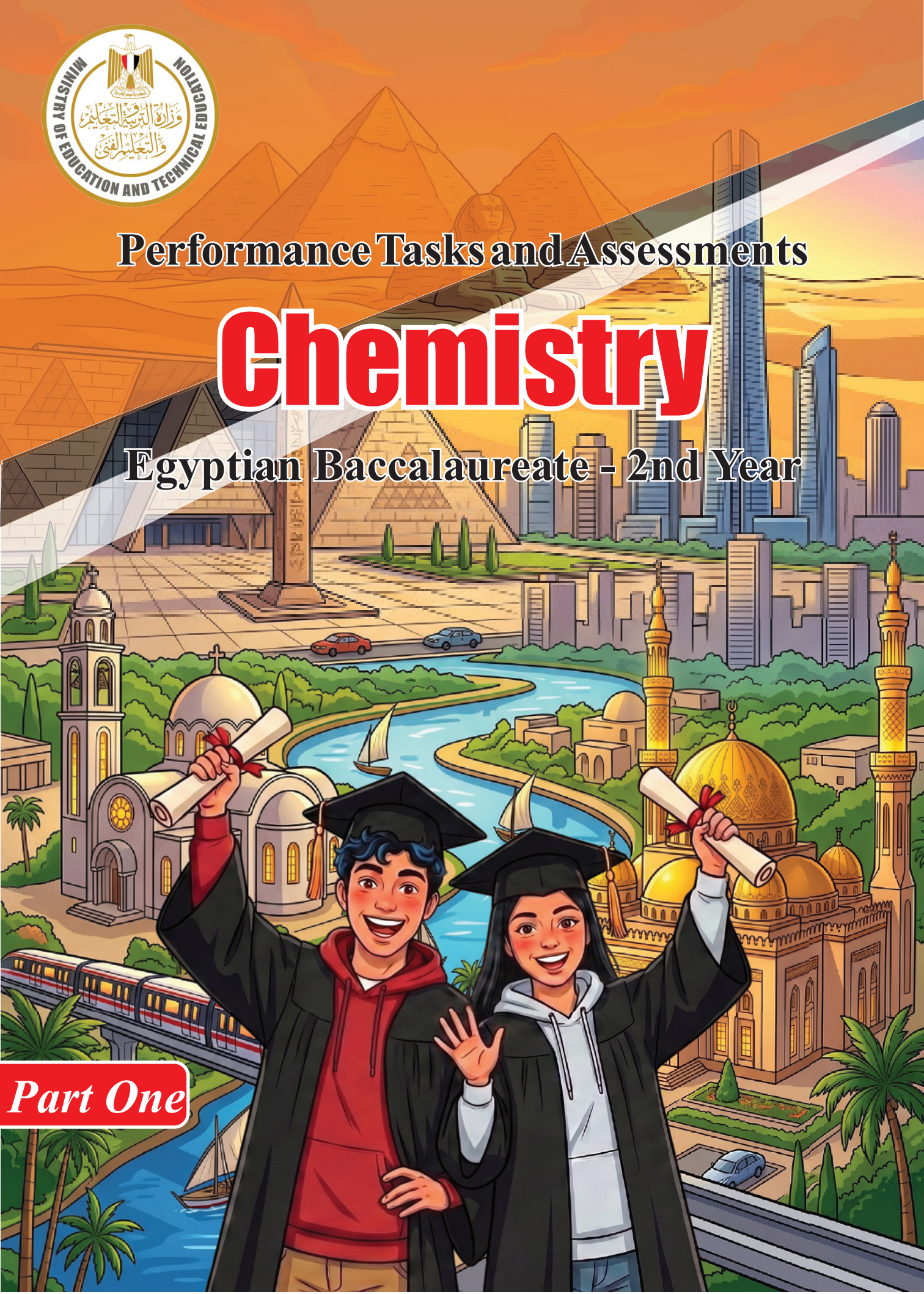
MINISTRY OF EDUCATION AND TECHNICAL EDUCATION

وزارة التربية والتعليم والتعليم الفني

Performance Tasks and Assessments

Chemistry

Egyptian Baccalaureate - 2nd Year



Part One

Introduction

The Ministry of Education and Technical Education recognizes the importance of empowering teachers with effective tools that elevate classroom performance, enhance the quality of education, and improve its outcomes. This is a real response to the voices of teachers, interacting with the feedback channels from the educational field, and meeting the needs of teachers for flexible and comprehensive educational tools that assist them in fulfilling their noble educational mission. This book has been designed to serve as an integrated educational support for teachers, helping them in planning and executing their teaching tasks efficiently. It also facilitates continuous assessment processes. The content has been designed to offer diverse models of effective classroom performance and educational activities created based on an interactive methodology that enhances active learning. It contributes to a qualitative shift in teaching practices, clearly focusing on the student as the core of the educational process. The book includes formative and diagnostic questions, as well as purposeful learning tasks that students can complete as homework, enhancing the integration of learning inside and outside the classroom and contributing to the sustainable construction of learning for students. These tools help develop critical and creative thinking, deepen understanding, and support and enhance student motivation, giving them a sense of achievement and excellence. It also includes short weekly tests and periodic assessments, allowing teachers to measure the extent of learning outcomes and address learning gaps early, providing feedback on the initial results. The performances at the end of each month are concluded with immediate training sessions that help improve student performance. These assessments are gradual, taking into account individual differences and targeting various levels of cognitive development, within a framework of diversity, depth, and integration, preparing students for monthly tests efficiently. This book is a true translation of the Ministry's directions to ease the burdens on parents, provide supporting educational content that enriches the classroom environment, and allow teachers more time for educational innovation and productive interaction with their students. It also forms an effective tool in supporting the Ministry's direction to enhance learning outcomes, achieving a real transformation in the learning environment—from memorization to understanding, from rote learning to application, and from passive reception to active participation. When we place this work in the hands of teachers and students, we hope it will be a valuable contribution to improving academic performance, enhancing the quality of education, and becoming an additional cornerstone in building a generation that is aware and knowledgeable, equipped with the skills and competencies needed for success in a world that demands creativity and innovation. It aims to have a tangible impact in realizing an ambitious educational vision for the future of education in our beloved country.

Allah is the one sought for help, and He guides to the right path...

Week (1)

First Period

Classwork

1- When 1 mol of ice at 0℃ is left in an open system, it is found to change into liquid water at 0℃.

Answer the following questions:

(a) Does the kinetic energy of the molecules increase? Why?

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(b) State the scientific name for the amount of heat energy absorbed from the surrounding medium.

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2- Which of the following choices expresses the amount of heat required to melt 9 g of ice at 0℃?

(Given that: heat of fusion of ice = 6.0 kJ/mol, molar mass of water = 18 g/mol)

(a) 6.0 kJ
(b) 3.0 kJ
(c) 12.0 kJ
(d) 9.0 kJ

Homework

1- Write the scientific explanation:

a- Using ice at 0℃ for cooling is better than using an equal amount of cold water at the same temperature 0℃.

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b- The temperature of a solid substance does not rise during the melting process, even though it absorbs an amount of heat.

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2- Which of the following expresses the amount of heat needed to completely convert a piece of ice with a mass of 50 g at 0℃ into liquid water at the same temperature? (Given that the heat of fusion of ice equals 0.334 kJ/g)

(a) 334 kJ
(b) 3.34 J
(c) 16.7 J
(d) 16.7 kJ

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Second Period

Classwork

1- Arrange the following compounds in ascending order according to their vapor pressure, with explanation: (water, ethanol, diethyl ether)

- Given that their boiling points are respectively (100℃, 78.4℃, 34.6℃)

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2- When measuring atmospheric pressure using a mercury column, an error occurred and air leaked into the upper vacuum space of the mercury tube.

- Does the reading of the height of the mercury column decrease or increase relative to the atmospheric pressure? Explain.
- Derive the mathematical formula that expresses the atmospheric pressure in the presence of this error.

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3- Which of the following expresses what happens when the volume of the vapor space is suddenly increased in a closed container holding a liquid and its vapor at constant temperature?

a) The rate of evaporation decreases and the vapor pressure decreases.

b) The rate of evaporation increases temporarily then returns to steady state, while the vapor pressure remains constant.

c) Both the rate of evaporation and the vapor pressure remain completely constant with no change.

d) The vapor pressure decreases and the rate of condensation continues to increase.

Homework

1- Given that boiling water at low pressure and low temperatures has very important uses in science and industry, such as drying heat-sensitive medicines.

-What is the value of atmospheric pressure (in hPa) required for water to boil at 10°C?

(Given that the vapor pressure of water at 10°C = 1230 Pa)

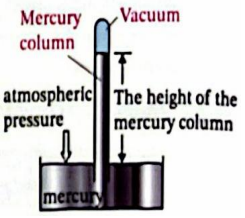
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2- When equal amounts of three liquids (A, B, C) are placed in the vacuum space shown in the opposite figure, each separately, and which have the following boiling points:

(A) = 60°C

(B) = 100°C

(C) = 40°C



And the atmospheric pressure was measured with each of them.

(a) Does the value of the atmospheric pressure differ depending on the type of liquid added?

(b) Rank the length of the mercury column for the three liquids.

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Week 1 Assessment

Model One

Question One: Choose the correct answer:

1- Which of the following has the lowest boiling point?

(a) HF (b) Na_2S (c) N_2 (d) H_2O

2- A mountain climber noticed that at the mountain summit, food takes a long time to cook.

-Which of the following is the correct explanation for this phenomenon?

(a) Water molecules become heavier.

(b) Atmospheric pressure lowers the boiling point.

(c) Atmospheric pressure raises the boiling point.

(d) Water gains greater thermal energy.

Essay Questions:

1-Arrange the following compounds in ascending order according to boiling point:

$HCl - H_2O - HF - CH_4$

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2- The opposite figure shows the melting points of the hydrides of elements (X, Y), respectively -78°C, -135°C, given that elements (X, Y) are two consecutive elements in Group 15, and the atomic mass of element (X) is less than that of element (Y).

-Write the chemical formula of the hydride of element (X) and (Y), using the periodic table of elements.

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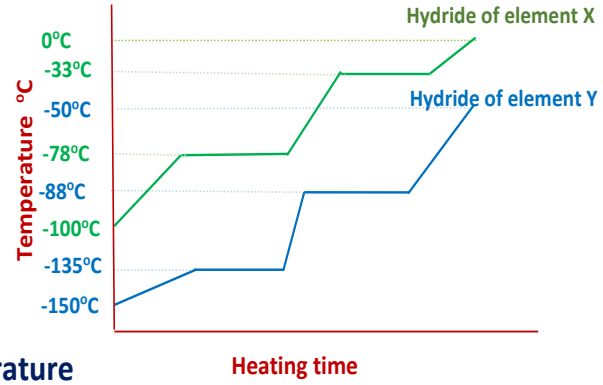
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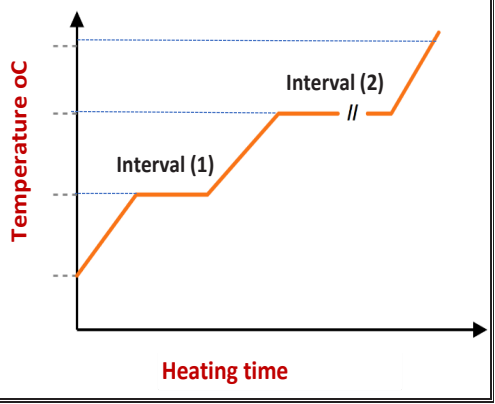
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3- The graph shows the change in temperature of a solid mass of substance (Y) with heating time until it completely changes into the gaseous state (Over two periods of constant temperature):

-What are the two basic processes that occur during the first and second periods of constant temperature, respectively? And specify the state of the substance in each of these two periods.

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Model Two

Question One: Choose the correct answer:

1- The elements of Group 15 (the nitrogen group) form compounds with hydrogen having the following boiling points: [SbH_3 = –17°C, AsH_3 = –55°C, PH_3 = –87°C, NH_3 = –33°C] The first three compounds show a trend of decreasing boiling point with decreasing molecular mass; however, ammonia (NH_3) deviates from this trend because of:

a) Strong covalent bonds b) Metallic bonds

c) Hydrogen bonds d) Van der Waals forces

2- Although both ammonia and hydrogen fluoride are capable of forming bonds between their molecules, the boiling point of hydrogen fluoride is 19.5°C while the boiling point of ammonia is -33°C.

-Which of the following choices explains the large difference between the boiling points?

(a) The higher electronegativity of fluorine compared to nitrogen.

(b) The inability of ammonia molecules to form hydrogen bonds.

(c) The molecular weight of hydrogen fluoride is greater than that of ammonia.

(d) Hydrogen fluoride is a liquid while ammonia is a gas.

Essay Questions:

1- Arrange the following substances in ascending order according to boiling point:

C_2H_5OH, NH_3, F_2

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2- At a pressure of 1.013×10^5 Pa and a temperature of 20°C, a glass tube closed at one end was filled with mercury and inverted in a basin containing mercury; the mercury column settled at 76.0 cm. When diethyl ether was injected, it all evaporated and the column dropped, and with the addition of more ether, it dropped further, and when liquid drops of ether remained, the column settled at 57.0 cm.

What is the saturated vapor pressure of diethyl ether at 20°C in Pa? Answer to the nearest two decimal places.

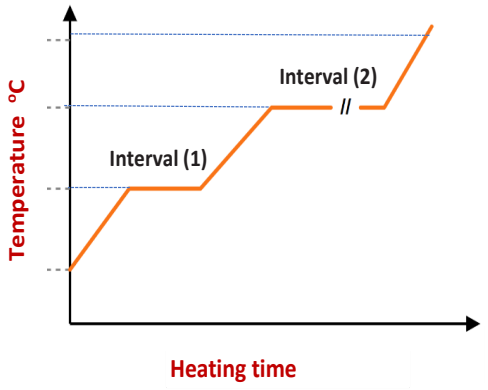
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3- The graph shows the change in temperature o heating time until it completely changes into the constant temperature):

-What is scientifically called the temperature at which the first period of constant temperature occurs, and the temperature at which the second period of constant temperature occurs?

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Model Three

1- 200 g of water at a temperature of 20℃ gained an amount of heat equal to 16.8 kJ, given that the specific heat of water is (4.2 kJ/g.℃). The final temperature of the water equals:

(a) 10℃ (b) 20℃ (c) 30℃ (d) 40℃

2- If the vapor pressure of a 50 mL volume of water at a temperature of 100°C equals the normal atmospheric pressure, then the vapor pressure of a 500 mL volume of water at the same temperature equals: (Atmospheric pressure = 1.013×10^5 Pa)

(a) 1.013×10^5 Pa (b) 5.036×10^5 Pa

(c) 2.026×10^5 Pa (d) 1.013×10^3 Pa

Essay Questions:

1- The opposite figure shows the melting points of the hydrides of elements (X, Y), respectively -78°C, -135℃, given that elements (X, Y) are two consecutive elements in Group 15, and the atomic mass of element (X) is less than that of element (Y).

- What is your explanation for the higher melting and boiling point of the hydride of element (X) compared to the hydride of element (Y)?

