Mark Scheme (Results)

October 2024

Pearson Edexcel International Advanced Level
In Chemistry (WCH16)
Paper 01 Practical Skills in Chemistry II

Question Number	Answer	Additional Guidance	Mark
1(a)(i)	An answer that makes reference to the following points: • AgI/silver iodide **(1)** • NH_3/ammonia **(1)** • $Fe(OH)_3$/iron(III)hydroxide/ $Fe(OH)_3.(H_2O)_3$ **(1)** • $BaSO_4$/barium sulfate **(1)**	If both name and formula are given, both must be correct Do not award ammonium/NH_4^+ Do not award $Fe(OH)_2$/iron(II)hydroxide Allow sulphate	**(4)**

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	• barium iodide / BaI_2	If name and formula are given, both must be correct Ignore any state symbols Do not award just Ba^{2+}/ barium	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(a)(iii)	An explanation that makes reference to the following points: • Fe(III)/Fe^{3+} **and** NH_4^+ **and** SO_4^{2-} **(1)** • Fe NH_4 $(SO_4)_2$ **(1)**	Accept cations in either order Allow formula with water of crystallisation. Ignore state symbols Ignore incorrect brackets e.g.(NH_4) TE from incorrect ions in M1	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(b)	An answer that makes reference to the following points: • iodine has been produced (from iodide ions) **(1)** • Fe(III) is reduced /Iron is reduced from +3 to +2 **(1)** **or** I^- oxidised/iodine is oxidised from -1 to 0	Allow I^- changes to I_2 Iodide ions oxidised to iodine scores both marks Allow Fe(III) acts as an oxidising agent/I^- acts as reducing agent Ignore references to the identity of the white ppt Do not award unbalanced (half)equations for M2	**(2)**

(Total for Question 1 = 9 marks)

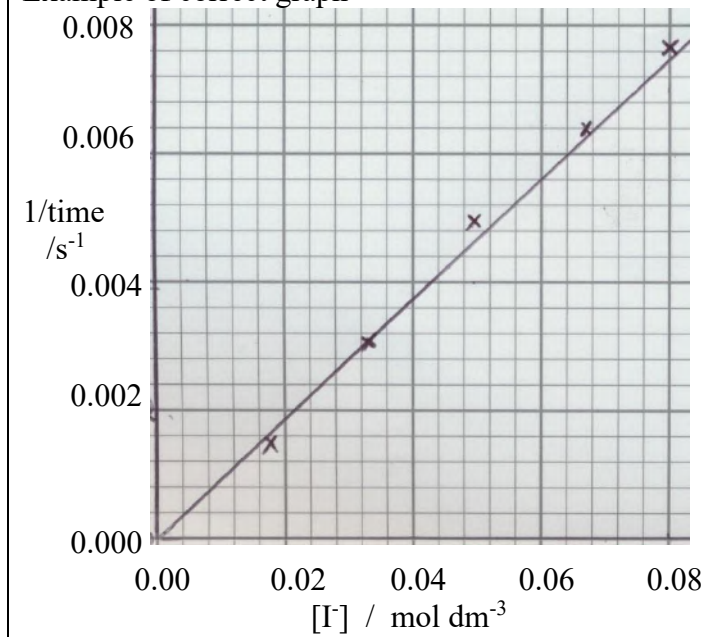
Question Number	Answer	Additional Guidance	Mark
2(a)(i)	An answer that makes reference to the following point: • burette or graduated pipette or pipettes with markings	Do not award just pipette Do not award volumetric pipette/flask Do not award measuring cylinder	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	An answer that makes reference to the following point: • blue/black/blue-black/dark blue	Allow colourless to blue/black Allow black-blue Do not award colourless/yellow/brown/purple	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(a)(iii)	An answer that makes reference to the following point: • the rate of reaction does not change significantly/is constant at the start of the reaction	Allow (so that)any change in concentration of the peroxydisulfate/iodide does not affect the reaction rate Allow so that the thiosulfate ions are used up/ Reaction 2 is complete before the concentrations of the reactants changes (significantly) Allow so that the concentration of the reactants does not change(significantly) Ignore any references to the rate depending on the thiosulfate concentration Ignore references to the iodine/iodide being completely used up	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(a)(iv)	An answer that makes reference to the following point: • so that the iodine disappears (in the reaction with the thiosulfate) before any reaction with the starch can occur	Allow arguments based on a slower rate for Reaction **2** e.g. the iodine would not be removed / the colour (of the complex) would appear too soon / straightaway/the colour change is delayed/not all the thiosulfate will react	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	• concentration potassium iodide in mixture **(1)**	Example of calculation $11 \times 0.200 \div 45 = 0.049$ (mol dm^{-3}) Ignore SF except 1 SF	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	An answer that makes reference to the following points: • axes, labels with units **and** scale chosen to cover at least half the graph in each direction **(1)** • 1st two and last two points correctly plotted (allow one small square) and best fit straight line. **(1)** Ignore third point.	Example of correct graph  Allow axes reversed	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(b)(iii)	An explanation that makes reference to the following points: • first order **(1)** • since the graph (of rate against concentration) is a straight line (through the origin)/ the rate/1/t is proportional to the concentration of iodide ions **(1)**	M2 is dependent on M1 Allow the gradient is constant Ignore references to half-lives Do not award contradictory reasoning e.g. concentration is proportional to time	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(c)(i)	An explanation that makes reference to two of the following points: • the temperature **(1)** • the (total) volume of the reaction mixture **(1)** • the volume of the KI (solution)/iodide ions **(1)** • the volume of $Na_2S_2O_3$ (solution)/thiosulfate **(1)**	Accept just "total volume" Allow the volumes of other reactants for 1 mark Ignore references to concentration of individual reactants. Do not award the volume of peroxydisulfate Do not award pressure	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(c)(ii)	An answer that makes reference to the following point: • rate = $k[S_2O_8^{2-}]\,[I^-]$	Allow $[I^-]\,[S_2O_8^{2-}]$ Allow K	**(1)**

