

1 The value of E_{cell} indicates whether the cell reaction is thermodynamically feasible. Which of the following is a correct statement about E_{cell} ?

- A E_{cell} is directly proportional to the equilibrium constant.
- B E_{cell} is directly proportional to the entropy change of the system, ΔS_{system} .
- C E_{cell} is directly proportional to the total entropy change, ΔS_{total} .
- D The value of $\ln E_{\text{cell}}$ is directly proportional to the total entropy change, ΔS_{total} .

(Total for Question = 1 mark)

2 The enthalpy changes of the reactions below are similar. The equilibrium constants for the two reactions are K_1 and K_2 respectively.

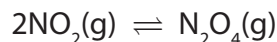


The value of K_1 is greater than K_2 because

- A ΔS_{system} is much more positive in Reaction 1.
- B $\Delta S_{\text{surroundings}}$ is much more positive in Reaction 1.
- C the EDTA^{4-} is more highly charged than Cl^{-} .
- D a lower concentration of EDTA^{4-} is needed than Cl^{-} .

(Total for Question = 1 mark)

3 For the reaction



at 450 K the total entropy change, ΔS_{total} , is negative. Hence the equilibrium constant, K_p , for this reaction at 450 K is

- A zero.
- B positive and greater than 1.
- C positive and less than 1.
- D negative.

(Total for Question = 1 mark)

4 The overall equation for a reaction between two chemicals, M and N, is

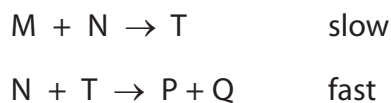


(a) This reaction occurs spontaneously at room temperature. Which of the following **must** be true?

(1)

- A $\Delta H_{\text{reaction}}^{\ominus}$ is positive.
- B $\Delta H_{\text{reaction}}^{\ominus}$ is negative.
- C $\Delta S_{\text{total}}^{\ominus}$ is positive.
- D $\Delta S_{\text{total}}^{\ominus}$ is negative.

(b) The reaction above occurs in two stages via an intermediate, T.



From this it can be deduced that the rate equation for the reaction between M and N is

(1)

- A rate = $k[M][N]$
- B rate = $k[M][N]^2$
- C rate = $k[M][T]$
- D rate = $k[N][T]$

(Total for Question = 2 marks)

- 5 Calcium carbonate decomposes at high temperature to form calcium oxide and carbon dioxide:



Calcium carbonate is **thermodynamically** stable at room temperature because for this reaction

- A the activation energy is high.
- B the enthalpy change, ΔH , is positive.
- C entropy change of the system (ΔS_{system}) is positive.
- D entropy change of the system (ΔS_{system}) is negative.

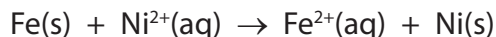
(Total for Question = 1 mark)

- 6 2-methylpropane has a smaller standard molar entropy at 298 K than butane. The best explanation for this is that 2-methylpropane has

- A a lower boiling temperature.
- B a higher standard molar enthalpy change of formation.
- C fewer ways of distributing energy quanta.
- D more ways of distributing energy quanta.

(Total for Question = 1 mark)

- 7 The equation for the reaction of iron and nickel(II) ions in aqueous solution is

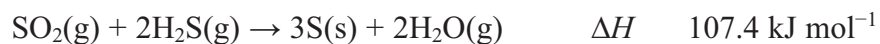


Under standard conditions the value of the equilibrium constant, K_c , for this reaction is greater than 1. Hence, for this reaction,

- A $\Delta S_{\text{total}}^{\ominus}$ and $E_{\text{reaction}}^{\ominus}$ are both positive.
- B $\Delta S_{\text{total}}^{\ominus}$ is positive and $E_{\text{reaction}}^{\ominus}$ is negative.
- C $\Delta S_{\text{total}}^{\ominus}$ is negative and $E_{\text{reaction}}^{\ominus}$ is positive.
- D $\Delta S_{\text{total}}^{\ominus}$ and $E_{\text{reaction}}^{\ominus}$ are both negative.

(Total for Question = 1 mark)

- 8 The reaction below is carried out at 25 °C. Use the equation and the data to answer the questions that follow.



Substance	Standard molar entropy, S^\ominus / $\text{J mol}^{-1} \text{K}^{-1}$
$\text{SO}_2(\text{g})$	248
$\text{H}_2\text{S}(\text{g})$	206
$\text{H}_2\text{O}(\text{g})$	189
$\text{S}(\text{s})$	32

- (a) The standard entropy change of the system, in $\text{J mol}^{-1} \text{K}^{-1}$, is (1)

- A 186
 B +186
 C 233
 D +233

- (b) The standard entropy change of the surroundings, in $\text{J mol}^{-1} \text{K}^{-1}$, is (1)

- A $107.4 \times 1000 / 25$
 B $107.4 \times 1000 / 25$
 C $107.4 \times 1000 / 298$
 D $107.4 \times 1000 / 298$

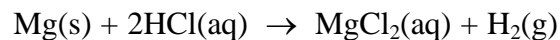
(Total for Question 2 marks)

9 A decrease in the entropy of the system, ΔS_{system} , occurs when

- A water freezes.
- B water boils.
- C water reacts with sodium.
- D water reacts with ethanoyl chloride.

(Total for Question 1 mark)

10 Which of the following is true for the exothermic reaction shown below?



- A ΔH positive
- B $\Delta S_{\text{surroundings}}$ positive
- C ΔS_{system} negative
- D ΔS_{total} negative

(Total for Question = 1 mark)

11 Which of these solid substances is likely to have the greatest standard entropy? Use of the data booklet is not required.

- A SnO
- B SnO₂
- C SnBr₂
- D SnBr₄

(Total for Question 1 mark)

12 Which reaction has the most positive entropy change for the system, ΔS_{system} ?

- A $\text{NaOH(aq)} + \text{HCl(aq)} \rightarrow \text{NaCl(aq)} + \text{H}_2\text{O(l)}$
- B $\text{AgNO}_3\text{(aq)} + \text{NaCl(aq)} \rightarrow \text{AgCl(s)} + \text{NaNO}_3\text{(aq)}$
- C $\text{C}_2\text{H}_4\text{(g)} + \text{HCl(g)} \rightarrow \text{C}_2\text{H}_5\text{Cl(l)}$
- D $\text{C}_4\text{H}_{10}\text{(g)} \rightarrow \text{C}_2\text{H}_4\text{(g)} + \text{C}_2\text{H}_6\text{(g)}$

(Total for Question 1 mark)

13 Barium carbonate decomposes in an endothermic reaction when heated to 1500 K.



What are the signs of the entropy changes at 1500 K?

		ΔS_{system}	$\Delta S_{\text{surroundings}}$
<input type="checkbox"/>	A	+	+
<input type="checkbox"/>	B	+	
<input type="checkbox"/>	C		+
<input type="checkbox"/>	D		

(Total for Question 1 mark)

14 When ammonium nitrate crystals dissolve in water, the entropy of the system

- A remains the same.
- B falls, because the hydrated ions are more ordered than the solid.
- C rises, because the ions in the crystal become hydrated in the solution.
- D rises, because the ions are arranged more randomly in the solution than in the crystal.

(Total for Question = 1 mark)