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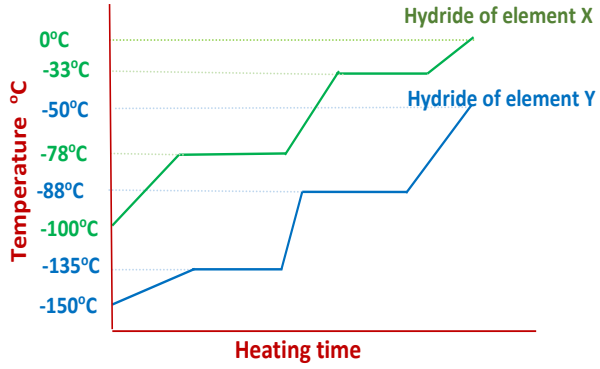
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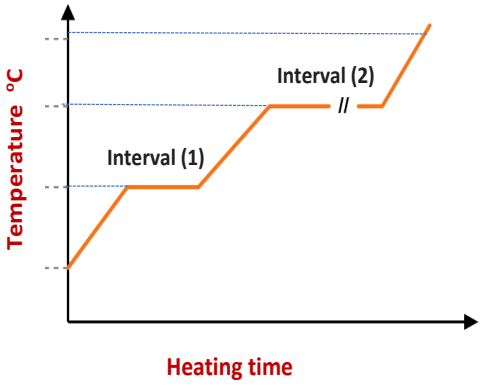
2- A certain mass of table salt NaCl at a temperature of 800℃ absorbed an amount of heat equal to 60.6 kJ to completely melt at the same temperature. Given that the heat of fusion of the salt equals 30.3 kJ/mol and the melting point of the salt is 800℃, calculate the mass of the salt in grams.

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3- The graph shows the change in temperature of a solid mass of substance (Y) with heating time until it completely changes into the gaseous state (over two periods of constant temperature):

-When substance (Y) gains thermal energy during the two periods of constant temperature and its temperature does not rise, what is this gained energy used for?

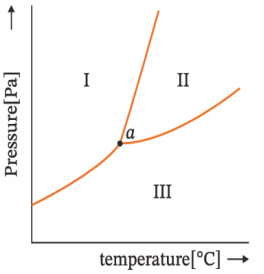
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Week (2)

First Period

Classwork



1- The opposite figure shows the phase diagram of (CO_2), were regions I, II, and III represent three different physical states of the substance, and point (a) is a distinctive point on the diagram.

1- Determine the physical state of the substance in each of regions I, II, III.

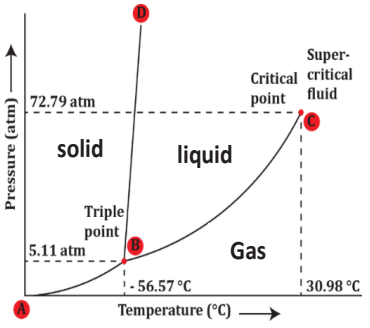
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2- If the substance is in region I and we want to convert it to region III without passing through region II, describe how this can be achieved by referring to the change in pressure and temperature, relative to the position of the triple point.

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2- From the opposite figure showing the phase diagram of carbon dioxide (dry ice), if we want to make dry ice melt (Change directly from the solid state to the liquid state) instead of sublimating, what condition must be met for the external pressure (po)?

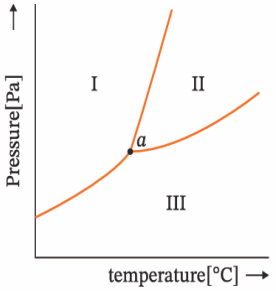
(a) po less than 1 atm

(b) po between 1 atm and 5.11 atm

(c) po greater than 5.11 atm and less than 72.79 atm

(d) po greater than 72.79 atm

Homework



1- The opposite figure shows the phase diagram of a certain substance (Where regions I, II, III represent three different physical states, and point a is the triple point).

1- What is the name of the boundary line between regions I and II? name of the boundary line between regions II and III?

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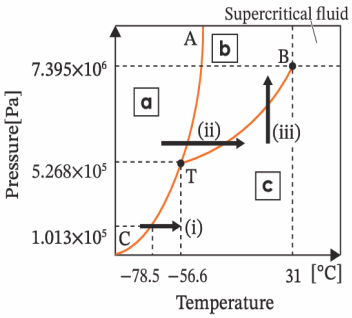
2- What happens to the melting temperature of the substance when pressure on it is increased?

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2- From the opposite figure showing the phase diagram of carbon dioxide (dry ice), if the temperature of a CO_2 gas sample is fixed exactly at -56.57°C, what happens to the state of the substance when we gradually increase the external pressure (po) starting from a value less than 5.11 atm to a value higher than 72.79 atm?



(a) The substance remains in the gaseous state throughout, no matter how much the pressure increases

(b) The substance changes directly from gas to solid without passing through any other state, then remains solid at higher pressures

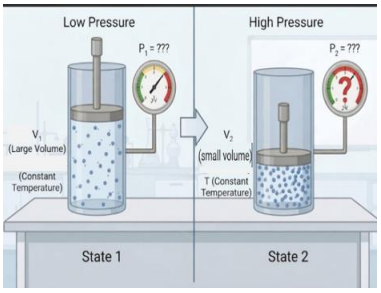
(c) The substance changes from gas to liquid, then from liquid to solid as the pressure continues to increase

(d) The substance changes from gas to solid at exactly 5.11 atm, then to liquid after exceeding 72.79 atm

Second Period

Classwork

1- Study the opposite figure carefully, then answer:



(a) What happens to the gas pressure (increases/decreases) in state (2)?

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(b) What is the name of the physical law and the mathematical formula that relates the two variables (V, P) shown in the figure at constant temperature (T)?

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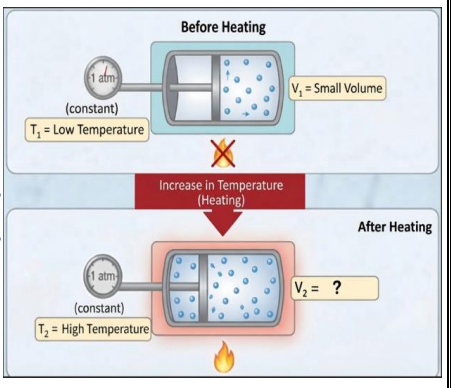
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2- Increasing the volume of 2.00 L of gas at 27°C to 3.00 L with constant pressure, what temperature [°C] is needed for this?

(a) 177
(b) 150
(c) 200
(d) 450

Homework

1- Study the opposite figure carefully, then answer:



(a) What happens to the gas volume (V) when its temperature (T) is increased (increases/decreases)?

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(b) What is the name of the physical law and the mathematical formula that relates the two variables (V, T) shown in the figure at constant pressure (P)?

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2- To increase the volume of 1.00 L of gas at 27°C to 1.60 L with constant pressure, what temperature [°C] is needed for this? (to the nearest whole number)

(a) 207
(b) 180
(c) 480
(d) 153

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Week 2 Assessment

Model One

Question One: Choose the correct answer:

1- If the triple point of a certain substance is -75°C, then the substance exists in the gaseous state only at:

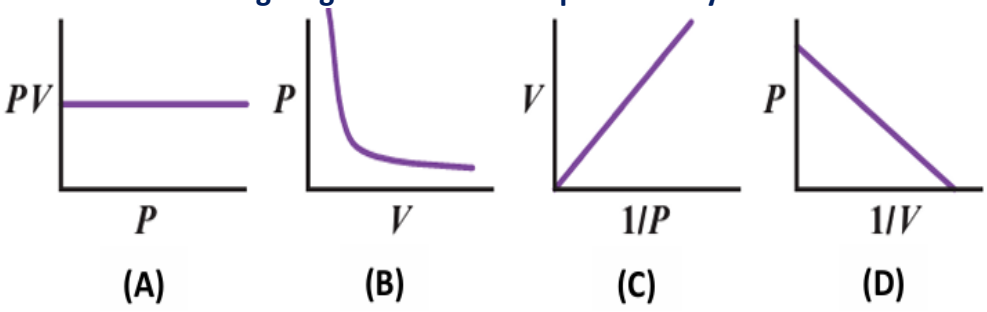
(a) -60°C, 0.0144 atm

(b) -80°C, 0.0144 atm

(c) -60°C, 1.44 atm

(d) -70°C, 0.144 atm

2- Which of the following diagrams does not represent Boyle's law?



Essay Questions:

1- From the opposite figure:

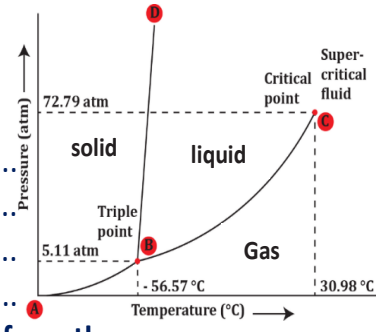
Determine the state of the substance at a pressure of 5 atm and a temperature of -18°C.

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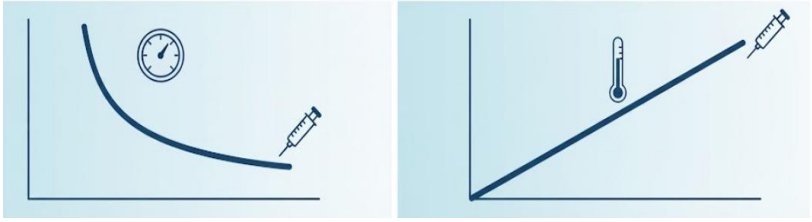
2- When weather balloons rise 100 m above the Earth's surface, the pressure decreases by 1200 Pa, and the temperature decreases by 0.65°C.

Does the volume of the balloon decrease or increase at this altitude? Explain.....?

(Atmospheric pressure at sea level = 1.013×10^5 Pa and temperature = 288.15 K)

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3- Study the following two graphs for a certain quantity of gas carefully, then answer:



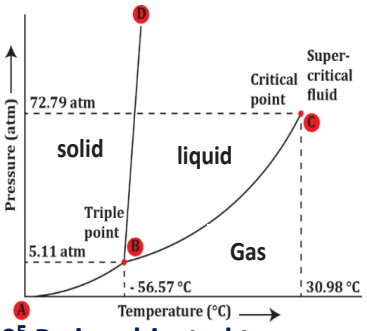
-Write on each of the vertical and horizontal axes the physical variable it represents (volume – pressure – temperature), specifying the constant variable in each case.

Model Two

Question One: Choose the correct answer:

1- From the opposite figure:

Which of the following transformations occurs by heating at 3.9 atm?



(a) solid → liquid (b) solid → gas

(c) gas → solid (d) liquid → solid

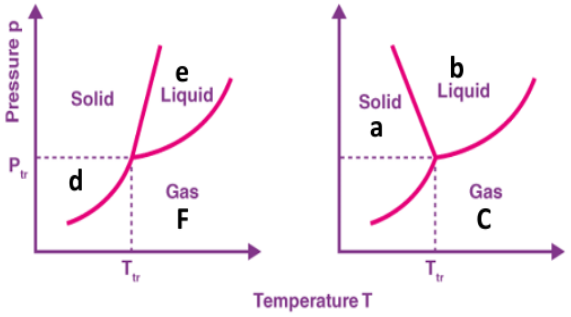
2- When a gas with a volume of 6.0 L at a pressure of 1.5×10^5 Pa is subjected to a pressure of 3.0×10^5 Pa at constant temperature, what is the volume [L]?

(To the nearest two decimal places)

(a) 1.50 (b) 3.00 (c) 4.50 (d) 6.00

Essay Questions:

1- Which of the following diagrams represents ice and which represents dry ice? Explain your answer below each diagram.



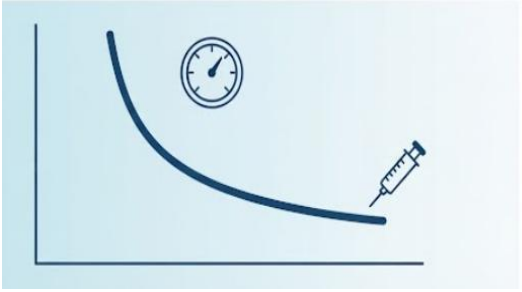
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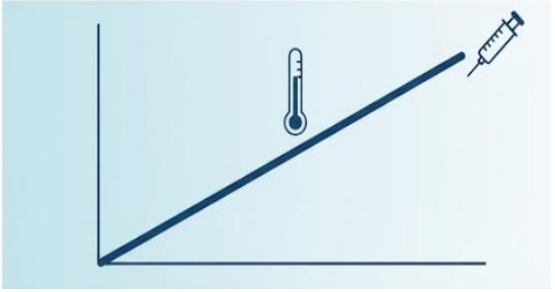
2- When a weather balloon rises and moves from the troposphere to the stratosphere layer, the balloon encountered a region where the temperature rose and the atmospheric pressure dropped sharply.

-Does the balloon's volume decrease or increase at this altitude? Explain.....?

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3- Study the following two graphs for a certain quantity of gas carefully, then answer:





-Write on each of the vertical and horizontal axes the physical variable it represents (volume – pressure – temperature), and name the physical law that governs each relationship.

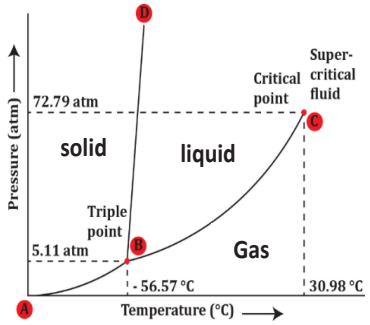
Model Three

1- From the opposite figure:

At a pressure of 5 atm and a temperature of -60°C, carbon dioxide gas exists in the state:

(a) gaseous (b) liquid

(c) solid (d) liquid, solid, and gaseous



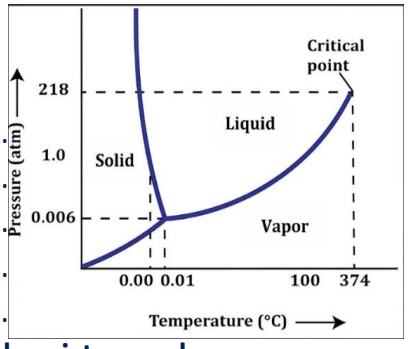
2- When a gas with a volume of 3.0 L at a pressure of 2.0×10^5 Pa is subjected to a pressure of 0.5×10^5 Pa at constant temperature, what is the volume [L]?

(a) 0.75 (b) 6.00 (c) 9.00 (d) 12.00

Essay Questions:

1- Referring to the opposite figure:

What are the physical states of water at an atmospheric pressure of 0.8 atm?



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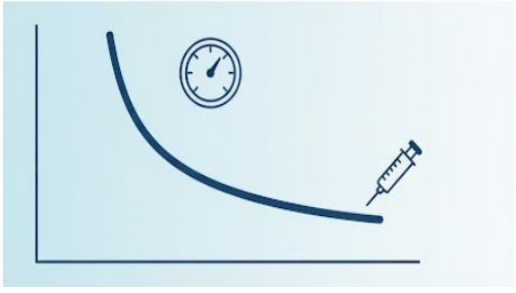
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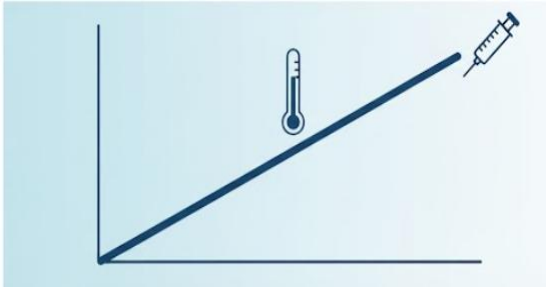
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2- A glass piston contains a fixed amount of ideal gas. If the piston undergoes a heating process that increases its absolute temperature by a certain percentage, and at the same moment the pressure on it is increased by a greater percentage. Does the volume of the gas inside the piston increase or decrease in this case? Explain?

