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EDEXCEL A LEVEL CHEMISTRY: QUESTIONS BY TOPIC

Equilibrium I (10)

A Level Chemistry Topic 10

4 questions · 61 marks · Mark schemes included

Pearson Edexcel A Level Chemistry (9CH0), June 2017 - June 2025

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HOW TO USE THIS BOOKLET

Questions are grouped by specification sub-topic; within each sub-topic they run from the lowest mark tariff to the highest.

Click any sub-topic heading or question row below to jump straight to it.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

QUESTION	SOURCE	MARKS	PAGE
10(a) DYNAMIC EQUILIBRIUM AND KC		3 questions · 45 marks	3
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10(+) SYNOPTIC AND MIXED QUESTIONS		1 question · 16 marks	13
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QUESTIONS

4 questions · 61 marks · grouped by sub-topic



SUB-TOPIC 10(a)

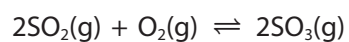
DYNAMIC EQUILIBRIUM AND KC

3 questions in this sub-topic · 45 marks · lowest tariff first



10 This question is about equilibrium systems.

(a) Sulfur dioxide and oxygen form an equilibrium with sulfur trioxide.



The composition of an equilibrium mixture at 698 K and a total pressure of 2.40 atm is shown in the table.

Substance	SO ₂ (g)	O ₂ (g)	SO ₃ (g)
Number of moles /mol	0.0160	0.0120	0.772

(i) Calculate the value of K_p at this temperature.

Include units, if appropriate.

(5)

(ii) Calculate the number of sulfur dioxide molecules present in this equilibrium mixture.

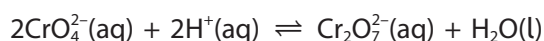
(1)



(iii) Deduce, by referring to K_p , how the number of sulfur dioxide molecules will change if more oxygen is added to the equilibrium mixture.

(2)

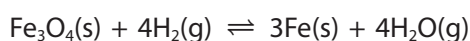
(b) An equilibrium exists in aqueous solution between the chromate(VI) ions and the dichromate(VI) ions.



Explain any change in the position of equilibrium if a few drops of sodium hydroxide solution are added to this equilibrium system.

(2)

(c) The equilibrium for the reaction between hydrogen gas and an oxide of iron is



The K_c expression for this equilibrium is

(1)

☐ A $K_c = \frac{[\text{Fe}] \times [\text{H}_2\text{O}]}{[\text{Fe}_3\text{O}_4] \times [\text{H}_2]}$

☐ B $K_c = \frac{[\text{Fe}]^3 \times [\text{H}_2\text{O}]^4}{[\text{Fe}_3\text{O}_4] \times [\text{H}_2]^4}$

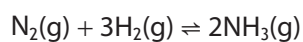
☐ C $K_c = \frac{[\text{H}_2\text{O}]}{[\text{H}_2]}$

☐ D $K_c = \frac{[\text{H}_2\text{O}]^4}{[\text{H}_2]^4}$

(Total for Question 10 = 11 marks)



- 9 Ammonia is manufactured by the Haber Process.



$$K_p = \frac{p(\text{NH}_3)^2}{p(\text{N}_2)p(\text{H}_2)^3}$$

- (a) The pressure used in the Haber Process is 200 atm.

Explain the effect, if any, of increasing the pressure on the equilibrium yield of ammonia.

(2)

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- (b) The equilibrium constants for K_p and K_c are related by the equation

$$K_p = \frac{K_c}{(RT)^{\Delta n}}$$

where Δn is the number of moles of reactants minus the number of moles of products.

Calculate the value of K_c at 500 K when the value of $K_p = 3.55 \times 10^{-2} \text{ atm}^{-2}$. Include the units for K_c .

[Use the value of $R = 0.0821 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$]

(4)



- (c) A mixture of 1.0 mol of nitrogen and 3.0 mol of hydrogen is left to reach equilibrium at 700 K.

