

OCR A-Level Chemistry A

Enthalpy changes

Questions only

The newest questions, about an hour. All 16 are in the exam generator.

Questions

9

Total marks

42

Time allowed

57 min

Name

Class or teacher

Date

Instructions

- Answer all questions in the spaces provided.
- Use black ink. Show your working for every calculation.
- You may use a scientific calculator and the OCR Data Sheet.
- Print the separate mark scheme when you are ready to mark your answers.

For marking

Q	Source	Marks	Score
1	2019 P1 Q10	1	
2	2022 P1 Q7	1	
3	2024 P1 Q7	1	
4	2024 P3 Q2	14	
5	2025 P1 Q17	16	
6	2025 P1 Q6	1	
7	2025 P3 Q6	6	
8	2020 P1 Q6	1	
9	2021 P1 Q8	1	

Total _____ / 42 Percentage _____ %

Questions from OCR past papers, 2019–2025, reproduced for revision. Practise these topics online, with instant marking:

whiteboardchemistry.com/revision/exam-questions/ocr-a-level-chemistry/?topics=enthalpy-changes&len=0

Questions

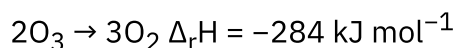
Enthalpy changes · 9 questions · 42 marks · time allowed 57 min

Q1 · June 2019 · Paper 1 (Periodic table, elements and physical chemistry) · Q10 · [1 mark]

This question also needs Alcohols and haloalkanes and Basic concepts of organic chemistry.

Radical reactions are responsible for the catalysed breakdown of the ozone layer.

The overall equation is shown below.



The molar gas volume in the ozone layer is approximately $2.5 \text{ m}^3 \text{ mol}^{-1}$.

What is the energy released, in kJ, during the breakdown of 1.0 m^3 of ozone in the ozone layer?

Tick (✓) one box.

☐ **A** 56.8

☐ **B** 113.6

☐ **C** 355

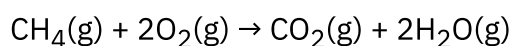
☐ **D** 710

Q2 · June 2022 · Paper 1 (Periodic table, elements and physical chemistry) · Q7 · [1 mark]

Bond enthalpies are shown in the table.

Bond	C–C	C–H	O–H	C–O	C=O	O–O	O=O
Bond enthalpy / kJ mol^{-1}	347	435	464	358	805	144	498

What is the enthalpy change, in kJ mol^{-1} , for the reaction below?



Tick (✓) one box.

☐ **A** -730

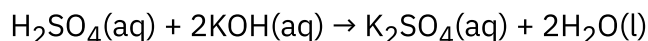
☐ **B** -544

☐ **C** +544

☐ **D** +730

Q3 · June 2024 · Paper 1 (Periodic table, elements and physical chemistry) · Q7 · [1 mark]

The equation for the reaction of sulfuric acid with potassium hydroxide is shown below.



25 cm³ of 1.00 mol dm⁻³ H₂SO₄ is reacted with excess KOH.

The energy given out is 2.8 kJ.

What is the enthalpy change of neutralisation, in kJ mol⁻¹?

Tick (✓) one box.

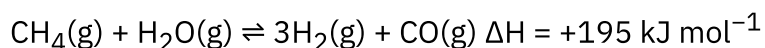
- ☐ **A** -56
- ☐ **B** -70
- ☐ **C** -112
- ☐ **D** -224

Q4 · June 2024 · Paper 3 (Unified chemistry) · Q2 · [14 marks]

This question also needs Amount of substance.

This question is about different areas of chemistry.

Hydrogen gas is manufactured by the chemical industry from the reversible reaction of methane and steam, shown below.



Average bond enthalpies are shown in the table.

Bond	H-H	O-H	C≡O
Average bond enthalpy / kJ mol ⁻¹	+436	+464	+1077

2(a)(i) Why do all average bond enthalpies have a positive value?

[1 mark]

2(a)(ii) Determine the C–H bond enthalpy, in kJ mol^{-1} , using the information above.

C–H bond enthalpy = kJ mol^{-1}

[3 marks]

2(a)(iii) Hydrogen gas is being considered as a household fuel to replace methane.

The enthalpy change of formation, $\Delta_f H$, for $\text{H}_2\text{O}(\text{l})$ is $-285.8 \text{ kJ mol}^{-1}$.

Determine the energy released when 60.0 m^3 of hydrogen is used as a household fuel at RTP.

Give your answer to **3** significant figures and in **standard form**.

energy released = kJ

[2 marks]

Compound A is a chloride of a Period 3 element.

A student carries out the 2 steps below to find the formula of compound A.

Step 1 The student adds 5.00×10^{-4} mol of compound A to water.

A colourless solution is formed.

Step 2 The colourless solution reacts with exactly 60.0 cm^3 of $2.50 \times 10^{-2} \text{ mol dm}^{-3} \text{ AgNO}_3(\text{aq})$ to form a white precipitate.