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3- Study the following two graphs for a certain quantity of gas carefully, then answer:





Write on each of the vertical and horizontal axes the physical variable it represents (volume – pressure – temperature); write the mathematical formula that governs each relationship.

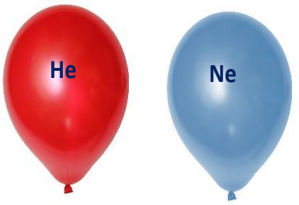
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Week (3)

First Period

Classwork

1- You have two balloons of the same volume at the same temperature containing different gases. Deduce the ratio between the number of moles of gas in each of them.



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2- The average lung capacity of a human is 6.0 liters. What is the maximum number of moles of air that fill your lungs while you are at the summit of Mount Everest (T = 200 K, P = 0.296 atm)? (R = 0.0821 L·atm/mol·K)

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3- A balloon containing gas with a volume of 6.45 L and a pressure of (800 mm-Hg) at a temperature of 24°C — the number of moles of gas inside the balloon equals (assuming ideal gas behavior):

(R = 8.3×10^{3} Pa·L/(K·mol), 1 mm-Hg = 133.3 Pa)

(a) 0.388
(b) 0.269
(c) 0.378
(d) 0.296

Homework

1- A tank with a volume of 200 L is filled with helium gas.
Calculate the mass of gas that generates a pressure of 2.70 [atm] inside the tank at 248 K? (He = 4 g/mol)

(R = 8.314 Pa·L / (K .mol) , 1 atm = 1.013×10^{5} Pa)

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2- A person climbed until he reached the summit of a towering mountain where the temperature is -5°C, carrying with him a tightly sealed bag of chips.
Describe, stating the reason, the motion of the molecules inside the bag at the top of the mountain.

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3- A quantity of carbon monoxide gas with a pressure of 58 mm-Hg and a volume of 155 mL. Its volume was increased at the same temperature to become 1.00 L; the gas pressure (mm-Hg) equals:

(a) 374 (b) 8.99
(c) 111 (d) 3734

Second Period

Classwork

1- Titan, the largest moon of the planet Saturn, has a surface pressure of 162.7 kPa, and its atmosphere consists of 82.0% nitrogen, 12.0% argon gas, and 6.0% methane gas. Based on data collected by the spacecraft "Voyager 1," calculate the partial pressure of each gas.

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2- A sample of oxygen gas was collected over water at a temperature of 15°C and a pressure of 738 torr, with a volume of 316 mL.

(Vapor pressure of water at 15°C ≈ 12.8 torr)

-What is the partial pressure (torr) of the oxygen?

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3- A 4.0-liter vessel containing N_2 at standard conditions (STP) is connected to a 2.0 liter vessel containing H_2 at standard conditions (STP) by a valve. If the valve is opened and the two gases mix, the mole fraction of hydrogen in the mixture equals:

(a) 0.034 (b) 0.33

(c) 0.50 (d) 0.67

Homework

1- A mixture of gases contains 2.00 mol of O_2, 3.00 mol of N_2, and 5.00 mol of He. If the total pressure of the mixture is 113.32 kPa, calculate the partial pressure of each gas.

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2- A gas sample was collected over water at a temperature of 15°C and a pressure of 738 torr, with a volume of 316 mL. (Vapor pressure of water at 15°C ≈ 12.8 torr)

-What would the volume of the sample be (mL) at standard temperature and pressure conditions when the water vapor pressure is removed?

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3- A mixture of oxygen and nitrogen gases, where the ratio of the number of moles of O_2 to the number of moles of N_2 equals 2:1 respectively. When 0.200 mol of argon gas is added to this mixture (at constant temperature), the pressure increases from 0.800 atm to 1.10 atm. How many moles of O_2 are in the mixture?

(a) 0.355 mol (b) 0.178 mol

(c) 0.533 mol (d) 0.200 mol

Week 3 Assessment

Model One

Question One: Choose the correct answer:

1- A real gas behaves closer to an ideal gas at:

(A) low pressure and high temperature

(B) low pressure and low temperature

(C) low volume and high temperature

(D) high pressure and high temperature

2- A flask with a capacity of 2.50 liters at 25℃ contains 0.016 mol of CO_2 and 0.035 mol of CH_4; the total pressure inside the flask equals: (R = 0.0821 L·atm/(mol·K))

(a) 31.4 mm-Hg

(b) 380 mm-Hg

(c) 0.041 mm-Hg

(d) 935 mm-Hg

Essay Questions:

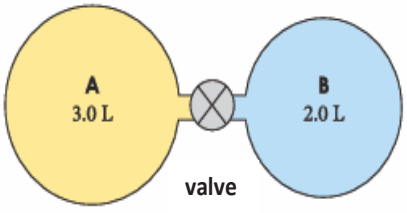
1- A highly volatile aromatic liquid substance with a mass of 1.5 g completely evaporated inside a glass syringe with a capacity of 500 mL at 100℃, and the resulting pressure recorded was 1.2×10^5 Pa. Calculate the relative molecular mass of this substance. ($R = 8.31\times10^3$ Pa·L/(K·mol))

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2- As shown in the figure, when nitrogen gas is placed at a pressure of 2.0×10^5 Pa in vessel A, and hydrogen gas in vessel B, and the valve is opened while keeping the temperature constant. **(N = 14, H = 1)**

-Will the total pressure after opening the valve be closer to the initial pressure of nitrogen or closer to the initial pressure of hydrogen? Justify your answer without performing calculations.



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3- A gas cylinder used in welding contains 0.25 mol of oxygen gas confined in a volume of 4.10 L at a pressure of 1.8×10^5 Pa. Calculate the temperature inside the cylinder in °C.

($R = 8.31\times10^3$ Pa·L/(K·mol)), (O = 16), (N = 14)

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Model Two

Question One: Choose the correct answer:

1- A vessel with a capacity of 1.50 mL... liters contain a gas at a pressure of 245 mmHg. When the gas is completely transferred to a vessel with a capacity of 350 mL at the same temperature, the pressure will equal:

(a) 1.05 mmHg
(b) 1.05 atm
(c) 2.14 atm
(d) 1050 mmHg

2- A vessel with a capacity of 3.00 L at a temperature of 30℃ contains nitrogen gas N_2 and oxygen gas O_2. Given that the number of moles of N_2 equals 0.020 mol, and that the total pressure inside the vessel equals 410 mm-Hg, calculate the number of moles of oxygen O_2 present in the vessel: (R = 0.0821 L·atm/(mol·K))

(a) 0.010 mol
(b) 0.045 mol
(c) 0.065 mol
(d) 0.020 mol

Essay Questions:

1- A study of the effects of certain gases on plant growth requires an artificial atmosphere consisting of 1.5% mol carbon dioxide, 18.0% mol oxygen, and 80.5% mol argon.

(a) Calculate the partial pressure of oxygen in the mixture if the total pressure is 99.33 kPa

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(b) If this atmosphere is to be maintained in a chamber with a capacity of 121 L at a temperature of 295 K, how many moles of oxygen (O_2) are required?

(R = 8.314 kPa·L/mol·K)

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2- A weather balloon is filled with 2.10 g of helium gas to occupy a volume of 12.5 L at 15°C. Calculate the pressure inside the balloon in pascals.

($R = 8.31\times10^3$ Pa·L/(K·mol)), (He = 4)

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Model Three

Question One: Choose the correct answer:

1- A tank with a volume of 200 L is filled with hydrogen gas.
Calculate the mass of the gas (H_2) (g) that generates a pressure of 2.70 atm inside the tank at 248 K? (H = 1 g/mol)
($R = 8.314\times10^3$ Pa·L/(mol·K) – 1 atm = 1.013×10^5 Pa)

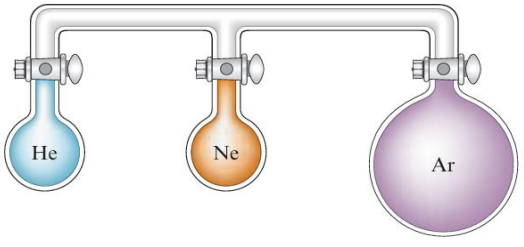
(a) 26.53 (b) 53.06
(c) 106.12 (d) 13.27

2- A closed vessel with a capacity of 1.80 L at a temperature of 20°C contains helium gas He and neon gas Ne. Given that the number of moles of He equals 0.010 mol, and that the total pressure inside the vessel equals 386 mm-Hg, calculate the number of moles of neon Ne present in the vessel: (R = 0.0821 L·atm/(mol·K))

(a) 0.010 mol (b) 0.028 mol
(c) 0.038 mol (d) 0.018 mol

Essay Questions:

1- From the opposite figure, and assuming that the volume of the connecting tubes can be neglected.



26.66kPa 40.53kPa 24.0 kPa

(a) Calculate the partial pressure of each gas after opening all the valves.

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(b) Calculate the total pressure after opening all the valves?

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2- To verify the type of an unknown gas used in a factory, a sample with a mass of 3.2 g was taken and its volume measured, found to be 2.24 L at 0°C and a pressure of approximately 1.0×10^5 Pa. Calculate the relative molecular mass of this gas, then determine which of the following gases it is likely to be:

(CH_4 = 16, N_2 = 28, O_2 = 32, CO_2 = 44)
(R = 0.0821 L·atm/(mol·K))

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Week (4)

First Period

Classwork

1-Compare between a real gas and an ideal gas in terms of:
(Molecular volume – attractive forces between molecules).

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2- what are the conditions of pressure and temperature at which the real gas behaves very closely to an ideal gas? Why?

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3-The mathematical formula PV = nRT describes only .....

(a) Real gas only
(b) Ideal gas
(c) Liquids
(d) Solids

Homework

1-Give the scientific explanation:

(a) At the molecular level, a real gas deviates from the ideal gas law at very high pressures and very low temperatures.

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(b) The volume of gas molecules and the attractive forces between them are neglected in an ideal gas, while they cannot be neglected in a real gas.

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3-Which of the following expresses the main difference between an ideal gas and a real gas?

(a) Ideal gas molecules have no volume and there are no attractive forces between them
(b) Ideal gas molecules have no fixed volume but there are attractive forces between them
(c) Ideal gas molecules move at a slower speed
(d) Ideal gas molecules are not affected by pressure

Second Period

Classwork

1-What does the "compressibility factor Z = $\frac{PV}{nRT}$" express, and what does it mean for the value of Z to equal 1?

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2-8 g of oxygen gas (O_2) occupies 5.6 L at a certain temperature and a pressure of 1 atm.
(a) Calculate the number of moles of gas in the sample (O_2 = 32 g/mol)
(b) Calculate the temperature at which the sample exists, in Celsius.
(R = 0.0821 atm·L/(mol·K))

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3-When the value of the compressibility factor (Z < 1) for a real gas at moderate pressure, the main reason for this is that:

(a) The attractive forces between molecules weaken their collisions with the container walls, making the observed pressure lower than the pressure expected for the ideal case.
(b) The volume of the molecules themselves becomes large compared to the total volume of the gas
(c) The thermal motion of the molecules increases greatly, reducing the attractive forces between them
(d) The number of moles of gas decreases as pressure increases

Homework

1-Give the scientific explanation:

1-The volume of gas molecules and the attractive forces between them are neglected in an ideal gas, while they cannot be neglected in a real gas.

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2-A small air bubble with a volume of 1.5 mL was released from the bottom of a lake, where the total pressure acting on it was 2.5 atm, and the water temperature was 7 °C (i.e., 280 K). The bubble gradually rose until it reached the surface of the water, where the pressure acting on it became 1 atm, and the temperature rose to 27 °C (i.e., 300 K).
-Calculate the volume of the bubble (V_2) upon reaching the water's surface, given that the amount of air inside the bubble is constant.

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3-The compressibility factor (Z) is mathematically defined as:

(a) Z = nRT/PV (b) Z = PV/nRT (c) Z = PV·nRT (d) Z = P/V

Week 4 Assessment

Model 1

Question 1: Choose the correct answer:

1-At constant pressure (P) and constant amount of substance (n) for an ideal gas, the relationship between volume (V) and absolute temperature (T) is:

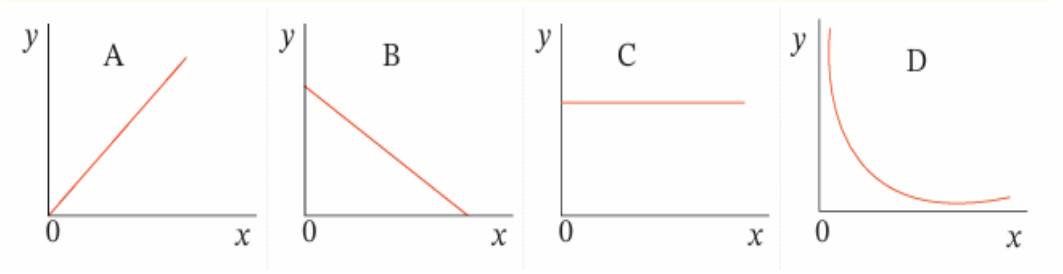
(a) Direct proportionality
(b) Inverse proportionality
(c) Quadratic
(d) No relationship between them

2-Which of the following expresses the mathematical formula for the volume of a gas in terms of temperature at constant pressure?

(a) $V = (nR/P)\ T$
(b) $V = (nR/T)\ P$
(c) $V = (P/nR)\ T$
(d) $V = nRP \cdot T$

Essay Questions:

1-For an ideal gas, choose the graph from A to D that represents each of the following relationships:



(a) The relationship between the absolute temperature T (x-axis) and the molar volume V/n (y-axis) when pressure is constant

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(b) The relationship between the amount of substance n (x-axis) and pressure P (y-axis) when volume and temperature are constant

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(c) The relationship between gas volume V (x-axis) and the amount of substance n (y-axis) when pressure and temperature are constant is represented by the graph

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Model- 2

Question 1: Choose the correct answer:

1-At constant temperature (T) and constant amount of substance (n) for an ideal gas, The relationship between volume (V) and pressure (P) is:

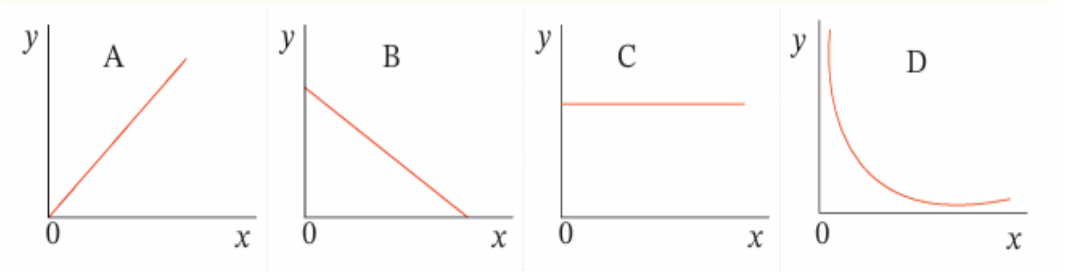
(a) Directly proportional
(b) Inversely proportional
(c) Quadratic
(d) No relationship between them

2-If the pressure acting on a certain amount of ideal gas is doubled at constant temperature, then its volume:

(a) Doubles
(b) Is halved
(c) Stays the same, unchanged
(d) Increases fourfold

Essay Questions:

1-For an ideal gas, choose the graph from A to D that represents each of the following relationships:



(a) The relationship between molar volume V/n (x-axis) and pressure P (y-axis) when temperature is constant

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(b) The relationship between volume V (x-axis) and the product of pressure and volume PV (y-axis) when the amount of substance and temperature are constant

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(c) The relationship between pressure P (x-axis) and the product of pressure and volume PV (y-axis) when the amount of substance and temperature are constant

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Model- 3

Question 1: Choose the correct answer:

1-Which of the following expresses the mathematical formula for the volume of a gas in terms of pressure at constant temperature?