Calculate the total pressure, in atmospheres, needed to produce a yield of 0.30 mol of ammonia at 700 K.

Give your answer to an appropriate number of significant figures.

You must show your working.

$$[K_p = 7.76 \times 10^{-5} \text{ atm}^{-2} \text{ at } 700 \text{ K}]$$

(5)



- (d) The value of the equilibrium constant, K_p , varies with temperature.

The equation relating the values of the equilibrium constant at two temperatures is

$$\ln \left[\frac{K_2}{K_1} \right] = \frac{\Delta H}{R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$$

The equilibrium constant, K_1 , for the formation of ammonia is $6.76 \times 10^5 \text{ atm}^{-2}$ when the temperature $T_1 = 298 \text{ K}$.

The enthalpy change $\Delta H = -92\,400 \text{ J mol}^{-1}$.

Calculate the value of the equilibrium constant for this reaction at 310 K.

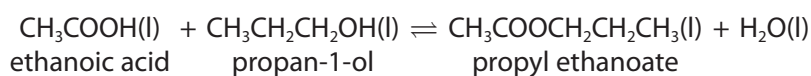
[Use the value of $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$]

(4)

(Total for Question 9 = 15 marks)



- 8 This question is about an experiment to determine the equilibrium constant, K_c , for an esterification reaction producing propyl ethanoate. The equation for the reaction is



In an experiment to determine the equilibrium constant, K_c , the following steps were carried out.

- 6.0 cm³ of ethanoic acid (0.105 mol), 6.0 cm³ of propan-1-ol (0.080 mol) and 2.0 cm³ of dilute hydrochloric acid were mixed together in a sealed boiling tube. In this pre-equilibrium mixture, there is 0.111 mol of water
- The mixture was left for one week, at room temperature and pressure, to reach equilibrium
- The equilibrium mixture and washings were transferred to a volumetric flask and the solution made up to exactly 250.0 cm³ using distilled water
- 25.0 cm³ samples of the **diluted** equilibrium mixture were titrated with a solution of sodium hydroxide, concentration 0.200 mol dm⁻³, using phenolphthalein as the indicator
- The mean titre was 23.60 cm³ of 0.200 mol dm⁻³ sodium hydroxide solution.

(a) State the role of the hydrochloric acid in the esterification reaction.

(1)

(b) (i) Calculate the total amount, in moles, of acid present in the **volumetric flask** in the equilibrium mixture.

(2)



- (ii) The 2.0 cm^3 of dilute hydrochloric acid contained 0.00400 mol of $\text{H}^+(\text{aq})$ ions. Use this and your answer to part (b)(i) to calculate the amount, in moles, of ethanoic acid present in the equilibrium mixture.

(1)

- (c) (i) The initial mixture in the boiling tube contained 0.105 mol of ethanoic acid. Use your answer to (b)(ii) to calculate the amount, in moles, of ethanoic acid that reacted to form the ester in the equilibrium mixture.

(1)

- (ii) Use information given in the method, and your answer to (c)(i), to calculate the amounts, in moles, of propan-1-ol, propyl ethanoate and water that are present in the equilibrium mixture.

(3)

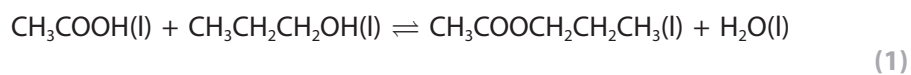
Moles of propan-1-ol at equilibrium.....

Moles of propyl ethanoate at equilibrium.....

Moles of water at equilibrium.....



(d) (i) Write the expression for the equilibrium constant, K_c , for this reaction.



(ii) Explain why it is possible, in this case, to calculate K_c using equilibrium amounts in moles, rather than equilibrium concentrations.

(2)

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(iii) Calculate the value of K_c .

Give your answer to an appropriate number of significant figures.

(2)



- (e) The pink colour of the phenolphthalein fades after the end-point of the titration has been reached.

