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MAINLAND LECTURE CENTER

CHM201: PHYSICAL CHEMISTRY II

There are three states of matter are solid, liquid and _____

Gas

The distinction between the three named states of matter is based on the _____ and their relative rate of motion within a given system

existence of micro properties

According to the _____, gas consists of a large number of molecules or atoms (i.e. submicroscopic particles) that are in constant motion and whose collision with each other and with the wall of the container is responsible for its randomness

kinetic theory

the _____ theory assumes that gas pressure is due to collision impacts of gas molecules (moving at different velocities) on the wall of the container

kinetic

The basic equilibrium properties that can be explained by the kinetic theory of gases are _____

Pressure of a gas, Temperature of a gas, Speed of a gas molecule and Collision number

Gas molecules are subjected to continuous and _____ movement which operates through collision with each other and with the walls of the container.

Rapid

due to their collision, _____ is defined

pressure

The relationship between pressure and volume is given by _____

Boyle's law

the relationship between volume and temperature is given by _____

Charles' law.

Fundamental equations of this nature are called _____

equation of state

Equation of state is a thermodynamic model that relates _____ or more state functions

Two

_____-was the first to develop documented equation of state, which he obtained through series of experiments using J-shaped glass tube to study the variation of the volume of a fixed mass of a gas with pressure (at constant temperature).

Robert Boyle (1662)

Boyle's law states that at constant temperature, the volume of a fixed mass of a gas is _____ proportional to its pressure.

Inversely

_____ law state that at constant pressure, the volume of a given mass of a gas is directly proportional to its absolute temperature

Charles

Dalton law (1801) is concerned about the partial pressure exerted by gases in a _____
mixture

_____ law states that for a mixture of gases which do not react chemically, the total pressure of the gas is the sum of the partial pressures exerted by the individual gases in the mixture **Dalton**

A mixture of 6.5 mol of hydrogen gas and 3.5 moles of oxygen gas were contained in a 3 m³ container at 273 K. Calculate the partial pressure of the individual gases

819.27 Pa

The ideal gas equation was developed by _____

Emile Clapeyron

In 1974, _____ derived an equation of state that can be used to interpret the behaviour of real gases

J. D. Van der Waals

_____ describes a process where particle of one gas is spread throughout another gas by molecular motion

Diffusion

Who discovered that lighter gases diffuse at a faster rate than heavy gases?

Thomas Graham

_____ law states that the rate of diffusion of all gases at constant temperature and pressure is inversely proportional to the square root of its molar mass **grahams law of diffusion**

_____ explains the escape of a molecule through a small hole in a container such that during the escape, there is no collision

Effusion

two gases at the same temperature will have the same _____ energy

kinetic

the _____ is the pressure exerted when an equilibrium is established between the number of particles evaporating and condensing within a given system

Vapour pressure

_____ is a surface process that involves escape of energetic molecules of liquid from the surface

Evaporation

evaporation will increase with _____

increase in temperature

In a _____, the escaping energetic molecules will not be able to get into the atmosphere but will be found above the surface of the liquid.

closed system (such as a closed container)

According to _____, increase in temperature of a dynamic equilibrium favours the forward reaction

Le Chatelier's principle

_____ law states that the pressure or fugacity (i.e. activity) of a single-phase mixture is equal to the mole-weighted sum of the component pressures

Raoult's law

Systems that obey Raoult's law are called _____ while non ideal solutions do not obey

ideal solutions

Deviations from Raoult's law may be _____ when the vapour pressure is higher than the expected

Positive

the _____-liquid boils at a temperature that is much lower than that of either pure components.

Azeotropic

systems with _____ deviations have vapour pressures that are lower than expected Raoult's vapour pressure

negative

The Antoine equation was developed by a French engineer, **Louis Charles Antoine** in _____
1888

_____ equation is a semi empirical equation that describes the relationship between temperature and vapour pressure for pure components.

Antoine

_____ equation shows that a linear relationship exists between logarithm of the vapour pressure and the inverse of temperature (compare this with the Arrhenius equation).

Antoine

When a condensed phase is in equilibrium with its own vapour, equilibrium vapour pressure is _____

Defined

The commonest method of calculating the sublimation pressure (i.e., the vapor pressure) of a solid is based on _____

estimation of the sublimation pressure from extrapolated liquid vapor pressures

A _____ is defined as a form of matter that is homogenous in a chemical composition and physical state

Phase

There are _____ types of phases

three

The number of degrees of freedom of a phase is the number of _____ variables which are dependent of each other

Intensive

There are two types of materials equilibrium which are phase equilibrium and _____

reaction equilibrium

_____ refers to the transport of matter between phases (solid, liquid, or gas) of the system without conversion of one species to another.

