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CONSOLIDATION EXERCISES**SECTION A: TYPICAL EXAM QUESTIONS****Question 1: 15 minutes**

In order to investigate the rate at which a reaction proceeds, a learner places a beaker containing concentrated nitric acid on a sensitive balance. A few pieces of copper metal are dropped into the nitric acid. Mass readings of the beaker and its contents are recorded every 15 s, from the moment the copper metal is dropped into the acid until shortly after there is no more copper metal present.

The mass readings taken during the investigation are given in the table below. The time at which the copper is dropped into the acid is recorded as 0 seconds.

Time (s)	Mass of Beaker and contents (g)	Decrease in mass (g)
0	114,6	0
15	113,0	0,6
30	111,6	2,2
45	110,4	4,2
60	109,4	5,2
75	108,7	5,9
90	108,4	6,2
105	108,3	6,3
120	108,3	6,3
135	108,3	6,3
150	108,3	6,3

1.1 Which of the two physical quantities, time or mass, is the independent variable in this investigation. Explain your answer. (3)

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To investigate the factors which affect this equilibrium, the following experiments were performed:

Experiment 1: A small quantity of concentrated HCl is added to the solution.

2.1 Observation:..... (1)

Experiment 2: The test tube with the solution is cooled by immersing it in ice water.

2.2 Observation:..... (1)

Experiment 3: A few drops of silver nitrate are added to the solution.

2.3 Observation:..... (2)

- 2.4 Tabulate your observations: (3)
- 2.5 Name the effect that is illustrated in experiment 1. (1)
- 2.6 Was the forward or reverse reaction favoured as a result of the addition of the concentrated HCl? (1)
- 2.7 Use your observation in experiment 2 to state whether the forward reaction is exothermic or endothermic. (1)
- 2.8 Make use of Le Chatelier's principle to justify your answer in 2.7. (4)
- 2.9 In experiment 3, a white precipitate is formed when the silver nitrate is added.
- 2.9.1 Give the name of the white solid. (1)
- 2.9.2 Give the balanced chemical equation to explain the formation of the white precipitate. (3)
- 2.9.3 Explain how the addition of the silver nitrate affected the equilibrium. (3)

[21]

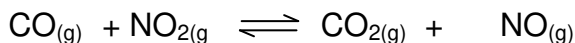
SECTION D: HOMEWORK

Question 1: 14 minutes (7 X 2 marks = 14 marks)

1.1 An iron nail reacts with a dilute solution of HCl. The rate of the reaction can be increased by:

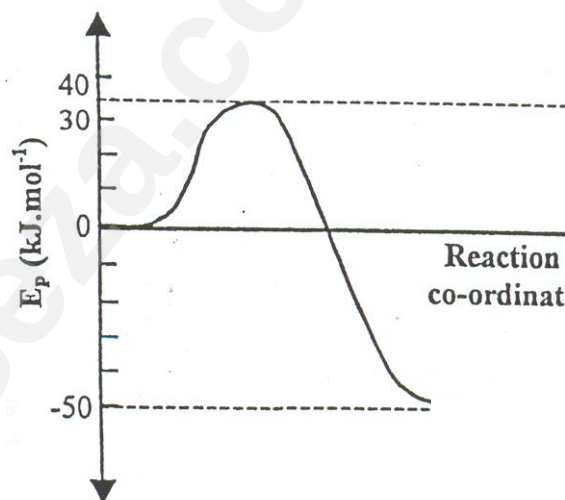
- A. lowering the temperature of the solution.
- B. increasing the pressure of the system.
- C. adding a small volume of water.
- D. adding a small volume of concentrated HCl.

1.2 This question refers to the accompanying graph, that represents the change in potential energy for the reaction:



The activation energy, in $\text{kJ}\cdot\text{mol}^{-1}$, for the reverse reaction is ...

- A. 35
- B. 50
- C. 85
- D. -50

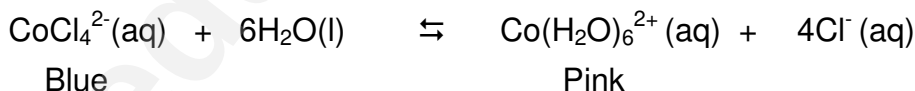


1.3 $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{H}_2\text{O}(\text{l}) \quad \Delta H = -285\text{kJ}$

How much energy is needed to decompose 5mol $\text{H}_2\text{O}(\text{l})$ into $\text{H}_2(\text{g})$ and $\text{O}_2(\text{g})$?

- A 285 kJ
- B 712,5 kJ
- C 570 kJ
- D 1425 KJ

1.4 Refer to the following equilibrium:

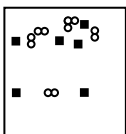


At equilibrium the colour of the solution is a pinkish-blue. A few drops of water are added to the equilibrium mixture. The colour of the solution

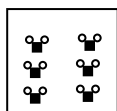
- A changes to blue
- B changes to pink
- C changes to blue then reverts to its original colour
- D remains unchanged

1.5 The equation for a reaction is: $2\text{S} + 3\text{O}_2 \rightarrow 2\text{SO}_3$

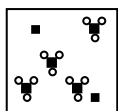
Consider a reaction mixture of S (■) and O₂ (⊖) in a closed container as illustrated below:



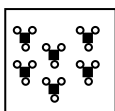
Which one of the following correctly represents the product?



