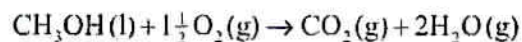


#3

SECTION A

Answer all questions. Write your answers in the boxes provided.

1. Methanol is made in large quantities as it is used in the production of polymers and in fuels. The enthalpy of combustion of methanol can be determined theoretically or experimentally.



	CH ₃ OH(l)	O ₂ (g)	CO ₂ (g)	H ₂ O(g)
Standard enthalpy of formation, $\Delta H_f^\ominus / \text{kJ mol}^{-1}$	-239	0	-394	-242
Entropy, $S^\ominus / \text{J K}^{-1} \text{mol}^{-1}$	240	205	214	189

HL

- (a) Using the information from the table above, determine the theoretical enthalpy of combustion of methanol. [2]

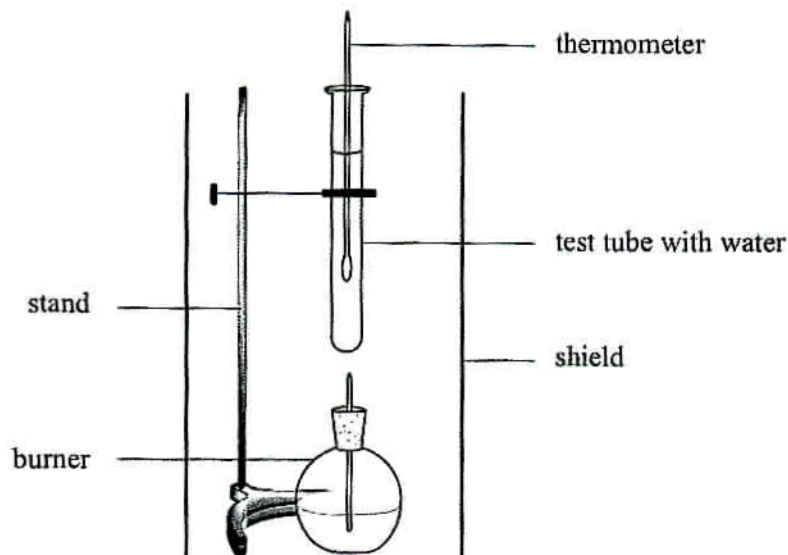
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(Question 1 continued)

- (b) The enthalpy of combustion of methanol can also be determined experimentally in a school laboratory. A burner containing methanol was weighed and used to heat water in a test tube as illustrated below.



The following data were collected.

Initial mass of burner and methanol / g	80.557
Final mass of burner and methanol / g	80.034
Mass of water in test tube / g	20.000
Initial temperature of water / °C	21.5
Final temperature of water / °C	26.4

- (i) Calculate the amount, in mol, of methanol burned. [2]

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(This question continues on the following page)



(Question 1 continued)

(ii) Calculate the heat absorbed, in kJ, by the water. [3]

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(iii) Determine the enthalpy change, in kJ mol^{-1} , for the combustion of methanol. [2]

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(c) The Data Booklet value for the enthalpy of combustion of methanol is -726 kJ mol^{-1} . Suggest why this value differs from the values calculated in parts (a) and (b).

(i) Part (a) [1]

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(ii) Part (b) [1]

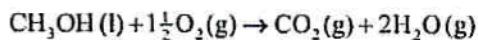
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HL

(d) Determine the ΔS^\ominus for the combustion of methanol.

[2]



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(e) Using the enthalpy of combustion for methanol from Table 12 of the Data Booklet and the ΔS^\ominus determined in part (d), calculate the standard free energy change for the combustion of methanol.

$= -726 \text{ kJ mol}^{-1}$

[3]

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HL

(f) Explain whether changing the temperature will alter the spontaneity of the reaction.

[1]

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