Phase equilibrium

The crossing of any two-phase curve in a phase diagram is called a _____

Transition

A _____ is a graphical presentation of what phases are in existence at various pressures and temperatures.

phase diagram

The region where the three phases co-exist in equilibrium is called _____

triple point

The _____ point defines the temperature and pressure, beyond which gases can no longer be compressed

triple

The _____ states that the number of degrees of freedom of a system in equilibrium is equal to the number of components minus the number of phases plus the constant two

phase rule

_____ is the pressure exerted when the number of energetically active molecules escaping from the surface of the liquid through evaporation is balanced by those returning to the liquid through condensation

Vapour pressure

The word thermodynamics is coined from two words; thermo, meaning _____ and dynamics, meaning _____

Heat, motion

thermodynamics literally means _____

heat in motion

_____ is the study of heat change accompanying chemical and physical changes

Thermodynamics

The _____ thermodynamics is therefore a branch of thermodynamics that study heat change accompanying chemical reactions

Chemical

The beginning of thermodynamics dates back to _____

1865

Thermodynamic system is the part of the universe chosen for _____ study

Thermodynamic

The commonest types of work that are associated with a chemical reaction are electrical and _____
expansion work

_____ can also be derived from chemical reactions and passed to their surroundings when the volume of the system expands

Work

The amount of work of expansion done by the reaction is equal to the product of the pressure (against which the system expands) and the change in the volume of the system. This type of work is called _____

pressure volume work

Thermodynamic systems can be classified into _____ major groups

Two

A _____ function describes the property of a system that depends only on the initial and final states of the system and not on the path that the system takes to arrive at that state.

State

examples of state functions are internal **energy, enthalpy, entropy, free energy**

Thermodynamic process is defined when there is an _____ change within the system

Energetic

Thermodynamic processes can be grouped into three major classes, namely _____

Pressure-volume, Temperature-entropy, Chemical potential-particle number

_____ is concerned with the transfer of mechanical or dynamic energy as the result of work

Pressure-volume

An _____ process occurs at constant pressure

Isobaric

An _____ process is a process that is carried out at constant volume

Isochoric

isochoric process is also called _____

isometric or isovolumetric

An _____ process is a process which occurs at a constant temperature

Isothermal

An _____ process is a system which is thermally insulated from its environment and its boundary is a thermal insulator

adiabatic

An _____ process is a process that is carried out at constant entropy

Isentropic

In thermodynamics, a _____ process is a process whose direction can be reversed by means of infinitesimal changes in some properties of the system.

Reversible

A _____ process is a sequence of processes that leaves the system in the same state in which it started.

Cyclic

For a cyclic process, its initial and final internal energies are _____
equal.

the total internal-energy change in any cyclic process is _____
zero

A _____ is a region of the system in which each intensive property (such as temperature and pressure) has at each instant either the same value throughout (homogeneous phase), or else a value that varies continuously from one point to another (heterogeneous phase).

Phase

An _____ is a surface where two different phases meet

Interface

A uniform phase is said to be isotropic if _____
exhibiting the same values of these properties in all directions

The first law of thermodynamics is sometimes called _____
the law of conservation of energy

_____ law can be stated as *The change in internal energy of a system, when heat is absorbed will lead to work done by the system or against the system.*

first law of thermodynamics

_____ refers to the transfer of energy across the boundary caused by a temperature gradient at the boundary
Heat

_____ refers to the transfer of energy across the boundary caused by the displacement of a macroscopic portion of the system on which the surroundings exert a force, or because of other kinds of concerted, directed movement of entities (e.g., electrons) on which an external force is exerted.

Work

_____ is the heat absorbed at constant pressure.

Enthalpy

_____ is a state function and can be represented as, $H = U + PV$ **enthalpy**

The _____ of a closed system is defined as the ratio of an infinitesimal quantity of heat transferred across the boundary under specified conditions and the resulting infinitesimal temperature change

heat capacity

_____ experiment attempts to measure the extent of deviation of the behaviour of a real gas from ideality

Joule-Thompson

Joule Thompson process is carried out at constant _____ (i.e adiabatic process) which implies that the work done will be equal to the change in internal energy

heat change

A _____ reaction is a reaction that can take place on its own without any external aid.

Spontaneous

An _____ process is a spontaneous process that can not be reversed

Irreversible

The major thermodynamic functions obtained from the first law of thermodynamics are internal energy and _____

Enthalpy

_____ energy is a state function obtained at constant volume but most chemical reactions are carried out at constant pressure, which implies that internal energy can not be a unique data for predicting the spontaneity of a chemical reaction

Internal

_____ is the heat absorbed at constant pressure

Enthalpy

Enthalpy change can lead to an exothermic or _____ reaction

Endothermic

_____ is defined as a measure of the degree of disorderliness of a system

Entropy

a system gets more disordered as the entropy increases and becomes more ordered as the entropy _____

decreases

The second law of thermodynamics can be stated as _____

The entropy of a natural system increases and tends toward a maximum

The entropy change, dS of an irreversible change of a closed system obeys the following inequality, , where dq is the amount of heat transferred to the system and T is the absolute temperature.

It is impossible to construct a device whose only effect, when it operates in a cycle, is heat transfer from a body to the device and the transfer by heat of an equal quantity of energy from the device to a warmer body.

A _____ process operates through sequence of processes such that the state of the system remains unchanged at the end of the processes

Cyclic

from the first law of thermodynamics, it can be stated that the work done by a cyclic process is _____ to the heat absorbed

equal

A _____ is any device that can transform heat into work or mechanical energy

heat engine

All the heat engines operate through the following consecutive steps which are _____

Absorption of heat from a source at a relatively high temperature called hot reservoir Performance of some mechanical work

Discard of heat at a lower temperature called the cold reservoir

Refrigerator and air conditioner are example of heat engines operating in reservoirs

The Carnot cycle consists of four different processes which are two isothermal processes and _____

two adiabatic processes.

The thermal efficiency of a heat engine such as the Carnot cycle is defined as _____
 w/q_2

At constant volume, the free energy is called _____ and its denoted by A
Helmoltz free energy

The second law of thermodynamics deals with _____ change of a system

Entropy

The four stages involved in the Carnot cycle are isothermal expansion, adiabatic expansion, isothermal compression and _____

adiabatic compression.