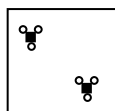
A



B



C

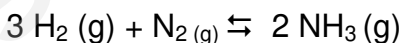


D

1.6 The best way to increase the rate of any reaction is to:

- A. increase the number of collisions between particles
- B. add an enzyme
- C. change the concentration of the products
- D. increase the size of the solid chunks

1.7 Which of the following methods of increasing the rate of a reaction is not applicable to the Haber process?



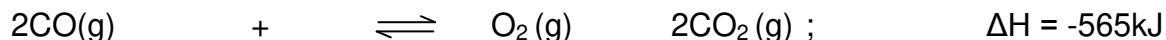
- A. increase the pressure
- B. increase the temperature
- C. increase the state of division
- D. add a catalyst

Question 2: 16 minutes (13 x 2 = 26 marks)

2.1 Lowering the temperature of an equilibrium reaction will:

- A. decrease the rate of the forward reaction only.
- B. decrease the rate of the reverse reaction only.
- C. decrease the rate of both the forward and reverse reactions.
- D. have no effect on the rate of reaction.

2.2 Assuming equilibrium is reached in the reaction:



A greater yield of carbon dioxide can be obtained by ...

- A. raising the temperature and pressure.
- B. raising the temperature and lowering the pressure.
- C. lowering the temperature and pressure.
- D. lowering the temperature and raising the pressure.

2.3 Carbon, carbon dioxide and carbon monoxide are in equilibrium in a container of which the volume can change. The balanced equation for the equilibrium reaction is as follows:



While the temperature is kept constant, the volume of the container is decreased and a new equilibrium is established. Which one of the following statements regarding the number of moles of CO and the concentration of CO at the new equilibrium condition is correct?

	Number of moles of CO	[CO]
(A)	the same	greater
(B)	Less	greater
(C)	Less	less
(D)	More	the same

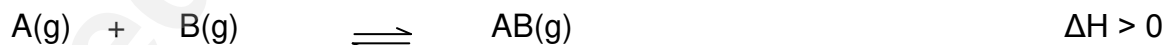
2.4 A saturated solution of NaCl in water is prepared at 60°C. The equation for this solubility equilibrium is:



Which one of the following changes will cause more NaCl_(s) to form?

- A. add H₂O.
- B. add a catalyst.
- C. increase temperature.
- D. decrease temperature.

2.5 Two substances, A and B, are in equilibrium with their product, AB, at a temperature of 10°C as indicated by the following equation:

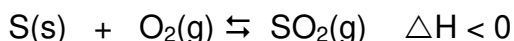


At 10°C the rate of the forward reaction is equal to $x \text{ mol}\cdot\text{s}^{-1}$.

The temperature is then increased. Which statement regarding the forward and reverse reaction rates is correct at the higher temperature?

	Forward rate	Reverse rate
(A)	equal to x	equal to x
(B)	less than x	less than x
(C)	greater than x	greater than x
(D)	less than x	greater than x
(E)	greater than x	less than x

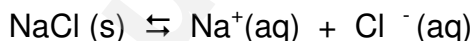
- 2.6. When an amount of sulphur and oxygen are sealed in a container at 700K, an equilibrium is established according to the following equation:



If the pressure is increased, while the temperature of 700K is maintained, the:

- A value of K_c increase
- B volume of the gases increase
- C amount of SO_2 decreases
- D amount of O_2 remains the same.

- 2.7. The following equilibrium exists in a saturated salt solution.



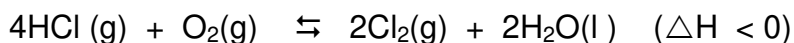
What can be done in order to obtain a precipitate of NaCl ?

- A Increase the pressure on the system
- B Heat the solution
- C Add concentrated Hydrochloric acid (HCl)
- D Bubble chlorine (Cl_2) through the solution.

- 2.8. In which of the following reactions will a *decrease* in pressure cause the yield of the product(s) to *increase*?