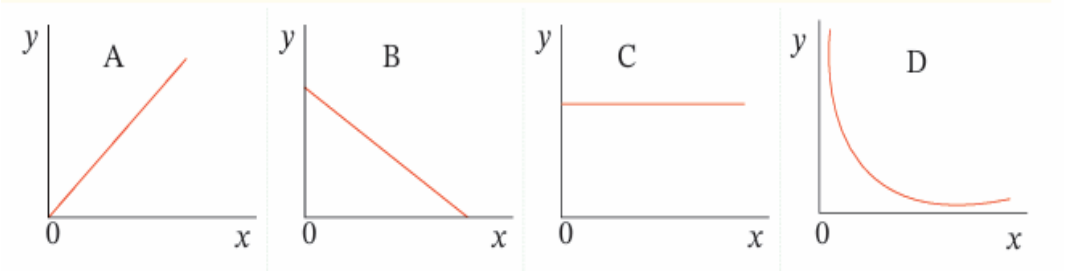
(a) V = (nR/P) T
(b) V = (nR/T) P
(c) V = (P/nR) T
(d) V = nRP · T

2-If the absolute temperature of a certain amount of ideal gas is doubled at constant pressure, then its volume:

(a) Doubles
(b) Is halved
(c) Stays the same, unchanged
(d) Becomes a quarter of its original value

Essay Questions:

1-For an ideal gas, choose the graph from A to D that represents each of the following relationships:



(a) The relationship between the amount of substance n (x-axis) and gas volume V (y-axis) when pressure and temperature are constant

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(b) The relationship between absolute temperature T (x-axis) and pressure P (y-axis) when the amount of substance and volume are constant

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(c) The relationship between pressure (x-axis) and volume V (y-axis) when the amount of substance and temperature are constant

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Week (5)

First Period

Classwork

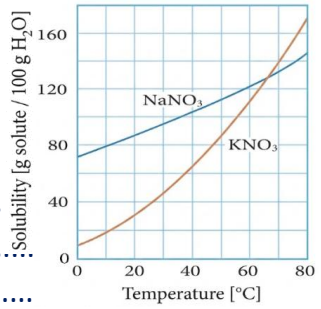
1-A solution was prepared by dissolving 5.85 g of $CaCl_2$ in water to form 250 mL of solution. Calculate the molarity of the solution. (Cl = 35.5, Ca = 40)

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2-The solubility curve shown in front of you represents the solubility of two substances ($NaNO_3$) and (KNO_3) in water.

-If you have 120 g of a saturated solution of $NaNO_3$ at 60 °C , and you cool it to 10 °C, calculate the mass of the resulting precipitate.



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3-**Which of the following represents the solution with the highest molarity?**

(Molar masses: NaCl = 58.5, KCl = 74.5, NaOH = 40, $C_6H_{12}O_6$ = 180)

(a) 5.85 g NaCl in 1 L

(b) 74.5 g KCl in 1 L

(c) 4.0 g NaOH in 0.5 L

(d) 1.80 g glucose in 1 L

Homework

1-Compare between the solubility of solids and gases in liquids in terms of: a) The effect of temperature.

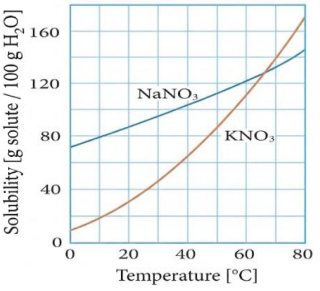
b) The effect of pressure.

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2-The solubility curve shown in front of you represents the solubility of two substances ($NaNO_3$) and (KNO_3) in water.

-If you add 30 g of KNO_3 to 100 g of water at 50 °C, describe the state of the resulting solution.



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3-Choose the correct answer from the following:

When mixing 100 mL of a NaCl solution with concentration 0.5 M with 100 mL of a NaCl solution with concentration 1.5 M, the concentration of the resulting solution equals:

(a) 0.5 M (b) 1.0 M (c) 1.5 M (d) 2.0 M

Second Period

1-"When a concentrated salt solution is separated from distilled water by a semi-permeable membrane, the net movement of water molecules is toward the salt solution."

- Explain the above statement in light of molecular motion theory.

2-Calculate the osmotic pressure (π) of a glucose solution with a molar concentration of 0.1 mol/L at a temperature of 27 °C.

(R = 0.082 atm/mol·K)

3- Choose the correct answer:

-Based on the mathematical relationship for osmotic pressure (π = cRT), what is the expected change in the pressure required to complete the reverse osmosis process when the concentration of dissolved ions in seawater increases?

(a) The pressure decreases proportionally with the decrease in solvent molecules.

(b) The pressure increases proportionally with the increase in molar concentration (C)

The pressure does not change because the gas constant (R) and temperature constant (T) are fixed.

(d) It becomes equal to zero as the kinetic energy of the ions increases.

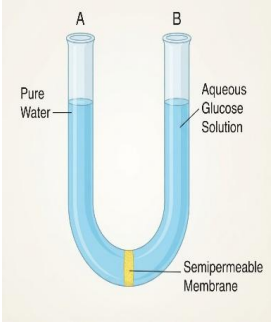
Homework

1-Compare between osmosis and reverse osmosis in terms of:

	Osmosis	Reverse Osmosis
Direction of water movement		
Use of external pressure		
Practical application		

2-In the figure opposite:

If you know that the concentration of the glucose solution is 0.033 M, what is the amount of pressure that must be applied to keep the liquid levels constant in the two branches at a temperature of 25 °C (R = 0.082 atm/mol·K), and on which branch should it be applied?



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3-Choose the correct answer:

In the osmotic pressure experiment, when a sucrose solution is used instead of glucose at the same molar concentration, the osmotic pressure:

(the molar mass of sucrose is greater than the molar mass of glucose)

(a) Increases because sucrose has a greater molar mass

(b) Decreases because sucrose is less soluble

(c) Remains constant due to constant concentration

(d) Remains constant due to constant R

Weekly Assessment (Week 5)

Model - 1

Question 1: Choose the correct answer:

1-Which of the following factors does not affect the solubility of a gas in a liquid at constant temperature?

(a) The nature of the gas and the solvent
(b) The pressure of the gas above the solution
(c) The volume of the container holding the solution
(d) Temperature

2-An aqueous solution contains 0.1 mol of a non-electrolyte substance in 500 g of water.
-What is the freezing point depression? (Kf for water = 1.86 °C· kg/mol)

(a) 0.186 °C (b) 0.372 °C (c) 0.093 °C (d) 0.744 °C

3-A hydrophobic colloid remains dispersed in its medium mainly because of:

(a) Strong hydration by surrounding water molecules
(b) Repulsive forces between particles carrying the same charge
(c) Its ability to form a gel
(d) Continuous dialysis (purification)

Essay Questions:

1-Explain how the solubility curve can be used to predict the amount of substance precipitated when a saturated solution is cooled.

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2-Calculate the molality of a solution containing 0.5 mol of sucrose ($C_{12}H_{22}O_{11}$) dissolved in 250 g of water.

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3-When 6 g of a non-ionizing substance is dissolved in water to form 500 mL of solution, the osmotic pressure of this solution was found to equal 4.92 atm at a temperature of 27 °C.
-Calculate the molar mass of the dissolved substance. (R = 0.082 atm/mol·K)

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4-During an experiment to purify a starch colloid contaminated with sodium ions (Na^+) and chloride ions (Cl^-), the mixture was placed in a bag made of a semi-permeable cellophane membrane and immersed in continuously renewed distilled water.
-When an external electric field is applied across the sides of the bag, what is the name of this process?

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Model - 2

Question 1: Choose the correct answer:

1-Which of the following substances dissolves more in water?

(a) Naphthalene ($C_{10}H_8$) (b) Cooking oil (c) Glucose ($C_6H_{12}O_6$) (d) Hexane

2-If you have two aqueous solutions equal in molality: one of a non-electrolyte substance, and the other of a strong electrolyte that dissociates into 3 ions.

-Which of the following is correct?

(a) Both solutions will have the same boiling and freezing points

(b) The electrolyte solution will have a higher boiling point and a lower freezing point

(c) The non-electrolyte solution will have a higher boiling point and a lower freezing point

(d) Cannot be compared without knowing the molar mass

3-Which of the following statements is true about hydrophobic colloids?

(a) They form easily by mixing the two substances

(b) They need stabilizing agents to maintain their stability

(c) They are not affected by the addition of salts

(d) They have a strong affinity for water

Essay Questions:

1- 5g of sodium chloride (NaCl) was dissolved in 95 g of water.

-Calculate the mass percentage of the solution.

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2-Two aqueous solutions (A) and (B) each contain 10 g of a different solute in 100 g of water.

Solution (A): contains a non-electrolyte solute (molar mass = 60 g/mol).

Solution (B): contains a strong electrolyte that dissociates into 3 ions (Molar mass = 120 g/mol).

(a) Calculate the boiling point of each solution separately.

(K_b for water = 0.52 °C·kg/mol, boiling point of pure water = 100 °C)

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3-A solution was prepared by dissolving 20 g of sodium hydroxide (NaOH) in 180 g of water. The density of the resulting solution = 1.2 g/mL. (NaOH = 40 g/mol)

(a) Calculate the mass percentage of the solution.

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4-When a river of fresh water meets seawater at the river mouth, vast areas of fertile mudflats known as a delta form as a result of the deposition of clay suspended in the fresh water.

-What happens to the clay particles when they come into contact with salty seawater to form the delta?

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Model- 3

Question 1: Choose the correct answer:

1-A student claims that adding sugar to water increases the boiling speed of water.
-Which of the following represents the correct scientific evaluation?

(a) The claim is correct, because sugar increases the final temperature.
(b) The claim is correct, because sugar reduces the heat capacity of water.
(c) The claim is incorrect, because adding sugar raises the boiling point, which increases the boiling time.
(d) The claim is incorrect, because sugar does not affect the properties of water.

2-Salts such as $CaCl_2$ are commonly used to melt ice on roads in winter.
Which option explains why $CaCl_2$ is chosen instead of NaCl even though both lower the freezing point?

(a) $CaCl_2$ is cheaper.
(b) $CaCl_2$ dissociates into 3 ions, which lowers the freezing point more for the same mass.
(c) NaCl is toxic to the environment.
(d) $CaCl_2$ has a distinctive color that makes it easier to see on roads.

3-If the osmotic pressure of a solution is 2.49×10^5 Pa at 27 °C, then its molar concentration equals:

(a) 0.1 mol/L (b) 0.3 mol/L (c) 0.5 mol/L (d) 1.0 mol/L

Essay Questions:

1-5 g of sodium chloride (NaCl) was dissolved in 95 g of water.
If the solution is diluted by adding 50 g of water, calculate the new mass percentage.

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2-Two aqueous solutions (A) and (B) each contain 10 g of a different solute in 100 g of water.
Solution (A): contains a non-electrolyte solute (molar mass = 60 g/mol).
Solution (B): contains a strong electrolyte that dissociates into 3 ions (Molar mass = 120 g/mol)
-Which of the two solutions has a higher boiling point? Explain why.

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3-A solution was prepared by dissolving 20 g of sodium hydroxide (NaOH) in 180 g of water. The density of the resulting solution = 1.2 g/mL. (NaOH = 40 g/mol)
- Calculate the molarity of the solution.

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4-A glucose solution (a non-ionizing substance) has an osmotic pressure (π) equal to 6.15 atm at a temperature of 27 °C. (R = 0.082 atm/mol·K)
a) Calculate the molar concentration (M) of the solution.

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b) Calculate the mass of glucose needed to prepare 250 mL of this solution, given that the molar mass of glucose = 180 g/mol

Week (6)

First Period

Classwork

1-Compare between the face-centered cubic lattice (FCC) and the hexagonal close-packed lattice (HCP) in terms of coordination number and packing efficiency.

	Face-Centered Cubic (FCC)	Hexagonal Close-Packed (HCP)
Coordination number		
Packing efficiency		

2-Write the relationship between the unit cell edge length (a) and the atomic radius (r) in the body-centered cubic lattice (BCC).

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3-**Which of the following options represents a crystal structure with a coordination number equal to 12?**

(a) BCC
(b) FCC
(c) Simple cubic
(d) Amorphous

Homework

1-Write the relationship between the unit cell edge length (a) and the atomic radius (r) in the face-centered cubic lattice (FCC).

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2-Compare between the face-centered cubic lattice (FCC) and the hexagonal close-packed lattice (HCP) in terms of the number of atoms in the unit cell and the coordination number.

	Face-Centered Cubic (FCC)	Hexagonal Close-Packed (HCP)
Number of atoms in the unit cell		
Coordination number		

3-Which of the following options represents the number of atoms contributed by corner atoms in the unit cell of the face-centered cubic lattice (FCC)?

(a) 1
(b) 2
(c) 3
(d) 4

Second Period

Classwork

1-Explain how the coordination number differs between an NaCl crystal and a CsCl crystal.

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2-Based on the principle of electric charge and ionic attraction, explain why ions in a crystal are not arranged randomly, but instead take on a regular geometric arrangement.

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3-The number of chloride ions (Cl^-) present in a single unit cell of a sodium chloride (NaCl) crystal is:

(a) 1 (b) 4 (c) 6 (d) 8

Homework

1-Compare between the sodium chloride crystal and the cesium chloride crystal in terms of: Unit cell: (its type, number of ions of each type in it)

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2-In a sodium chloride (NaCl) crystal, if the unit cell edge length = 5.64×10^{-8} cm, and the radius of the Na^+ ion = 1.16×10^{-8} cm: Given that the molar mass of NaCl = 58.5 g/mol, Avogadro's number $N_a = 6.0 \times 10^{23}$/mol, and the unit cell contains 4 formula units of NaCl:

(a) Calculate the radius of the Cl^- ion.

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3-Which of the following options represents the coordination number of a given ion within the crystal lattice of potassium chloride?

(a) The total number of ions present within a single unit cell.

(b) The number of electrons the atom lost or gained to become an ion.

(c) The number of oppositely charged ions that directly surround it and are in contact with it.

(d) The number of covalent and coordinate bonds the ion shares with neighboring ions.

Weekly Assessment (Week 6)

Model - 1

Question 1: Choose the correct answer:

1-Which of the following describes the BCC, FCC, and HCP crystal systems?

(a) FCC and HCP systems have the same atomic packing factor (APF = 0.74), while BCC has a lower packing factor (0.68)

(b) FCC and HCP systems have the same atomic packing factor (0.74) and the same coordination number (12), while BCC has a packing factor of (0.68) and a coordination number of (8)

(c) BCC and HCP unit cells contain the same number of effective atoms (4), while the FCC unit cell contains only two atoms

(d) The BCC system has the highest atomic packing efficiency, making it the most ductile and malleable

2-Which of the following describes the number and type of ion located at the center of the CsCl unit cell?

(a) Cl^- ion

(b) Two Cs^+ ions

(c) Cs^+ ion

(d) Two Cl^- ions

Essay Questions:

1-The radius of a nickel atom is 1.24 Å, and the crystal is a maximally close-packed cube (FCC). Calculate the density of solid nickel. 1 Å = 1×10^{-8} cm, M(Ni) = 58.7 g/mol, $N_A = 6.022\times10^{23}$

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2-An engineer wants to use two metals, one as a substitute for copper and the other as a substitute for iron, and is presented with a metal of unknown crystal structure that has an HCP system. Should this metal be used as a substitute for copper or for iron? Explain your choice.