The second law of thermodynamics is often called the _____
law of entropy

The third law of thermodynamics was developed between 1906 and 1912, by _____

Walther Nernst

_____law clarifies that the entropy change of a system at absolute zero is a well defined constant because at absolute zero, the system is in its ground state

third law of thermodynamics

_____law states not only ΔS will reach zero at 0 K, but S itself will also reach zero as long as the crystal has a ground state with only one configuration

Gilbert Lewis and Merle Randall

the _____of thermodynamics states that the entropy of a perfect crystal of a pure substance approaches zero as the temperature approaches zero

third law

the Limitations of the third law of thermodynamics are namely;

Glassy solids even at 0K has entropy greater than zero.

Solids having mixtures of isotopes do not have zero entropy at 0K. For instance, entropy of solid chlorine is not zero at 0K.

Crystals of CO, N₂O, NO, H₂O, etc. do not have perfect order even at 0 K thus their entropy is not equal to zero.

The _____law of thermodynamics states that "If two thermodynamic systems are each in thermal equilibrium with a third, then they are in thermal equilibrium with each other." **Zeroth**

The _____can be defined as the rate of change of concentration of the reactant or the product

rate of a chemical reaction

A _____reaction is characterised by a non dependency of the rate of the reaction on concentration

zero order

The _____of a chemical reaction is the time taken for the concentration of the reactant to be reduced by half its initial value

half life

A _____reaction is a one in which the rate of reaction is proportional to the concentration of the reactant raised to the power of unity

first order

Increase in the rate of a chemical reaction will be accompanied by _____

increase in the rate constant

_____suggested that reaction occurs when molecules collide and that not all collision leads to chemical reaction

Arrhenius

The collision that leads to chemical reaction are called _____

effective collision.

According to _____, the fraction of molecules having energy, equal to or greater than the activation energy

Boltzmann equation

The transition state theory was developed in the 20th century by _____

Eyring

According to the _____, a reaction forming a product, first forms an intermediate which is in thermodynamic equilibrium with the molecules of the reactant

transition state theory

_____ is the number of molecules that react in an elementary reaction and is numerically equal to the sum of the stoichiometric coefficients of reactants in the elementary reaction.

Molecularity of a reaction

A reaction is said to be **unimolecular**, **bimolecular** or **termolecular** when one, two or three molecules come together to form products respectively

A _____ reaction occurs when a single molecule rearranges its atoms to produce one or more products

Unimolecular

The basic theory in explaining the mechanism of a unimolecular reaction was proposed by _____

Frederick Alexander Lindemann (1922)

The _____ law states that the velocity of a chemical reaction is proportional to the concentration of the reactants (the proportionality constant in this case is the rate constant). **law of mass**

the _____ is the study of the rate of chemical reactions or processes.

Chemical kinetics

Chemical kinetics can be viewed in terms of macroscopic and _____ components

Microscopic

In the _____ level, the amount of reactant that has reacted or the amount of product formed as well as the rate of their formation/consumption are considered

macroscopic

The specific heat of silver is $0.0565 \text{ cal/g}^\circ\text{C}$. Assuming no loss of heat to the surroundings or to the container, calculate the final temperature when 100 g of silver at 40°C is immersed in 60 g of water at 10°C .

12.6 °C

Calculate the ΔH° value of the reaction: $\text{HCl} + \text{NH}_3 \rightarrow \text{NH}_4\text{Cl}$. ΔH° values for HCl, NH_3 and NH_4Cl are -92.30, -80.29 and -314.4 respectively

-141.8

Which of the following statements about enthalpy is incorrect?

Enthalpy and internal energy of a system are always identical

enthalpy is a state function

ΔH is the enthalpy change at constant pressure Reactions which absorb heat have a positive ΔH

Which of these followings would lead to an increase in the internal energy of a system?

Work done on the system Work

done by the system Loss of heat

from the system

Adiabatic expansion of the system

One mole of an ideal gas is heated at a constant pressure of 101300 N m^{-2} , from 273.2 K to 373 K . Calculate the work involved $R = 8.314 \text{ J/mol/K}$.

8.314 J/mol

83.14 J/mol

831.4 J/mol

8314 J/mol

If a gas absorbs 1000 J of heat and expands by 0.5 dm^3 against a constant pressure of 4 atm ($1 \text{ atm} = 100000 \text{ Pa}$), then the change in internal energy is approximately

800 J

Which of the following expressions is associated with the law of conservation of energy?

$dE = q + w$

The first law of thermodynamics deals with

conservation of energy

The molar heat capacity of Al is $24.4 \text{ J/mol/}^\circ\text{C}$. How much heat energy is required to heat 100 g of Al from 20°C to 80°C ? (Al = 27)

5422 J

Which of these is true of an isochoric system? Takes

place at constant temperature

Heat is allowed into the system but not allowed out of the system

Volume remains constant

Pressure is not constant

The common-ion effect is _____

promotes condensation promotes

evaporation. increases solubility

reduces ionization.

Which of these is incorrect about the pH of a solution? It is a

measure of the acidity of the solution

The higher the pH, the more acidic the solution is

$$\text{pH} = -\log[\text{H}^{\{+\}}]$$

an alkali has a higher pH value than an acid

the magnitude of K_w indicates that _____

water autoionizes only to a very small extent

A substance that is capable of acting as both an acid and as a base is _____

Amphoteric

A Brønsted-Lowry acid is defined as a substance that _____

acts as a proton donor

What is the conjugate base of HCO_3^- ?