- A $2 \text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2 \text{SO}_3(\text{g})$
- B $2 \text{H}_2\text{O}(\text{g}) \rightleftharpoons 2 \text{H}_2(\text{g}) + \text{O}_2(\text{g})$
- C $2 \text{NO}_2(\text{g}) \rightleftharpoons \text{N}_2\text{O}_4(\text{g})$
- D $2 \text{HI}(\text{g}) \rightleftharpoons \text{H}_2(\text{g}) + \text{I}_2(\text{g})$

2.9. Consider the following system which is in equilibrium:



The yield of chlorine gas can best be *increased* by the following combination of changes in temperature and pressure:

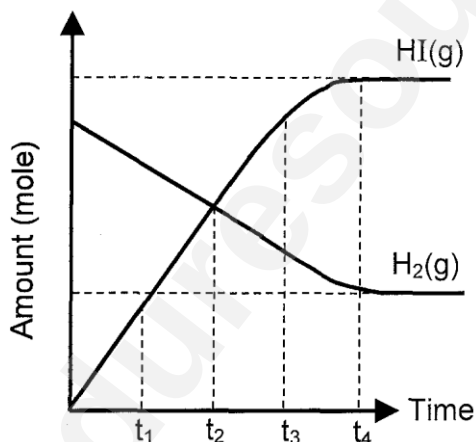
	Temperature	Pressure
A	Increase	Decrease
B	decrease	Decrease
C	decrease	Increase
D	increase	Increase

2.10. The following reversible reaction is used in the production of hydrogen iodide gas:

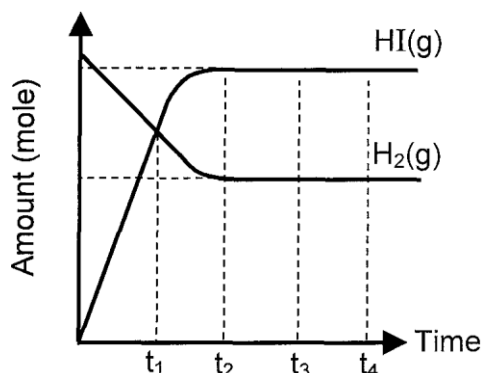


The graph X of amount of reagents against time was obtained when the reaction was carried out under certain conditions.

The graph Y was obtained for the same experiment using the same amount of $\text{H}_2\text{(g)}$, but certain changes were made to the conditions affecting the system.



GRAPH X

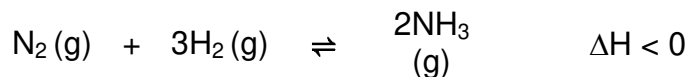


GRAPH Y

Which one of the following sets of changes could have been introduced to the system to obtain graph Y?

- A More $\text{I}_{2\text{(g)}}$ was added and the temperature was decreased.
- B The temperature and pressure was decreased.
- C A catalyst was added and the temperature was increased.
- D A catalyst was added and the temperature was decreased.

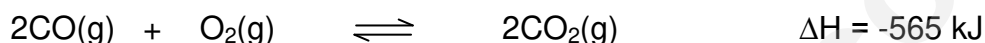
2.11. An equilibrium in a closed container is represented by the following equation:



Which one of the following actions will affect both the value of K_C and the concentration of ammonia present at equilibrium?

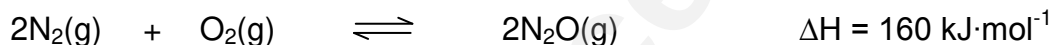
- A Adding a suitable catalyst
- B Reducing the temperature
- C Increasing the mass of nitrogen
- D Increasing the pressure at a constant temperature

2.12. Assuming equilibrium is reached in the reaction:



- A. A greater yield of carbon dioxide can be obtained by:
- B. raising the temperature and pressure.
- C. raising the temperature and lowering the pressure.
- D. lowering the temperature and the pressure.
- E. lowering the temperature and raising the pressure.

2.13. Consider the following equilibrium reaction:

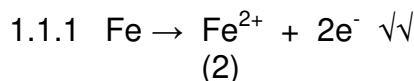


Which ONE of the following changes gives the greatest increase in the equilibrium yield of N_2O ?

	TEMPERATURE	PRESSURE
(A)	Decrease	Increase
(B)	Decrease	Decrease
(C)	Increase	Increase
(D)	Increase	Decrease

SECTION E: SOLUTIONS TO SESSION 26 HOMEWORK

Question 1:



1.1.2 Oxygen ✓ (1)

1.1.3 $E^\theta_{\text{cell}} = E^\theta_{\text{cathode}} - E^\theta_{\text{anode}}$ ✓
 $= 0,4 - (-0,44)$ ✓
 $E^\theta_{\text{cell}} = 0,84 \text{ V}$ ✓
 Because the emf is positive, the reaction is spontaneous. ✓ (5)

1.1.1 Mg is a stronger reducing agent ✓ than Fe and will be oxidised ✓
(2)

Or Mg loses electrons more easily than Fe and becomes oxidised.

Or Fe is a weaker reducing agent than Mg and will not be oxidised.

1.2.2 Electrolytes in the soil ✓✓ or salts dissolved ✓ in the moist soil. ✓
(2)

1.2.3 Mg is oxidised or becomes corroded or used up. ✓ (1)



- 1.2.5 Any two:
 • Paint ✓
 • Electroplating ✓
 • Oil or waterproofing
 • Galvanising
 • Plastic coating (2)

- 1.2.6 Advantage: ANY ONE:
 • Plastic is cheaper ✓
 • Does not rust

- Disadvantage: Any one:
 • Not degradable ✓
 • Not as strong as iron (2)