

# CHEMISTRY

## 1. CHEMISTRY

Writer: American Heritage

Toss Up: Short Answer

What type of hybridization occurs in the molecule sulfur hexafluoride?

Bonus Answer:  $d^2 sp^3$

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Bonus: Multiple Choice

Which of the following best describes a bonding molecular orbital

W) A molecular orbital lower in energy than the atomic orbitals of which it is composed

X) A molecular orbital higher in energy than the atomic orbitals of which it is composed

Y) A molecular orbital equal in energy to the atomic orbitals of which it is composed

Z) A molecular orbital with exactly twice the energy of the atomic orbitals of which it is composed

Bonus Answer: W

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## 2. CHEMISTRY

Writer: American Heritage

Toss Up: Multiple Choice

Which of the following compounds is soluble in water at room temperature?

W)  $AgSO_4$

X)  $CaS$

Y)  $CaSO_4$

Z)  $PbF_2$

Toss Up Answer: X

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Bonus: Short Answer

A solution is prepared with an unknown solvent, and  $NaNO_3$ . 4L of the solvent are mixed with 42 moles of  $NaNO_3$  to produce a 7 molar solution. Find the density of the solvent in grams per centimeter cubed.

Bonus Answer:  $1.5 \text{ g/cm}^3$

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## 3. CHEMISTRY

Writer: American Heritage

Toss Up: Multiple Choice

Which of the following elements has the highest first ionization energy?

W) Boron

X) Nitrogen

Y) Carbon

Z) Oxygen

Toss Up Answer: X

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Bonus: Multiple Choice

Livermorium (element 116) was synthesized by bombarding curium (element 96) with what other element?

W) Neon

X) Argon

Y) Titanium

Z) Calcium

Bonus Answer: Z

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## 4. CHEMISTRY

Writer: Stuyvesant

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: X

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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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## 5. CHEMISTRY

Writer: Stuyvesant

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)? Include its full electron configuration.

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

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## 6. CHEMISTRY

Writer: Stuyvesant

Toss Up: Short Answer

What is the name of the elements in Group 16?

Bonus Answer: Chalcogens (Accept: Chalcogen, Oxygen Family)

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Bonus: Short Answer

When Carbonic acid is created what does it always decompose into?

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

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## 7. CHEMISTRY

Writer: Centennial

Toss Up: Short Answer

What is the most significant component in duralumin, other than aluminum?

Bonus Answer: Copper

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**Bonus: Short Answer**

The addition of copper makes the alloy susceptible to which process, from which pure aluminum is usually protected?

**Bonus Answer: Corrosion**

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**8. CHEMISTRY**

**Writer: Centennial**

**Toss Up: Short Answer**

63/37 leaded solder is this type of mixture, which melts at once instead of melting as components.

**Bonus Answer: Eutectic**

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**Bonus: Short Answer**

Apart from tin whiskers, lead-free solder also suffers from this problem at low temperatures.

**Bonus Answer: Tin pest**

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**9. CHEMISTRY**

**Writer: Granada Hills**

**Toss Up: Multiple Choice**

What is the name of the group of the periodic table that includes selenium?

- W) Halogens
- X) Noble gases
- Y) Alkali metals
- Z) Chalcogens

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What is the general name of the compounds that are highly toxic and are formed from reacting ammonia with baking soda?

**Bonus Answer: Chloramines**

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**10. CHEMISTRY**

**Writer: Granada Hills**

**Toss Up: Short Answer**

Helium has a molar mass of 4 grams per mole and effuses at a rate of 10 moles per minute. If you have an unknown gas with a molar mass of 16 grams per mole, How many moles per minute would it effuse at?

**Bonus Answer: 5**

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**Bonus: Short Answer**

By name or number, indicate all of the following choices that would undergo SN1.

- I. 2-bromo-2-methylpropane
- II.  $\text{CH}_3\text{CHCHCH}_2\text{Cl}$
- III. Polyethylene

**Bonus Answer: I only**

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## 11. CHEMISTRY

Writer: Granada Hills

Toss Up: Short Answer

What element has one electron in the 4f subshell?

Bonus Answer: Lanthanum

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Bonus: Multiple Choice

The compound  $\text{NbCl}_5$  would have which of the following shapes?

- W) octahedral
- X) seesaw
- Y) square planar
- Z) trigonal bipyramidal

Bonus Answer: W

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## 12. CHEMISTRY

Writer: Centennial

Toss Up: Short Answer

How many alkenes have the formula of  $\text{C}_4\text{H}_8$ ?

Bonus Answer: four

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Bonus: Short Answer

Rank the following elements in increasing order of melting point: vanadium, iron, cobalt, tantalum

Bonus Answer: cobalt, iron, vanadium, tantalum

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## 13. CHEMISTRY

Writer: Brooklyn Tech

Toss Up: Short Answer

What type of energy release allows the formation of ionic bonds to be an exothermic process?

