

# CHEMISTRY

## 1. CHEMISTRY

### Toss Up: Multiple Choice

What form of hybridization is found in Sulfur Hexafluoride?

- W)  $sp^3$
- X)  $sp^3d^2$
- Y)  $sp^3d^3$
- Z)  $sp^4d^3$

Toss Up Answer: Y

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### Bonus: Multiple Choice

Which of the following amino acids is aromatic?

- W) Tryptophan
- X) Glutamic Acid
- Y) Methionine
- Z) Lysene

Bonus Answer: W

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## 2. CHEMISTRY

### Toss Up: Multiple Choice

Which of the following is the ionic charge of the Dimercury ion?

- W)  $1+$
- X)  $0$
- Y)  $2+$
- Z)  $1-$

Toss Up Answer: Y

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### Bonus: Short Answer

What is the electron configuration of Iron(III)?

Bonus Answer:  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$

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## 3. CHEMISTRY

### Toss Up: Short Answer

What is the name of the elements in Group 16?

Bonus Answer: Chalcogens (Accept: Chalcogen)

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### Bonus: Short Answer

When Carbonic acid is created, it always decomposes into:

Bonus Answer: Dihydrogen Monoxide and Carbon Dioxide (Accept:  $H_2O$  and  $CO_2$ , Water and  $CO_2$ )

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## 4. CHEMISTRY

### Toss Up: Short Answer

What is the chemical formula of Thiocyanate?

Bonus Answer:  $SCN^-$  (Read as: SCN minus)

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### Bonus: Multiple Choice

Which of the following is the name of an isotope of Hydrogen?

- W) Protium

- X) Hydronium
- Y) Kydronium
- Z) Zirconium

**Bonus Answer: W**

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## 5. CHEMISTRY

**Toss Up: Short Answer**

What feature of a chemical species allows it to act as a ligand in a complex ion?

**Bonus Answer: It has a lone pair of electrons that can act as a Lewis base. (Accepts: Has electrons that act as a Lewis Base, Acts as a Lewis base)**

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**Bonus: Multiple Choice**

Which of the following ionic solutions is colorless?

- W) Cu(2+)
- X) Ni(2+)
- Y) Mn(7+)
- Z) Zn(2+)

**Bonus Answer: Z**

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## 6. CHEMISTRY

**Toss Up: Short Answer**

Which elements are in the liquid state at room temperature?

**Bonus Answer: Bromine and Mercury (Accept: Br and Hg)**

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**Bonus: Multiple Choice**

In a gaseous, exothermic reaction, which of the following changes makes no difference to the position of equilibrium?

- W) Change of Temperature
- X) Adding more reactants
- Y) Adding a catalyst
- Z) Removing products

**Bonus Answer: Y**

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## 7. CHEMISTRY

**Toss Up: Short Answer**

How many different structures can Formic Acid (HCO<sub>2</sub>H) form?

**Bonus Answer: Two (2)**

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**Bonus: Short Answer**

What is the pH of a Ca(OH)<sub>2</sub> solution with Calcium(2+) concentration of  $5.0 \times 10^{-6}$ ?

**Bonus Answer: 9.00 (Accept: Nine)**

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## 8. CHEMISTRY

**Toss Up: Multiple Choice**

- w
- W) f
- X) a
- Y) a

Z) a

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

- a
- W) w
- X) w
- Y) w
- Z) w

**Bonus Answer: X**

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## 9. CHEMISTRY

**Toss Up: Short Answer**

What is  $K_{sp}$  for  $W$ ?

**Bonus Answer:  $1.0 \times 10^{-14}$**

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**Bonus: Multiple Choice**

Which of the following acids is not diprotic?

- W) Sulfuric Acid
- X) Oxalic Acid
- Y) Carbonic Acid
- Z) Citric Acid

**Bonus Answer: Z**

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## 10. CHEMISTRY

**Toss Up: Short Answer**

Order the following by the strength of their intermolecular forces, from strongest to weakest. 1. Methane, 2. Chloromethane, 3. Water, 4. Ethanol

**Bonus Answer: 3, 4, 2, 1**

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**Bonus: Short Answer**

What does naphthalene smell like?

**Bonus Answer: Mothball, insect killer, mold killer**

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## 11. CHEMISTRY

**Toss Up: Multiple Choice**

Which electronic transition requires the addition of the most energy?

- W)  $n=1$  to  $n=3$
- X)  $n=5$  to  $n=2$
- Y)  $n=2$  to  $n=3$
- Z)  $n=4$  to  $n=1$

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

Which of the following is FALSE?

- W) The 4d orbitals are in the fourth period of the periodic table.

- X) The 7s orbitals are in the seventh period of the periodic table.
- Y) The 4f orbitals are in the sixth period of the periodic table.
- Z) The 6s orbitals are spherical in shape.

**Bonus Answer: W**

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## 12. CHEMISTRY

**Toss Up: Multiple Choice**

Most elements in the periodic table are

- W) metals
- X) nonmetals
- Y) liquids
- Z) gases

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

In which of the following pairs of elements is the element with the lower boiling point listed first?

