15.2 Entropy & Spontaneity

Question Paper

Course	DP IB Chemistry
Section	15. Energetics/Thermochemistry (HL only)
Topic	15.2 Entropy & Spontaneity
Difficulty	Hard

Time allowed: 10

Score: /5

Percentage: /100

Question 1

Which row correctly describes a reaction that only occurs spontaneously at a low temperature?

	Reaction	$\Delta H_{reaction}$
A.	$X(g) + Y(g) \rightarrow Z(g)$	exothermic
B.	$R(s) \rightarrow T(g) + U(g)$	endothermic
C.	$E(g) \rightarrow 3F(g)$	endothermic
D.	$M(g) + 2N(g) \rightarrow P(g) + Q(g)$	endothermic

[1 mark]

Question 2

Urea reacts with water to produce carbon dioxide and ammonia via the following reaction

$$CO(NH_2)_2(aq) + H_2O(l) \rightarrow CO_2(g) + 2NH_3(g) \qquad \Delta H = 133\ kJ\ mol^{-1}$$

Thermodynamic data for the components of this reaction are

Substance	$CO(NH_2)_2(aq)$	$H_2O(l)$	$CO_2(g)$	$NH_3(g)$
$S^{\ominus}$ $(J\ K^{-1}\ mol^{-1})$	105	70	214	192

At which of the following temperatures will this reaction become feasible?

A. $\frac{133}{[214 + (2 \times 192)] - (105 + 70)}$

B. $\frac{[214 + (2 \times 192)] - (105 + 70)}{133}$

C. $133 - \frac{[214 + (2 \times 192)] - (105 + 70)}{1000}$

D. $\frac{133 \times 1000}{[214 + (2 \times 192)] - (105 + 70)}$

[1 mark]

Question 3

Which reaction occurs with the largest increase in entropy?

A. $Pb(NO_3)_2(s) + 2KI(s) \rightarrow PbI_2(s) + 2KNO_3(s)$

B. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

C. $3H_2(g) + N_2(g) \rightarrow 2NH_3(g)$

D. $H_2(g) + I_2(g) \rightarrow 2HI(g)$

[1 mark]

Question 4

Which is correct for the reaction $H_2O\,(g) \rightarrow H_2O\,(l)$?

A. Enthalpy increases and entropy increases.

B. Enthalpy decreases and entropy increases.

C. Enthalpy increases and entropy decreases.

D. Enthalpy decreases and entropy decreases.

[1 mark]

Question 5

Which factors will increase the entropy of this system?

$$CaCO_3\,(s) \rightleftharpoons CaO\,(s) + CO_2\,(g)$$

I. Increasing the temperature without changing the volume of the container.

II. Decreasing the concentration of the gas without changing the volume of the container.

III. Increasing the pressure without changing the volume of the container.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

[1 mark]