Bonus Answer: lattice energy

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Bonus: Short Answer

How many electrons fill the f orbital?

Bonus Answer: 14

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## 14. CHEMISTRY

Writer: Brooklyn Tech

Toss Up: Multiple Choice

Which of the following two compounds will react in an aqueous solution to form a precipitate?

- W) Ammonium Nitrate and Sodium Chloride
- X) Potassium Hydroxide and Calcium Acetate
- Y) Magnesium Bromide and Sodium Chromate
- Z) Lead Chlorate and Potassium Sulfide

Toss Up Answer: Z

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Bonus: Short Answer

Which isotope of Uranium is fissile?

**Bonus Answer: Uranium-235**

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## **15. CHEMISTRY**

**Writer: Brooklyn Tech**

**Toss Up: Multiple Choice**

Bromine is a

W) black solid

X) red liquid

Y) colorless gas

Z) highly inflammable gas

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

Which of the following is not an isotope of hydrogen?

W) Tritium

X) Deuterium

Y) Protium

Z) Yttrium

**Bonus Answer: Z**

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## **16. CHEMISTRY**

**Writer: Brooklyn Tech**

**Toss Up: Multiple Choice**

The inert gas which is substituted for nitrogen in the air used by deep sea divers for breathing, is

W) Argon

X) Xenon

Y) Helium

Z) Krypton

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

The property of a substance to absorb moisture from the air on exposure is called

W) osmosis

X) deliquescence

Y) efflorescence

Z) desiccation

**Bonus Answer: X**

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## **17. CHEMISTRY**

**Writer: Brooklyn Tech**

**Toss Up: Short Answer**

How many electrons can fill the d orbital?

**Bonus Answer: 10 electrons**

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**Bonus: Short Answer**

If a process is only thermodynamically favorable at high temperatures then it has...

Bonus Answer: High enthalpy and high entropy

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## 18. CHEMISTRY

Writer: Brooklyn Tech

Toss Up: Multiple Choice

What is the name of  $\text{CoCl}_2$ ?

W) Cobalt(II) Chloride

X) Cobalt(III) Chloride

Y) Copper(II) Chloride

Z) Copper(III) Chloride

Toss Up Answer: W

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Bonus: Short Answer

What type of compound is  $\text{CoCl}_2$ ?

Bonus Answer: Ionic Compound

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## 19. CHEMISTRY

Writer: Brooklyn Tech

Toss Up: Short Answer

At what point does a liquid boil?

Bonus Answer: When the vapor pressure and atmospheric pressure are equal.

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Bonus: Short Answer

Which term is used to describe the resistance to flow of a liquid?

Bonus Answer: viscosity

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## 20. CHEMISTRY

Writer: Brooklyn Tech

Toss Up: Multiple Choice

At what temperature in degrees Celsius is water most dense?

W) 11

X) 4

Y) 0

Z) -5

Toss Up Answer: X

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Bonus: Multiple Choice

In which compound or molecule is Oxygen's oxidation number not -2?

W) Hydrogen oxide

X) Hydrogen fluoride

Y) Dioxygen difluoride

Z) Potassium hydroxide

Bonus Answer: Y

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## 21. CHEMISTRY

Writer: Lakeside

Toss Up: Short Answer

Order the following three gases from least to greatest in terms of value of  $b$  in the Van der Waals equation: Benzene, Neon, and Hydrogen.

**Bonus Answer: HYDROGEN, NEON, BENZENE**

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**Bonus: Multiple Choice**

Adding an inert gas into a gas-phase equilibrium at constant volume will result in an equilibrium shift in which direction?

- W) the equilibrium will shift towards the side with fewer moles of gas
- X) the equilibrium will shift towards the side with more moles of gas
- Y) the equilibrium will not shift
- Z) it depends on the gas

**Bonus Answer: Y**

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## 22. CHEMISTRY

**Writer: Lakeside**

**Toss Up: Short Answer**

What is the hybridization and the molecular geometry about the central atom in the molecule phosphorous pentachloride?

**Bonus Answer: DSP3 AND TRIGONAL BIPYRAMIDAL**

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**Bonus: Short Answer**

What is the bond order for diatomic oxygen?

**Bonus Answer: TWO**

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## 23. CHEMISTRY

**Writer: Lakeside**

**Toss Up: Multiple Choice**

Which of the following is true about Raoult's Law?

