

# CHEMISTRY

## 1. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

Which of these compounds is not a saturated compound?

- W) ethane
- X) propanol
- Y) butanal
- Z) acetylene

Toss Up Answer: Z

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Bonus: Short Answer

What are the two compounds formed when ethanoic acid and ethanol react?

Bonus Answer: Ethyl ethanoate and water

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## 2. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

What is the fourth most abundant element on Earth?

- W) Oxygen
- X) Carbon
- Y) Sulfur
- Z) Argon

Toss Up Answer: X

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Bonus: Short Answer

What metal forms compounds that give a grayish-white color?

Bonus Answer: Lead

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## 3. CHEMISTRY

Writer: Ashneel Das

Toss Up: Short Answer

How many mL of 0.5 M Barium Hydroxide are needed to neutralize 500 mL of 1 M Hydrochloric Acid completely?

Bonus Answer: 500 mL

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Bonus: Short Answer

Calculate the pOH of a solution given the  $H^+$  concentration is  $1.0 \times 10^{-5}$

Bonus Answer: 9

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## 4. CHEMISTRY

Writer: Ashneel Das

Toss Up: Multiple Choice

How many carbon atoms and hydrogen atoms are present in one molecule of hexane?

- W) 6 hydrogen, 14 carbon
- X) 6 carbon, 14 hydrogen
- Y) 6 carbon, 12 hydrogen
- Z) 6 carbon, 10 hydrogen

Toss Up Answer: X

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Bonus: Short Answer

Identify which of the following statements about carbon dioxide are true: 1) It has a molar mass of approximately 44 g/mol 2) It is a polar molecule 3) It has two double bonds

**Bonus Answer: 1 and 3**

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## 5. CHEMISTRY

**Writer: Ashneel Das**

**Toss Up: Multiple Choice**

What type of bond is formed between two atoms with an electronegativity difference of 1.0?

- W) Polar Covalent
- X) Nonpolar Covalent
- Y) Ionic
- Z) Hydrogen

**Toss Up Answer: W**

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**Bonus: Short Answer**

Of the following, which increase with atomic number in group 5 of the periodic table? 1) Atomic Radius 2) Atomic mass 3) First Ionization Energy

**Bonus Answer: 1 and 2**

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## 6. CHEMISTRY

**Writer: Jason Mohabir**

**Toss Up: Multiple Choice**

How many electrons occupy the bonding molecular orbitals of a CN triple bond?

- W) 2
- X) 4
- Y) 6
- Z) 8

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

Which of the following compounds would have the highest boiling point?

- W) CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>
- X) CH<sub>3</sub>NH<sub>2</sub>
- Y) CH<sub>2</sub>F<sub>2</sub>
- Z) CH<sub>3</sub>OH

**Bonus Answer: Z**

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## 7. CHEMISTRY

**Writer: Jason Mohabir**

**Toss Up: Multiple Choice**

The H-C-O bond angle in H<sub>2</sub>C=O (formaldehyde) is approximately:

- W) 90
- X) 109
- Y) 120
- Z) 180

**Toss Up Answer: Y**

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**Bonus: Short Answer**

In which compound does carbon have the highest oxidation state?

1. CH<sub>4</sub>
2. HCN
3. H<sub>2</sub>CO
4. CH<sub>2</sub>Cl<sub>2</sub>

**Bonus Answer: 2. HCN**

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## 8. CHEMISTRY

**Writer: Ashneel Das**

**Toss Up: Multiple Choice**

Which of the following has the highest electronegativity?

- W) Francium  
X) Carbon  
Y) Fluorine  
Z) Oxygen

**Toss Up Answer: Y**

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**Bonus: Short Answer**

How many times faster does hydrogen diffuse through a hole than oxygen?

**Bonus Answer: 4**

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## 9. CHEMISTRY

**Writer: Ivan Zhang**

**Toss Up: Multiple Choice**

What does Pauli's Exclusion Principle state?

- W) Electrons of an atom must have the same spin  
X) No two electrons of an atom travel in the same orbital  
Y) no two electrons in an atom can be at the same time in the same state or configuration  
Z) Electrons can switch spin automatically

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What law states that electrons in the same orbitals reorganize themselves to maximize spin?

**Bonus Answer: Hund's law**

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## 10. CHEMISTRY

**Writer: Ivan Zhang**

**Toss Up: Short Answer**

What is the largest ion with an equal amount of protons and neutrons?

**Bonus Answer: Ca<sup>20+</sup>**

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**Bonus: Short Answer**

Who is regarded as the father of the modern periodic table? (1st and last name)

**Bonus Answer: Dmitri Mendeleev**

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## 11. CHEMISTRY

**Writer: Ashneel Das**

**Toss Up: Multiple Choice**

Which of the following radioactive isotopes is used in the treatment of thyroid cancer?

- W) Carbon-12

- X) Iodine-131
- Y) Uranium-238
- Z) Technetium-99

**Toss Up Answer: X**

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**Bonus: Short Answer**

If a radioactive isotope has a half life of 2 years, how long would it take for 1/8 of the original material to remain?

**Bonus Answer: 6 years**

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## 12. CHEMISTRY

**Writer: Zoe Orlin**

**Toss Up: Short Answer**

What element has the largest atomic radius?

**Bonus Answer: Francium**

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**Bonus: Multiple Choice**

What is the most electronegative element?