CO_3^{2-}

For the following reaction, which of the following is a conjugate acid-base pair? $\text{H}_2\text{PO}_4^- (\text{aq}) + \text{NH}_3 (\text{aq}) \rightarrow \text{HPO}_4^{2-} (\text{aq}) + \text{NH}_4^+ (\text{aq})$

H_2PO_4^- and HPO_4^{2-}

A Brønsted-Lowry base is defined as a substance that

acts as a proton acceptor

In the following reaction, which is a Brønsted-Lowry base? $\text{HC}_2\text{O}_4^- (\text{aq}) + \text{H}_2\text{O} (\text{l})$

$\rightarrow \text{H}_3\text{O}^+ (\text{aq}) + \text{C}_2\text{O}_4^{2-} (\text{aq})$

H_2O

For the following reaction, which of the following is a conjugate acid-base pair? $\text{HC}_2\text{O}_4^- (\text{aq}) + \text{H}_2\text{O} (\text{l}) \rightarrow \text{H}_3\text{O}^+ (\text{aq}) + \text{C}_2\text{O}_4^{2-} (\text{aq})$

HC_2O_4^- and $\text{C}_2\text{O}_4^{2-}$

A statement of the second law of thermodynamics is that

the entropy of the universe is continually increasing.

Which of the following involves a decrease in entropy?

the sublimation of carbon dioxide the

dissolution of NaCl in water the

evaporation of ethanol

the freezing of liquid water into ice

Thermodynamics can be used to determine all of the following EXCEPT the direction in which a reaction is spontaneous.

the extent to which a reaction occurs.

the rate of reaction.

the temperature at which a reaction is spontaneous.

If a chemical reaction has a positive change in entropy, ΔS , then
the disorder of the system increases.

If the reaction $A + B \rightleftharpoons C$ has an equilibrium constant greater than one, which of the following statements is correct?
The reaction is product favoured.

The heat of combustion for 1 mole of carbon to carbon dioxide is -410 kJ. How many kJ of heat would be liberated from the complete combustion of 60.0 g of carbon?
-2050 kJ

Use the equations to answer the question. $2A + B \rightarrow A_2B$ $\Delta H = -217.3$ kJ; $B + C \rightarrow BC$ $\Delta H = -867.5$ kJ. What is the value of ΔH for the reaction $2A + BC \rightarrow A_2B + C$?
650.2 kJ

What does it mean if the ΔH value for a chemical reaction is positive?
reactants have less potential energy than products.

Which process is exothermic? the
boiling of liquid nitrogen **the**
freezing of water
the sublimation of dry ice the
vaporization of water

The temperature remains constant as energy is added to a substance. How may the substance be changing?
From a liquid to a gas

Powdered marble reacts more rapidly with HCl than the chips of marble because:
Surface area of powdered marble is more than that of chips of marble and hence there are more collisions between the molecules of reactants

In the reaction: $2B \rightarrow \text{Product}$; the rate equation is: $\text{Rate} = k[B]$. If the concentration of B is doubled, the rate of reaction will increase by a multiple of
Two

Rusting of iron is an example of _____ reaction
Slow

In a reaction: $2A \rightarrow B + 2C$, which of the statements is true? Rate of formation of B = Rate of disappearance of A
Rate of formation of C = Rate of formation of B
Rate of disappearance of A = Rate of formation of C
Rate of disappearance of A = Rate of formation of B

The reactions catalyzed by sunlight are called _____ reactions

Photochemical

The reactions with the high value of energy of activation are

Slow

The minimum additional energy, above the average internal energy, which the reacting molecules must possess so that their collision result in a reaction is known as _____

Activation energy

For a reaction: $2\text{H}_2 + 2\text{NO} \rightarrow 2\text{H}_2\text{O} + \text{N}_2$ the rate law is $R = k [\text{H}_2][\text{NO}]^2$ The Order of the reaction is?

3

Milk sours more rapidly in summer than in winter because_

in summer, the temperature is high due to which effective collisions increase and hence the rate of reaction becomes fast

Which of the following statements about the kinetics of the reaction $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{HBr}(\text{g})$ is definitely true?

The reaction is first order with respect to bromine, Br_2 The reaction is second order overall.

The presence of hydrogen bromide, HBr , inhibits the rate of the reaction

It is not possible to determine anything about the kinetics of the reaction from the stoichiometry.

In a reaction in which the rate of the reverse reaction is equal to the rate of the forward reaction, a state of _____ is attained.

dynamic equilibrium

If a process is exothermic and not spontaneous, then what must be true?

$\Delta S > 0$

$\Delta S < 0$

$\Delta H > 0$

$\Delta G = 0$

A reaction with a negative value of ΔG is said to be _____

Spontaneous

Every type of chemical bond contains a certain amount of energy. The total bond energy, which is essentially equivalent to the total potential energy of the system, is a quantity known as: **enthalpy**.

Predict the signs of ΔH and ΔS for the evaporation of water at 35°C .

$\Delta H > 0$ and $\Delta S > 0$

$\Delta H > 0$ and $\Delta S < 0$

$\Delta H < 0$ and $\Delta S > 0$
 $\Delta H < 0$ and $\Delta S < 0$

Calculate the standard entropy change for the following reaction, $2 \text{Ag}_2\text{O}(s) \rightarrow 4 \text{Ag}(s) + \text{O}_2(g)$; given $S^\circ[\text{Ag}_2\text{O}] = 121.3 \text{ J/K}\cdot\text{mol}$, $S^\circ[\text{Ag}(s)] = 42.6 \text{ J/K}\cdot\text{mol}$, and $S^\circ[\text{O}_2(g)] = 205.1 \text{ J/K}\cdot\text{mol}$.