- W) total vapor pressure of a solution is based on the vapor pressures and mole fractions of the constituents
- X) there is no such thing as a nonideal solution when using Raoult's law
- Y) low boiling azeotropes can be fractionally distilled via addition of another chemical
- Z) ideal solutions contain constituents that have stronger intermolecular interactions with the each other than themselves

**Toss Up Answer: W**

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**Bonus: Short Answer**

Because Gibbs free energy is limited to isobaric reactions, which thermodynamic potential is used instead, which assumes constant temperature and volume?

**Bonus Answer: HELMHOLTZ FREE ENERGY**

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## 24. CHEMISTRY

**Writer: Brooklyn Tech**

**Toss Up: Multiple Choice**

Which element has the highest electronegativity?

- W) Bromine
- X) Krypton
- Y) Iodine
- Z) Xenon

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

What is the anhydride of sulfuric acid?

- W) Hydrogen Sulfide
- X) Hydrogen Oxide
- Y) Sulfur Dioxide
- Z) Sulfur Trioxide

**Bonus Answer: Z**

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**25. CHEMISTRY**

**Writer: Brooklyn Tech**

**Toss Up: Multiple Choice**

Which of the following hydrocarbons is the most reactive?

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

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What is the name of the acid mixture that can dissolve Gold?

**Bonus Answer: Aqua Regia**

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**26. CHEMISTRY**

**Writer: Brooklyn Tech**

**Toss Up: Multiple Choice**

Which of the following substances would be expected to have the highest melting point?

- W) Sodium Chloride
- X) Calcium Chloride
- Y) Potassium Hydride
- Z) Magnesium Oxide

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

HF is a weak acid when compared with HCl. How can this be explained?

- W) HF has a stronger covalent bond than does HCl
- X) HF has a weaker covalent bond than does HCl
- Y) HF has hydrogen bonding, while HCl has dipole-dipole bonding
- Z) HF has dipole-dipole bonding, while HCl has hydrogen bonding

**Bonus Answer: W**

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**27. CHEMISTRY**

**Writer: Brooklyn Tech**

**Toss Up: Multiple Choice**

Sodium hydroxide and copper(II) nitrate solutions are mixed. What precipitates out?

- W) No precipitate because no reaction occurs



- X) Copper
- Y) Sodium Nitrate
- Z) Copper(II) Hydroxide

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What is the oxidation number of Manganese in  $\text{MnO}_2$ ?

**Bonus Answer: +4**

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**28. CHEMISTRY**

**Writer: Brooklyn Tech**

**Toss Up: Short Answer**

What is the most electropositive element on the periodic table?

**Bonus Answer: Francium**

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**Bonus: Short Answer**

What is the lightest element to have isotopes that are all radioactive?

**Bonus Answer: Technetium**

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**29. CHEMISTRY**

**Writer: Brooklyn Tech**

**Toss Up: Multiple Choice**

The law which states that the amount of gas dissolved in a liquid is proportional to its partial pressure is

- W) Dalton's law
- X) Gay Lussac's law
- Y) Henry's law
- Z) Raoult's law

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

The most malleable metal is

- W) platinum
- X) silver
- Y) iron
- Z) gold

**Bonus Answer: Z**

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**30. CHEMISTRY**

**Writer: Venice**

**Toss Up: Multiple Choice**

Which of the following is not a copolymer?

- W) Myoglobin
- X) Polyvinyl chloride
- Y) High-impact polystyrene
- Z) Teflon

**Toss Up Answer: Z**

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**Bonus: Short Answer**

If the cathode of a galvanic cell is copper, name all of the following four elements that would not produce a spontaneous current when placed at the other electrode: 1) zinc; 2) manganese; 3) gold; 4) hydrogen

**Bonus Answer: MANGANESE AND GOLD (ACCEPT: 2 AND 3)**

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### 31. CHEMISTRY

**Writer: Venice**

**Toss Up: Short Answer**

You have a solution with a mixture of common cations. What acid could you add to the solution if you only wanted to remove the silver, lead, and mercurous ions?

**Bonus Answer: HYDROCHLORIC AID**

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**Bonus: Multiple Choice**

Given that the  $K_a$  of hypochlorous acid is  $3.5 \times 10^{-8}$  [three point five times ten to the negative eighth], which of the following best approximates the pH of a 0.1 M solution of hypochlorous acid?

W) 1.2

X) 4.2

Y) 6.4

Z) 7.6

**Bonus Answer: X**

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### 32. CHEMISTRY

**Writer: Venice**

**Toss Up: Short Answer**

A combination of which two acids in a 3:1 ratio has a large enough standard reduction potential to dissolve gold and platinum?

**Bonus Answer: HYDROCHLORIC ACID AND NITRIC ACID**

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**Bonus: Multiple Choice**

For which of the following molecules do enantiomers not exist?

W) 2-butanol

X) Dichloromethane

Y) 1,1-chlorofluoropropane

Z) 3-hexanol

**Bonus Answer: X**

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