

Name of the Student: _____

Max. Marks : 19 Marks

Time : 19 Minutes

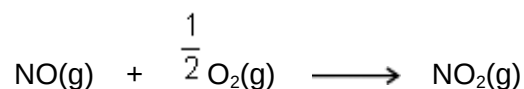
Q1.

The oxides nitrogen monoxide (NO) and nitrogen dioxide (NO₂) both contribute to atmospheric pollution.

The table gives some data for these oxides and for oxygen.

	$S^\ominus / \text{JK}^{-1} \text{mol}^{-1}$	$\Delta H_f^\ominus / \text{kJ mol}^{-1}$
O ₂ (g)	211	0
NO(g)	205	+90
NO ₂ (g)	240	+34

Nitrogen monoxide is formed in internal combustion engines. When nitrogen monoxide comes into contact with air, it reacts with oxygen to form nitrogen dioxide.



- (a) Calculate the enthalpy change for this reaction.

(2)

- (b) Calculate the entropy change for this reaction.

(2)

- (c) Calculate the temperature below which this reaction is spontaneous.

(2)

- (d) Suggest **one** reason why nitrogen dioxide is **not** formed by this reaction in an internal combustion engine.

(1)

- (e) Write an equation to show how nitrogen monoxide is formed in an internal combustion engine.

(1)

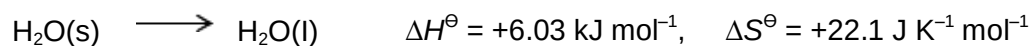
- (f) Use your equation from part (e) to explain why the free-energy change for the reaction to form nitrogen monoxide stays approximately constant at different temperatures.

(2)

(Total 10 marks)

Q2.

Consider the following process that represents the melting of ice.



- (a) State the meaning of the symbol $^\ominus$ in $\Delta H^\ominus$.

(1)

- (b) Use your knowledge of bonding to explain why $\Delta H^\ominus$ is positive for this process.

(2)

- (c) Calculate the temperature at which $\Delta G^\ominus = 0$ for this process. Show your working.

(3)

- (d) The freezing of water is an exothermic process. Give **one** reason why the temperature of a sample of water can stay at a constant value of 0 °C when it freezes.

(1)

- (e) Pure ice can look pale blue when illuminated by white light. Suggest an explanation for this observation.

(2)

(Total 9 marks)