+132.9 J/K

All of the following processes lead to an increase in entropy EXCEPT increasing the temperature of a gas.

freezing a liquid.

evaporating a liquid.

forming mixtures from pure substances.

All of the following statements concerning entropy are true EXCEPT

entropy is zero for elements under standard conditions.

entropy is a state function.

a positive change in entropy denotes a change toward greater disorder. entropy values are greater than or equal to zero.

Of the following product-favoured processes, which are endothermic? 1. the combustion of methane to produce water and carbon dioxide. 2. the expansion of an ideal gas. 3. the melting of ice at temperatures greater than 0°C .

1 only

2 only

3 only

2 and 3

For the following system at equilibrium, what will cause the partial pressure of HF to increase?



adding $\text{UF}_4(g)$

A beaker with a mixture of ice and water is maintained at equilibrium: $\text{H}_2\text{O}(s) + \text{heat} \rightleftharpoons \text{H}_2\text{O}(l)$; If the temperature of the system is decreased:

Ice melts to form liquid water (shift to the right)

When extra NH_3 is added to the following system at equilibrium: $3\text{H}_2(g) + \text{N}_2(g) \rightleftharpoons 2 \text{NH}_3(g)$, what happens?

In order to restore equilibrium, the reaction shifts left, toward reactants

The reaction below is exothermic: $2\text{SO}_2(g) + \text{O}_2(g) \rightleftharpoons 2\text{SO}_3(g)$. Le Chatelier's Principle predicts that _____ will result in an increase in the number of moles of SO_3

(g) in the reaction container

increasing the pressure

Equilibrium is a state of dynamic molecular behaviour, meaning that
reactants turn into products and products turn into reactants at equal rates

In general, the rate of a reaction can be increased by all the factors except

Increasing the activation energy

Increasing the temperature

Increasing the concentration of reactants Using a catalyst

The factor that affects the rate of reaction is

Temperature of the reactants

Nature and concentration of the reactants Catalyst

All of these

The rate of chemical reaction _____

Decreases as the reaction proceeds

Rate of reaction is defined as the _____

Rate of change of concentration Of either reactant or product per unit time

The term $\frac{dx}{dt}$ in the rate expression refers to the

Change in concentration of the reactants with time

The conjugate base of HCl is

Cl^-

Which of the followings is not a Bronsted acid?

AlCl_3

The pH of a solution is 4.6; what is its pOH?

9.4

The pH of a neutral solution is_

7

How long would a constant current of 18.0 amperes be required to flow in order for 9000. coulombs of charge to pass through a cell

500 s

How many coulombs of charge pass through a cell if 2.40 amperes of current are passed through the cell for 85.0 minutes?

12200 C

What's the concentration of Ag^+ ion in a saturated silver chloride solution? $K_{\text{sp}} = 1.56 \times 10^{-10}$.

0.0000125 M

Buffering is:

due to LeChatelier's Principle

is a process that is done by a solution made up of a weak acid and its salt influenced by the common ion effect

all of these

Which of the following mixtures produces a buffer solution?

0.300 M NaOH + 0.100 M HCl (50 mL each)

0.300 M KNO_3 + 0.100 M NaCl (50 mL each)

0.300 M NH_4Cl + 0.100 M HCl (50 mL each)

0.400 M CH_3COOH + 0.100 M CH_3COONa (50 mL each)

Consider the equilibrium of AgCl(s) in water. What is the effect of adding KCl?

The reaction goes to the left

A process taking place at constant pressure is termed _____?

Isobaric

A process in which no heat is allowed to enter or leave a system is termed _____??

Adiabatic

the zeroth law of thermodynamics is based on the concept of _____

thermodynamic equivalence

Which of the following is not a state function?

Work

43.4 kcal of heat is required to decompose 2 mole of mercury(II) oxide according to the equation $2\text{HgO(s)} \rightarrow 2\text{Hg(l)} + \text{O}_2\text{(g)}$. What quantity of energy is required to decompose 10.8 g of HgO ? ($\text{Hg} = 200.59$, $\text{O} = 16$)

1.09 kcal

Which of these is not an extensive property of a system?

Density

Which of the following statements is correct?

temperature is an intensive property while heat is an extensive property

only exchange of matter with the surrounding is possible

only exchange of energy with the surrounding is possible

exchange of both matter and energy with the surrounding is possible

Which of the following statements describes an isolated system?

No exchange of matter and energy with the surrounding is possible

only exchange of matter with the surrounding is possible
only exchange of energy with the surrounding is possible

exchange of both matter and energy with the surrounding is possible

Which of the followings is not a type of system?

Intensive

Closed Open

Isolated

Which of these does not depict thermodynamics? Performance of car engine

Rate of reaction

Melting of ice

Boiling water for coffee

The _____ law of thermodynamics discusses entropy.

Second

The conjugate acid of H_2O is H_3O^+ is _____ (True or False)?

True

The _____ scale of temperature has absolute zero for its zero point

Kelvin

_____ is the amount of heat required to melt one gram of substance at its melting point.

latent heat of fusion

The pH of an aqueous solution which is 0.0020 M HClO_4 is _____

2.7

For a reversible system at constant temperature the value of K_c increases if the concentration are changed at equilibrium. (true or false)

true

Free energy change at equilibrium is _____

zero

Only _____ substances can undergo electrolysis.