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3-If the radius of the sodium ion = 0.95 Å, and the radius of the chloride ion = 1.81 Å, calculate the edge length of the NaCl unit cell.

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Model - 2

Question 1: Choose the correct answer:

1-Which of the following relationships between atomic radius (r) and unit cell edge length (a) is correct?

(a) BCC: ($a = 2r$), FCC: ($\sqrt{3}\, a = 4r$)

(b) BCC: ($\sqrt{2}\, a = 4r$), FCC: ($a = 2r$)

(c) BCC: ($\sqrt{3}\, a = 4r$), FCC: ($a = 2\sqrt{2}\, r$)

(d) In all cubic crystal systems (SC, BCC, FCC): ($a = 4r$)

2-Which of the following describes a crystal in which the coordination number of an ion equals 8?

(a) NaCl

(b) CsCl

(c) HCP

(d) FCC

Essay Questions:

1-Chromium metal crystallizes according to the body-centered cubic (BCC) lattice structure. If the radius of the chromium (Cr) atom is 1.25 Å, what is the density of chromium metal in g/cm^3? (Cr = 52 g/mol, $N_a = 6.022\times10^{23}$, 1 cm = 10^8 Å)

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2-The coordination number in NaCl equals 6. Explain why.

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3-In a cesium chloride (CsCl) crystal, if the unit cell edge length = 0.41 nm, and the radius of the Cl^- ion = 0.17 nm, and the radius of the Cs^+ ion is unknown:
(1 nm = 10^{-7} cm) The molar mass of CsCl = 168.5 g/mol Avogadro's number $N_A = 6.0 \times 10^{23}$/mol, the unit cell contains one formula unit of CsCl
-Calculate the density of the crystal in g/cm^3

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Model - 3

Question 1: Choose the correct answer:

1-In the face-centered cubic (FCC) lattice, the relationship between the atomic radius (r) and the unit cell edge length (a) is:

(a) $a = \sqrt{(2/4)}\ r$

(b) $a = \sqrt{(3/4)}\ r$

(c) $r = \sqrt{(2/3)}\ a$

(d) $r = \sqrt{(3/2)}\ a$

2-In a sodium chloride (NaCl) crystal, the number of sodium (Na^+) ions in the unit cell equals:

(a) 1

(b) 4

(c) 6

(d) 8

Essay Questions:

1-An electrical engineer is presented with an unknown metal whose unit cell edge length is 4.04 Å, molar mass 26.98 g/mol, and density 2.70 g/cm³. By comparing the crystal structure of this metal with that of copper, can this metal be used in manufacturing wires for conducting electricity?

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2-Compare between the crystal structures of NaCl and CsCl in terms of the number of ions in the unit cell and the coordination number.

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3-In a cesium chloride (CsCl) crystal, if the unit cell edge length = 0.41 nm, and the radius of the Cl^- ion = 0.17 nm, and the radius of the Cs^+ ion is unknown:
(1 nm = 10^{-7} cm) The molar mass of CsCl = 168.5 g/mol , Avogadro's number $N_A = 6.0 \times 10^{23}$/mol the unit cell contains one formula unit of CsCl
- Calculate the radius of the Cs^+ ion in nm.

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Week (7)

First Period

Classwork

1- Compare between the enthalpy of bond breaking and the enthalpy of bond formation.

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2- Explain: the sign of ΔH is negative when a bond is formed.

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3- Choose the correct answer:

-If you know that the enthalpy of combustion of carbon in the following reaction is ΔH° = -393.5 kJ/mol

$$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$$

Then the change in enthalpy for the equation $2C_{(s)} + 2O_{2(g)} \rightarrow 2CO_{2(g)}$ equals:

(a) 393.5 kJ

(b) +787 kJ

(c) -196.8 kJ

(d) -787 kJ

Homework

1- Clarify the difference between the enthalpy of formation and bond enthalpy.

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2- Explain: the sign of ΔH is positive when a bond is broken.

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3- Choose the correct answer:

If you know that for the reactions:

$$A \rightarrow B,\ \Delta H_1 = -120\ kJ\ mol^{-1}$$

$$B \rightarrow C,\ \Delta H_2 = +50\ kJ\ mol^{-1}$$

What is the total change in enthalpy for the reaction A → C?

(a) +70 kJ

(b) -70 kJ

(c) -140 kJ

(d) -120 kJ

Second Period

Classwork

1- Explain scientifically:what happens at the cathode (positive electrode) in the Daniell cell while it is operating, and write the chemical equation representing the reaction occurring there.

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2- What is the essential role played by the porous vessel in ensuring the continuous operation of the Daniel cell?

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3- Calculate the quantity of electricity produced from the oxidation of one mole of lead in a lead-acid cell. ($F = 9.65\times10^4$ C/mol)

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4- Choose the correct answer:

-In galvanic (electrochemical) cells, energy is converted from:

(a) electrical to light energy only
(b) chemical to electrical energy
(c) thermal to chemical energy
(d) light to electrical energy

Homework

1- Explain scientifically what happens at the anode (negative electrode) in the Daniel cell while it is operating, and write the chemical equation representing the reaction occurring there.

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2- What is the scientific name for the electric potential difference generated between the two electrodes of the Daniel cell under standard measurement conditions?

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3- A lead-acid battery consists of ..... and lead as electrodes in dilute sulfuric acid. When 0.1 mole of lead is completely converted during discharge, the quantity of electricity obtained is ..... (Coulombs, C), and the concentration of the dilute sulfuric acid decreases by ..... (g) (H = 1.0, O = 16, S = 32, Pb = 207), ($F = 9.65\times10^4$ C/mol)

4- Choose the correct answer:

During the operation of the Daniel cell, how do the masses of the zinc (Zn) and copper (Cu) electrodes change over time?

(a) The mass of zinc decreases and the mass of copper increases.
(b) The mass of copper decreases and the mass of zinc increases.
(c) The masses of both electrodes decrease at the same rate.
(d) The mass of copper increases while the mass of zinc remains constant.

Weekly Assessment (Week 7)
Model - 1

Question 1: Choose the correct answer:

1- Which of the following statements represents the precise statement of Hess's Law in thermochemistry?

(a) The rate of a chemical reaction is a constant that does not change

(b) The total change in enthalpy does not depend on the reaction pathway

(c) The surrounding temperature does not affect the equilibrium state

(d) The mass of the reactants changes during the reaction

2- During the operation of the Daniel cell, which of the following represents the direction of electron movement through the external circuit (the external wire connecting the two electrodes)?

(a) From the anode to the cathode.

(b) From the cathode to the anode.

(c) From the salt bridge to the solution.

(d) From the solution to the salt bridge.

Essay Questions:

1- Calculate the heat of combustion of nitric oxide gas, NO, according to the following equation:

$NO(g) + ½ O_2(g) \rightarrow NO_2(g)$

Given the following thermochemical equations:

$½ N_2(g) + ½ O_2(g) \rightarrow NO(g)$, $\Delta H = +90.29$ kJ mol^{-1}

$½ N_2(g) + O_2(g) \rightarrow NO_2(g)$, $\Delta H = +33.2$ kJ mol^{-1}

2- Based on your study of the Daniel electrochemical cell, design a hypothetical galvanic cell whose electrodes are elements (A) and (B), knowing that both are divalent, and that element (A) is the anode (negative electrode).

(a) Draw a diagram illustrating the cell, showing on it the direction of electron movement and the components of the porous vessel.

(b) Write the representation symbol for the cell (cell notation) representing the reaction occurring in it.

3- From the conventional symbol: $Mg \mid Mg^{2+} \parallel Cu^{2+} \mid Cu$

a) Identify the anode and the cathode

b) Identify the direction of electron movement

c) Name the metal whose mass decreases

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4- Identify the anode and the cathode in the lead-acid cell. What happens at each electrode (oxidation/reduction)?

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Model - 2

Question 1: Choose the correct answer:

1- Using the following thermochemical equations:

$C + O_2 \rightarrow CO_2$, $\Delta H = -394$ kJ

$CO + \frac{1}{2} O_2 \rightarrow CO_2$, $\Delta H = -283$ kJ

Which of the following represents the enthalpy of the reaction: $C + \frac{1}{2} O_2 \rightarrow CO$

(a) -677 kJ

(b) -111 kJ

(c) +111 kJ

(d) +677 kJ

2- Which of the following represents the reaction occurring in the Daniel cell?

(a) A neutralization reaction between the salts in the cell.

(b) A chemical reaction resulting from the absorption of electrical energy.

(c) An oxidation-reduction reaction.

(d) Generation of light energy as a result of the kinetic energy of ions.

Essay Questions:

1- Calculate the change in enthalpy for the following reaction:

$$CH_{4(g)} + 2\ O_{2(g)} \rightarrow CO_{2(g)} + 2\ H_2O_{(l)}$$

Given that the enthalpy of formation for CH_4, CO_2, and H_2O are (-74.8 kJ mol^{-1}), (-393.5 kJ mol^{-1}), and (-286 kJ mol^{-1}) respectively.

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2- Through your study of the Daniel electrochemical cell, design a cell with electrodes X and Y, each in its own solution, such that X is the anode.

(a) Draw the cell.

(b) Which solution is preferred to have the higher concentration, and why?

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3- If the zinc electrode in the Daniel cell is replaced with a nickel electrode, which electrode represents the anode? And why?

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4- When charging a lead-acid battery, 96,500 coulombs were consumed. What is the increase in the weight of the lead electrodes? (H = 1.0, O = 16, S = 32, Pb = 207), ($F = 9.65 \times 10^4$ C/mol)

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Model -3

Question 1: Choose the correct answer:

1- Given the following thermochemical reactions:

$2NO_{(g)} \rightarrow N_2O_{2(g)}$, $\Delta H = -147.5$ kJ/mol

$N_2O_{2(g)} + H_{2(g)} \rightarrow N_2O_{(g)} + H_2O_{(g)}$, $\Delta H = -193.4$ kJ/mol

$N_{2(g)} + H_2O_{(g)} \rightarrow N_2O_{(g)} + H_{2(g)}$, $\Delta H = +323.4$ kJ/mol

Which of the following choices represents the ΔH for the following reaction:

$2NO_{(g)} + 2H_{2(g)} \rightarrow N_{2(g)} + 2H_2O_{(g)}$

(a) +193.4 kJ/mol (b) +664.3 kJ/mol

(c) -340.9 kJ/mol (d) -664.3 kJ/mol

2- The ions that move toward the anode half-cell through the salt bridge (porous vessel) are:

(a) Anions (negative ions) (b) Cations (positive ions)

(c) Electrons of the electrode (d) Water molecules only

Essay Questions:

1- If you know that for the reactions:

$A \rightarrow 3B$, $\Delta H_1 = -50$ kJ mol^{-1}

$B \rightarrow C$, $\Delta H_2 = -42$ kJ mol^{-1}

What is the total enthalpy change for the reaction $A \rightarrow 3C$?

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2- Through your study of the Daniel electrochemical cell, design a cell with electrodes X and Y, each in its own solution, such that X is the anode.

(Given that X and Y are divalent)

(a) Write the oxidation reaction in the cell, indicating at which electrode it occurs.

(b) Which electrode's mass increases?

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3- If the concentration of Zn^{2+} increases significantly during the operation of the Daniel cell, what happens to the reaction and the electromotive force?

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4- In a fuel cell (phosphoric acid type), answer the following:

a) Write the oxidation half-reaction and the reduction half-reaction

b) Write the overall reaction of the cell

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Week (8)

First Period

Classwork

1- In electrolysis, the process is the reverse of that in galvanic cells. Explain this.

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2- When using two platinum electrodes during electrolysis, what happens at the anode in the following cases?

a) The solution contains halide ions

b) The solution contains sulfate ions in an acidic medium

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3- Choose the correct answer:

-All of the following describe electrolysis except:

(a) Electrical energy is converted into chemical energy

(b) The two electrodes can be made of the same material

(c) Only direct electric current is used

(d) Electrical energy can be obtained from it

Homework

1- When is water reduced in an electrolytic cell, and when are hydrogen ions reduced?

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2- What are the products of electrolysis of a dilute sulfuric acid solution?

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3- Choose the correct answer:

-When electrolyzing molten sodium chloride, the following is formed: .....

(a) Hydrogen gas is released at the cathode and chlorine gas at the anode

(b) Sodium collects at the cathode and oxygen gas is released at the anode

(c) Hydrogen gas is released at the cathode and oxygen gas at the anode

(d) Sodium collects at the cathode and chlorine gas is released at the anode

Second Period

Classwork

1- What is meant by a membrane that only positive ions (cations) can pass through?

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2- In the ion-exchange membrane method, what would you expect if iron and carbon were substituted for each other?

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3- Choose the correct answer:

In the ion-exchange membrane method, a highly concentrated sodium chloride solution is used, so chloride ions are oxidized at the anode instead of hydroxide ions because:

(a) The reduction potential of hydroxide is smaller

(b) The concentration of chloride ions is much higher than that of hydroxide ions

(c) Hydroxide is completely incapable of being oxidized

(d) Hydroxide reacts directly with the electrode without oxidation

Homework

1- State the scientific reason: During the electrolysis of silver nitrate using two different electrodes, one of which is silver, the mass of the cathode increases.

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2- During the electrolysis of a concentrated sodium chloride solution using carbon electrodes, answer the following:

a) What happens at both the anode and the cathode?

b) What is the explanation for that?

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3- Choose the correct answer:

In the ion-exchange membrane, ... solution collects at the anode and ..... solution at the cathode

(a) sodium chloride – sodium hydroxide

(b) sodium hydroxide – sodium chloride

(c) containing chloride ions – containing sodium ions

(d) containing hydrogen ions – containing sodium ions

Weekly Assessment (Week 8)
Model - 1

Question 1: Choose the correct answer:

1- In the electrolysis of copper chloride solution, copper ions move toward ..... while chloride ions move toward .....

(a) anode – anode
(b) cathode – cathode
(c) cathode – anode
(d) anode – cathode

2- The cationic exchange membrane is a method for obtaining .....

(a) sodium chloride
(b) sodium hydroxide
(c) sodium nitrate
(d) sodium sulfate

Essay Questions:

1- What are the products of electrolysis at the anode for a solution in a basic medium, and if the medium is changed to acidic, what changes?

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2- In the ion-exchange membrane method, only positive cations are allowed to pass from half-cell ..... to half-cell ..... and positive hydrogen ions are not allowed to pass in the opposite direction because they .....

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3- When electrolysis is performed using inert electrodes such as carbon, the carbon does not participate in the chemical reactions in the cell, while when using two different electrodes, one iron and the other silver, to electrolyze a silver nitrate solution — which one participates in the cell reactions, and what happens at each electrode?

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Week (1)

First Period

Classwork

1- When 1 mol of ice at 0°C is left in an open system, it is found to change into liquid water at 0°C.

Answer the following questions:

(a) Does the kinetic energy of the molecules increase? Why?

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(b) State the scientific name for the amount of heat energy absorbed from the surrounding medium.

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2- Which of the following choices expresses the amount of heat required to melt 9 g of ice at 0°C?

(Given that: heat of fusion of ice = 6.0 kJ/mol, molar mass of water = 18 g/mol)

(a) 6.0 kJ

(b) 3.0 kJ

(c) 12.0 kJ

(d) 9.0 kJ

Homework

1- Write the scientific explanation:

a- Using ice at 0°C for cooling is better than using an equal amount of cold water at the same temperature 0°C.

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b- The temperature of a solid substance does not rise during the melting process, even though it absorbs an amount of heat.

