Practice Question Set For A-Level
Subject : Chemistry
Paper-1 Topic: Physical 1

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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

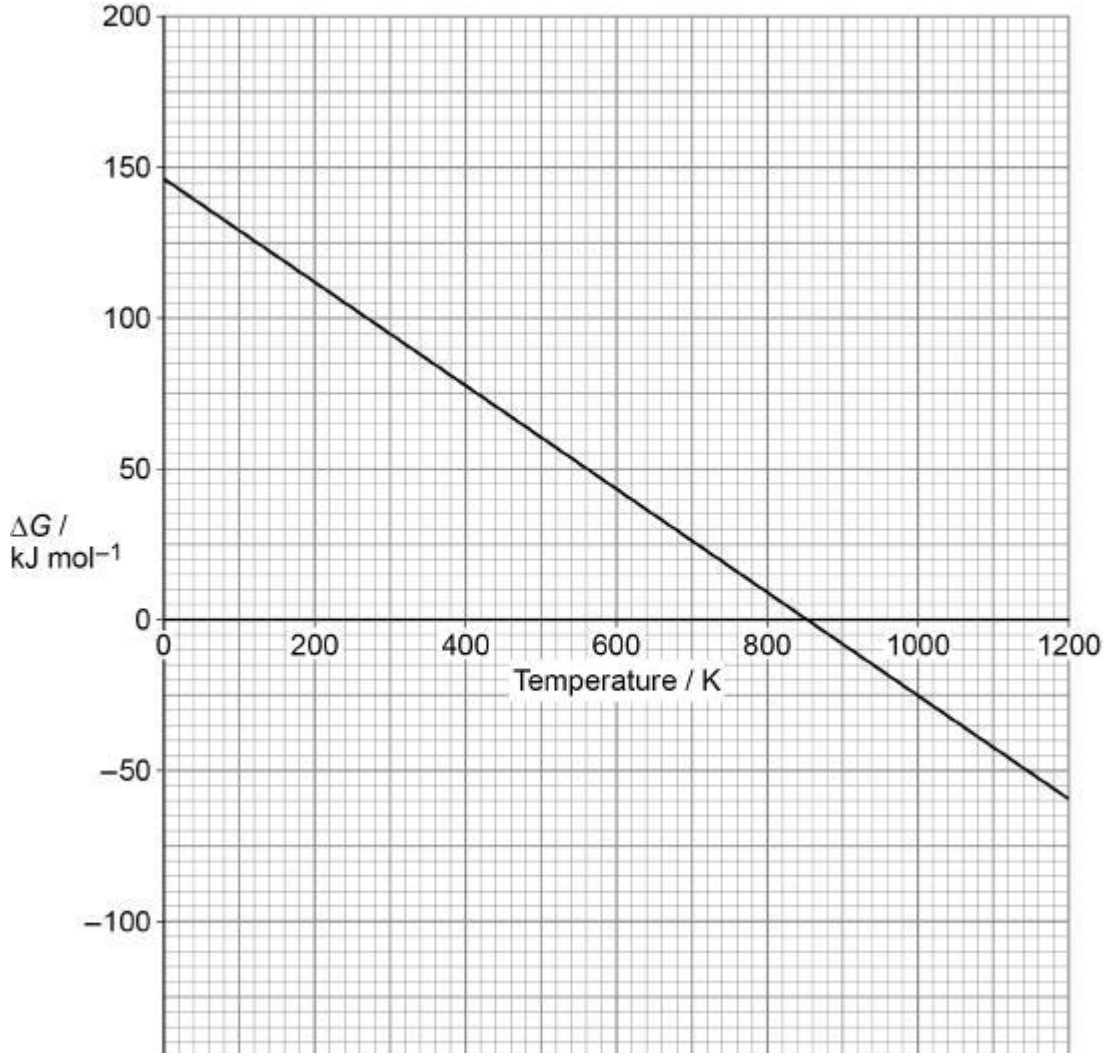
(a) Use the equation and the data in the table above to calculate the Gibbs free-energy change (ΔG), in kJ mol^{-1}, for this reaction at 890 K

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.



(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.

_____

_____

_____

(1)

(Total 11 marks)