(ionic or electrovalent)

If more collisions can be made to take place in a given time, the rate of the reaction will _____

Increase

In order for a reaction to occur, the particles must _____
collide

A high pH value means that the solution has a low concentration of $H^{+}(aq)$ ions-
_(True/false)
True

If the rate of a reaction increases by a factor of 9 when the concentration of a reactant is tripled, then the reaction is _____ order with respect to that reactant.
second

If a hypothetical rate law is $rate = k[A]^2[B]^2$ what is the overall reaction order?
4

The temperature at which the motion of particles theoretically ceases is known as _____ zero.
Absolute

For a first order reaction, the rate of the reaction doubles as the concentration of the reactant(s) doubles (true or false)
true

There are _____ laws of thermodynamics
Four

_____ Variables are dependent on the mass of the material
extensive

_____ Variables are independent of the mass of material
intensive

_____ system is a system in which both energy and matter can exchange with the surroundings.
Open

The rate at which a substance takes part in a chemical reaction depends upon its _____
concentration

Conductivity is inversely proportional to the degree of ionization of a weak electrolyte (true or false)
false

A solution of a weak acid and its salt is known as a _____ solution
buffer

According to the Bronsted-Lowry theory a base is an electron acceptor. (true or false)
false

In any Bronsted-Lowry acid-base equilibrium, there are invariably acid-base pairs. (true or false)
True

A catalyst makes a reaction more exothermic _____ (true or false)

false

Rate of reaction generally _____ with the raise in temperature

Increases

The sum of all exponents of concentration terms in the rate equation is called _____

order

Rivers flowing from mountain to field shows decrease in entropy..(true or false)

false

For a spontaneous reaction ΔG is _____

Negative

During fusion, the entropy of the system (increases or decreases)

increases

1 mole of an ideal gas is heated at a constant pressure of 101.3 KPa, from 273.2 K to 373 K. The work involved is _____ J. ($R = 8.314 \text{ J/mol/K}$)

831.4 J

1 g of ice will occupy _____ space than 1 g of water (less/more)

Less

In a closed system, heat neither leaves nor enters. _____ (true or false)

false

The energy required to cook your meals is an extensive property (true or false)

True

Refractive index is an intensive property _____ (true or false)

True

The entropy of a pure crystal at 0 K is _____ J/K.

0

For any process, the change in entropy of the universe equals the sum of entropy changes to the system and the _____

surroundings

The change in entropy for any process is not dependent upon the pathway by which the process occurs. In other words, the change in entropy for any process is a _____ function

state

The total energy of the universe is constant. This is a statement of the _____ law of thermodynamics

First

The time required for a constant current of 18.0 amperes to flow in order for 9000 coulombs of charge to pass through a cell is _____

500 s

The higher the pH, the _____ the acidity

Lower

A substance that is capable of acting as both an acid and as a base is _____

Amphoteric

The conjugate base of HCl is _____

chloride ion

A Brønsted-Lowry base is defined as a substance that acts as a _____ acceptor

Proton

The rate law for a reaction is $\text{Rate} = k[A][B]$. The overall order of the reaction is _____

Two

Increase in pressure will lead to an increase in the rate of all types of reactions. (true or false)

False

In the reaction: $2B \rightarrow \text{Product}$; the rate equation is: $\text{Rate} = k[B]$. If the concentration of 'B' is doubled, the rate of reaction will increase by a multiple of _____

Two

A reaction catalyzed by light is called a _____ reaction

Photochemical

The minimum additional energy, above the average internal energy, which the reacting molecules must possess so that their collision result in a reaction is known as _____

Activation energy

The entropy change in the freezing of water is positive; (True or false)

False

If $\Delta H^\circ = +119 \text{ kJ}$ and $\Delta S^\circ = +263 \text{ J/K}$, the temperature at which the reaction becomes spontaneous is _____ K

452

In a reaction in which the rate of the reverse reaction is equal to the rate of the forward reaction, a state of _____ is attained.

Dynamic equilibrium

A reaction with a negative value of ΔG is said to be _____

Spontaneous

Every type of chemical bond contains a certain amount of energy. The total bond energy, which is essentially equivalent to the total potential energy of the system, is a quantity known as: **enthalpy**

The first law of thermodynamics deals with conservation of energy

Law

A process taking place at constant pressure is termed _____

Isobaric

A process in which no heat is allowed to enter or leave a system is termed _____

Adiabatic

The zeroth law of thermodynamics is based on the concept of _____

thermodynamic equivalence

The law of thermodynamics discusses entropy

Second

1 g of ice will occupy _____ space than 1 g of water (less/more)

Less

The energy required to cook your meals is an extensive property; (true or false)

True

Refractive index is an intensive property _____

True

The entropy of a pure crystal at 0 K is _____ J/K

0

A beaker with a mixture of ice and water is maintained at equilibrium: $\text{H}_2\text{O(s)} + \text{heat} \rightleftharpoons \text{H}_2\text{O(l)}$; If the temperature of the system is decreased: _____

Ice melts to form liquid water (shift to the right)

In order to restore equilibrium, the reaction shifts left, toward reactants

The reaction below is exothermic: $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$. Le Chatelier's Principle predicts that _____

will result in an increase in the number of moles of $\text{SO}_3(\text{g})$ in the reaction container.