Give a possible explanation for this observation.

(2)

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- (f) Explain what you could do to confirm that one week is sufficient time for the mixture to reach equilibrium.

(2)

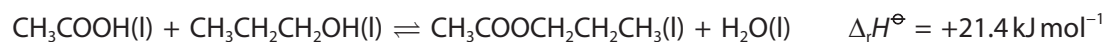
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- (g) A student repeated the experiment, but left the mixture in a water bath at 40 °C until equilibrium was reached.



Deduce the effect, if any, on this student's value for K_c compared with that obtained in part (d)(iii).

(2)

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(Total for Question 8 = 19 marks)



TOPIC 10

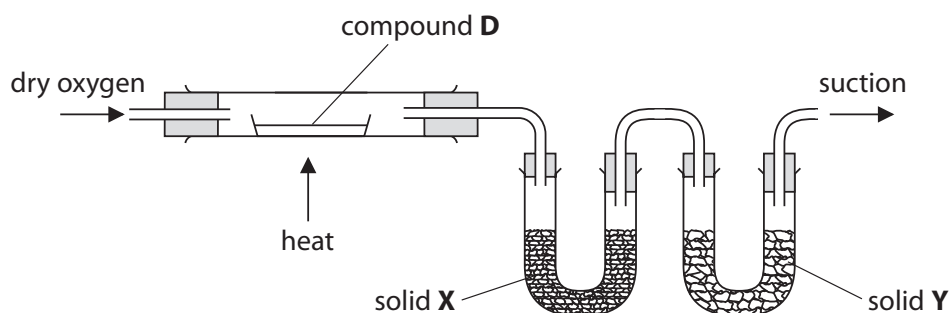
SYNOPTIC AND MIXED QUESTIONS

1 question in this sub-topic · 16 marks · lowest tariff first



10 Organic compound **D** contains the elements carbon, hydrogen, oxygen and nitrogen only.

- (a) A sample of **D** was burned completely in the apparatus shown.
Solid **X** absorbed the water formed in the combustion.
Solid **Y** absorbed the carbon dioxide.



- (i) The masses of solids **X** and **Y** increased during the experiment.

Explain the effect, if any, on the changes in mass of **X** and **Y** if the oxygen gas was not dry.

(3)

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- (ii) On combustion in dry oxygen, 3.36 g of **D** produced 0.72 g of water and 5.28 g of carbon dioxide.

This sample of **D** also contained 0.56 g of nitrogen.

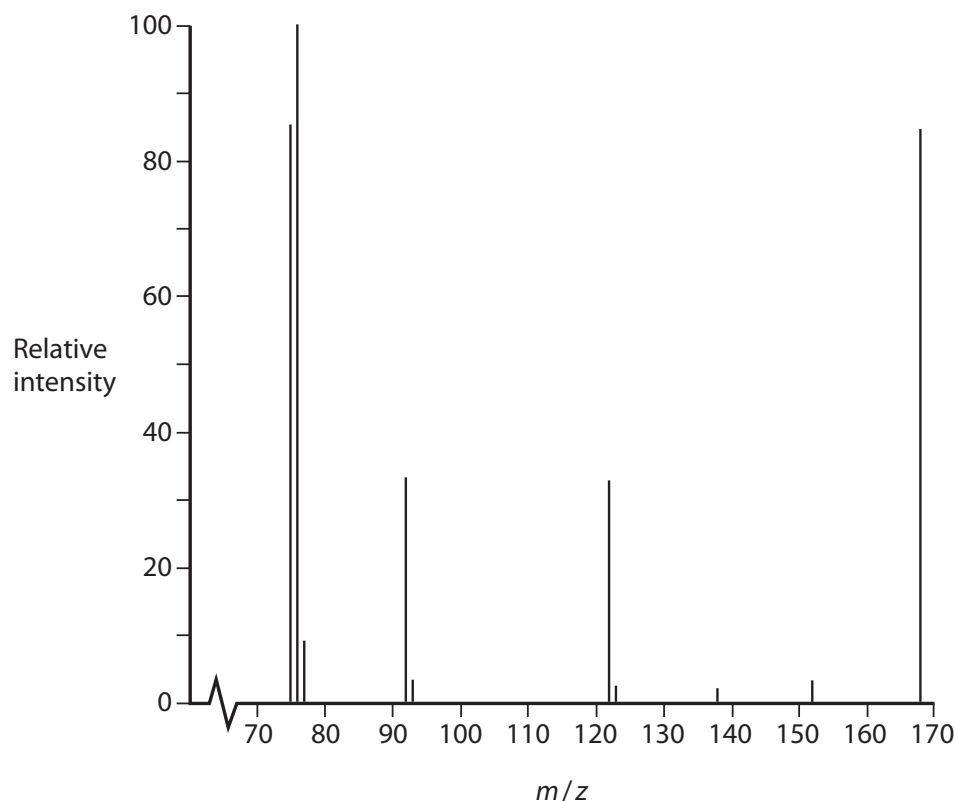
Use these data to calculate the empirical formula of compound **D**.