- W) Na, Cs
- X) Te, Se
- Y) P, N
- Z) Ba, Sr

**Bonus Answer: Z**

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## 13. CHEMISTRY

**Toss Up: Multiple Choice**

An electron is also called this in nuclear reactions.

- W) Alpha particle
- X) Positron
- Y) Gamma Ray
- Z) Beta Particle

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

In which of the following are nuclear particles listed in order of increasing penetrating power?

- W) Alpha particles < beta particles < neutrons
- X) Beta particles < alpha particles < neutrons
- Y) Neutrons < alpha particles < beta particles
- Z) Beta particles < neutrons < alpha particles

**Bonus Answer: W**

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## 14. CHEMISTRY

**Toss Up: Multiple Choice**

Which of the following is a correct formula?

- W)  $\text{KH}_2\text{PO}_4$
- X)  $\text{CaC}_2\text{H}_3\text{O}_2$
- Y)  $\text{Na}_2\text{ClO}_4$

Z)  $\text{Ba}(\text{CO}_3)_2$

**Toss Up Answer: W**

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**Bonus: Short Answer**

What is the formula for the iodate ion?

**Bonus Answer:  $\text{IO}_3^-$**

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## 15. CHEMISTRY

**Toss Up: Multiple Choice**

Which compound, made from the indicated pairs of ions, will be insoluble?

W) Iron (III) and phosphate ion

X) Bromide ion and ammonium ion

Y) Calcium ion and bromide ion

Z) Bromide ion and iron (III)

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

When the combustion reaction for benzene is properly balanced with the smallest whole-number coefficients, the sum of the coefficients is

W) 15

X) 12

Y) 35

Z) 17.5

**Bonus Answer: Y**

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## 16. CHEMISTRY

**Toss Up: Multiple Choice**

Which of these molecules has the most pi bonds?

W) HCN

X)  $\text{PF}_5$

Y)  $\text{NH}_3$

Z)  $\text{SO}_3$

**Toss Up Answer: W**

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**Bonus: Short Answer**

What name should be given to a molecule with the formula  $\text{N}_2\text{O}_5$ ?

**Bonus Answer: dinitrogen pentoxide**

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## 17. CHEMISTRY

**Toss Up: Multiple Choice**

Sulfur forms the following compounds:  $\text{SO}_2$ ,  $\text{SOCl}_2$ , and  $\text{SO}_3^{2-}$ . Which form of hybridization is NOT represented by these molecules?

W) sp

X)  $\text{sp}^2$

Y)  $\text{sp}^3$

Z) None of these

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

Which of the following is least related to the strength of a covalent bond?

- W) vibrational frequency
- X) bond order
- Y) bond length
- Z) bond direction

**Bonus Answer: Z**

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**18. CHEMISTRY****Toss Up: Multiple Choice**

Compared to ideal gases, real gases tend to have

- W) larger volumes
- X) lower average kinetic energies
- Y) lower pressures
- Z) Both (W) and (Y)

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

A gas has a density, at STP, of  $3.48 \text{ g L}^{-1}$ . The most reasonable formula for this compound is

- W)  $\text{C}_2\text{H}_6$
- X)  $\text{C}_6\text{H}_6$
- Y)  $\text{CCl}_4$
- Z)  $\text{CaF}_2$

**Bonus Answer: X**

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**19. CHEMISTRY****Toss Up: Multiple Choice**

Which element is expected to have the greatest polarizability?

- W) Fe
- X) Ca
- Y) Ne
- Z) S

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

A student observed that a small amount of acetone sprayed on the back of the hand felt very cool compared to a similar amount of water. Your explanation of this phenomena should be that

- W) all organic compounds do this
- X) acetone has a lower viscosity and transfers heat quanta better
- Y) water has a higher heat capacity than acetone, therefore retaining more heat
- Z) the higher vapor pressure of acetone results in more rapid evaporation and heat loss

**Bonus Answer: Z**

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**20. CHEMISTRY**

**Toss Up: Multiple Choice**

Diamond is classified as

- W) a covalent crystal
- X) an ionic crystal
- Y) a molecular crystal
- Z) a metallic crystal

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

A liquid substance that exhibits low intermolecular attractions is expected to have

- W) low viscosity, low boiling point, and low heat of vaporization
- X) high viscosity, low boiling point, and low heat of vaporization
- Y) low viscosity, high boiling point, and low heat of vaporization
- Z) low viscosity, low boiling point, and high heat of vaporization

**Bonus Answer: W**

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**21. CHEMISTRY**

**Toss Up: Multiple Choice**

Which of the following factors will contribute to a decrease in oxygen in a pond?