increasing the pressure Equilibrium is a state of dynamic molecular behaviour, meaning that _____

reactants turn into products and products turn into reactants at equal rates

In general, the rate of a reaction can be increased by all the factors except _____

Increasing the activation energy

Increasing the temperature

Increasing the concentration of reactants Using a catalyst

The factor that affects the rate of reaction is _____

Temperature of the reactants

Nature and concentration of the reactants Catalyst

All of these

Milk sours more rapidly in summer than in winter because _____

in summer, the temperature is high due to which effective collisions increase and hence the rate of reaction becomes fast

Calculate the ΔH° value of the reaction: $\text{HCl} + \text{NH}_3 \rightarrow \text{NH}_4\text{Cl}$ ΔH° values for HCl, NH_3 and NH_4Cl are -92.30, -80.29 and -314.4 respectively

-141.8

Which of the following expressions is associated with the law of conservation of energy? $dG = dH - TdS$

$q = mCdT$ **$dE =$**

$q + w$ $H = E +$

PV

The first law of thermodynamics deals with _____

conservation of energy

The molar heat capacity of Al is $24.4 \text{ J/mol}^\circ\text{C}$. How much heat energy is required to heat 100 g of Al from 20°C to 80°C ? (Al = 27) 5422 J

Which of these is true of an isochoric system? Takes

place at constant temperature

Heat is allowed into the system but not allowed out of the system

Volume remains constant

Pressure is not constant

Which of the following is not a state function? Enthalpy

Entropy

Work

free energy

The minimum additional energy, above the average internal energy, which the reacting molecules must possess so that their collision result in a reaction is known as _____

Activation energy

Which of these is not an extensive property of a system?

Density

Mass'

Volume

Energy

Which of the following statements is correct?

Temperature is an extensive property while heat is an intensive property **temperature is an intensive property while heat is an extensive property** both temperature and heat are intensive properties

both temperature and heat are extensive properties

Which of the following statements describes an isolated system?

No exchange of matter and energy with the surrounding is possible

only exchange of matter with the surrounding is possible only exchange of energy with the surrounding is possible

exchange of both matter and energy with the surrounding is possible

Which of the followings is not a type of system? Closed

Open

Intensive

Isolated

Thermodynamics deals essentially with one of these
process of change

chemical systems

controlled chemical reactions

variables

Which of these is not correct about a system.

system can be complicated as a rocket shooting towards the moon

system is homogenous if physical properties and chemical composition are not identical throughout the system

system may be heterogenous depending on its contents and conditions A

system may be as simple as a gas contained in a closed vessel

The rest of the universe around a system is described as _____

Surroundings

A _____ system is one that exchanges neither energy nor matter with its surroundings.

isolated

A _____ allows for exchange of energy (heat or work) with the surroundings, but matter is not allowed to enter or leave it.

closed system

The temperature at which the Joule-Thomson coefficient is zero for a gas is called _____

inversion temperature

A heat input of 40.59 kJ is required to vapourise 1 mole of water at 101.3 kN m^{-2} pressure at 373.15K.

What is the energy change for the process?

$37.49 \text{ kJ mol}^{-1}$

When a gas kept in a cylinder expands isothermally and irreversibly, against a constant pressure

temperature does not change during the process

Which of these is not correct about adiabatic expansion. temperature of the system decreases. The heat capacity has a zero value ΔT and ΔE are negative.

internal energy increases

From the first law of thermodynamic; $\Delta U = q + W$. The sign of W is positive when heat absorbed leads to increase in _____.

internal energy

For an adiabatic change, the heat absorbed or given off; is

Equal to zero

When molecules of gas collide with each other, the change in momentum is

Equal to zero

: What is the kinetic energy of an ideal gas occupying a volume of 32.4 dm^3 at stp ($p = 101325 \text{ Pa}$)

4924.40 Nm

What is the kinetic energy of an ideal gas occupying a volume of 32.4 dm^3 at stp ($p = 101325 \text{ Pa}$)

4924.40 Nm

The macroscopic property of gases which the kinetic theory explains include the following except

Pressure

When the pressure of a gas is lowered; its density is _____

Increased

The relationship between pressure and volume gas is given by _____ law

Boyle's

90 cm³ gas syringe contain 70 cm³ of gas was compressed to 45 cm³. If the atmospheric pressure is 1 atm, calculate the pressure of the gas in the syringe after compression

1.56 atm

The average kinetic energy of a gas is a measure of the _____ of that gas

Absolute temperature

Within the liquid system, the more energetic particles/molecules are found _____

On the surface liquid/particles

At the normal boiling point of a liquid, the prevailing vapour pressure of the liquid is _____ the ambient atmospheric

pressure

Equal to

The Raoult's law can be used to estimate _____ of liquid in a mixture

No of moles

System with negative deviations have vapour pressure that are _____ expected Raoult's vapour pressure

Equal to

Thermodynamic property which depends on the quantity of matter in the system is known as

extensive

Ice is a good example of a _____ phase system

2

There are _____ types of material equilibrium

Two

The transport of matter between phases of system without conversion of one species to another is known as

Phase equilibrium

In a phase diagram, the crossing of any two-phase curve is called a

Transition

In an isochoric process, the work done is equal to

0

There are _____ equilibrium on the phase diagram of water

Three

The change from solid to vapour is known as

Sublimation

On phase diagram, the region where three phases co-exist in equilibrium is called _____ point

Triple

The temperature and pressure beyond which gases can no longer be compressed is known as