You **must** show your working.

(5)



(b) Part of the mass spectrum of **D** is shown.



Deduce the molecular formula of **D**. Justify your answer.

(2)

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(c) Compound **D** contains a benzene ring.

(i) Give the molecular formula of the species that causes the peak at $m/z = 76$ in the mass spectrum of **D**.

(1)

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- (ii) Draw the structures of the **three** possible isomers of **D** containing a benzene ring.

(2)

- (iii) The ^{13}C NMR spectrum of compound **D** has four peaks.

Identify the structure of **D**. Justify your answer by labelling the different carbon environments in **all** the structures drawn in (c)(ii).

(3)

(Total for Question 10 = 16 marks)



MARK SCHEMES

official Pearson Edexcel mark schemes



Question Number	Answer	Additional Guidance	Mark
10(a)(i)	(M1) calculation of mole fractions (1) (M2) calculation of partial pressures (1) (M3) expression of K_p (1) (M4) calculation of value of K_p (1) (M5) units (1)	<u>Example of calculation</u> $X_{\text{SO}_2} = 0.0160 \div 0.8 = 0.02(0)$ $X_{\text{O}_2} = 0.0120 \div 0.8 = 0.015$ $X_{\text{SO}_3} = 0.772 \div 0.8 = 0.965$ $P_{\text{SO}_2} = 0.02(0) \times 2.40 = 0.048$ $P_{\text{O}_2} = 0.015 \times 2.40 = 0.036$ $P_{\text{SO}_3} = 0.965 \times 2.40 = 2.316$ $K_p = \frac{(P_{\text{SO}_3})^2}{(P_{\text{SO}_2})^2 \times P_{\text{O}_2}}$ Do not award square brackets $K_p = \frac{2.316^2}{0.048^2 \times 0.036} =$ $K_p = 64668.4 \dots / 6.46684 \dots \times 10^4$ $K_p = 65000 / 6.5 \times 10^4 / 64700 / 6.47 \times 10^4$ Ignore SF except 1 atm⁻¹ Correct final answer without working scores (5)	(5)



Question Number	Answer	Additional Guidance	Mark
10(a)(ii)	calculation of the number of molecules	Example of calculation $N = (n \times L = 0.0160 \times 6.02 \times 10^{23})$ $= 9.632 \times 10^{21}$ Ignore SF except 1SF Do not award if any units are given	(1)

Question Number	Answer	Additional Guidance	Mark
10(a)(iii)	An answer that makes reference to the following points: - to ensure that K_p stays the same/ quotient stays the same or only temperature changes the value of K_p (1) - the number of (sulfur dioxide) molecules decreases Either because the equilibrium shifts to the right or because one of the denominators (oxygen) has increased so the other denominator (sulfur dioxide) has to decrease (1)	Standalone marks Allow concentration changes have no effect on the value of K_p Allow 'moles' for molecules	(2)



