Question number	Answer	Notes	Marks
2 (a) (i)	<b>M1</b> 0.53 ÷ 106		2
	<b>M2</b> 0.005(0) (mol)	correct answer scores (2)	
(ii)	<b>M1</b> $n(CO_2) = 0.005 \text{ mol / answer to}$ (a)(i)		2
	<b>M2</b> $vol(CO_2) = (110 \div 0.005) = 22 000 $ (cm <sup>3</sup> )	correct answer scores (2)	
	OR 110 ÷ <b>M1</b> correctly evaluated		
(b)	any two from:		2
	M1 the bung was not replaced quickly after the acid was added (so some carbon dioxide/gas escaped)	allow 'the bung was not on tightly/there was a leak around the bung (so some carbon dioxide/gas escaped)'	
	M2 (some) carbon dioxide/gas dissolved in the water (in the trough or in the acid)	allow `reacted with the water'	
	M3 sodium carbonate is not pure		

Answer	Notes	
M1 $n(Na_2S_2O_3) = 0.300 \times 20$ OR 0.006(0) mol 1000 (= $n(SO_2)$ )  M2 $Mr$ of $SO_2 = 32 + (2 \times 16)$ OR 64		
M3 mass of $SO_2 = (0.006 \times 64) = 0.38 (g)$	Mark CQ throughout Accept any number of sig fig Correct final answer with or without marking scores 3 marks	
M1 mass of SO <sub>2</sub> in 1 dm <sup>3</sup> = $\frac{0.38(4) \times 1000}{50}$	M1 CQ on M3 in ai	
= 7.6(8) (g)	Accept any number of sig fig	
M2 this is less than 100 so no SO <sub>2</sub> will escape	If candidate value for M1 is greater than 100, award M2 for opposite argument If no answer to M1 then M2 cannot be awarded	
OR		
M1 volume of solvent is $50 \text{cm}^3$ which would dissolve $(100/20) = 5(g)$ M2 0.384(g) is less than 5(g) so no SO <sub>2</sub> would escape	If answers based on volume of solvent = $20cm^3$ eg $20cm^3$ which would dissolve $(100/50)$ = $2(g)$ 0.384(g) is less than $2(g)$ so no $SO_2$ would escape worth 1 mark	
	M1 $n(\text{Na}_2\text{S}_2\text{O}_3) = 0.300 \times 20$ OR $0.006(0)$ mol $1000$ (= $n(\text{SO}_2)$ )  M2 $M\text{r}$ of $\text{SO}_2 = 32 + (2 \times 16)$ OR $64$ M3 mass of $\text{SO}_2 = (0.006 \times 64) = 0.38 \text{ (g)}$ M1 mass of $\text{SO}_2$ in $1 \text{ dm}^3 = 0.38(4) \times 1000$ $50$ $= 7.6(8) \text{ (g)}$ M2 this is less than $100 \text{ so no SO}_2$ will escape  OR  M1 volume of solvent is $50\text{cm}^3$ which would dissolve $(100/20) = 5(\text{g})$ M2 $0.384(\text{g})$ is less than $5(\text{g})$ so no $\text{SO}_2$	M1 $n(\text{Na}_2\text{S}_2\text{O}_3) = 0.300 \times 20  \text{OR } 0.006(0) \text{ mol} \\ 1000 \\ (= n(\text{SO}_2))$ M2 $Mr$ of $\text{SO}_2 = 32 + (2 \times 16) \text{ OR } 64$ M3 $\text{mass of } \text{SO}_2 = (0.006 \times 64) = 0.38 \text{ (g)}  \text{Mark } \text{CQ throughout} \\ \text{Accept any number of sig fig} \\ \text{Correct final answer with or without marking} \\ \text{scores } 3 \text{ marks}$ M1 $\text{mass of } \text{SO}_2 \text{ in } 1 \text{ dm}^3 = \underbrace{0.38(4) \times 1000}_{50}  \text{M1 CQ on M3 in ai}}_{50}$ $= 7.6(8) \text{ (g)}  \text{Accept any number of sig fig}$ M2 this is less than $100 \text{ so no } \text{SO}_2 \text{ will escape}}_{200000000000000000000000000000000000$

b	as the (hydrochloric) acid/HCl is added	Allow (immediately) after (all) the acid/HCl added  Ignore when the solutions are mixed	1
c i	timer started too late / stopped too early  OR  thermometer (scale) read incorrectly / timer read	Allow misread/incorrectly recorded the	1
::	incorrectly	temperature/time	
ii	19.5 (s)	Accept range 19-20	1

Question number			Answer		Notes	
5	d	İ	M1	times are (very) short	Accept reaction happens too/very/so quickly (so hard to time accurately/precisely) Ignore reaction is quicker Ignore hard(er) to measure rate Allow human reaction time becomes significant Allow references to shorter times producing greater percentage (measurement) uncertainties/errors	2
			M2	heat loss greater	Accept heat loss occurs more quickly Accept difficult to maintain a higher temperature/keep temperature constant Ignore references to evaporation occurring	
		ii	M1	more collisions/particles have energy equal to/greater than the activation energy	Ignore particles have more (kinetic) energy Ignore harder/more vigorous collisions Ignore references to speed of particles	
			1	(therefore there are) more successful collisions second)	if state activation energy is lowered scores 0/2 references to concentration scores 0/2	2

Question number		Expected answer	Accept	Reject	Marks	
4 (a)	(i)	108/24 = 4.5	1 mark for answer of 4.8(2) (molar volume = 22.4dm <sup>3</sup> )		1	
		= 4.5	= 22.4um )			
	(ii)	$M_r$ of $NaN_3 = 65$	23 + (14 x3)		1	
		Moles of $NaN_3 = 3$ OR two thirds of (a)(i)			1	
		Mass of $NaN_3 = 195$ (g) OR moles of $NaN_3 \times M_r$	Correct answer with no working scores 3		1	
		[Mark consequentially at each stage]				
(b)	(i)	Removes (harmful) sodium	Produces <u>more</u> nitrogen / gas OR bag inflates more quickly		1	
	(ii)	$K_2O(s) + SiO_2(s) \rightarrow K_2SiO_3(s)$			1	
		OR $K_2O(s) + SiO_2(s) \rightarrow K_2SiO_3(I)$				
		IGNORE same numbers of $Na_2O$ on both sides of equation				
(c)	(i)	Precipitation	Double decomposition	Double displacement	1	
	(ii)	Filtration / filter IGNORE refs to adding water	Decanting / pour off liquid	Sieving / evaporation / distillation / crystallisation / heat	1	

е	Any	three from		
	M1 M2	concentration of the (hydrochloric/nitric) acid volume of the (hydrochloric/nitric) acid	Allow amount for volume	
	M3 M4	volume of the (nydrochione/mitric) acid volume of sodium thiosulfate temperature	If neither M2 or M3 scored allow 1 mark for total volume of the mixture OR depth of liquid in the flask	3
			Ignore reference to volume of water Ignore references to size of flask/same apparatus Ignore references to distance of eye from flask/ the X/references to timing	