2(b)(i) Write an ionic equation, with state symbols, for the reaction in Step 2.

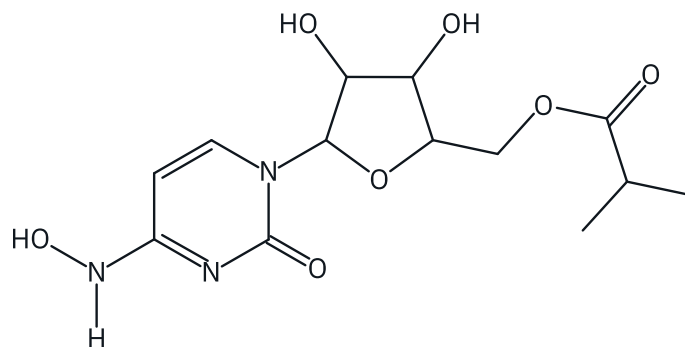
[1 mark]

2(b)(ii) Determine the formula of compound A.

formula of A =

[3 marks]

Compound B, shown below, is an antiviral medicine.



compound B

2(c)(i) What is the molecular formula of compound B?

[1 mark]

2(c)(ii) How many chiral carbon atoms are there in one molecule of compound B?

[1 mark]

2(c)(iii) A research chemist synthesises two related compounds, compound C and compound D, from compound B.

- In compound C, the N atoms in compound B had been replaced by P atoms.
- In compound D, the O atoms in compound B had been replaced by S atoms.

What is the difference between the relative molecular masses of compound C and compound D?

difference =

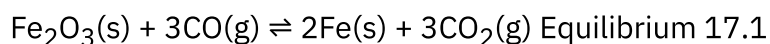
[2 marks]

Q5 · June 2025 · Paper 1 (Periodic table, elements and physical chemistry) · Q17 · [16 marks]

This question also needs Equilibrium constants K_c and K_p and Lattice enthalpy, entropy and free energy.

This question is about carbon monoxide and carbon as reducing agents in industry.

Iron(III) oxide, Fe_2O_3 , can be reduced by carbon monoxide to form iron.



Some standard enthalpy change of formation, $\Delta_f H^\ominus$, and standard entropy, $S^\ominus$, values are shown in the table.

Substance	$\text{Fe}_2\text{O}_3(\text{s})$	$\text{CO}(\text{g})$	$\text{Fe}(\text{s})$	$\text{CO}_2(\text{g})$
$\Delta_f H^\ominus / \text{kJ mol}^{-1}$	-824	-111	0	-394
$S^\ominus / \text{J K}^{-1} \text{mol}^{-1}$	87	198	To calculate in part (a)(iv)	214

17(a)(i) Explain why the standard enthalpy change of formation of Fe has a value of 0 kJ mol^{-1} .

[1 mark]

17(a)(ii) Calculate the enthalpy change, $\Delta_r H$, for the forward reaction in Equilibrium 17.1.

$\Delta H = \text{kJ mol}^{-1}$

[2 marks]

17(a)(iii) Explain why the standard entropy of CO_2 is greater than the standard entropy of Fe_2O_3 .

[2 marks]

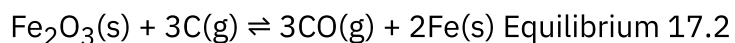
17(a)(iv) The standard entropy change, $\Delta S^\ominus$, for the forward reaction in Equilibrium 17.1 has a value of $+15 \text{ J K}^{-1} \text{ mol}^{-1}$.

Use data from the table to calculate the standard entropy, $S^\ominus$, of Fe.

$$S^\ominus = \text{J K}^{-1} \text{ mol}^{-1}$$

[2 marks]

17(b) Carbon can also reduce $\text{Fe}_2\text{O}_3(\text{s})$ to iron as shown in Equilibrium 17.2.



$$\Delta H = +491 \text{ kJ mol}^{-1}$$

$$\Delta S = +543 \text{ J K}^{-1} \text{ mol}^{-1}$$

The forward reaction is only feasible at high temperatures.

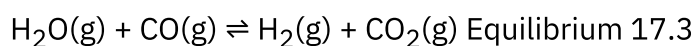
- Show that the forward reaction is **not** feasible at 100 °C.
- Calculate the minimum temperature, in K, for the forward reaction to be feasible.

Give the minimum temperature to the nearest whole number.

T = K

[3 marks]

Steam can be reduced by carbon monoxide in a reversible reaction.



$$\Delta H = -39.9 \text{ kJ mol}^{-1}$$

At 700 K the value of K_p is 8.13.

17(c)(i) Explain why K_p for Equilibrium 17.3 has no units.

[1 mark]

17(c)(ii) An equal number of moles of steam and carbon monoxide are left at 700 K in a sealed container until equilibrium is reached.

At equilibrium, both H_2 and CO_2 have a partial pressure of 211 kPa.

Calculate the partial pressures of H_2O and CO at equilibrium.