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2- Which of the following expresses the amount of heat needed to completely convert a piece of ice with a mass of 50 g at 0°C into liquid water at the same temperature? (Given that the heat of fusion of ice equals 0.334 kJ/g)

(a) 334 kJ

(b) 3.34 J

(c) 16.7 J

(d) 16.7 kJ

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Model -3

Question 1: Choose the correct answer:

1- During electrolysis, the cations in the solution move toward ..... and the anions in the solution move toward .....

(a) the positive electrode – the negative electrode
(b) the anode – the cathode
(c) the cathode – the anode
(d) the electrode where reduction occurs – the electrode where oxidation occurs

2- In the electrolysis of water in the presence of an electrolyte, ... gas collects at the anode and ..... gas at the cathode

(a) oxygen – hydrogen
(b) hydrogen – oxygen
(c) electrolyte – oxygen
(d) electrolyte – hydrogen

Essay Questions:

1- Compare the electrolysis of sodium chloride in the following cases:

Physical state of the compound	Product at the anode	Product at the cathode
Molten sodium chloride		
Concentrated sodium chloride solution		
Dilute sodium chloride solution		

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2- Compare electrolytic cells and electricity-producing (galvanic) cells in terms of: energy conversions – the charge of the anode and cathode – the electrode where oxidation occurs and the one where reduction occurs

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3- Do elements that precede hydrogen in the reactivity series precede hydrogen, or does hydrogen precede them, in the reduction process? Why?

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Week (9)

First Period

Classwork

1- "When one coulomb of electricity passes, a certain mass of a substance is deposited." What is the scientific term for the above statement?

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2- If the rate law of a certain reaction is:

$v = k[A]^2[B]$

What happens to the reaction rate if the concentration of both [A] and [B] is doubled?

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3- Choose the correct answer:

Which of the following mathematical equations directly expresses the relationship between the mass of deposited substance (m) and the electrochemical equivalent (Z), given the current (I) passing through over a time period (t) .....

(a) I = Zmt

(b) Z = mIt

(c) m = ZIt

(d) m = ZI/t

Homework

1- During the electroplating of a metal key using a silver nitrate solution, what would you expect regarding the mass of the metal key — an increase, decrease, or no change? Explain.

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2- If a constant electric current passes through an electrolytic cell for a certain period of time, a mass of one of the metals is deposited on the electrode.

What happens to the deposited mass of metal if:

a) The current intensity is doubled while the time remains constant?

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b) The time is doubled while the current intensity remains constant?

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3- Choose the correct answer:

When a quantity of electricity of 2 F passes through an electrolytic cell containing molten Al_2O_3, the mass of aluminum deposited is ..... (Al = 27 g/mol)

(a) 54 g (b) 9 g (c) 13.5 g (d) 18 g

Second Period

Classwork

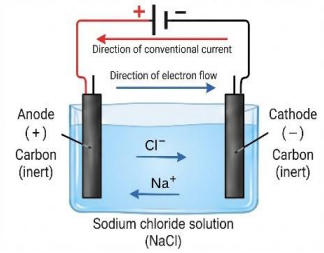
1- For the reaction: $H_2 + I_2 \rightarrow 2HI$

If the rate of disappearance of H_2 equals 0.25 mol/(L·s), calculate the rate of formation of HI.

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2- In an electrolytic cell for a sodium chloride (NaCl) solution, reactions occur at the cathode and anode.

Write the chemical equations for the reactions occurring at each electrode, clarifying the products of the reaction.



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3- Choose the correct answer:

When electrolyzing a $CuSO_4$ solution using copper electrodes, the reaction equation at the cathode is .....

(a) $Cu \rightarrow Cu^{2+} + 2e^-$ (b) $Cu^{2+} + 2e^- \rightarrow Cu$

(c) $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$ (d) $2H_2O \rightarrow H_2 + 2OH^-$

Homework

1- The electrolysis of copper is used to obtain copper of high purity.

- Explain the idea of electrolytic copper refining, clarifying:

a) The type of electrode that represents the impure copper.

b) The type of electrode that represents the pure copper.

c) The direction of movement of copper ions.

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2- If the rate law of a certain reaction is: $v = k[A]^2[B]$

What happens to the reaction rate if only the concentration of [B] is doubled?

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3- Choose the correct answer:

"In any two electrolysis processes, if the quantity of electricity passed is equal, then the masses of the deposited substances are equal." What is the most accurate evaluation of this statement?

(a) Always true

(b) False; because the mass also depends on the type of substance and its electrochemical equivalent

(c) True only if the time is also equal

(d) False; because the mass does not depend on the quantity of electricity

Weekly Assessment (Week 9)
Model - 1

Question 1: Choose the correct answer:

1- In the relation: m = ZIt

If the time increases to three times its value while all other factors remain constant, the deposited mass:

a) decreases to a third

b) doubles

c) becomes three times its value

d) does not change

2- If a current of intensity 5 A passes for 20 s, the quantity of electricity equals:

(a) 25 C

(b) 100 C

(c) 200 C

(d) 400 C

Essay Questions:

1- Compare between the anode and cathode in an electrolytic cell in terms of:

Point of comparison	Anode	Cathode
Sign		
Type of reaction		
Electron movement		

2- What is the scientific explanation for the following statement:

"When two electrolytic cells are connected in series, the quantity of electricity passing through both cells is equal."

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3- If the quantity of electricity passing through an electrolytic cell increases, how would you expect the mass of the deposited substance to change?

Does the mass depend on the quantity of electricity alone, or are there other factors that must be taken into account? Explain.

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4- The concentration of a reactant decreased from 0.70 mol/L to 0.10 mol/L over 20 s. Calculate the average rate of disappearance of the reactant.

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Model -2

Question 1: Choose the correct answer:

1- The mass of the deposited substance during electrolysis is directly proportional to:

(a) electrical resistance only

(b) the quantity of electricity passing through the circuit

(c) potential difference only

(d) the surface area of the electrode only

2- If a current of intensity 2 A passes for 10 min, the quantity of electricity passing equals:

(a) 20 C

(b) 120 C

(c) 1200 C

(d) 600 C

Essay Questions:

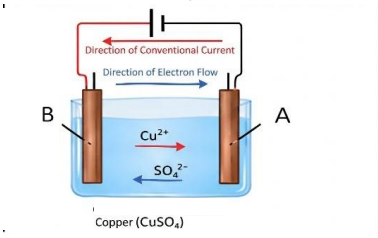
1- What is meant by the electrochemical equivalent (Z) of a substance? Then write the relation by which it can be calculated using molar mass and valency.

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2- In front of you is an electrolytic cell for a $CuSO_4$ solution.

If electrode A is connected to the positive terminal of the current source, and electrode B is connected to the negative terminal:



a) What is the name of electrode A?

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b) What is the name of electrode B?

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c) What type of reaction occurs at A?

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3- If you wanted to design an electrolytic cell to deposit a specific amount of a metal onto the surface of a metallic object, what data would you need to know before operating the cell?

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4- What is meant by the average rate of a reaction? Write the mathematical relation used to calculate it in terms of the change in concentration and the change in time.

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Model -3

Question 1: Choose the correct answer:

1- If the intensity of the current passing through an electrolytic cell is doubled while the time remains constant, the mass of the deposited substance:

(a) decreases to half

(b) does not change

(c) doubles

(d) becomes four times its value

2- When two electrolytic cells are connected in series:

(a) $Q_A > Q_B$

(b) $Q_A < Q_B$

(c) $Q_A = Q_B$

(d) $Q_A = 2Q_B$

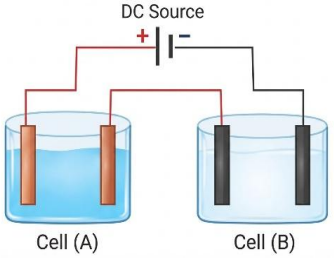
Essay Questions:

1- In an electrolytic cell, a mass of silver amounting to 5.4 g was deposited.
Given that the molar mass of silver M_{Ag} = 108 g/mol ,and the valency of silver = 1, calculate the quantity of electricity required to deposit this mass.

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2- A figure shows two electrolytic cells connected in series.
If the quantity of electricity passing through the first cell is Q_A = 9650 C
calculate the quantity of electricity passing through the second cell.



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3- In an electrolytic cell, a student observed that the mass of one electrode increases while the mass of the other electrode decreases.
What is the explanation for that?

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4- "If the temperature increases by 20°C, the reaction rate only doubles." Is this statement correct according to what you have studied? Explain your answer.

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Week (10)

First Period

Classwork

1- State three factors that affect the rate of a chemical reaction, provided one of them is a factor that comes out of the reaction unchanged as it entered?

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2- Which reacts faster: placing an effervescent tablet in warm water, or in cold water? With explanation

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3- Choose the correct answer:

Yogurt is placed in a warm place for two hours then moved to the refrigerator, the reason is:

(a) Increasing heat decreases the rate of the chemical reaction

(b) Decreasing heat increases the rate of the chemical reaction

(c) Increasing heat increases the rate of the chemical reaction

(d) Cooling increases the surface area, decreasing the reaction rate

Homework

1- What is the relationship between the number of collisions and the concentration of the reactant?

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2- State two examples of the effect of light on a chemical reaction?

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3- Choose the correct answer: Which reacts faster:

(a) Lumps of calcium carbonate with dilute hydrochloric acid

(b) Powdered calcium carbonate with dilute hydrochloric acid

(c) Lumps of calcium carbonate with concentrated hydrochloric acid

(d) Powdered calcium carbonate with concentrated hydrochloric acid

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Second Period

Classwork

1- For a chemical reaction to occur, two conditions must be met. What are they? (In light of the concepts of the transition state and activation energy)

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2- State the scientific reason: In a three-way catalyst, inert metals such as platinum are used, and a honeycomb (cellular) structure is used

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3- Choose the correct answer:

In the adjacent diagram, the difference between the activation energy with a catalyst and without a catalyst is:

(a) The difference between a and b
(b) The difference between b and c
(c) The difference between a and c
(d) The difference between products and reactants

Homework

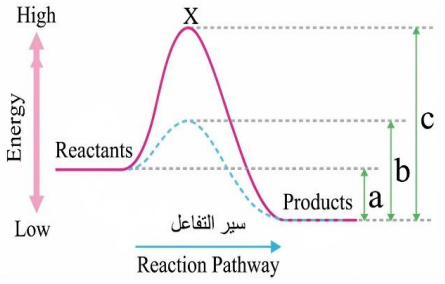
1- Which is greater, and why: the activation energy without a catalyst or with a catalyst present?

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2- What is meant by the transition state? Does reaching it mean the reaction has occurred?

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3- Choose the correct answer: In an exothermic reaction:

(a) The energy of the reactants is less than the energy of the products
(b) The energy of the products is greater than the energy of the reactants
(c) The energy of the products equals the energy of the reactants
(d) The energy of the reactants is greater than the energy of the products

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Weekly Assessment (Week 10)
Model - 1

Question 1: Choose the correct answer:

1- Increasing temperature increases the reaction rate, and the reason is:

(a) More particles are formed
(b) Increase in the number of activated molecules
(c) Increase in activation energy
(d) Decrease in activation energy

2- The catalyst works to:

(a) Increase the temperature of the reaction
(b) Lower the minimum energy required for the reaction to occur
(c) Increase the activation energy
(d) Increase the surface area of the reacting substances

Essay Questions:

1- For a productive reaction to occur, the particles must:

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2- In the case of a reversible exothermic reaction, which is greater and why: the activation energy of the forward reaction or the reverse reaction, with explanation?

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3- Complete: Increasing the concentration of the reactants increases ..... and does not affect the ..... energy, nor the ..... heat of the reaction

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Model- 2

Question 1: Choose the correct answer:

1- In the process of photosynthesis in plants, it is established that ..... is one of the factors affecting the rate of the chemical reaction

(a) Concentration of the substance
(b) Temperature
(c) Light
(d) The catalyst

2- The catalyst in a chemical reaction works to .....

(a) Lower the activation energy only
(b) Increase the number of collisions between the reacting particles only
(c) Both a and b
(d) There is no correct answer

Essay Questions:

1- **Explain: The magnitude of the enthalpy change (ΔH) of a chemical reaction stays the same when the reaction is reversed — only its sign is reversed — while the activation energy changes to a completely different value.**

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2- When 1 gram of calcium powder reacts with 10 ml of concentrated hydrochloric acid, and another reaction with the same volume and concentration of acid but with the mass of calcium powder increased to 2 grams — which is faster, stating the factor responsible for that?

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3- What is the reason for the negative sign when calculating the change in enthalpy for an exothermic reaction?

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Model -3

Question 1: Choose the correct answer:

1- The unit of measurement for the rate of a chemical reaction is .....

(a) g/second
(b) mol/second
(c) molar/second
(d) All of the above

2- As the chemical reaction proceeds, the concentration of the reactants ..... while the concentration of the products .....

(a) increases – increases
(b) increases – decreases
(c) decreases – increases
(d) decreases – decreases

Essay Questions:

1- What is the difference between a homogeneous and a heterogeneous catalyst?

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2- What is the scientific reason: Increasing temperature increases the number of collisions?

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3- When nitrogen and hydrogen gases are compressed into a smaller volume at constant temperature, the reaction rate increases. In your view, what is the reason, in light of the factors affecting the rate of a chemical reaction?

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Week (11)

First Period

Classwork

1- In a sealed transparent vessel, a student places a sample of brown nitrogen dioxide (NO_2) gas; the gas initially appears dark brown. After some time passes, what happens? What is your reasoning for what you observed?

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2- Correct the following statement: In a reversible reaction, it begins with 100% concentration of reactants and ends with 100% concentration of products.

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3- Choose the correct answer:

All of the following describe a complete (irreversible) reaction except:

(a) It proceeds in one direction

(b) No equilibrium state occurs in it

(c) The concentration of products reaches a maximum value

(d) It proceeds in two opposite directions

Homework

1- Compare between a complete reaction and a reversible reaction in terms of: the concentration of reactants and products at the end of the reaction?

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2- One of the two reaction types (complete/reversible) cannot have a precipitate among the products. Which one, and why?

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3- Choose the correct answer:

In the state of chemical equilibrium, the forward and reverse reactions continue to occur

(a) such that the rate of the forward reaction exceeds the rate of the reverse reaction by double

(b) such that the rate of the forward reaction is less than the rate of the reverse reaction by half

(c) such that the rate of the forward reaction equals the rate of the reverse reaction

(d) the reaction ends with only products present

Second Period

Classwork

1- Write the equilibrium law for the following reaction: $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

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2- Given that the concentrations of the reacting and product substances are respectively $[N_2] = 0.2M$, $[H_2] = 0.2M$, $[NH_3] = 0.1M$ at equilibrium, calculate the value of the equilibrium constant for the reaction in the previous question.

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3- Choose the correct answer:

Reaching the state of equilibrium means that:

(a) The concentration of products = the concentration of reactants

(b) The reactants are completely finished and 100% products are reached

(c) The concentrations of both reactants and products remain constant

(d) The reaction has ended

Homework

1- State the scientific reason: Solid substances are not included in calculating the equilibrium constant of a reaction?

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2- What is meant by dynamic chemical equilibrium?

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3- Choose the correct answer: If the equilibrium constant is given by the relation: $K = [A]/[B]^4$, then the unit of measurement of the equilibrium constant equals

(a) $[mol/L]^{-2}$

(b) $[mol/L]^3$

(c) $[mol/L]^2$

(d) $[mol/L]^{-3}$

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Week -11- Assessment

Model 1

Question 1: Choose the correct answer:

1- In the following reaction: $N_2O_4(g) \rightleftharpoons 2NO_2(g)$, the value of KC for the reaction is given by the relation ..... and if the concentration of each gas at equilibrium is $[N_2O_4] = 0.03M$, $[NO_2] = 0.15M$, then the value of the equilibrium constant equals .....