- W) decreasing salinity
- X) increasing acidity
- Y) increasing temperature
- Z) increasing surface tension of the water

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

When KCl dissolves in water, the solution cools noticeably to the touch. It may be concluded that

- W) the entropy increase overcomes the unfavorable heat of dissolution
- X) KCl is relatively insoluble in water
- Y) the entropy decreases when KCl dissolves
- Z) the boiling point of the solution will be less than 100 degrees Celsius

**Bonus Answer: W**

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**22. CHEMISTRY**

**Toss Up: Multiple Choice**

Modern automobiles use a catalytic converter to

- W) increase horsepower by burning more gasoline
- X) absorb pollutants from the exhaust
- Y) complete the combustion of unburned gases
- Z) cool the exhaust gases

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

A catalyst will NOT

- W) increase the forward reaction rate

- X) shift the equilibrium to favor the products
- Y) alter the reaction pathway
- Z) increase the speed at which equilibrium will be achieved

**Bonus Answer: X**

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## 23. CHEMISTRY

### Toss Up: Multiple Choice

The evaporation of any liquid is expected to have

- W) a positive  $\Delta H$  and a negative  $\Delta S$
- X) a negative  $\Delta H$  and a negative  $\Delta S$
- Y) a positive  $\Delta H$  and a positive  $\Delta S$
- Z) a positive  $\Delta H$  and a negative  $\Delta S$

**Toss Up Answer: Y**

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### Bonus: Multiple Choice

Which of the following is most likely to be true?

- W) Combustion of organic compounds has a negative  $\Delta H$
- X) A positive  $\Delta G$  indicates a thermodynamically favorable reaction.
- Y) A positive  $\Delta S$  always means that the reaction is thermodynamically favored.
- Z) A thermodynamically favored reaction always goes to completion.

**Bonus Answer: W**

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## 24. CHEMISTRY

### Toss Up: Multiple Choice

Which of the following pairs of constants are NOT mathematically related to each other?

- W) Equilibrium constant and Gibbs free energy
- X) Rate constant and activation energy
- Y) Standard cell voltage and equilibrium constant
- Z) Standard cell voltage and rate constant

**Toss Up Answer: Z**

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### Bonus: Multiple Choice

Which of the following is FALSE?

- W) Reduction involves a gain of electrons
- X) Batteries are galvanic cells
- Y) A thermodynamically favored reaction always has a positive  $E$
- Z) Electrolysis reactions always produce a gas at at least one electrode.

**Bonus Answer: Z**

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## 25. CHEMISTRY

### Toss Up: Multiple Choice

For compounds with the same number of carbon atoms, the compound with the lowest boiling point is expected to be

- W) a ketone
- X) an amine
- Y) an ether



Z) an alcohol

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

To have cis and trans isomers, a compound must have

W) sp bonded carbon atoms

X) sp<sup>3</sup> bonded carbon atoms

Y) sp<sup>2</sup> bonded carbon atoms

Z) (W) and (X)

**Bonus Answer: Y**

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## 26. CHEMISTRY

**Toss Up: Short Answer**

In complex of manganese (II) ion exhibiting a low spin state, how many d electrons are paired?

**Bonus Answer: Four**

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**Bonus: Short Answer**

What is the conjugate base of HPO<sub>4</sub>(<sup>2-</sup>) (Read as: Hydrogen Phosphate)?

**Bonus Answer: PO<sub>4</sub>(<sup>3-</sup>) (Accept: Phosphate, PO four 3 minus)**

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## 27. CHEMISTRY

**Toss Up: Multiple Choice**

Which of the follow is true regarding complex ions?

W) Their formation constants are usually very small and they often form colored coordination compounds.

X) Their formation constants are usually very small and they often form colorless coordination compounds.

Y) Their formation constants are usually very large and they often form colored coordination compounds.

Z) Their formation constants are usually very large and they often form colorless coordination compounds.

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

Which of the following is a monodentate ligand?

W) Oxalate

X) Chloride Ion

Y) Aluminum (III) Ion

Z) Ammonium Ion

**Bonus Answer: X**

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## 28. CHEMISTRY

**Toss Up: Multiple Choice**

When the reaction of Silver Nitrate (aqueous) and Sodium Chloride (aqueous) goes to completion, what is formed?

W) A Gas

X) Water

Y) An Acid

Z) A Precipitate

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

When does the value of pH equal the value of pKa?

W) when  $[HA]=[A^-]$  (Read as: the molarity of the conjugate base equals the molarity of the conjugate acid)

X) at the end point of a titration

Y) everywhere in the buffer region

Z) in the Henderson-Hasselbach equation

**Bonus Answer: W**

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**29. CHEMISTRY****Toss Up: Multiple Choice**

For which of the following can the Ksp values be compared to determine relative molar solubilities?

W)  $Ag_2CrO_4$  and  $AgBr$  (Read as: Silver Chromate and Silver Bromide)

X)  $Ag_2SO_4$  and  $CaSO_4$  (Read as: Silver Sulfate and Calcium Sulfate)

Y)  $PbCl_2$  and  $PbSO_4$  (Read as: Lead two Chloride and Lead two Sulfate)

Z)  $ZnS$  and  $AgI$  (Read as: Zinc Sulfide and Silver Iodide)

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What is the molecular geometry associated with a coordination number of 6?

**Bonus Answer: Octahedral**

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**30. CHEMISTRY****Toss Up: Short Answer**

What is the stoichiometric point when exactly enough titrant is used to react?