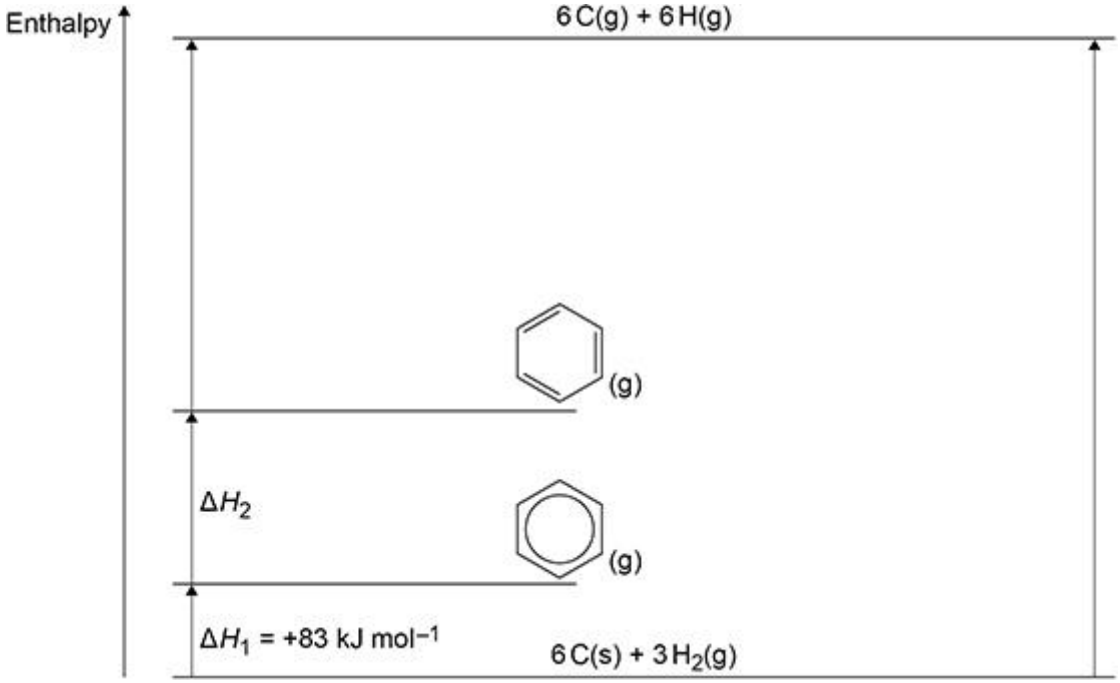
Q2.

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

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.

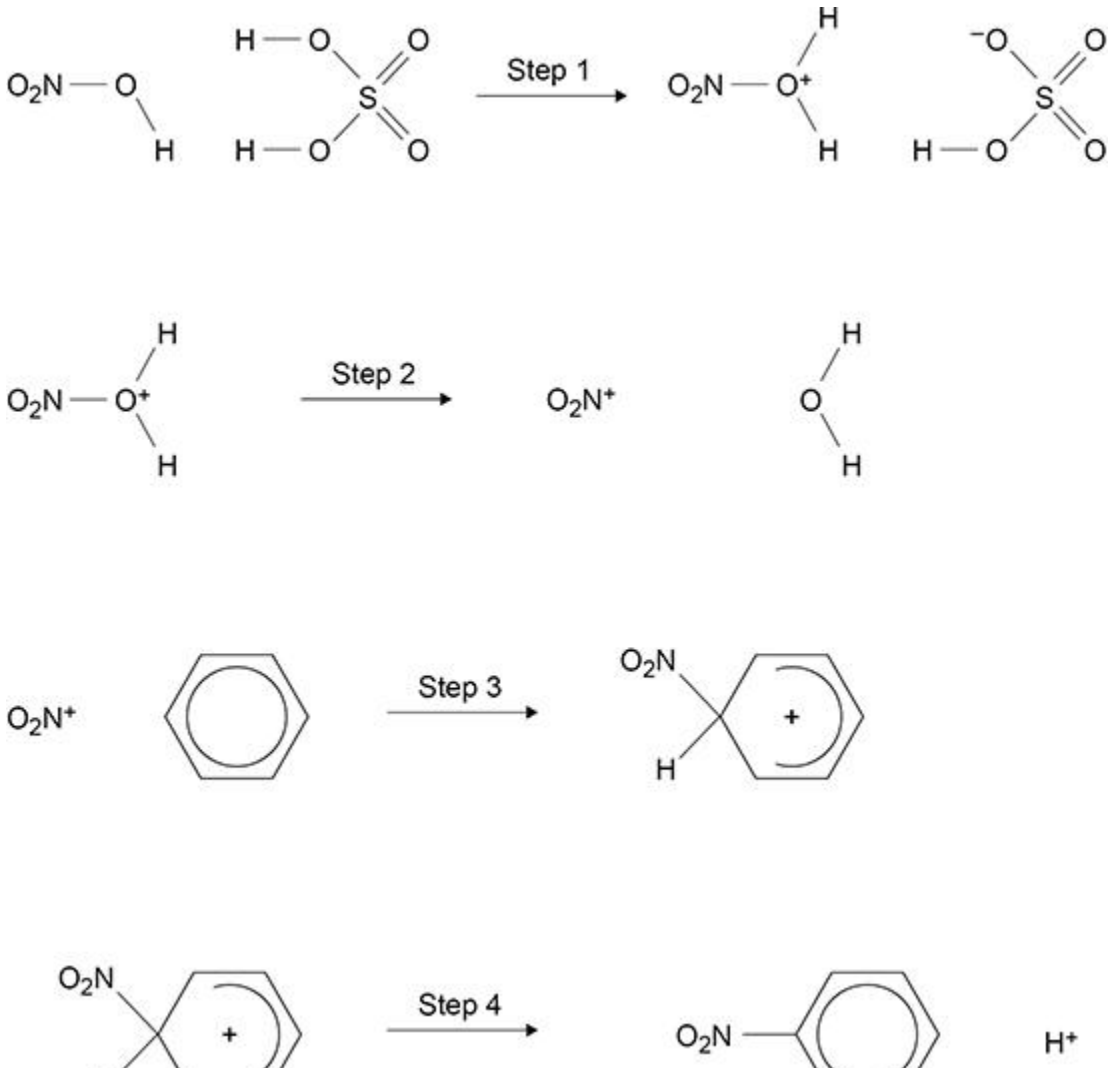
Figure 2 shows the incomplete mechanism for this reaction.

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



(5)

(Total 9 marks)