Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Physical

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Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Q1.

Methanol is formed when carbon dioxide and hydrogen react.

$$CO_2(g) + 3\ H_2(g) \rightleftharpoons CH_3OH(g) + H_2O(g)$$

The table contains enthalpy of formation and entropy data for these substances.

	$CO_2(g)$	**$H_2(g)$**	**$CH_3OH(g)$**	**$H_2O(g)$**
$\Delta_f H$ / kJ mol^{-1}	–394	0	–201	–242
S / J K^{-1} mol^{-1}	214	131	238	189

(a) Use the equation and the data in the table above to calculate the Gibbs free-energy change (ΔG), in kJ mol^{-1}, for this reaction at 890 K

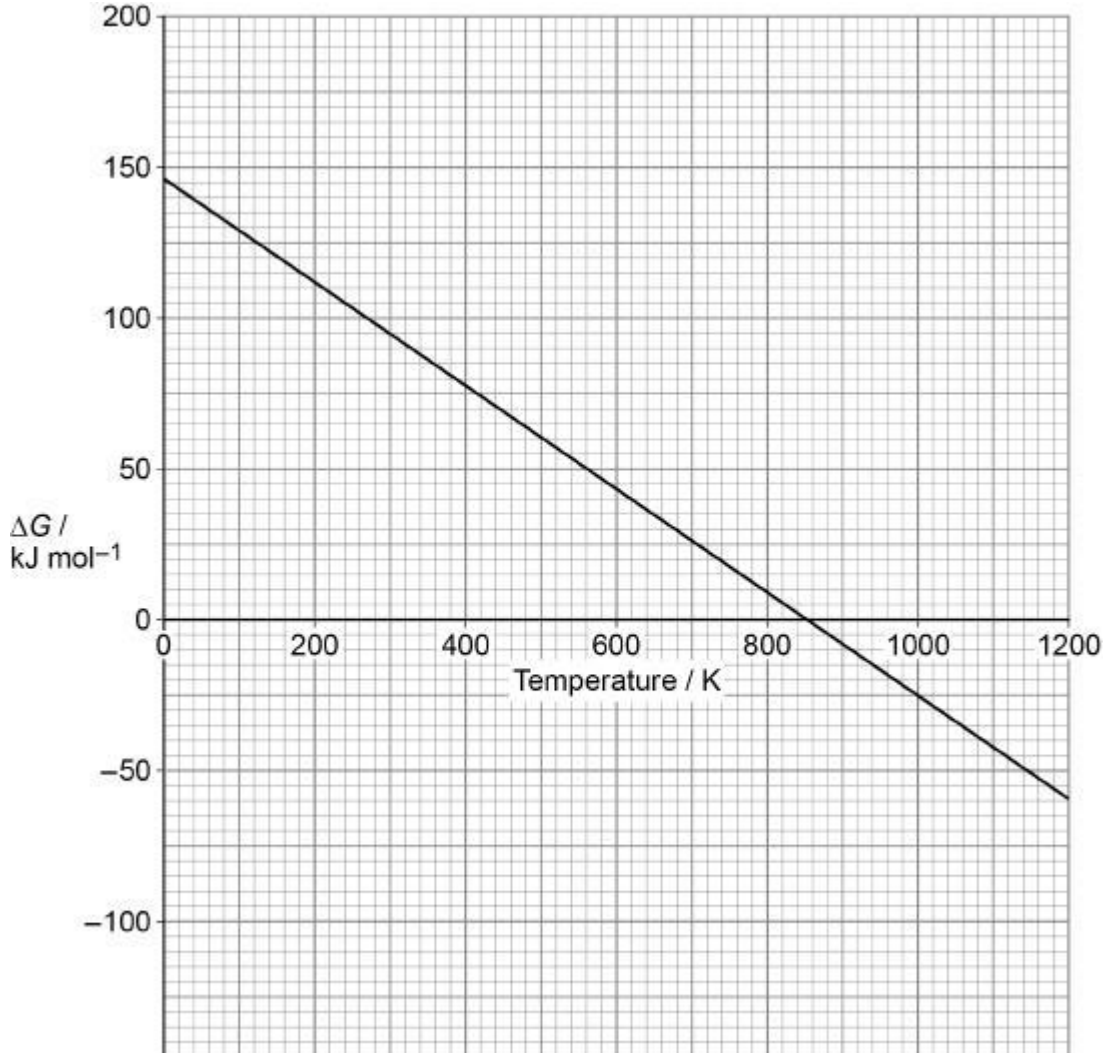
ΔG _____ kJ mol^{-1}

(6)

The graph below shows how the Gibbs free-energy change varies with temperature in a different gas phase reaction.