**Bonus Answer: Equivalence Point**

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**Bonus: Short Answer**

What is the point in a titration at which an indicator changes color?

**Bonus Answer: Endpoint**

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**31. CHEMISTRY****Toss Up: Short Answer**

What is the coordination number of  $Ag_2C_2O_4$  (Silver Oxalate)?

**Bonus Answer: 2**

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**Bonus: Short Answer**

What two elements are liquid at room temperature?

**Bonus Answer: Bromine and Mercury (Accept: Br and Hg)**

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**32. CHEMISTRY****Toss Up: Short Answer**

What is the only letter that does not appear in the Periodic Table of Elements?

**Bonus Answer: J**

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**Bonus: Short Answer**

Which element has the largest atomic radius?

**Bonus Answer: Cesium (Accept: Cs)**

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### 33. CHEMISTRY

Toss Up: Short Answer

What is the hybridization of the molecular bonds of Ammonia?

Bonus Answer: sp<sup>3</sup>

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Bonus: Short Answer

Which element is most likely to act as an ideal gas?

Bonus Answer: Hydrogen (Accept: H)

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### 34. CHEMISTRY

Toss Up: Short Answer

What is the name of a mixture of metals?

Bonus Answer: Alloy

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Bonus: Short Answer

What is the name given to all Group 16 elements?

Bonus Answer: Chalcogens

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### 35. CHEMISTRY

Toss Up: Short Answer

Which element is a dark red liquid at room temperature?

Bonus Answer: Bromine

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Bonus: Short Answer

What is the combining capacity of Calcium?

Bonus Answer: 2

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### 36. CHEMISTRY

Toss Up: Short Answer

Which noble gas is heavier than air?

Bonus Answer: Xenon (Accept: Xe)

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Bonus: Short Answer

What is the mass of Sodium Chloride that is in the average human body? Answer in grams.

Bonus Answer: 250 grams

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### 37. CHEMISTRY

Toss Up: Short Answer

What is the most common isotope of Hydrogen?

Bonus Answer: Protium

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Bonus: Short Answer

What is the hybridization of carbon atoms in alkanes?

Bonus Answer: sp<sup>3</sup>

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### 38. CHEMISTRY

Toss Up: Short Answer

In the standard notation for a voltaic cell, the double vertical line "||" represents

Bonus Answer: A standard Hydrogen Electrode (Accept: Hydrogen Electrode)

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**Bonus: Short Answer**

Approximately how long must a current of 5.0 amperes be maintained to electroplate 60 g of calcium from molten Calcium Chloride (Molar Mass = 111 g/mol)? Answer in hours.

**Bonus Answer: 16 hours**

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**39. CHEMISTRY**

**Toss Up: Short Answer**

1)An aqueous solution with amount of of OH<sup>-</sup> ions is greater than that of H<sup>+</sup> ions is what

**Bonus Answer: basic**

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**Bonus: Short Answer**

3)Charles law talks about what?

**Bonus Answer: Hot air rising after being heated**

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**40. CHEMISTRY**

**Toss Up: Short Answer**

If pure water boils at 100C,how many additional calories of heat are needed to convert 1 gram of water from the liquid to the vapor?!

**Bonus Answer: 540**

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**Bonus: Short Answer**

What is the name for the straight-chain alkane containing 5 carbons?

**Bonus Answer: pentane**

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**41. CHEMISTRY**

**Toss Up: Short Answer**

If the electronegativity difference in the bonding atoms is intermediate , what type of bond is formed?

**Bonus Answer: polar covalent**

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**Bonus: Short Answer**

what is the formula for potassium perchlorate?

**Bonus Answer: kclo4**

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**42. CHEMISTRY**

**Toss Up: Short Answer**

gypsum is what percent water by weight? (atomic masses of calcium = 40; sulfur = 32 and oxygen = 16.)

**Bonus Answer: 21!!!!!!**

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**Bonus: Short Answer**

What is the general name for a hypothetical gas that does not obeys Boyles's law at all temperatures and pressures?

**Bonus Answer: not ideal**

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**43. CHEMISTRY**

**Toss Up: Short Answer**

fuel additive in what is commonly known as "dry-gas" by solubilizing water to reduce contamination in gasoline:

**Bonus Answer: Isopropyl Alcohol**

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**Bonus: Multiple Choice**

The latent heat of vaporization for water at its boiling point and in kJ per mole is:

- W) 6.01
- X) 42.7
- Y) 40.7
- Z) 40,000,000

**Bonus Answer: Y**

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**44. CHEMISTRY****Toss Up: Short Answer**

What is the halide with no known stable isotopes?

**Bonus Answer: Astatine**

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**Bonus: Multiple Choice**

Which of the following molecules is a saturated hydrocarbon?