Partial pressure of H_2O = kPa

Partial pressure of CO = kPa

[3 marks]

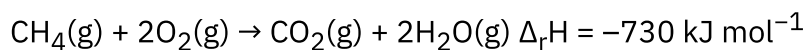
17(c)(iii) At a second temperature the value of K_p for Equilibrium 17.3 is 129.

Explain whether the second temperature is higher or lower than 700 K.

[2 marks]

Q6 · June 2025 · Paper 1 (Periodic table, elements and physical chemistry) · Q6 · [1 mark]

Methane reacts with oxygen as shown in the equation:



The table shows some bond enthalpies.

Bond	O–H	O=O	C=O
Bond enthalpy / kJ mol^{-1}	+464	+498	+805

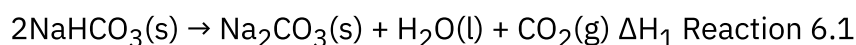
What is the bond enthalpy, in kJ mol^{-1} , of the C–H bond in methane?

Tick (✓) one box.

- ☐ **A** +109
- ☐ **B** +367
- ☐ **C** +435
- ☐ **D** +568

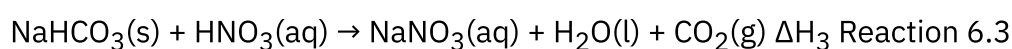
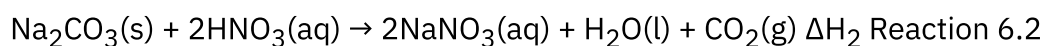
Q7 · June 2025 · Paper 3 (Unified chemistry) · Q6 · [6 marks]

6 The enthalpy change of Reaction 6.1, ΔH_1 , shown below, is difficult to measure directly by experiment.



The enthalpy changes of reaction for the reactions of Na_2CO_3 and NaHCO_3 with excess $\text{HNO}_3(\text{aq})$ can be measured by experiment.

The reactions are shown below as Reaction 6.2 and Reaction 6.3.



A student reacts $\text{Na}_2\text{CO}_3(\text{s})$ with $\text{HNO}_3(\text{aq})$ to find ΔH_2 for Reaction 6.2.

Student's method

Weigh a bottle containing $\text{Na}_2\text{CO}_3(\text{s})$ and weigh a polystyrene cup.

Add about 30 cm^3 of $1.00 \text{ mol dm}^{-3} \text{ HNO}_3(\text{aq})$ to the polystyrene cup and measure its temperature.

Add the $\text{Na}_2\text{CO}_3(\text{s})$, stir the mixture, and measure the maximum temperature reached.

Weigh the empty bottle and weigh the polystyrene cup with the final solution.

Mass readings

Mass of bottle + $\text{Na}_2\text{CO}_3(\text{s})$ / g	3.26
Mass of empty bottle / g	1.29
Mass of polystyrene cup / g	21.08
Mass of polystyrene cup + final solution / g	54.58

Temperature readings

Initial temperature of $\text{HNO}_3(\text{aq})$ / °C	20.0
Maximum temperature of final solution / °C	24.0

The student follows a similar method and reacts $\text{NaHCO}_3(\text{s})$ with $\text{HNO}_3(\text{aq})$ to find ΔH_3 for Reaction 6.3.

The student calculates ΔH_3 for Reaction 6.3 as $+19.8 \text{ kJ mol}^{-1}$.

Calculate ΔH_2 for Reaction 6.2 and determine the enthalpy change of Reaction 6.1, ΔH_1 .

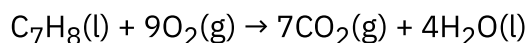
Assume that the density and specific heat capacity, c , of the final solution are the same as for water.

Show your working, including an energy cycle linking the enthalpy changes.

[6 marks]

Q8 · November 2020 · Paper 1 (Periodic table, elements and physical chemistry) · Q6 · [1 mark]

The equation for the combustion of C_7H_8 is shown in the following equation.



Enthalpy changes of formation are shown in the table.

Substance	$C_7H_8(l)$	$CO_2(g)$	$H_2O(l)$
$\Delta_f H / \text{kJ mol}^{-1}$	+12	-394	-286

Calculate the enthalpy of combustion, in kJ mol^{-1} , for the hydrocarbon C_7H_8 .

Tick (✓) one box.

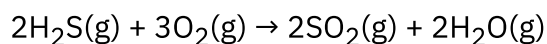
- ☐ **A** -3914
- ☐ **B** -692
- ☐ **C** +692
- ☐ **D** +3914

Q9 · November 2021 · Paper 1 (Periodic table, elements and physical chemistry) · Q8 · [1 mark]

Bond enthalpies are given in the table.

Bond	H-S	O=O	S=O	O-H
Bond enthalpy / kJ mol^{-1}	+346	+498	+531	+464

What is the enthalpy change, in kJ mol^{-1} , for the reaction below?



Tick (✓) one box.

- ☐ **A** -174
- ☐ **B** -1102
- ☐ **C** -1794
- ☐ **D** -2098

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Mark scheme:

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