Question Number	Answer	Additional Guidance	Mark
10(b)	An explanation that makes reference to the following points: - equilibrium position shifts to the left (1) (because) the hydroxide ions combine with/neutralise the H⁺ ions to remove them from the equilibrium (1)	'Equilibrium moves to the right' scores (0) Allow Hydroxide ions react with H⁺ ions to make water/ hydroxide ions react with H⁺ ions to reduce their number/concentration Ignore reference to 'more products formed'	(2)

Question Number	Answer	Mark
10(c)	The only correct answer is D $K_c = \frac{[\text{H}_2\text{O}]^4}{[\text{H}_2]^4}$ A is not correct because the solids should not be included in the expression and the powers of the remaining substituents have been omitted B is not correct because the solids should not be included in the expression C is not correct because the powers of the substituents have been omitted	(1)

(Total Question 10 = 11 marks)



Question Number	Answer	Additional Guidance	Mark
9(a)	An explanation that makes reference to the following points: - there are fewer moles / molecules / particles of (gas) on the right (1) - so (equilibrium) yield of ammonia increases (1)	Any reference to equilibrium constant changing scores (0) overall Allow 4 moles / molecules of gas on the left and 2 moles / molecules on right Allow 'equilibrium shifts to the right' M2 is conditional on M1 or the idea of fewer particles on the right / increasing the value of the quotient / Q Allow reverse argument	(2)

Question Number	Answer	Additional Guidance	Mark
9(b)	- rearrangement of formula (1) - substitution of correct values (1) - calculation of K_c (1) - units (1)	<u>Example of calculation</u> $K_c = K_p \times (RT)^{\Delta n}$ $K_c = 3.55 \times 10^{-2} \times (0.0821 \times 500)^2$ $K_c = 59.821$ TE on Δn Stand alone mark $\text{dm}^6 \text{mol}^{-2}$ or $\text{mol}^{-2} \text{dm}^6$ Correct value with units and no working scores (4) Ignore SF except 1 SF M1 and M2 can be in reverse order	(4)

Question Number	Answer	Additional Guidance	Mark																				
9(c)	- calculation of eqm moles (1) - expressions for 3 partial pressures (1) - substitution of values into K_p expression (1) - rearrangement of K_p expression (1) - calculation of total pressure and answer to 1 / 2 SF (1)	<u>Example of calculation</u> <table border="1"> <thead> <tr> <th></th><th>N₂</th><th>H₂</th><th>NH₃</th></tr> </thead> <tbody> <tr> <td>Initial mol</td><td>1.0</td><td>3.0</td><td>-</td></tr> <tr> <td>Eqm mol</td><td>1.0 - 0.15 = 0.85</td><td>3.0 - (3 x 0.15) = 2.55</td><td>0.30</td></tr> <tr> <td>Total mol at eqm</td><td colspan="3">0.85 + 2.55 + 0.30 = 3.7</td></tr> <tr> <td>Partial pressure</td><td>$\frac{0.85}{3.7} \times P$</td><td>$\frac{2.55}{3.7} \times P$</td><td>$\frac{0.30}{3.7} \times P$</td></tr> </tbody> </table> $K_p = 7.76 \times 10^{-5} = \frac{\left(\frac{0.30 \times P}{3.7}\right)^2}{\left(\frac{0.85 \times P}{3.7}\right)\left(\frac{2.55 \times P}{3.7}\right)^3}$ $7.76 \times 10^{-5} = \frac{0.087419}{P^2}$ $P^2 = 1126.5 \text{ (atm}^2\text{)}$ $P = 33.564$ $= 34 / 30 \text{ (atm)}$ Allow any symbol for total pressure Allow TE throughout Correct answer to 1 or 2 SF with some working scores (5) Correct answer to 1 or 2 SF with no working scores (4)		N ₂	H ₂	NH ₃	Initial mol	1.0	3.0	-	Eqm mol	1.0 - 0.15 = 0.85	3.0 - (3 x 0.15) = 2.55	0.30	Total mol at eqm	0.85 + 2.55 + 0.30 = 3.7			Partial pressure	$\frac{0.85}{3.7} \times P$	$\frac{2.55}{3.7} \times P$	$\frac{0.30}{3.7} \times P$	(5)
	N ₂	H ₂	NH ₃																				
Initial mol	1.0	3.0	-																				
Eqm mol	1.0 - 0.15 = 0.85	3.0 - (3 x 0.15) = 2.55	0.30																				
Total mol at eqm	0.85 + 2.55 + 0.30 = 3.7																						
Partial pressure	$\frac{0.85}{3.7} \times P$	$\frac{2.55}{3.7} \times P$	$\frac{0.30}{3.7} \times P$																				



