Sriram Pendyala

Science Bowl

Science Bowl Chemistry Questions: 25 Toss-ups and Bonuses

1. Toss-up: Chemistry: Multiple Choice: A process by which gas molecules escape through a tiny hole in a membrane without collisions is called

W. Boyle’s Law

X. diffusion

Y. effusion

Z. deviation

ANSWER: Y  
Bonus: Chemistry: Multiple Choice: Using Graham's Law of Effusion, which of the following is the correct ratio between the rate of effusion of molecular Hydrogen and Helium gas at 25 °C?

W. 1:

X. :1

Y. 1:2

Z. 2:1

ANSWER: X

1. Toss-up: Chemistry: Multiple Choice: Which of the following four choices has four substances ranked in order of increasing boiling point?

W. H2O < Ar < Cl2 < BrCl

X. BrCl < Ar < Cl2 < H2O

Y. Ar < BrCl < H2O < Cl2

Z. Ar < Cl2 < BrCl < H2O

ANSWER: Z

Bonus: Chemistry: Multiple Choice: Which of the following is an INCORRECT statement about colligative properties in ideal solutions?

W. They depend on the solvent.

X. They depend on the type of solute.

Y. They depend on the number of solute particles.

Z. They depend on temperature.

ANSWER: X

1. Toss-up: Chemistry: Multiple Choice: Which of the following noble gases should show the greatest deviation from the ideal gas law at high pressures and low temperatures?

W. He

X. Ar

Y. Xe

Z. All deviate equally.

ANSWER: Y

Bonus: Chemistry: Multiple Choice: Some assumptions from the Kinetic Molecular Theory of Gases are listed below. Which one is most frequently cited to explain Charles law?

W. The average kinetic energy of gas particles is directly proportional to the Kelvin temperature.

X. Collisions of gas particles are elastic and total kinetic energy of the gas is constant.

Y. A gas consists of tiny particles moving in random straight line motion.

Z. The volume of the particles is negligible compared to the volume of the gas.

ANSWER: W

1. Toss-up: Chemistry: Multiple Choice: Assume the following substance are mixed in equal parts in aqueous solution. Which of the following solutions would not exhibit properties characteristic of a buffer?

W. Sodium phosphate monobasic and Sodium phosphate dibasic

X. Ammonia and Ammonium Chloride

Y. Acetic Acid and Sodium Acetate

Z. Nitric Acid and Sodium Nitrate

ANSWER: Z

Bonus: Chemistry: Multiple Choice: Which of the following buffers is based on respiration and metabolism, and exists in the blood to regulate blood pH?

W. H3PO4\H2PO4-

X. H2CO3\HCO3-

Y. HNO3\NO3-

Z. .H2C2O4\HC2O4-

ANSWER: X

1. Toss-up: Chemistry: Multiple Choice: Which of the following is expected to have the largest dipole moment?

W. H2

X. CO2

Y. KCl

Z. CH2O

ANSWER: Y

Bonus: Chemistry: Multiple Choice: The layer of graphite are held together by:

W. Covalent bonds

X. dipole-dipole forces

Y. London dispersion forces

Z. Ionic bonds

ANSWER: Y

1. Toss-up: Chemistry: Multiple Choice: The approximate O-S-O bond angle in SO2 is which of the following?

W. 90

X. 105

Y. 120

Z. 180

ANSWER: Y

Bonus: Chemistry: Multiple Choice: Of the following choices of molecules or polyatomic ions, which one has sp2 hybridization of the central atom?

W. PH3

X. CO32-

Y. ICl3

Z. I3-

ANSWER: X

1. Toss-up: Chemistry: Multiple Choice: Why does fluoride treatment render teeth more resistant to tooth decay?

W. fluoride kills the bacteria in the mouth that make the acids that decay teeth

X. fluoride stimulates production of tooth enamel to replace that lost to decay

Y. fluoride dissolves plaque, reducing its decaying contact with teeth

Z. fluoride converts hydroxyapatite to fluorapatite that is less reactive with acids produced by decay

ANSWER: Z

Bonus: Chemistry: Multiple Choice: Why does the upper atmosphere contain only very little dissociated nitrogen?