- W) C<sub>2</sub>H<sub>4</sub>
- X) C<sub>3</sub>H<sub>8</sub>
- Y) CH<sub>3</sub>OH
- Z) C<sub>4</sub>H<sub>6</sub>

**Bonus Answer: X**

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**45. CHEMISTRY****Toss Up: Multiple Choice**

A tetrahedral molecule, XY<sub>4</sub> would be formed if X were using the orbital hybridization:

- W) p<sup>2</sup>
- X) s<sup>2</sup>
- Y) sp<sup>2</sup>
- Z) sp<sup>3</sup>

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

How does a Bronsted-Lowry differ from its conjugate base?

- W) The acid has one more proton.
- X) The acid has one less proton.
- Y) The acid has one more electron.
- Z) The acid has one less electron.

**Bonus Answer: W**

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**46. CHEMISTRY****Toss Up: Multiple Choice**

Which of the following molecules has a Lewis structure that is a resonance hybrid?

- W) C<sub>2</sub>H<sub>6</sub>
- X) HBr
- Y) SO<sub>2</sub>
- Z) CH<sub>4</sub>

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What mass of HCL dissolved to make a 1 liter solution will give a PH of 1? Give your answer in grams rounded to the nearest hundredth.

**Bonus Answer: 0.37**

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## 47. CHEMISTRY

**Toss Up: Multiple Choice**

Which one of these metals doesn't produce a red flame in a flame test?

W) Rubidium

X) Strontium

Y) Cesium

Z) Lithium

**Toss Up Answer: Y**

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**Bonus: Short Answer**

A solution contains some BaSO<sub>4</sub> at 25° C. It is found to contain 4x10<sup>-5</sup> mole/liter of Ba<sup>2+</sup> ions. What is the K<sub>sp</sub> of the BaSO<sub>4</sub> in scientific notation?

**Bonus Answer: 1.6\*10<sup>-9</sup>**

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## 48. CHEMISTRY

**Toss Up: Short Answer**

What material is used in a flame test to filter out light from yellow flames?

**Bonus Answer: Cobalt glass (accept smalt or cobalt blue glass)**

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**Bonus: Short Answer**

What is the name for the effect that describes why under certain conditions, hot water will freeze faster than cold water?

**Bonus Answer: The Mpemba effect**

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## 49. CHEMISTRY

**Toss Up: Short Answer**

What principle states that an electron will occupy the lowest energy orbital that can receive it?

**Bonus Answer: Afbau Principle**

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**Bonus: Short Answer**

What is the name of the radioactive decay chain for uranium-235?

**Bonus Answer: Actinium series or Plutonium cascade.**

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## 50. CHEMISTRY

**Toss Up: Multiple Choice**

Polystyrene is produced by which of the following reactions:

W) free radical vinyl polymerization from the monomer styrene

X) metallocene catalysis polymerization

Y) graft copolymerization

Z) butadiene polymerization

**Toss Up Answer: W**

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**Bonus: Short Answer**

What general term describes a substance whose electrons are all spin-paired and that are weakly repelled by magnetic fields?

**Bonus Answer: Diamagnetic**

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## 51. CHEMISTRY

**Toss Up: Multiple Choice**

Most non-metals are

- W) paramagnetic
- X) ferromagnetic
- Y) diamagnetic
- Z) antiferromagnetic

**Toss Up Answer: Y**

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**Bonus: Short Answer**

It is hard to find temperatures at which oils and fats boil because before they boil, they begin to break down. What is the name of this point?

**Bonus Answer: Smoke Point**

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## 52. CHEMISTRY

**Toss Up: Multiple Choice**

Vacuum systems require materials with very low outgassing rates. Which of these metals would be suitable for use in a vacuum chamber?

- W) Cadmium
- X) Zinc
- Y) Magnesium
- Z) Aluminum

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Which one of these crystal lattice structures best describes the networking of Ti, Zn, and Mg?

- W) BCC
- X) FCC
- Y) HCP
- Z) LFC

**Bonus Answer: Y**

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## 53. CHEMISTRY

**Toss Up: Multiple Choice**

Although water molecules are locked together by strong hydrogen bonds, they can reconfigure themselves through which phenomena:

- W) Adhesion
- X) Brownian Motion
- Y) Quantum Tunneling
- Z) The Mpemba Effect

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Superfluidity is a state of matter which exhibits which of the following properties:

Extreme surface tension  
Near-zero viscosity  
High electrical conductivity  
High thermal conductivity

**Bonus Answer: 2 and 4**

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## 54. CHEMISTRY

**Toss Up: Multiple Choice**

Which type of nuclear reactor does not require a moderator?

- W) Light Water Reactor
- X) Heavy Water Reactor
- Y) Graphite Moderated Reactor
- Z) Fast Breeder Reactor

**Toss Up Answer: Z**

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**Bonus: Short Answer**

Which types of fuel cells mainly use platinum catalysts?

- PEMFC
- PAFC
- DMFC
- MCFC

**Bonus Answer: 1 and 3**

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## 55. CHEMISTRY

**Toss Up: Short Answer**

Which form of coal has the highest percentage of carbon?

**Bonus Answer: anthracite**

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**Bonus: Multiple Choice**

Which of the following is a salt?