Question Number	Answer	Additional Guidance	Mark
9(d)	- substitution of numbers into expression (1) - evaluation of $\Delta H/R$ and $1/T_1 - 1/T_2$ (1) - rearrangement of expression (1) - evaluation of expression (1)	<u>Example of calculation</u> $\ln\left(\frac{K_2}{6.76 \times 10^5}\right) = \left(\frac{-92400}{8.31}\right)\left(\frac{1}{298} - \frac{1}{310}\right)$ $\ln\left(\frac{K_2}{6.76 \times 10^5}\right) = -11119.1 \times 1.299 \times 10^{-4}$ $= -1.4444$ $K_2 = 6.76 \times 10^5 \times e^{-1.4444}$ TE on M2 $K_2 = 1.59467 \times 10^5 / 159467(\text{atm}^{-2})$ TE on M3 Allow answer from earlier correct rounding to 2 or more SF Ignore SF except 1 SF Correct answer with no / some working scores (4)	(4)

(Total for Question 9 = 15 marks)



Question Number	Acceptable Answers	Additional Guidance	Mark
8(a)	Any one from: Catalyst / speeds up reaction / increases rate / increases rate of attainment of equilibrium / lowers activation energy	Ignore any mention of protonation or mechanism for catalysis Do not award additional incorrect types of reaction	(1)

Question Number	Acceptable Answers	Additional Guidance	Mark
8(b)(i)	- calculation of moles of H⁺ in 25.0 cm³ (1) - calculation of moles of H⁺ in 250 cm³ flask (1)	Ignore SF throughout 8(b)(i) to 8(c)(ii) except 1 SF, which should be penalised once only <u>Example of calculation:</u> (moles NaOH = $0.200 \times \frac{23.60}{1000}$) = 0.00472 (mol) (= mol H ⁺ in 25.0 cm ³) (= 10×0.00472) = 0.0472 (mol) (in 250 cm ³) Allow TE for M2 on moles of NaOH Correct answer with or without working scores 2 marks	(2)

Question Number	Acceptable Answers	Additional Guidance	Mark
8(b)(ii)	subtracts moles of H⁺ in HCl from answer to (b)(i)	<u>Example of calculation:</u> 0.0472 – 0.00400 = 0.0432 (mol) Allow TE on answer to part (b)(i)	(1)



Question Number	Acceptable Answers	Additional Guidance	Mark
8(c)(i)	calculation of moles of CH₃COOH that have reacted	Example of calculation: $(0.105 - 0.0432) = 0.0618$ Allow TE on part (b)(ii) unless negative value	(1)

Question Number	Acceptable Answers	Additional Guidance	Mark
8(c)(ii)	- calculation of equilibrium moles of CH₃CH₂CH₂OH (1) - calculation of equilibrium moles of CH₃COOCH₂CH₂CH₃ (1) - calculation of equilibrium moles of H₂O (1)	Example of calculation: $0.0800 - 0.0618 = 0.0182$ 0.0618 $0.111 + 0.0618 = 0.1728$ Allow TE on answer to part (c)(i) unless negative value	(3)