Question Number	Answer		Additional Guidance	Mark
2(d)	• two simultaneous equations	**(1)**	$-6.03 = -(E_a \times 0.00351 \div R) + \text{constant}$ $-3.47 = -(E_a \times 0.00314 \div R) + \text{constant}$	**(3)**
	• subtraction	**(1)**	$-2.56 = -(E_a \times 0.00037 \div R)$	
	• evaluation of activation energy with sign and units	**(1)**	(+)57.496 kJ mol^{-1} / (+)57496/57500/57000 J mol^{-1} Ignore SF except 1 SF Correct answer with some evidence of working scores 3 Using values correctly rounded to 3SF (+)58181/58180/ 58200/58000 J mol^{-1} Using 1/285 and 1/318 gives (+)58425/58430/58400/58000 J mol^{-1}	
	An alternative method: • in a graph of lnk against 1/T the gradient gives −Ea/R • gradient can be found by subtraction of lnk ÷ subtraction of 1/T		gradient = $\frac{-3.47 - (-6.03)}{0.00314 - 0.00351} = -6918.9\ K^{-1}$	
	• rearrangement to give Ea		$-(-6918.9 \times 8.31) = (+)\ 57.496$ kJ mol^{-1} Ignore SF except 1 SF	

(Total for Question 2 = 15 marks)

Question Number	Answer		Additional Guidance	Mark
3(a)(i)	A description that makes reference to three of the following points:			**(3)**
	• add deionised/distilled water to the solid (in a beaker)	**(1)**	Allow the use of a funnel to transfer solid to flask	
	• (transfer solution to) a **volumetric flask** with washings	**(1)**	Do not award conical flask/measuring cylinder	
	• make up to the mark (with deionised/distilled water) and invert/mix	**(1)**	M3 depends on the use of a volumetric flask in M2	

Question Number	Answer		Additional Guidance	Mark
3(a)(ii)	An explanation that makes reference to two of the following points:			**(2)**
	• volume measured using a measuring cylinder is less accurate/precise than a (volumetric) pipette	**(1)**	Allow reverse argument	
	• the ethanedioic acid volume/amount is stoichiometric/ used in the titration calculation/is a limiting factor	**(1)**		
	• the sulfuric acid acidifies the mixture/ provides hydrogen ions for the reaction/must be in excess	**(1)**	Ignore references to a catalyst	

Question Number	Answer	Additional Guidance	Mark
3(a)(iii)	An answer that makes reference to the following point: • the titration is self-indicating / the end-point is when the mixture becomes purple/pale pink	Allow colourless to pink Allow reactants and products are different colours Do not award pink to colourless	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(a)(iv)	An explanation that makes reference to the following points: • the reaction has a high activation energy / rate is slow (at room temperature) **(1)** • the reaction will be faster at a higher temperature/heat is needed to supply the activation energy **(1)** • Mn^{2+} ions are produced (in the titration reaction) (which) act as a catalyst/ the reaction is autocatalysed **(1)**	Allow the reaction is exothermic Allow Mn^{2+} ions speed up the reaction	**(3)**