- W) Water
- X) Soap
- Y) Plastic
- Z) Rust

**Bonus Answer: X**

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## 56. CHEMISTRY

**Toss Up: Multiple Choice**

Which element has the lowest atomic number with no stable isotopes?

- W) Bismuth
- X) Technetium
- Y) Uranium
- Z) Radium

**Toss Up Answer: X**

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**Bonus: Short Answer**

What color is the H-alpha spectral line?



Bonus Answer: Red

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## 57. CHEMISTRY

Toss Up: Short Answer

How many nodes does a 3p orbital have?

Bonus Answer: 2

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Bonus: Short Answer

Name any amino acid that contains a phenyl group.

Bonus Answer: Phenylalanine, Tyrosine, Tryptophan

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## 58. CHEMISTRY

Toss Up: Short Answer

If the molar mass of neon is 20 grams and the molar mass of argon is 40 grams, to the nearest tenth, what is the ratio of the rates of effusion of neon to argon?

Bonus Answer: 1.4

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Bonus: Multiple Choice

Which element has the highest second ionization energy?

- W) Lithium
- X) Hydrogen
- Y) Helium
- Z) Beryllium

Bonus Answer: W

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## 59. CHEMISTRY

Toss Up: Short Answer

To the nearest tenth of a liter, at standard conditions, how many liters does two moles of methane gas take up?

Bonus Answer: 44.8

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Bonus: Multiple Choice

What is the main method of helium production?

- W) Retrieval from the upper atmosphere
- X) Distillation from natural gas
- Y) Extraction from rock compounds
- Z) Distillation from the lower atmosphere

Bonus Answer: X

=====

## 60. CHEMISTRY

Toss Up: Short Answer

What metal is the least reactive?

Bonus Answer:

Platinum

=====

Bonus: Multiple Choice

Which of the following is closest to the percentage of the isotope Uranium-235 in nature?

- W) 20%
- X) 5%

Y) 1%  
Z) 0.10%

**Bonus Answer: Y**

=====

## 61. CHEMISTRY

**Toss Up: Short Answer**

Assuming no double or triple bonds in the molecule, what form of hybridization does a ketone carbon have?

**Bonus Answer: sp<sup>2</sup>**

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**Bonus: Multiple Choice**

Which of the following is amphoteric?

- W) Zinc Oxide
- X) Aluminum Chloride
- Y) Acetic Acid
- Z) Magnesium Oxide

**Bonus Answer: W**

=====

## 62. CHEMISTRY

**Toss Up: Multiple Choice**

Which of the following is a nonpolar molecule with polar bonds

- W) F<sub>2</sub>
- X) CHF<sub>3</sub>
- Y) HCl
- Z) CO<sub>2</sub>

**Toss Up Answer: Z**

-----

**Bonus: Short Answer**

When M<sub>2</sub>S<sub>3</sub> is heated in air, it is converted to MO<sub>2</sub>. A 4.000g sample of M<sub>2</sub>S<sub>3</sub> shows a decrease in mass of .277 g when it is heated in air. To the nearest whole number, what is the average atomic mass of M?

**Bonus Answer: 184 g/mol**

=====

## 63. CHEMISTRY

**Toss Up: Short Answer**

What is the theoretical end of a titration?

**Bonus Answer: equiv point**

-----

**Bonus: Short Answer**

In the electrolysis of a copper chloride solution, what forms at the cathode and anode, respectively?

**Bonus Answer: CATHODE = COPPER (ACCEPT: Cu); ANODE = CHLORINE (ACCEPT: CHLORINE GAS or Cl<sub>2</sub>)**

=====

## 64. CHEMISTRY

**Toss Up: Short Answer**

A Buchner funnel is a piece of laboratory glassware often used in chemistry labs for what?

**Bonus Answer: Filtration**

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**Bonus: Short Answer**

Why are oxygenates used as gasoline additives?

Bonus Answer: ALLOW FOR MORE COMPLETE COMBUSTION

=====

## 65. CHEMISTRY

Toss Up: Short Answer

Name all of the following 4 species that contain an odd number of electrons: O<sub>2</sub><sup>1-</sup>; O<sub>2</sub><sup>2-</sup>; SO<sub>2</sub>; CO

Bonus Answer: O<sub>2</sub><sup>1-</sup>

-----

Bonus: Short Answer

What are the 2 alkenes (read as: al-KEENS) with the shortest carbon chains and lowest molecular weights?

Bonus Answer: ethene

=====

## 66. CHEMISTRY

Toss Up: Short Answer

You need to prepare 500 milliliters of a 0.100 molar NaOH solution from a 0.250 molar solution. What volume, in milliliters, of the 0.250 molar solution must be diluted to 500 milliliters?

Bonus Answer: 200

-----

Bonus: Short Answer

Can MASS SPECTROMETRY be used to calculate endpoint pH?

Bonus Answer: nahh

=====

## 67. CHEMISTRY

Toss Up: Short Answer

What is the general name for a hypothetical gas that obeys Boyle's law at all temperatures and pressures?