The straight line graph for this gas phase reaction has been extrapolated to zero Kelvin.

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(b) Use the values of the intercept and gradient from the graph to calculate the enthalpy change (ΔH), in kJ mol^{-1}, and the entropy change (ΔS), in J K^{-1} mol^{-1}, for this reaction.

ΔH _____ kJ mol^{-1}

ΔS _____ J K^{-1} mol^{-1}

(4)

(c) State what the graph above shows about the feasibility of the reaction.

_____

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(1)

(Total 11 marks)

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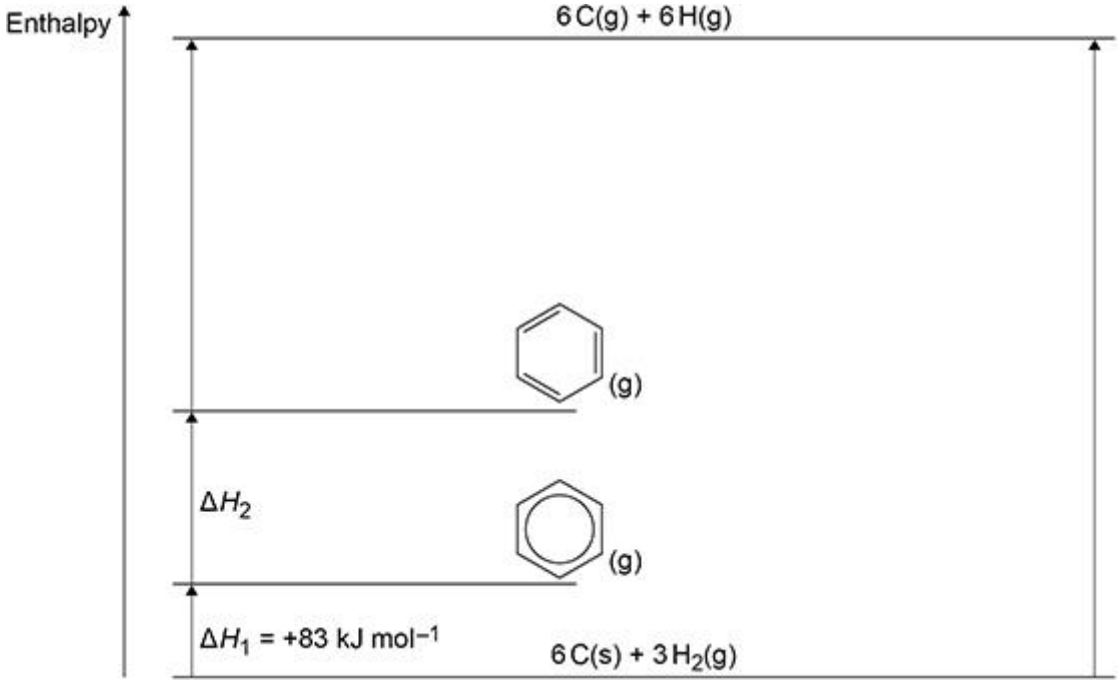
Q2.

Kekulé suggested this structure for benzene. 

Benzene is now represented by this structure. 

Figure 1 shows the relative stability of  compared to .

Figure 1



(a) Use **Figure 1** and the data shown in the table below to calculate ΔH_2

	ΔH / kJ mol^{-1}
Enthalpy of atomisation for carbon	+715
Enthalpy of atomisation for hydrogen	+218
Bond enthalpy (C–C)	+348
Bond enthalpy (C=C)	+612
Bond enthalpy (C–H)	+412

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ΔH_2 _____ kJ mol^{-1}

(3)

(b) Explain, in terms of structure and bonding, why 

is more thermodynamically stable than 

_____

_____

_____

(1)

(c) A mixture of concentrated nitric acid and concentrated sulfuric acid reacts with benzene.

Figure 2 shows the incomplete mechanism for this reaction.