Critical point

The phase diagram of carbon (iv) is known to display a triple point which is above _____

Atmospheric pressure

At which pressure is it likely to have liquid carbon (iv) oxide

5.11 atm

The phase diagram of water displays a triple point which is _____ atmospheric pressure

Below

The phase diagram of carbon (iv) oxide shows _____ phases

Three

An isobaric process occurs at _____

Constant pressure

When the vapour pressure and the prevailing atmospheric pressure are equal, the associated temperature is the _____ of that liquid

Boiling point

Thermodynamics is the study of heat change accompanying
Chemical and physical reactions

An entropy is a thermodynamic process which is carried out at constant
internal energy

.....equilibrium is attained when rate of sublimation of solid equals the rate of deposition of its vapour phase
Solid vapour

Thermodynamic system is usually separated from the surroundings by the _____
Boundary

When the volume of a thermodynamic system expands work is generated against it's
Surroundings

The equation $C_p = C_v + R$ is heat capacity at constant pressure from equation it means, that
 C_p is always greater than C_v by an amount equal to the gas constant

The 4 basic equilibrium properties that can be explained by the kinetic theory of gas are
Temperature, pressure speed of gas molecule and collision number

The findings of Gay-Lussac /Jacques Charles on the relationship between the volume of gas and its temperature is that there exist a ____
Linear relationship between volume and temperature

The total pressure of a mixture of gases is equal to the sum of the partial pressures of the gases in the mixture. This assertion is presumed based on the fact that ____
The gases do not react chemically with each other

The ideal gas equation and the parameters in it are these ____
 $PV=nRT$ P= pressure, V= volume, n=no of moles, R= gas constant, T= absolute temperature

A given gas mixture consist of n mole of nitrogen nN_2 and n mole of Oxygen nO_2 . The total pressure of the mixture is P_T . The equations for the partial pressure of nitrogen and oxygen in the mixture respectively are
 $(nN_2 / nN_2 + nO_2) P_T$; $(nO_2 / nN_2 + nO_2) P_T$

Equation of state is a dynamic model
that relates two or more state functions

For cases when the intermolecular forces among the particles of a gas is not negligible, the ideal gas equation can be modified for such cases, as shown below
 $PV=(P+a/V^2) (V-b) = RT$ (for 1 mole)

The difference between evaporation and boiling is that
Evaporation is a surface process while boiling involves

Evaporation process, when equilibrium is reached the forward reaction converts liquid to vapour and the reverse reaction involves the reconversion of vapour to liquid. The forward reaction is endothermic because
Heat is needed to convert liquid to vapour

Boiling of liquid occurs when the prevailing vapour pressure of the liquid is
Equal to the ambient atmospheric pressure

In an ideal mixture of liquids, the partial pressure of each component in the mixture is equal to the vapour pressure of the pure component
Multiplied by its mole fraction in the mixture

The Raoult's law states that the pressure of fugacity or a single phase mixture is equal to the
Mole weighted sum of the component pressure

Raoult's law is most applicable to non- electrolytes and non-polar molecules because
Their molecules have weak intermolecular attraction

Deviation from Raoult's law is positive when vapour pressure is
Higher than expected Rault's vapour pressure

Negative deviation from Raoult's law is to the fact that
Stronger intermolecular attraction exists between constituents of the mixture than exists in the pure components

The significance of the positive and negative deviations from Raoult's law is they can be used for determination of the
The thermodynamic activity of coefficients of the constituents of the mixtures

Solid vapour equilibrium is attained
when rate of sublimation of solid equals the rate of deposition of its vapour phase

In a typical phase diagram of water, the critical point defines the
Temperature and pressure beyond which gases can no longer be compressed

On the phase diagram of carbon (iv) oxide, the triple point is found to be above atmospheric pressure (5.11atm). This implies that
It is not possible to have liquid Carbon (iv) oxide at pressure less than (5.11atm)

The mathematical expression of the phases rule is $F = C - P + 2$, where F is the degree of freedom. F represents the
Environmental conditions which can be varied without changing the number of phases in the system

Chemical thermodynamics study the heat change accompanying chemical reactions. The major objectives of chemical thermodynamics is to establish conditions needed for
Predicting the feasibility of chemical reactions, phase change and solution formation

A system does not allow exchange of matter, heat or work with the surrounding. It means
The mass and total energy of the system will remain constant over time

A state function refers to the property of a system
Which depends only on the initial and final states of the system

An isochoric process, is a process that is carried out at constant value
The work done is zero since change in volume is zero

An adiabatic process is a system which is thermally insulated from its environment and its boundary is a thermal insulator. This implies
Energy is neither added or subtracted from the system

A cyclic process is a sequence of processes that leaves the system in the same state in which it started. This implies that
The total internal energy change in cyclic process is zero

The first law of thermodynamics is sometimes called the law of conservation of energy because
it accounts for the input and output energies when a system does work

The three significant parameters in the first law of thermodynamics are
Work, heat and internal energy

An ideal gas undergoing isothermal expansion is characterized by a constancy of temperature. Hence the internal energy is
Equal to zero

The collision of the molecules of gas is elastic, this implies, the collision
does not involve loss of energy

Energy and volume are examples of _____ property
extensive

The slowest step in any chemical reaction is
Rate limiting step

Molecularity of a reaction
As numerically equal to the sum of stoichiometric coefficients of reactants in elementary reaction

The effect of temperature on the rate of a chemical reaction, it accepted that reaction rate doubles for every _____
rise in temperature
10°C