Bonus Answer: Ideal

-----

Bonus: Short Answer

Knowing that the chemical name for gypsum is calcium sulfate dihydrate, gypsum is what percent water by weight? Assume the atomic masses of calcium = 40; sulfur = 32 and oxygen = 16.

Bonus Answer: 21

=====

## 68. CHEMISTRY

Toss Up: Short Answer

Charles law talks about what?

Bonus Answer: Hot air rising

-----

Bonus: Short Answer

According to VSEPR bonding theory, what type of geometry does a molecule have when the central atom is surrounded by 4 bonded groups, such as in methane?

Bonus Answer: TETRAHEDRAL

=====

## 69. CHEMISTRY

Toss Up: Multiple Choice

The ideal fuel for fuel cell use is:

W) compressed natural gas

X) reformulated gasoline

Y) hydrogen

Z) Methanol

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

Which is the correct name for  $\text{N}_2\text{O}_3$

**Bonus Answer: Dinitrogen Trioxide**

---

## 70. CHEMISTRY

**Toss Up: Multiple Choice**

Which one of the following has the greatest tendency to lose an electron?

W) Zn

X)  $\text{Cl}^-$

Y)  $\text{Br}_2$

Z) A mixture of  $\text{PbSO}_4$  and  $\text{H}_2\text{O}$

**Toss Up Answer: W**

---

**Bonus: Short Answer**

The wavelength of yellow light is 600 nanometers. What is the wavelength in centimeters: (use scientific notation)

**Bonus Answer:  $6.0 \times 10^{-5}$**

---

## 71. CHEMISTRY

**Toss Up: Multiple Choice**

Which of the following is more soluble in ethanol than in water?

W)  $\text{I}_2$

X)  $\text{HCl}$

Y)  $\text{AgNO}_3$

Z)  $\text{NH}_3$

**Toss Up Answer: W**

---

**Bonus: Short Answer**

Reactions of which order are typically associated with catalysts?

**Bonus Answer: zeroth**

---

## 72. CHEMISTRY

**Toss Up: Multiple Choice**

Which of the following is not a reason for the use of nitrogen in many explosives?

W) these explosives form gases, which expand

X) the bond between two nitrogen atoms is very strong

Y) these explosives form toxic compounds such as cyanide

Z) nitrogen is widely available

**Toss Up Answer: Y**

---

**Bonus: Multiple Choice**

Which of the following is closest to the bond angle in ammonia?

W) 120 degrees

X) 109.5 degrees

Y) 107 degrees

Z) 100 degrees

**Bonus Answer: Y**

=====

## 73. CHEMISTRY

### Toss Up: Multiple Choice

An adiabatic process for an ideal gas is represented on a p-V diagram by:

- W) a horizontal line
- X) a vertical line
- Y) a hyperbola
- Z) none of these

**Toss Up Answer: Z**

-----

### Bonus: Multiple Choice

Evidence that molecules of a gas are in constant motion is:

- W) winds exert pressure
- X) two gases interdiffuse quickly
- Y) warm air rises
- Z) gases are easily compressed

**Bonus Answer: X**

=====

## 74. CHEMISTRY

### Toss Up: Multiple Choice

If the molecules in a tank of hydrogen have the same rms speed as the molecules in a tank of oxygen, we may be sure that:

- W) the pressures are the same
- X) the hydrogen is at the greater pressure
- Y) the temperatures are the same
- Z) the oxygen is at the higher temperature

**Toss Up Answer: Z**

-----

### Bonus: Multiple Choice

The number of degrees of freedom of a rigid diatomic molecule is

- W) 2
- X) 3
- Y) 4
- Z) 5

**Bonus Answer: Z**

=====

## 75. CHEMISTRY

### Toss Up: Multiple Choice

The number of degrees of freedom of a triatomic molecule is:

- W) 1
- X) 3
- Y) 6
- Z) 9

**Toss Up Answer: Z**

---

**Bonus: Short Answer**

The internal energy of an ideal gas depends on which of the following: temperature, pressure, volume.

**Bonus Answer: Temperature**

---

## **76. CHEMISTRY**

**Toss Up: Multiple Choice**

The root-mean-square speed of molecules in a gas is:

- W) the most probable speed
- X) that speed such that half the molecules are moving faster than  $v_{rms}$  and the other half are moving slower
- Y) the average speed of the molecules
- Z) none of these

**Toss Up Answer: Z**

---

**Bonus: Multiple Choice**

An ideal monatomic gas has a molar specific heat  $C_v$  at constant volume of:

- W)  $R$
- X)  $3R/2$
- Y)  $5R/2$
- Z)  $7R/2$

**Bonus Answer: X**

---

## **77. CHEMISTRY**

**Toss Up: Multiple Choice**

Monatomic, diatomic, and polyatomic ideal gases each undergo slow adiabatic expansions from the same initial volume and the same initial pressure to the same final volume. The magnitude of the work done by the environment on the gas:

- W) is greatest for the polyatomic gas
- X) is greatest for the diatomic gas
- Y) is greatest for the monatomic gas
- Z) is the same only for the diatomic and polyatomic gases