Question Number	Acceptable Answers	Additional Guidance	Mark
8(d)(i)	$(K_c =) \frac{[\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_3][\text{H}_2\text{O}]}{[\text{CH}_3\text{COOH}][\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}]}$	IGNORE state symbols even if incorrect Do not award round brackets	(1)



Question Number	Acceptable Answers	Additional Guidance	Mark
8(d)(ii)	An explanation that makes reference to the following points: - Same number of moles/molecules on both sides of the equation (1) (so) volume / V cancels in K_c expression (1)	2 marks could be scored by a correct mathematical expression showing V or dm^3 cancel Allow same number of terms on top and bottom of K_c expression Allow units cancel out Allow "all divided by the same volume"	(2)

Question Number	Acceptable Answers	Additional Guidance	Mark
8(d)(iii)	- calculates value of K_c (1) - final value of K_c quoted to 2 or 3 SF (1)	<u>Example of calculation</u> $K_c = \frac{(0.0618) \times (0.1728)}{(0.0432) \times (0.0182)} = 13.58241758$ $= 14 / 13.6 \text{ (no units)}$ Correct answer with no working gains full marks Ignore units No TE on wrong K_c expression	2



Question Number	Acceptable Answers	Additional Guidance	Mark
8(e)	An explanation that makes reference to the following points: - the equilibrium shifts to the left or the mixture absorbs carbon dioxide from the atmosphere (1) - so the mixture is (becoming more) acidic / the acid reforms (1)	Mark independently Allow no longer alkaline Do not award just "pH decreases"	(2)

Question Number	Acceptable Answers	Additional Guidance	Mark
8(f)	An explanation that makes reference to the following points: - carry out / repeat experiment and leave for longer than a week (1) - the titre value / K_c value will remain unchanged (if equilibrium has been established) (1)	Ignore pH probes / checking pH Allow repeat experiment and check titres within first week Allow moles / concentration are unchanged Ignore just "results unchanged"	(2)

Question Number	Acceptable Answers	Additional Guidance	Mark
8(g)	An answer that makes reference to the following points: K_c value will be greater than that calculated in (d)(iii) (1) - because the (forward) reaction is endothermic or backward / reverse reaction is exothermic (1)	M2 depends on M1 Ignore References to the equilibrium position shifting to the right (with increasing temperature)	(2)

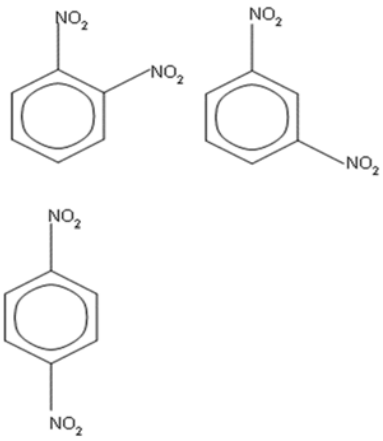
(Total for Question 8 = 19 marks)**TOTAL FOR PAPER 3 = 120 MARKS**

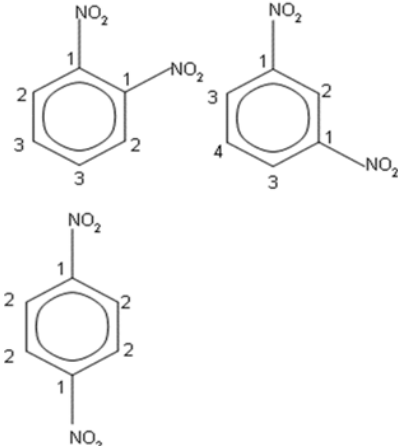
Question Number	Acceptable Answers	Additional Guidance	Mark
10(a)(i)	An explanation that makes reference to the following points: (the increase in mass of) X will increase and (the increase in mass of) Y will stay the same (1) - because X will also absorb the water / moisture in the oxygen (1) (Y stays the same) because the water / moisture has already been absorbed by X (1)	Allow greater change in mass for X if it is clear that it is an increase Allow X reacts with the water in oxygen Do not award X absorbs oxygen Allow because Y only absorbs carbon dioxide / CO₂ Allow because Y does not absorb water Allow because the amount of carbon dioxide / CO₂ does not change	(3)