W. most of the nitrogen is in the troposphere and not in the upper atmosphere

X. the dissociated nitrogen very rapidly diffuses out of the atmosphere and into space

Y. nitrogen atoms are extremely reaction and so react with other substances immediately upon their formation

Z. the bond energy of nitrogen is very high and it does not absorb radiation very effectively

ANSWER: Z

1. Toss-up: Chemistry: Multiple Choice: In a common alkaline dry cell battery, the powder in the anode is:

W. Zinc

X. KOH

Y. Iron

Z. MnO2

ANSWER: W

Bonus: Chemistry: Multiple Choice: In use of a lead storage battery, the electrodes are consumed. In such a battery,

W. the anode is Pb

X. the anode is PbSO4

Y. the anode is PbO2

Z. the cathode is Pb

ANSWER: W

1. Toss-up: Chemistry: Multiple Choice: An equilibrium constant with a large magnitude, much greater than 1, indicates that a system favors which of the following at equilibrium?

W. reactants

X. products

Y. neither reactants nor products

Z. the equilibrium constant is not indicative of reactant and product concentrations at equilibrium

ANSWER: X

Bonus: Chemistry: Short Answer: In the reaction: Ni(s) + 4 CO(g) → Ni(CO)4 (g), the metal-ligand compound Nickel tetracarbonyl is formed, whose high volatility at room temperature and toxicity have earned it its name "liquid death". Find the equilibrium constant for this reaction.

ANSWER: Accept or

1. Toss-up: Chemistry: Multiple Choice: Which of the following processes is used to create much of the US's sulfuric acid, and uses vanadium pentoxide as a catalyst?

W. Mond process

X. Haber process

Y. Contact Process

Z. Acid process

ANSWER: Y

Bonus: Chemistry: Multiple Choice: Which of the following is the name of the industrial process for the extraction of Sulfur from the ground?

W. Mond Process

X. Haber Process

Y. Sulfur Process

Z. Frasch Process

ANSWER: Z

1. Toss-up: Chemistry: Multiple Choice: Of the following substances, which is the most volatile at STP?

W. CBr4

X. CCl4

Y. CF4

Z. CH4

ANSWER: Z

Bonus: Chemistry: Multiple Choice: Which process occurring during solution formation between Ammonium Nitrate and Water is exothermic?

W. Separation of solute particles

X. Separation of solvent particles

Y. Interaction of solvent with solute

Z. Melting of Solvent Particles

ANSWER: Y

1. Toss-up: Chemistry: Multiple Choice: Which of the following ions below has is isoelectric with, having the same electron configuration as, a noble gas?

W. Li2+

X. Be2+

Y. B2+

Z. N2-

ANSWER: X

Bonus: Chemistry: Multiple Choice: Which of the following is the electron configuration for the S2-, or Sulfide, ion?

W. [Ar] 3s23p6

X. [Ar] 3s23p2

Y. [Ne] 3s23p6

Z. [Ne] 3s23p2

ANSWER: Y

1. Toss-up: Chemistry: Multiple Choice: In general, the solubility of this state increases in water as temperature decreases.

W. solid

X. liquid

Y. gas

Z. plasma

ANSWER: Y

Bonus: Chemistry: Multiple Choice: As the concentration of a solute in a solution increasese, the freezing point of the solution \_\_\_\_\_\_\_ and the boiling point of the solution \_\_\_\_\_\_\_\_\_.

W. decreases, decreases

X. increases, increases

Y. increases, decreases

Z. decreases, increases

ANSWER: Z

1. Toss-up: Chemistry: Multiple Choice: Which of the following halogen oxyacids is the strongest in aqueous solution?

W. HClO

X. HClO2

Y. HClO3

Z. HClO4

ANSWER: Z

Bonus: Chemistry: Which of the following is a diprotic acid?

W. H3PO4

X. H3PO3

Y. H3PO2

Z. H3P

ANSWER: X

1. Toss-up: Chemistry: Multiple Choice: The man scientific difficulty in achieving a controlled fusion process is the

W. enormous repulsion between nuclei being fused

X. enormous repulsion between the electrons of atoms being fused

Y. very large number of positrons emitted

Z. very large number of x-rays and gamma rays emitted

ANSWER: W

Bonus: Chemistry: Multiple Choice: Which one the following devices converts radioactive emissions to light for detection by using the phosphor Zinc Sulfide?