**Toss Up Answer: W**

---

**Bonus: Multiple Choice**

The mean free path of a gas molecule is:

- W) the shortest dimension of the containing vessel
- X) the cube root of the volume of the containing vessel
- Y) average distance between adjacent molecules
- Z) average distance a molecule travels between intermolecular collisions

**Bonus Answer: Z**

---

## **78. CHEMISTRY**

**Toss Up: Multiple Choice**

The change in entropy is zero for:

- W) reversible adiabatic processes

- X) reversible isothermal processes
- Y) reversible processes during which no work is done
- Z) . all adiabatic processes

**Toss Up Answer: W**

---

**Bonus: Multiple Choice**

The Hall-Heroult process is used in the production of:

- W) Mg
- X) Fe
- Y) Al
- Z) Au

**Bonus Answer: Y**

---

**79. CHEMISTRY**

**Toss Up: Short Answer**

Which famous chemist formulated the rule that mass is conserved through chemical reactions?

**Bonus Answer: Lavoisier**

---

**Bonus: Multiple Choice**

Which of the following is the strongest oxidizing agent?

- W) Pb<sup>2+</sup>
- X) I<sub>2</sub>
- Y) Ag<sup>+</sup>
- Z) Pb

**Bonus Answer: Y**

---

**80. CHEMISTRY**

**Toss Up: Multiple Choice**

What is the hybridization of the sulfur atom in SF<sub>4</sub>?

- W) sp<sup>2</sup>
- X) sp<sup>3</sup>
- Y) sp<sup>3</sup>d
- Z) sp<sup>3</sup>d<sup>2</sup>

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Which famous chemist proposed the modern kinetic molecule theory for gasses?

**Bonus Answer: Bernoulli**

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**81. CHEMISTRY**

**Toss Up: Short Answer**

Which famous chemist was responsible for creating the field of colloid chemistry and created laws for effusion and diffusion

**Bonus Answer: Graham**

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**Bonus: Short Answer**

What law, proposed by Joseph Proust, states that a chemical compound will always have its own characteristic ratio

of elemental components?

**Bonus Answer: The Law of Definite Proportions (Law of constant composition)**

=====

## 82. CHEMISTRY

**Toss Up: Short Answer**

In 1774, Joseph Priestly isolated what element by heating a powdered mercury compound?

**Bonus Answer: Oxygen**

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**Bonus: Multiple Choice**

Which of these is the strongest electrolyte

W)  $\text{HNO}_2$

X)  $(\text{NH}_2)_2\text{CO}$

Y)  $\text{C}_2\text{H}_5\text{OH}$

Z)  $\text{NH}_4$

**Bonus Answer: W**

=====

## 83. CHEMISTRY

**Toss Up: Multiple Choice**

Which element has 10 stable isotopes, the highest of any element?

W) Lead

X) Xenon

Y) Tin

Z) Copper

**Toss Up Answer: Y**

-----

**Bonus: Short Answer**

Name the compound that has a formula of  $\text{C}_{60}$ .

**Bonus Answer: buckminsterfullerene (or buckyballs)**

=====

## 84. CHEMISTRY

**Toss Up: Multiple Choice**

Which of the following, when added to hydrofluoric acid, would decrease its acidity?

W) sodium fluoride

X) ammonium nitrate

Y) acetic acid

Z) sodium nitrate

**Toss Up Answer: W**

-----

**Bonus: Short Answer**

What is the name of the type of relatively unstable bonding found in many electron deficient compounds, such as  $\text{BeH}_2$ ?

**Bonus Answer: three center bond**

=====

## 85. CHEMISTRY

**Toss Up: Short Answer**

Which nitrogen hydride is the most stable?

**Bonus Answer: ammonia**

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**Bonus: Multiple Choice**



Why isn't silicon a suitable candidate for life like carbon is?

- W) Silicon is too heavy
- X) Silicon atoms are too big to form pi bonds
- Y) Silicon is more reactive
- Z) Silicon is rarer in the earth's crust

**Bonus Answer: X**

=====

## 86. CHEMISTRY

**Toss Up: Multiple Choice**

Which noble gas is the most reactive?

- W) Xenon
- X) Radon
- Y) Helium
- Z) Argon

**Toss Up Answer: W**

=====

**Bonus: Short Answer**

How many carbon atoms are in a single molecule of trinitrotolulene, or TNT?

**Bonus Answer: 7**

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## 87. CHEMISTRY

**Toss Up: Short Answer**

What is the oxidation state of chlorine in perchloric acid?

**Bonus Answer: +7**

=====

**Bonus: Short Answer**

The formula for the combustion of methane is  $\text{CH}_4 + 2\text{O}_2 \text{ yields } \text{CO}_2 + 2\text{H}_2\text{O}$ . Given that the heat of formation of methane gas is -75 kilojoules per mole, the heat of formation of carbon dioxide is -400 kilojoules per mole, and the heat of formation of water is -300 kilojoules per mole, find the heat of combustion for methane.

**Bonus Answer: 925kJ/mol**

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