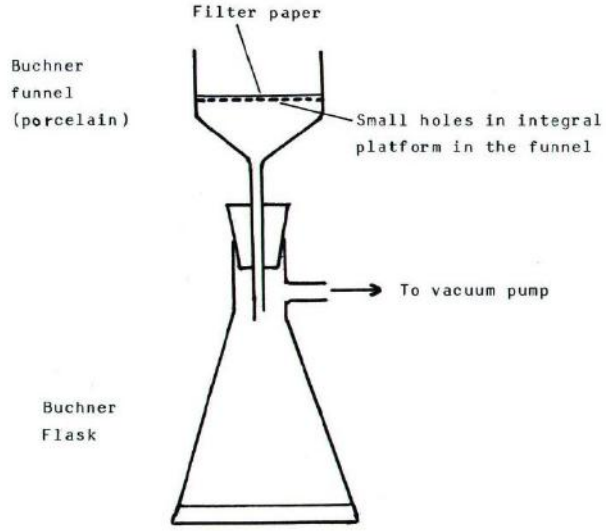
Question Number	Answer		Additional Guidance	Mark
3(a)(v)	• mol of manganate(VII) in titre	**(1)**	Example of calculation $19.90 \times 0.0203 \div 1000 = 4.0397 \times 10^{-4}$ / 0.00040397 (mol)	**(4)**
	• mol ethanedioic acid in 250 cm^3	**(1)**	$0.00040397 \times 5/2 \times 10 = 1.00993 \times 10^{-2}$ / 0.010099 (mol)	
	• mass water in solid	**(1)**	$1.27 - (0.010099 \times 90) = 0.36107$(g)	
	• mole ratio of ethanedioic acid : water	**(1)**	0.0101 : 0.36107 ÷ 18 0.0101 : 0.020059 / 2.0059×10^{-2} 1: 2 so x=2	
	Alternative M3: molar mass of ethanedioic acid		Alternative M3 1.27 ÷ 0.010099 = 125.75	
	Alternative M4: moles water		125.75 – 90= 35.751 35.751 ÷ 18 = 1.9862 ~ 2 so x=2	
			Correct answer with some working scores 4 Ignore SF for M1,M2 and M3 Do not award M4 if answer is not an integer	

Question Number	Answer		Additional Guidance	Mark
3(b)	An answer that makes reference to three of the following points: Method 1 • titrate (a solution of) ethanedioic acid with (aqueous) sodium hydroxide (noting the volume NaOH added at the end point)	**(1)**		**(3)**
	• using thymol blue as an indicator	**(1)**	Ignore colour change even if incorrect	
	• add ($25cm^3$) ethanedioic acid to the mixture and measure the pH using a pH meter	**(1)**	Allow: add half the titre volume of NaOH to a different $25cm^3$ sample of ethanedioic acid, and measure the pH using a pH meter	
	Method 2 • add (small portions of) sodium hydroxide, noting the pH after each addition	**(1)**		
	• until the first neutralisation/ sharp rise in pH has been observed	**(1)**	This could be determined by using any indicator but not phenolphthalein	
	• plot a graph of pH (against the volume of alkali added) and determine the point of half- neutralisation	**(1)**		

(Total for Question 3 = 16 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)	An explanation that makes reference to three of the following points • corrosive **(1)** • toxic/acute toxicity/poisonous/fatal/lethal **(1)** • **serious/long term** health hazard/carcinogenic/cancer **(1)**	 corrosive | toxic | carcinogenic 2 correct scores 1 3 correct scores 2	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)(i)	An explanation that makes reference to two of the following points: • below 0ºC the reaction is (too) slow **(1)** • above 5ºC the diazonium salt/the product (of Reaction1) will decompose/HNO_2/nitrous acid is unstable **(1)**	Accept phenol/nitrogen is formed Do not award the final product will decompose	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	A description that makes reference to two of the following points: • (Buchner)funnel with perforated base and filter paper **(1)** • (Buchner) flask with side arm, seal(bung) and connection to (vacuum) pump/reduced pressure **(1)** To score both marks both pieces of apparatus must be identifiable as separate		**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)(iii)	A description that makes reference to three of the following points: • (place sample of solid in) a capillary/melting point tube **(1)** • insert tube into melting temperature apparatus **(1)** Or Thiele tube/ oil bath with thermometer • heat (to 110°C then slowly) till sample melts **(1)**	Accept a small tube/Pasteur pipette If a water bath is stated then M3 cannot be scored A labelled diagram may score M1 and M2 Ignore descriptions of recrystallisation	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(c)	An answer that makes reference to the following point: • the solubility (in water) increases (so dye is lost from the body more easily/ the dye is more easily washed off the hands)	Ignore any reasons given for the increased solubility even if incorrect.	**(1)**

(Total for Question 4 = 10 marks)