W. Geiger Counter

X. Photographic Film

Y. Scintillation Counter

Z. Gamma Detector

ANSWER: Y

1. Toss-up: Chemistry: Multiple Choice: The primary use of nitric acid is:

W. manufacture of plastics

X. manufacture of explosives

Y. dissolution of gold and silver for electroplating

Z. manufacture of fertilizers

ANSWER: Z

Bonus: Chemistry: Multiple Choice: The end use of mined phosphate rock is predominantly:

W. as a strong acid

X. as a strong reducing agent

Y. detergents

Z. fertilizer

ANSWER: Z

1. Toss-up: Chemistry: Multiple Choice: What scientist won the Nobel Prize in Chemistry in 1920 for his work on the thermodynamics of chemical reactions and his discovery of the third law of thermodynamics, and has a famous electrochemical named after him used to calculate the emf of a galvanic cell?

W. Erwin Schrodinger

X. Max Planck

Y. Walther Nernst

Z. Henrick Lorentz

ANSWER: Y

Bonus: Chemistry: Multiple Choice: Cathodic protection of a metal pipe against corrosion usually entails:

W. attaching an active metal to make the pipe the anode in an electrochemical cell

X. coating the pipe with another metal whose standard reduction potential is less negative than that of the pipe

Y. attaching a dry cell to reduce any metal ions which might by formed

Z. attaching an active metal to make the pipe the cathode in an electrochemical cell

ANSWER: Z

1. Toss-up: Chemistry: Multiple Choice: Which of the choices below is not characteristic of a metallic solid?

W. excellent thermal conductivity

X. variable melting point

Y. extreme brittleness

Z. variable hardness

ANSWER: Y

Bonus: Chemistry: Multiple Choice: The solid silicon carbide, SiC, occurs naturally, but rarely, in the mineral moissanite, and has a Mohs hardness number of 9.5, compared to 10 for diamond. Why is silicon carbide have such an excellent hardness?

W. It has sheets of strong, sigma bonded carbons

X. It has covalent bonds running in 3 dimension throughout the solid

Y. It is an ionic solid, and forms Silicon and Carbide ions

Z. It crystallizes in a body-centered cubic lattice

ANSWER: X

1. Toss-up: Chemistry: Multiple Choice: In which of the following is the central atom of the species d2sp3 hybridized?

W. PCl3

X. PCl5

Y. XeF4

Z. XeF6

ANSWER: Y

Bonus: Chemistry: Multiple Choice: Using the molecular orbital theory, determine the bond order of N22+.

W. 0

X. 1

Y. 2

Z. 3

ANSWER: Y

1. Toss-up: Chemistry: Multiple Choice: Which of the following products is NOT formed by the explosion of nitroglycerin?

W. H2

X. N2

Y. H2O

Z. CO2

ANSWER: W

Bonus: Chemistry: Multiple Choice: Dynamite consists of nitroglycerine mixed with which of the following?

W. potassium nitrate

X. damp potassium hydroxide

Y. TNT

Z. diatomaceous earth

ANSWER: Z

1. Toss-up: Chemistry: Short Answer: Which transition metal is part of the electron-transfer molecules called cytochromes in the respiratory chain?

ANSWER: Fe (Iron)

Bonus: Chemistry: Short Answer: What orbital is being filled in the Lanthanide series?

ANSWER: 4f

1. Toss-up: Chemistry: Short Answer: This substance in nuclear reactors slows down neutrons in a reactor so the fuel can capture them more efficiently.

ANSWER: moderator

Bonus: Chemistry: Short Answer: This refers to the potential energy of a particular nucleus as compared to the sum of potential energies of its component nucleons.

ANSWER: Thermodynamic stability

1. Toss-up: Chemistry: Short Answer: A catalyst works by changing what aspect of a reaction ?

ANSWER: Activation Energy

Bonus: Chemistry: Short Answer: This is the name of the unstable substance present at the top of the activation energy hill that can seldom be isolated by itself.

ANSWER: Transition State (DO NOT ACCEPT: intermediate)

1. Toss-up: Chemistry: Short Answer: The point in a titration at which exactly enough strong base has been added to react with all of the acid present is called the what?

ANSWER: equivalence point, stoichiometric point

Bonus: Chemistry: Short Answer: At the halfway point in an weak acid-strong base titration, the pH of the solution equals what?

ANSWER: pKa of the acid (-log Ka)

1. Toss-up Chemistry: Short Answer: A reaction system reaches equilibrium when what state function reaches its minimum?

ANSWER: Gibbs Free Energy

Bonus: Chemistry: Short Answer: Given that a liquid boils at 100K and absorbs 1000J per mole of liquid vaporized at this temperature, find its entropy of vaporization.

ANSWER: 10 J/K