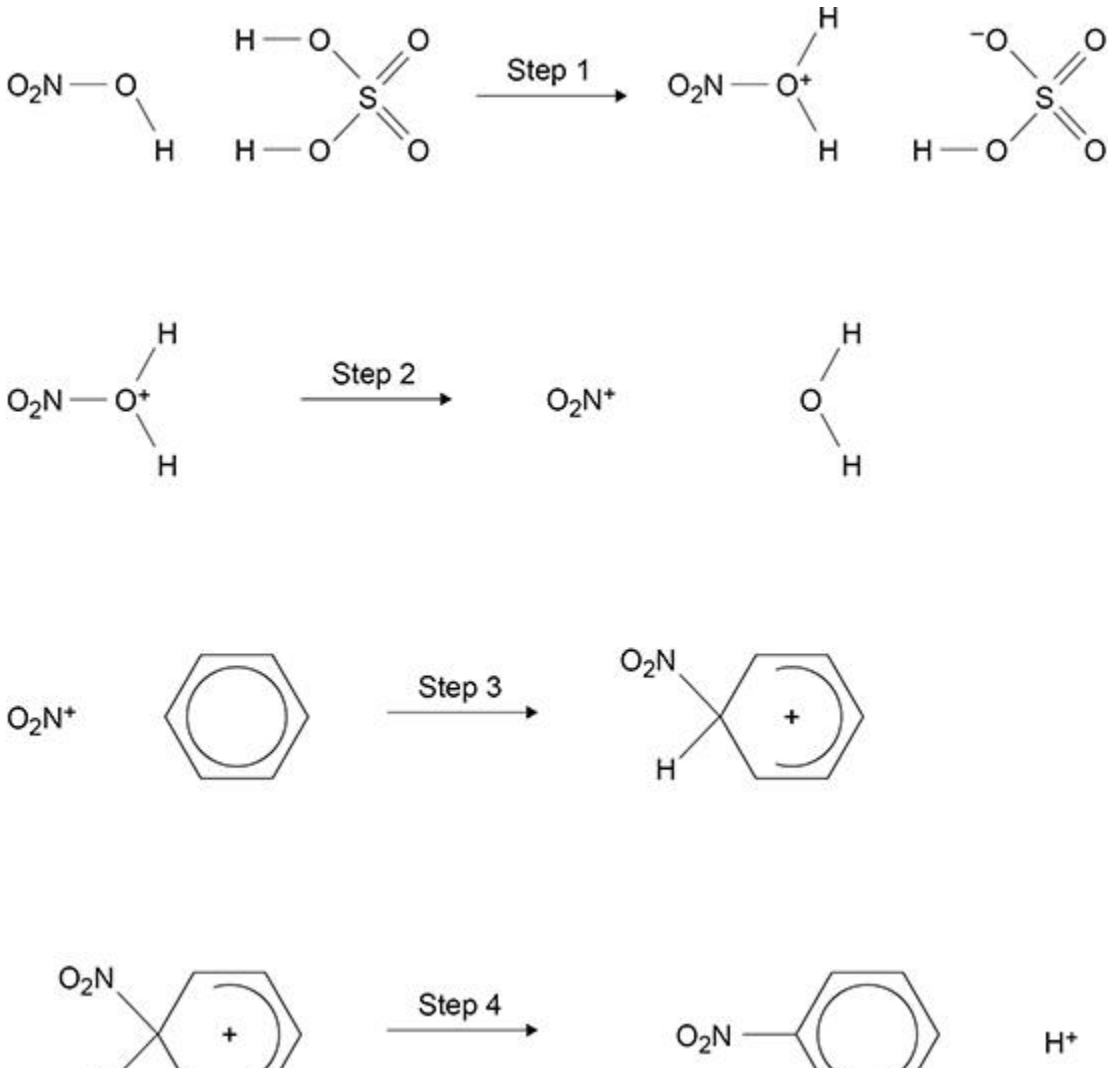
Name the mechanism.

Complete the mechanism in **Figure 2** by adding
- any lone pairs of electrons involved in each step
- **two** curly arrows in step **1**
- a curly arrow in step **2**
- a curly arrow in step **3**
- a curly arrow in step **4**.

Name of mechanism _____

Figure 2

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(5)

(Total 9 marks)

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