

Question	Answers	Extra information	Mark	AO / Specification reference
01.1	92 kJ		1	AO2 4.6.2.2
01.2	if a system is in equilibrium and a change is made to any of the conditions, the system responds to counter the change		1	AO2 4.6.2.4
01.3	it shifts to the right		1	AO2 4.6.2.7
02.1	2 O atoms are drawn with 1 shell each 1 O atom has 6 dots and 2 crosses, the other 6 crosses and 2 dots O atoms share 2 dots and 2 crosses		2	AO2 4.2.1.4
02.2	a reaction that transfers energy to the surroundings		1	AO1 4.5.1.1
02.3	more SO ₃ is added – shifts to the left pressure is increased – shifts to the right temperature is increased – shifts to the left more O ₂ is added – shifts to the right		1 1 1 1	AO2 4.6.2.5 4.6.2.6 4.6.2.7
03.1	methanol gas is the product in unsealed container, product would escape (into surroundings) therefore, forward reaction would continue (to produce methanol) or continue to completion		1 1 1	AO1 4.6.2.3
03.2	Level 3: Three conditions identified with matching description of how the change will affect the position of the equilibrium. Full explanation of why change occurs provided.		5-6	AO1 4.6.2.4

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	Level 2: At least two conditions identified with a matching description of how the change will affect the position of the equilibrium. Attempt at explanations given, with some accurate points given.		3-4	4.6.2.5 4.6.2.6 4.6.2.7
	Level 1: At least one condition identified, thought description of how the change will affect position not given, incorrect, or incomplete. No attempt at explanation provided.		1-2	
	No relevant comment.		0	
	Indicative content: <u>increasing (total) pressure</u> • shifts equilibrium to the right/results in a greater relative amount of product • because there is a smaller number of molecules on this side of the equation <u>decreasing temperature</u> • shifts the equilibrium to the right / results in a greater relative amount of product • because the reaction is exothermic in the reaction shown <u>increase the amount/concentration of reactant</u> • the equilibrium shifts to the right / results in a greater relative amount of product until equilibrium is established again • because there is a smaller number of molecules shown in the equation on the left and the concentrations of all substances will change until equilibrium is reached again			

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03.3	mass of one mole of CO = $12 + 16 = 28$ g 10 g of CO is $\frac{10}{28} = 0.3571$ mol from the equation, 0.3571 mole of CO makes 0.3571 mole of methanol mass of one mole of methanol = $12 + 16 + (4 \times 1) = 32$ g mass of 0.3571 mol of methanol = $0.3571 \times 32 = 11.4$ g		1 1 1 1 1 1	AO2 4.3.2.1 4.3.2.2
04.1	reversible		1	AO1 4.6.2.1
04.2	H ₂ and I ₂ react together to make HI at the same rate that HI reacts to form H ₂ and I ₂		1	AO2 4.6.2.3
04.3	when H ₂ and I ₂ react together to make HI energy is transferred from the surroundings/the system takes in energy from the surroundings		1 1	AO1 4.5.1.1 4.6.2.1
05.1	reactants and products can escape from the apparatus		1	AO2 4.6.2.3
05.2	Bunsen burner		1	AO1
05.3	steam/water/water vapour		1	AO2 4.6.2.2
05.4	attach bung and delivery tube to test tube feed delivery tube into beaker in ice water		1 1 1	AO3

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06.1	place it in a bigger water bath/ensure that the level of the solution is below the level of the water or stir it		1	AO3
06.2	heating the mixture shifts the equilibrium towards the blue cobalt ion solution/right hand side/product solution		1 1	AO3 4.6.2.6
06.3	pink to blue		1	AO3 4.6.2.5
06.4	concentration of chloride ions is increased so a change occurs to counteract the change and the equilibrium shifts to the right/relative amount of product increases		1 1 1	AO2 4.6.2.5
07.1	increases the pressure so more of the colourless N_2O_4 is formed because the system is responding to counteract the change by shifting the position of the equilibrium to the side with the smaller number of molecules		1 1 1 1	AO3 4.6.2.4 4.6.2.7
07.2	the temperature of the mixture is decreased so the relative amount of product at equilibrium decreases or position of equilibrium moves to left hand side so the colour change gets lighter/colourless/clear		1 1 1	AO3 4.6.2.4 4.6.2.7
07.3	no effect because there are the same number of molecules shown in the equation in both the products and reactants		1 1 1	AO2 4.6.2.6
08.1	three (minutes) the amounts of both X and Y are constant from this time onwards		1 1	AO2 4.6.2.7

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08.2	they are the same		1 1	AO3
08.3	forward		1	AO1 4.6.2.3
09.1	$\text{ICl(l)} + \text{Cl}_2(\text{g}) \rightleftharpoons \text{ICl}_3(\text{s})$ or $\text{ICl}_3(\text{s}) \rightleftharpoons \text{Cl}_2(\text{g}) + \text{ICl(l)}$	one mark for identifying ICl and Cl_2 as the reactants one mark for state symbols one mark for reversible arrow	3	AO3 4.6.2.2
09.2	exothermic		1	AO3 4.6.2.2
09.3	ice bath reduces the temperature of the system in exothermic reactions, energy is transferred to the surroundings so increasing the temperature/minimising the change		1 1 1	AO3 4.6.2.1
10.1	ammonium chloride		1	AO2 4.6.2.2
10.2	reaction is reversible therefore, as ammonia and hydrogen chloride gases cool, they react to form ammonium chloride		1 1 1	AO3 4.6.2.6
10.3	crystals turn blue		1	AO3 4.6.2.1
10.4	test tube would warm up		1	AO3 4.6.2.2

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11.1	three		1	AO2 4.3.2.1
11.2	$14 + (3 \times 1)$ $= 17$		1 1	AO2 4.3.1.2
11.3	$\frac{68}{17}$ $= 4$		1 1	AO2 4.3.2.1
11.4	$4 \times 6.02 \times 10^{23}$ $= 2.41 \times 10^{24}$	one mark for correct number of significant figures	1 1 1	AO2 4.3.2.1
12.1	Any two from: • moves around on surface of water • fizzing • lilac/mauve/purple flame	one mark for each correct answer up to two marks	2	AO1 4.1.2.5
12.2	lithium hydroxide hydrogen		1 1	AO1 4.1.2.5 4.4.1.2
12.3	no change		1	AO1 4.4.1.2

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13.1	2SO ₂ g two		1 1 1	AO2
13.2	forward reaction		1	AO2 4.6.2.2
13.3	more energy transferred to break reactant bonds than is transferred to surroundings on formation of product bonds		1	AO3 4.5.1.3
13.4	decrease yield		1	AO2 4.6.2.6
13.5	higher/increase rate of reaction		1	AO2 4.6.1.2
13.6	provide an alternative reaction pathway with a lower activation energy so more frequent collisions with enough energy to react		1 1 1	AO1 4.6.1.4
13.7	increase pressure fewer molecules in the products so equilibrium position will shift right to minimise change	accept answer that matches with students' balanced equation	1 1 1	AO1 4.6.2.7
13.8	expensive/dangerous		1	AO3