Question Number	Acceptable Answers	Additional Guidance	Mark
10(a)(ii)	- calculation of mol C/ CO₂ (1) - calculation of mol H (1) - calculation of mol N (1) - calculation of mol O (1) - empirical formula (1)	<u>Example of calculation</u> mol CO₂ = 5.28/44 = 0.12 = mol C or mass C = 5.28 x 12/44 = 1.44 (g) mol C = 1.44/12 = 0.12 mol H₂O = 0.72/18 = 0.04 mol H = 2 x mol H₂O = 0.08 or mass H = 0.72 x 2/18 = 0.08 mol H = 0.08 x 1 = 0.08 mol N₂ = 0.56/28 = 0.02 mol N = 2 x mol N₂ = 0.04 or mass N = 0.56 mol N = 0.56/14 = 0.04 mass O = 3.36 – (12 x 0.12 + 1 x 0.08 + 14 x 0.04) = 1.28 (g) mol O = 1.28/16 = 0.08 TE on masses of C, H and N (0.12 C : 0.08 H : 0.04 N : 0.08 O) C₃H₂NO₂ Allow symbols in any order TE on incorrect moles but the ratio must be a whole number and include C, H, N and O if no O, only M1, M2 and M3 can be awarded Ignore use of O₂ / O / N₂ / N in the 'words' Correct empirical formula with some working at each stage scores (5) but correct empirical formula with no working scores M5 only	(5)



Question Number	Acceptable Answers	Additional Guidance	Mark
10(b)	- molecular ion is at $m/z = 168$ or 168 is equal to the M_r of D / twice the empirical formula / 2×84 / $168 \div 2 = 84$ / M_r of empirical formula is 84 (1) (so the molecular formula is) $C_6H_4N_2O_4$ (1)	Allow 168 shown on spectrum along with the rest of the explanation Do not award M1 for any other value Stand alone mark Ignore structural / displayed / skeletal formula Do not award $C_6H_4N_2O_4^+$	(2)
Question Number	Acceptable Answers	Additional Guidance	Mark
10(c)(i)	$C_6H_4^+$	Allow $H_4C_6^+$ Do not award just C_6H_4	(1)

Question Number	Acceptable Answers	Additional Guidance	Mark
10(c)(ii)	3 correct formulae (2)	<u>Examples of formulae</u>  Allow (1) for any 2 correct formulae Allow (2) for three disubstituted benzenes with incorrect substituents / (1) for any two disubstituted benzenes with incorrect substituents Allow incorrectly displayed formulae of NO₂ groups In (c)(ii) and (iii): Allow Kekule structures Allow hydrogen atoms shown on benzene Ignore connectivity of NO₂ groups Penalise missing circle in benzene once only	(2)

Question Number	Acceptable Answers	Additional Guidance	Mark
10(c)(iii)	D identified as 1,3-dinitrobenzene and 4 different carbon environments labelled (1) 3 different carbon environments labelled on 1,2-dinitrobenzene (1) 2 different carbon environments labelled on 1,4-dinitrobenzene (1)	<u>Examples of identification</u>  These labels may be shown on the structures in (c)(ii) The identification of D can be assumed if it is the only structure with 4 carbon environments labelled Allow any form of identification of the carbon environments e.g. numbers, letters, equivalent carbon environments circled TE on disubstituted benzene substituents in (ii) Penalise only half the carbon environments labelled once only	(3)

(Total for Question 10 = 16 marks)