates heat/power			
		or incineration reduces waste	[1]	[2]	
	(ii)	landfill sites are unsightly			
		incineration produces carbon dioxide/global warming		[2]	
	(iii)	waste can be recycled			
		use biodegradable products			
		reduce the amount of packaging		[2]	24
13	**(a)**	H_2O_2 and HO_2^- acid and base	[1]		
		H_2O and H_3O^+ base and acid	[1]	[2]	
	(b)	Adding water moves the equilibrium to the RHS [1] increases H^+ (decreases pH) [1]		[2]	
	(c)	**(i)** measure the volume of oxygen produced			
		draw a graph of volume against time			
		measure the slope of the graph (to determine rate)/calculate gradient			
		graph of rate versus concentration (of hydrogen peroxide)		[4]	
		(ii) step 1 is slow/rate determining	[1]		
		step 2 is fast	[1]	[2]	
		or step 1 is slower than step 2			
		(iii) OBr^-		[1]	
		(iv) second		[1]	
		(v) a catalyst participates in a reaction but is not used up		[1]	
		(vi) add silver nitrate solution	[1]		
		filter off the silver bromide	[1]		
		weigh the silver bromide, (relate mass of AgBr to Br^-)	[1]	[3]	
	(d)	X = 0 Y = 1 Z = 2 (or more)		[2]	18

					AVAILABLE MARKS
14	**(a)**	olive oil/vegetable oil		[1]	
	(b)	dissolve the fat in a suitable solvent/shake	[1]		
		with a solution of iodine/bromine	[1]		
		the colour disappears	[1]	[3]	
	(c)	boil/heat the sample with hydrochloric acid [1]			
		separate the insoluble petroleum oil [1]			
		weigh/determine volume of the petroleum oil [1]			
		Any **two**		[2]	
	(d)	3 mol of NaOH = mol of fat hence 8.33×10^{-4} mol of fat			
		0.84 g of iodine I = 0.84/127 = 0.0066 = 0.0033 mol I_2			
		1 I_2 = 1 C═C 0.0033/8.33×10^{-4} = 3.96/4 per molecule			
		$\frac{3.96}{3}$ = 1.32 per fatty acid		[3]	
	(e)	**(i)** glycerol		[1]	
		(ii) 		[3]	
		(iii) hydrogen (gas)	[1]		
		passed over/through/reacted with oil/180 °C	[1]		
		nickel catalyst	[1]	[3]	
	(f)	place the sample in a capillary tube sealed (at one end)	[1]		
		heat slowly	[1]		
		in oil bath/melting point apparatus	[1]		
		note temperature at which sample starts to melt and finishes melting	[1]		
		comment on determining substance as an oil/fat at 25 °C	[1]	[5]	
		Quality of written communication		[2]	23

				AVAILABLE MARKS
15	**(a)**		[2]	
	(b)	**(i)** –log 40 = –1.6	[2]	
		(ii) $[H^+] = 2$ pH = –log 2 = –0.3	[2]	
		(iii) $K = 40 = [H^+][NO_3^-]/[HNO_3] = [H^+]^2/[HNO_3] = [H^+]^2/2$ $[H^+]^2 = 80$ $[H^+] = 8.9$ pH = –0.95	[3]	
		(iv) nitric acid is treated as a weak acid in **(iii)** and strong in **(ii)**	[1]	
	(c)	**(i)** $Na_2O + 2HNO_3 \rightarrow 2NaNO_3 + H_2O$	[1]	
		(ii) $Al_2O_3 + 6HNO_3 \rightarrow 2Al(NO_3)_3 + 3H_2O$	[1]	
		(iii) $NH_3 + HNO_3 \rightarrow NH_4NO_3$	[1]	
		(iv) a substance/an oxide will react in acid or alkali/base	[1]	
	(d)	**(i)** $2Al + 2NaOH + 2H_2O \rightarrow 2NaAlO_2 + 3H_2$ **or** $2Al + 2NaOH + 6H_2O \rightarrow 2NaAl(OH)_4 + 3H_2$	[1]	
		(ii) $HNO_3 + 4H_2 \rightarrow NH_3 + 3H_2O$	[1]	
		(iii) $8Al + 8NaOH + 3HNO_3 \rightarrow 8NaAlO_2 + 3NH_3 + H_2O$	[1]	
	(e)	ammonium nitrate is slightly acidic because of the weak base ammonia [1] sodium nitrate is neutral because of the strong base sodium oxide [1] aluminium nitrate is acidic because of the weaker base aluminium oxide [1]	[3]	
	(f)	**(i)** known quantities of nutrients/nitrogen or easily spread as granules/powder causes eutrophication or explanation or nitrate problems with babies	[2]	
		(ii) improve soil structure or free on farms smell or explained problems of storage	[2]	24
			Section B	**100**
			Total	**120**