(a) $K_C = [N_2O_4]^2/[NO_2] - 0.9$ (b) $K_C = [N_2O_4]/[NO_2]^2 - 0.6$

(c) $K_C = [NO_2]^2/[N_2O_4] - 0.75$ (d) $K_C = [NO_2]^2/[N_2O_4] - 0.9$

2- The state of chemical equilibrium (equilibrium state): a state in which ..... are equal, and ..... remain constant.

(a) the concentrations of reactants and products – the rate of the forward and reverse reaction

(b) the rate of the forward and reverse reaction – the concentrations of reactants and products

(c) the time of occurrence of the forward and reverse reaction – the masses of the substances

(d) the masses of the reacting and product substances – the times of the forward and reverse reactions

Essay Questions:

1- When 6.00 mol of hydrogen and 3.00 mol of bromine are placed in a 10 L vessel and the vessel is kept at a certain temperature, the following reaction occurs:

$$H_{2(g)} + Br_{2(g)} \rightleftharpoons 2HBr_{(g)}.$$

Upon reaching equilibrium, there are 5.00 mol of hydrogen bromide.

Answer the following questions:

(a) Calculate the equilibrium constant for this reaction to the nearest two decimal places.

(b) When 3.00 mol of hydrogen and 3.00 mol of bromine are placed in the same vessel and kept at the same temperature as in (a), how many moles of hydrogen bromide will form? (Your answer to the nearest two decimal places)

2- Write the equilibrium constant expression in terms of molar concentrations for each of the following reactions:

1- $2K_{(s)} + 2HCl_{(aq)} \rightarrow 2KCl_{(aq)} + H_{2(g)}$ 2- $BaCl_{2(aq)} + 2AgNO_{3(aq)} \rightleftharpoons Ba(NO_3)_{2(aq)} + 2AgCl_{(s)}$

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3- When acetic acid (CH_3COOH) and ethanol (C_2H_5OH) react in the presence of concentrated sulfuric acid as a catalyst, ethyl acetate ($CH_3COOC_2H_5$) and water form, and the system reaches equilibrium.

Answer the following questions to the nearest two decimal places.

$$CH_3COOH_{(aq)} + C_2H_5OH_{(l)} \rightleftharpoons CH_3COOC_2H_{5(aq)} + H_2O_{(l)}$$

When 2.0 mol of acetic acid reacts with 6.0 mol of ethanol, and upon reaching equilibrium there are 1.2 mol of ethyl acetate, calculate the equilibrium constant K for this reaction.

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Model -2

Question 1: Choose the correct answer:

1- The equilibrium constant of a reversible reaction equals exactly one when:

(a) The concentration of reactants = the concentration of products

(b) The concentration of reactants < the concentration of products

(c) The concentration of reactants > the concentration of products

(d) The value of the numerator in the equilibrium law equals the value of the denominator

2- Upon reaching the state of chemical equilibrium, all of the following may occur except:

(a) The concentrations of substances in the reaction become constant

(b) The rates of the forward and reverse reactions become equal

(c) The concentration of the reactants equals the concentration of the products

(d) The reactants are completely used up and only products remain

Essay Questions:

1- When 4.00 mol of hydrogen is added to 3.50 mol of iodine in a 100 L vessel at constant temperature, and at equilibrium there are 6.00 mol of hydrogen iodide. Give your answers to the nearest two decimal places.

$$H_2 + I_2 \rightleftharpoons 2HI$$

(a) Write the equilibrium constant expression for the reaction in terms of molar concentrations.

(b) Calculate the equilibrium constant for this reaction.

(c) When 8.00 mol of hydrogen and 8.00 mol of iodine are placed in the same vessel and kept at the same temperature, how many moles of hydrogen iodide will form?

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2- When gases escape from a chemical reaction, the reaction becomes complete and proceeds in one direction, while the same reaction, if it occurs in a closed vessel, becomes reversible. What is the explanation for that?

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3- When acetic acid (vinegar) reacts with ethyl alcohol, the ester ethyl acetate forms along with water. Suggest a method by which this reversible reaction can be made a complete reaction proceeding in one direction?

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Model -3

Question 1: Choose the correct answer:

1- The reaction in which the vessel contains both reactants and products together is the ..... reaction

(a) exothermic
(b) complete
(c) endothermic
(d) reversible

2- The practical evidence that a reaction has reached the state of equilibrium is .....

(a) The rates of the forward and reverse reactions are equal
(b) The concentrations of the reacting and product substances in the reaction medium remain constant
(c) That it is dynamic
(d) An increase in the concentration of products

Essay Questions:

1- In the reaction of hydrogen and nitrogen gases to form ammonia gas, write the balanced chemical equation for the reaction, then answer the following:

a) Write the equilibrium law for the reaction.

b) Calculate the value of the equilibrium constant if all concentrations of substances equal 0.1M.

c) When 0.2M of each of the nitrogen and hydrogen gases react, what is the concentration of the ammonia gas produced?

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2- When sodium chloride reacts with silver nitrate, a precipitate of silver chloride forms along with a solution of sodium nitrate. Write the chemical equation representing the reaction, then write the equilibrium law for the reaction

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3- Draw the graphs representing the states of chemical equilibrium in which:

a) The concentration of products > the concentration of reactants.
b) The concentration of products < the concentration of reactants.
c) The concentration of products = the concentration of reactants.

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Week (12)

First Period

Classwork

Answer the following questions:

1- In the following equilibrium reaction:

$$H_2 + I_2 \rightleftharpoons 2HI,\ \Delta H = +51\ kJ$$

a) When more hydrogen gas is added, what happens to the amount of hydrogen iodide gas? Why?

b) What happens when the pressure on this reaction is lowered, and why?

2- $X_2 + 3Y_2 \rightleftharpoons 2XY_3,\ \Delta H\ (-)$

a) When the temperature is raised, what happens to the concentration of XY_3 gas? With explanation?

b) When X_2 gas is withdrawn from the reaction space, what happens to the concentration of Y_2 gas, with explanation?

3- Choose the correct answer: From the following reaction:

$$2SO_2 + O_2 \rightleftharpoons 2SO_3,\ \Delta H\ (-)$$

(a) Adding more oxygen gas increases the concentration of SO_3 gas

(b) Raising the temperature drives the reaction toward forming SO_3 gas

(c) Increasing the pressure drives the reaction toward forming O_2 gas

(d) Increasing the volume of the vessel in which the reaction occurs drives the reaction toward forming SO_3 gas

Homework

1- Answer the following questions:

In the following equilibrium reaction: $CH_4 + H_2O \rightleftharpoons CO + 3H_2$

a) When more carbon monoxide gas is added, what happens to the concentration of methane gas? With explanation

b) When the pressure on the reaction is increased, does the reaction proceed in the forward or reverse direction? With explanation

2- $AgCl_{(s)} \rightleftharpoons Ag^+_{(aq)} + Cl^-_{(aq)}$

What happens when a small amount of table salt is added to this reaction? With explanation

3- Choose the correct answer:

In the following reaction: $N_2 + 3H_2 \rightleftharpoons 2NH_3,\ \Delta H\ (-)$

(a) Raising the temperature leads to the formation of more ammonia gas

(b) Lowering the pressure leads to the formation of more ammonia gas

(c) Increasing the concentration of nitrogen gas decreases the concentration of hydrogen

(d) This reaction is not affected by a change in pressure

Second Period

Classwork

Answer the following questions:

1-In the reaction: $2SO_2 + O_2 \rightleftharpoons 2SO_3$

a) What happens when Ar is added at constant pressure? With explanation?

b) What happens when a catalyst is added to this reaction? With explanation?

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2 - This following reaction is in a closed vessel - $2NO_2 \rightleftharpoons N_2O_4$.

-What happens when an inert gas is added in the following two cases:

a) Constant volume

b) Constant total pressure

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3- Choose the correct answer

Based on the equilibrium reaction for ammonia synthesis expressed by the equation:

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

-Which of the following changes leads to an increase in the percentage yield of ammonia

(a) Lowering the temperature and lowering the pressure

(b) Raising the temperature and lowering the pressure

(c) Lowering the temperature and increasing the pressure

(d) Raising the temperature and increasing the pressure

Homework

-Answer the following questions:

1-The following reaction is at equilibrium: $N_2 + 3H_2 \rightleftharpoons 2NH_3$

-What happens:

a) Adding a catalyst? Why?

b) Adding argon gas at constant temperature and total pressure?

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2- H_2 + Br_2 $\rightleftharpoons$ 2HBr, ΔH (–)

Orange red

a) What factors reduce the reddish-orange color

b) What happens when the pressure is increased? Why?

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3- Choose the correct answer In the reaction: $2SO_2 + O_2 \rightleftharpoons 2SO_3$, ΔH (–)

a) Adding more O_2 gas drives the reaction to the left

b) Adding SO_2 increases the concentration of SO_3

c) Increasing the pressure drives the reaction to the left

d) Raising the temperature drives the reaction to the right

Week -12-Assessment

Model 1

Question 1: Choose the correct answer:

1- In the following reaction: $X_2 + Y_2 \rightleftharpoons 2XY, \Delta H (-)$

All of the following affect the position of this equilibrium except:

a) Raising the temperature

b) Lowering the temperature

c) Adding more X_2 gas

d) Increasing the pressure

2- $2SO_2 + O_2 \rightleftharpoons 2SO_3, \Delta H (-)$

Which of the following shifts the reaction toward the formation of SO_3

a) Raising the temperature

b) Lowering the pressure

c) Lowering the temperature

d) Decreasing the concentration of O_2

Essay Questions:

1- $H_2 + Cl_2 \rightleftharpoons 2HCl$

Pressure does not affect the above reaction... state why?

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2- $\underset{\text{colorless}}{H_2} + \underset{\text{violet}}{I_2} \rightleftharpoons \underset{\text{colorless}}{2HI}$

When more hydrogen gas is added, the violet color decreases. state why?

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3- State two factors that do not affect the position of equilibrium?

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Model 2

Question 1: Choose the correct answer:

1- In the following reaction:

$$N_2 + O_2 \rightleftharpoons 2NO, \Delta H (+)$$

-All of the following affect this reaction and increase NO except:

a) Adding more O_2

b) Raising the temperature

c) Lowering the pressure

d) Adding more N_2

2- $2NH_3 \rightleftharpoons N_2 + 3H_2$, ΔH (+)

-Which of the following increases the dissociation of ammonia gas?

a) Lowering the temperature

b) Increasing the pressure

c) Adding a catalyst

d) Lowering the pressure

Essay Questions:

1- What happens when an inert gas is added to an equilibrium reaction at constant temperature and volume: $H_2 + Br_2 \rightleftharpoons 2HBr$

Orange red

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2- When more hydrogen bromide gas is added, the reddish-orange vapors increase. State why? $N_2 + 3H_2 \rightleftharpoons 2NH_3$, ΔH (–)

State three factors that could be used to affect the previous reaction to obtain more ammonia gas?

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3- Compare the effect of raising the temperature on an equilibrium reaction that is exothermic - endothermic

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Model -3

Question 1: Choose the correct answer:

1- In the following reaction: $CO + 2H_2 \rightleftharpoons CH_3OH, \Delta H (-)$

Which of the following factors leads to obtaining more CH_3OH

a) Lowering the pressure

b) Raising the temperature

c) Increasing the volume of the reaction vessel

d) Lowering the temperature

2- $2NO + O_2 \rightleftharpoons 2NO_2, \Delta H (-)$

colorless colorless reddish-brown

-Which of the following factors increases the reddish-brown color

a) Adding a catalyst

b) Adding an inert gas at constant temperature and volume

c) Lowering the pressure

d) Lowering the temperature

Essay Questions:

1- $2SO_2 + O_2 \rightleftharpoons 2SO_3$

What happens when the pressure on the above reaction is increased? Why?

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2-How can the violet color be increased in the following reaction?

$H_2 + I_2 \rightleftharpoons 2HI, \Delta H (-)$

violet

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3-When does adding an inert gas affect an equilibrium reaction?

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Week (13)

First Period

Classwork

-Answer the following questions:

1- You have two solutions equal in concentration, one hydrochloric acid solution and the other sugar solution. ... How can you identify each of them? With explanation?

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2- A weak acid with concentration 0.12M and Ka value equal to 1.06×10^{-5}. Calculate its degree of ionization

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3- Choose the correct answer

Which of the following represents the result of passing hydrogen chloride gas into water?

a) It ionizes completely and conducts electric current weakly

b) It does not ionize and conducts electric current weakly

c) It ionizes completely and conducts electric current strongly

d) It ionizes weakly and conducts electric current weakly

Homework

1- Answer the following questions:

(i) When diluting two solutions equal in concentration, one of sulfuric acid and the other of ammonia, how can you distinguish between each of them? With explanation?

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(ii) A weak base with an ionization constant of 1.04×10^{-4} , and concentration 0.06M, calculate its degree of ionization?

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3-Choose the correct answer: -

When ammonia gas is passed into water -

a) All ammonia molecules are converted into ions

b) Some molecules are converted into ions and it conducts electric current well

c) It exists in the solution only in the form of molecules

d) It exists in a large proportion as molecules and a small proportion as ions

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Second Period

Classwork

Answer the following questions:

1- An acetic acid solution has a concentration of 0.06M and a degree of dissociation of 0.055. Find

a) Its hydrogen ion concentration

b) Its pH

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2- An ammonia solution has a concentration of 0.2M and a and an ionization constant (K_b)1.05×10^{-5}. Find:

a) The hydroxide ion concentration

b) Its pOH

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3-Choose the correct answer:

When the temperature of water is raised:

a) The value of the ionic product of water decreases

b) The ionization of water decreases

c) The value of pH decreases

d) The value of pH increases

Homework

Answer the following questions:

1- A sulfuric acid solution has a concentration of 0.1M. Calculate

a) Its hydrogen ion concentration

b) Its pH value

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2- You have two solutions, one of hydrochloric acid and the other of sulfuric acid, both equal in concentration

a) Which solution conducts electric current better? Why?

b) Which solution has a higher pH, and why?

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3- Choose the correct answer.

If the concentration of each of the following solutions is 0.2M, which of them contains the lowest concentration of hydrogen ions

a) CH_3COOH b) HCl c) NH_4OH d) H_2SO_4

Week -13- Assessment

Model 1

Choose the correct answer:

1-When the temperature of water is raised:

a) The value of KW remains constant

b) The concentration of hydrogen ions decreases

c) The value of pH decreases

d) The value of pH increases

2- A weak acid has a concentration equal to 0.1M and a degree of ionization of 0.02, then the value of its pOH is

a) 1.698

b) 1.23

c) 11.302

d) 12.77

3- Calculate the pH value of an NaOH solution with a concentration equal to 0.1M

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Model- 2

Choose the correct answer

1- When hydrogen chloride gas is passed into water

a) The pH value of the water remains constant

b) The pOH value of the water increases

c) The pH value of the water increases

d) The pOH value of the water remains constant

2- Given that an ammonia solution has a concentration of 0.03M and a degree of ionization of 0.016, then the value of its pH is

a) 1.681

b) 11.681

c) 10.681

d) 3.318

3- Calculate the pOH value of a nitric acid (HNO_3) solution with a concentration equal to 0.2M

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Model -3

1- Choose the correct answer:

-When ammonia gas is passed into water

a) The pH value increases

b) The pOH value increases

c) The concentration of hydrogen ions increases

d) The solution becomes acidic

2- Given that a barium hydroxide ($Ba(OH)_2$) solution has a concentration equal to 0.01M, then its pH value is

a) 7

b) 0.7

c) 11.1

d) 12.3

3- Which has the higher pH value:

A hydrochloric acid solution or a sulfuric acid solution, each with a concentration of 0.01M

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Week (14)

First Period

Classwork

Answer the following questions:

1- When hydrochloric acid (HCl) solution is added to sodium acetate salt (CH_3COONa), acetic acid (CH_3COOH) forms. Based on the concept of "displacement of weak acids," explain why acetic acid does not have the ability to cause the reverse reaction?

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2- Compare the aqueous behavior of each of the ions (HCO_3^-) and (HSO_4^-) in water in terms of the type of ion produced, OH^- or H^+, and the resulting effect on litmus indicator in each case, explaining the reason for the difference despite both being hydrogen salts.

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3- Choose the correct answer:

When a strong acid is added to a salt of a weak acid, the following forms:

a) A salt of a weak acid and a strong acid
b) A salt of a strong acid and a weak acid
c) A salt and an acid, both weak
d) No reaction occurs

Homework

1- Explain with a chemical equation how you can prepare a weak base such as ammonium hydroxide (NH_4OH) using the displacement of bases reaction.

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2- A salt such as ($NaHCO_3$) is chemically classified in its formula as an "acid salt" due to the presence of a hydrogen atom, yet its aqueous solution shows a "basic" effect. Write the (ionic equation) explaining the reaction of the bicarbonate ion (HCO_3^-) with water, which led to the change from the expected acidic property to basic.

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3- Choose the correct answer:

-Which of the following reactions represents the displacement of weak acids?

a) $NaCl + CH_3COOH \rightarrow$

b) $CH_3COONa + HCl \rightarrow$

c) $NH_4Cl + NaOH \rightarrow$

d) $NaCl + H_2O \rightarrow$

Second Period

Classwork

1- State the scientific reason:

(a) Why doesn't the pH value of a buffer solution change significantly when drops of a strong acid or strong base are added to it?

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(b) Why does a buffer solution (such as a mixture of acetic acid and sodium acetate) have the ability to resist changes in pH when a small amount of acid or base is added.

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2- Choose the correct answer:

The ability to resist changes in pH when a small amount of acid or base is added is known as:

a) Hydrolysis
b) Buffering action
c) Chemical equilibrium
d) Complete neutralization

Homework

1- State the scientific reason:

(i) No noticeable increase in $[H^+]$ concentration is observed when an acid is added to a buffer solution composed of acetic acid and sodium acetate.

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(ii) When hydroxide ions (OH^-) are added to the buffer solution (CH_3COOH / CH_3COONa), the pH value remains approximately constant and does not rise significantly.

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2- Choose the correct answer:

Which of the following can be used as a buffer solution?

a) A strong acid and its salt
b) A strong base and its salt
c) A weak acid and its salt, or a weak base and its salt
d) A strong acid and a strong base

Week -14 -Assessment
Model -1

Question 1: Choose the correct answer:

1- In the displacement of weak bases reaction ($NH_4Cl + NaOH \rightarrow NaCl + NH_4OH$), the resulting substance NH_4OH is classified as:

a) A strong base
b) A weak base
c) A strong acid
d) A neutral salt

2- In a buffer solution composed of acetic acid and sodium acetate, sodium acetate exists in the solution in the form of:

a) Non-ionized molecules
b) An escaping gas
c) Fully dissociated ions, CH_3COO^- and Na^+
d) An insoluble precipitate

Essay Questions:

1- Three solutions of unknown salts are given: the first resulting from the reaction of (strong acid + weak base), the second from (weak acid + strong base), and the third from (strong acid + strong base). How can you practically, and without using chemical indicators, but relying only on your understanding of ionization theory and acid formation, predict the behavior of each solution toward litmus paper?

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2- State the scientific explanation:
Why does the bicarbonate ion (HCO_3^-) behave basic while the hydrogen sulfate ion (HSO_4^-) behaves acidic in water, despite both containing a hydrogen atom in their ionic structure?

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3- Write the equation representing the reaction of acetic acid (CH_3COOH) molecules with added hydroxide ions (OH^-), and what results from this reaction?

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Model -2

Question 1: Choose the correct answer:

1- Which of the following chemical formulas represents a normal salt?

(a) $NaHCO_3$

(b) CaCl(OH)

(c) Na_2CO_3

(d) $NaHSO_4$

2- When hydrogen ions (H^+) are added to a buffer solution composed of (CH_3COOH / CH_3COONa), they react with:

a) Water molecules

b) Sodium ions (Na^+)

c) Acetate ions (CH_3COO^-) to form acetic acid molecules

d) Hydroxide ions (OH^-)

Essay Questions:

1- "Any salt whose chemical formula shows a hydrogen (H) symbol must always have an aqueous solution with an acidic effect." Discuss this statement in light of your study of salts such as sodium bicarbonate ($NaHCO_3$), supporting your answer with scientific explanation.

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2- State the scientific reason:

Acetic acid (CH_3COOH) cannot displace hydrochloric acid (HCl) from a sodium chloride solution?

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3- Write the equation representing the reaction of acetate ions (CH_3COO^-) with hydrogen ions added to the buffer solution, and why does the concentration [H^+] not increase noticeably?

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Model- 3

Question 1: Choose the correct answer:

1- The basic effect of a sodium bicarbonate solution is due to the fact that the HCO_3^- ion resulting from ionization reacts with water and forms:

(a) H^+

(b) OH^-

(C) H_3O^+

(d) Cl^-

2- When hydroxide ions (OH^-) are added to the buffer solution (CH_3COOH / CH_3COONa), they react with:

a) Sodium ions

b) Acetic acid (CH_3COOH) molecules to form water molecules

c) Acetate ions

d) Sodium chloride

Essay Questions:

1- What do you expect to happen when sodium hydroxide (NaOH) solution is added to ammonium chloride (NH_4Cl) solution?

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2- State the scientific reason:

-Although the neutralization reaction between a strong acid and a strong base produces a salt and water, adding a salt formed from (a weak acid and a strong base) to water changes the relative concentration of OH^- ions in the solution. What is the source of this increase?

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3- Explain, using equations, the ionization in the aqueous solution of the mixture of acetic acid and sodium acetate used as a buffer solution.

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Week (15)

First Period

Classwork

1-Answer the following questions:

(i) The solubility equilibrium in a saturated solution of a sparingly soluble salt is considered a "dynamic" (kinetic) equilibrium and not a static one, despite no apparent change being observed at the visible level.
Explain the above statement.

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(ii) Write the equation representing the solubility equilibrium of silver chromate, Ag_2CrO_4, in water, and derive the mathematical relation for the salt's solubility product, Ksp.

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2- Choose the correct answer:

-Which of the following represents the state that occurs in a saturated solution in which the rate of dissolution equals the rate of precipitation?

a) Solubility product
b) Solubility equilibrium
c) Hydrolysis
d) Buffer solution

Homework

1- Derive the mathematical formula for calculating the solubility product (Ksp) of a sparingly soluble salt with the formula A_aB_β.

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2- What do you expect to happen to the rate of dissolution and the rate of precipitation when an additional amount of a sparingly soluble salt is added to a solution that has already reached the state of "solubility equilibrium" at constant temperature?

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3- Choose the correct answer:

-Which of the following represents the product of the concentrations of the dissolved ions at solubility equilibrium?

a) The ionic product, K_w
b) The solubility product, K_{sp}
c) The dissociation constant
d) Chemical equilibrium

Second Period

Classwork

1- Whether precipitation will occur in an aqueous solution is determined by comparing the product of the molar concentrations of the ions with the solubility product constant. Explain how this is applied practically.

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2- When two aqueous solutions are mixed, the concentration of barium ions becomes $[Ba^{2+}] = 1.0 \times 10^{-5}$ mol/L and the concentration of sulfate ions $[SO_4^{2-}] = 2.0 \times 10^{-5}$ mol/L.
Does precipitation of barium sulfate occur? Given that the solubility product constant is Ksp = 1.1×10^{-10}

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3- Choose the correct answer:

-Comparing the molar concentrations of ions with the solubility product constant is used to determine whether the following will occur:

a) Chemical equilibrium
b) Precipitation in an aqueous solution
c) Evaporation of the solution
d) Oxidation-reduction

Homework

1- State the scientific reason:

- How can the value of the solubility product constant and the product of the molar concentrations of the ions be used to determine the state of the aqueous solution (no precipitation occurs, precipitation occurs, or equilibrium is established)?

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2- When two aqueous solutions are mixed, the concentration of lead ions becomes $[Pb^{2+}] = 1.5 \times 10^{-4}$ mol/L and the concentration of sulfate ions $[SO_4^{2-}] = 1.0 \times 10^{-4}$ mol/L.
-Does precipitation of lead sulfate occur? Given that the solubility product constant is Ksp = 1.6×10^{-8}

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3- Choose the correct answer:

-Which of the following relations indicates that "precipitation occurs" for silver chromate?

a) $K_{sp} \leq [Ag^+]^2[CrO_4^{2-}]$
b) $K_{sp} > [Ag^+]^2[CrO_4^{2-}]$
c) $K_{sp} = [Ag^+]^2[CrO_4^{2-}]$
d) The concentration of ions equals zero

Week -15 -Assessment

Model -1

Question 1: Choose the correct answer:

1- Which of the following represents the solubility product constant of a sparingly soluble salt?

a) Its value changes with the change in concentrations of the dissolved ions

b) Constant at constant temperature

c) Changes with the change in the amount of precipitated solid salt

d) Constant with changing temperature

2- In a solution of silver chromate, when K_{sp} $[Ag^+]^2[CrO_4^{2-}]$, then:

a) Complete precipitation of the solution occurs

b) Solubility equilibrium is established

c) The salt completely dissociates without reversal

d) The rate of precipitation becomes zero

Essay Questions:

1- State the scientific reason:

(a) The solubility product constant Ksp remains constant regardless of changes in the concentrations of individual ions, but it changes only with temperature.

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(b) The insoluble solid substance does not appear in the mathematical expression for the solubility product Ksp.

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2- When two solutions are mixed to form an aqueous solution containing silver ions $[Ag^+] = 2.0 \times 10^{-4}$ mol/L and chloride ions $[Cl^-] = 1.5 \times 10^{-4}$ mol/L

-Does precipitation of silver chloride occur? Given that the value of its solubility product is:

Ksp = 1.6×10^{-10}

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Model -2

Question 1: Choose the correct answer:

1- The correct mathematical expression for the solubility product of a sparingly soluble salt with the general formula A_aB_β is:

(a) $K_{sp} = [A^{m+}][B^{n-}]$

(b) $K_{sp} = [A^{m+}]^a[B^{n-}]^b$

(C) $K_{sp} = [aA^{m+}][bB^{n-}]$

(d) $K_{sp} = \frac{[A^{m+}]^a[B^{n-}]^b}{[A_aB_b]}$

2- In a solution of silver chromate, when $K_{sp} > [Ag^+]^2[CrO_4^{2-}]$, then:

(a) No precipitation occurs

(b) Precipitation occurs

(c) Solubility equilibrium always occurs

(d) The salt dissolves completely

Essay Questions:

1- When a solution containing free silver ions is added to a saturated solution of silver chromate (Ag_2CrO_4), deduce the resulting effect on the concentration of chromate ions (CrO_4^{2-}) and on the state of equilibrium.

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2- For a salt with the formula A_2B, if you know that the concentration of the positive ion A^+ at equilibrium equals twice the concentration of the negative ion B^{2-}, derive the mathematical formula for calculating Ksp in terms of the concentration of the negative ion only.

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3- When an aqueous solution containing calcium ions [Ca^{2+}] = 4.0 x 10^{-3} mol/L is mixed with a solution containing sulfate ions [SO_4^{2-}] = 2.5 x 10^{-3} mol/L

-Does precipitation of calcium sulfate occur? Given that the solubility product constant is: Ksp = 9.0 x 10^{-6}

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Model -3

Question 1: Choose the correct answer:

1- Upon reaching solubility equilibrium for silver chromate, Ag_2CrO_4, the correct expression for the solubility product is:

(a) $K_{sp} = [Ag^+][CrO_4^{2-}]$

(b) $K_{sp} = [Ag^+]^2[CrO_4^{2-}]$

(C) $K_{sp} = 2[Ag^+][CrO_4^{2-}]$

(d) $K_{sp} = [Ag^+][CrO_4^{2-}]^2$

2- In a solution of silver chromate, when $K_{sp} \leq [Ag^+]^2[CrO_4^{2-}]$, then:

a) Immediate precipitation occurs

b) No precipitation occurs

c) The reaction stops completely

d) No ions remain present

Essay Questions:

1- If the dissolution reaction of a sparingly soluble salt in water is exothermic (ΔH < 0 [negative]), what change occurs in the value of the solubility product Ksp and the concentration of ions when the saturated solution is heated?

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2- The term "solubility product, Ksp" is used for sparingly soluble salts in water, while it is not used for fully soluble salts such as sodium chloride. What is your scientific explanation for the above statement?

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3- When sodium hydroxide is added to an aqueous solution containing magnesium ions so that their concentration becomes $[Mg^{2+}] = 1.0 \times 10^{-3}$ mol/L and the concentration of hydroxide ions $[OH^-] = 2.0 \times 10^{-4}$ mol/L

Does precipitation of magnesium hydroxide occur? Given that its solubility product is: $Ksp = 1.8 \times 10^{-11}$

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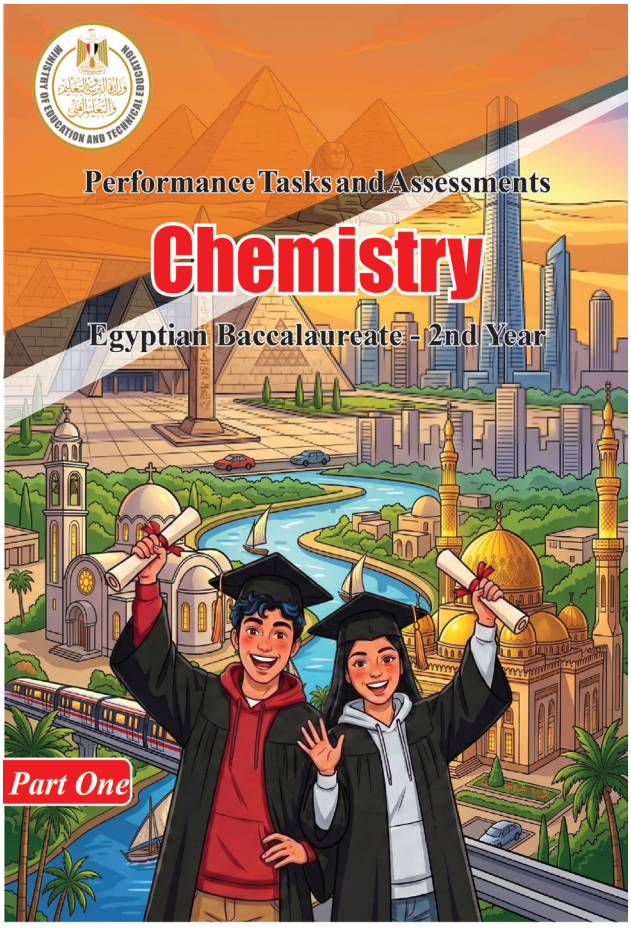
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