- W) Francium
- X) Beryllium
- Y) Fluorine
- Z) Lithium

**Bonus Answer: Y**

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## 13. CHEMISTRY

**Writer: Calvin Aw**

**Toss Up: Multiple Choice**

Which of the following isoelectronic ions has the largest ionic radius?

- W) Sulfur: 2-
- X) Chlorine: 1-
- Y) Potassium: 1+
- Z) Calcium: 2+

**Toss Up Answer: W**

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**Bonus: Short Answer**

Complete the sentence with one word: As the nuclear charge of an ion increases, the ionic radius \_\_\_\_\_.

**Bonus Answer: decreases (Do not accept decrease)**

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## 14. CHEMISTRY

**Writer: Calvin Aw**

**Toss Up: Multiple Choice**

Which of the following is false about metals?

- W) Metals are malleable and ductile
- X) Metals tend to lose electrons to become cations
- Y) Metallic reactivity increases as you go down a group.
- Z) All metals are solid at room temperature

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Which of the following metals isn't solid at room temperature?

- W) Mercury
- X) Tantalum
- Y) Barium
- Z) Chromium

**Bonus Answer: W**

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## 15. CHEMISTRY

**Writer: Calvin Aw**

**Toss Up: Short Answer**

How many orientation of f orbitals are there?

**Bonus Answer: 7**

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**Bonus: Short Answer**

The Pauli Exclusion Principle states that at most how many electrons can occupy a single atomic orbital?

**Bonus Answer: 2**

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## 16. CHEMISTRY

**Writer: Janine Goh**

**Toss Up: Short Answer**

Which group of the periodic table has a fully filled d orbital?

**Bonus Answer: Group 12**

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**Bonus: Short Answer**

Name 2 elements that behave both as a metal and non-metal

**Bonus Answer: Any 2: Boron, silicon, germanium, arsenic, antimony, tellerium, (polonium)**

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## 17. CHEMISTRY

**Writer: Janine Goh**

**Toss Up: Short Answer**

Which group of elements has the lowest ionization energy?

**Bonus Answer: Alkali metals**

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**Bonus: Short Answer**

What are the elements in group 5 called?

**Bonus Answer: Pnictogens**

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## 18. CHEMISTRY

**Writer: Janine Goh**

**Toss Up: Multiple Choice**

Which of the following elements are Lanthanides?

- W) Lawrencium
- X) Meltnerium
- Y) Seaborgium
- Z) Terbium

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What unit does electronegativity use?

Bonus Answer: No unit

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## 19. CHEMISTRY

Writer: Andrew Chen

Toss Up: Short Answer

Order the following in terms of the rate of diffusion along them, from fastest to slowest. 1: Open Surface. 2: Through an amorphous material. 3: Through a crystal.

Bonus Answer: 1, 3, 2

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Bonus: Multiple Choice

Which of the following is a thermal conductor, but not an electrical one?

- W) Graphite
- X) Graphene
- Y) Diamond
- Z) Polystyrene

Bonus Answer: Y

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## 20. CHEMISTRY

Writer: Ashneel Das

Toss Up: Short Answer

If you have a 1 L of a 10 M solution of HCl and you want 2 L of a 5 M solution of HCl, how much water must you add?

Bonus Answer: 1 L

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Bonus: Short Answer

If the pOH of a solution is 6, what is the concentration of H<sup>+</sup> ions?

Bonus Answer:  $1.0 \times 10^{-8}$  (also 0.00000001)

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## 21. CHEMISTRY

Writer: Kerwin Chen

Toss Up: Short Answer

Roger Y. Tsien, Osamu Shimomura, and Martin Chalfie were awarded the 2008 Nobel Prize in Chemistry for the discovery and development of which protein?

Bonus Answer: Green Fluorescent Protein, GFP

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Bonus: Multiple Choice

Which organism was the Green Fluorescent Protein first isolated from?

- W) Anglerfish
- X) Jellyfish
- Y) Squids
- Z) Gulper Eels

Bonus Answer: X

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## 22. CHEMISTRY

Writer: Kerwin Chen

Toss Up: Multiple Choice

Which element is most electronegative?

- W) Chlorine
- X) Fluorine

Y) Astatine

Z) Cesium

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

What is the range of electronegativity values?

W) 0.0 to 1.0

X) 0.0 to 2.0

Y) 0.0 to 3.0

Z) 0.0 to 4.0

**Bonus Answer: Z**

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## 23. CHEMISTRY

**Writer: Kerwin Chen**

**Toss Up: Multiple Choice**

How many orbitals does the p sublevel have?

W) 1

X) 2

Y) 3

Z) 4

**Toss Up Answer: Y**

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**Bonus: Short Answer**

which element has the electron configuration  $1s^2 2s^2 2p^6 3s^1$  in its ground state?

**Bonus Answer: Sodium, Na**

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## 24. CHEMISTRY

**Writer: Ashneel Das**

**Toss Up: Short Answer**

Where does oxidation occur in an electrochemical cell?

**Bonus Answer: Anode**

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**Bonus: Short Answer**

In the redox reaction  $2H_2 + O_2 \rightarrow 2H_2O$  how many electrons are transferred?

**Bonus Answer: 4**

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## 25. CHEMISTRY

**Writer: Andrew Chen (Senior)**

**Toss Up: Multiple Choice**

When 50 mL of stock solution of 6M NaCl (aq) is diluted into a 150 mL solution what will be the molarity of the diluted solution?

W) 3M

X) 2M

Y) 1M

Z) 6M

**Toss Up Answer: X**

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**Bonus: Short Answer**

What is the given equation for calculating molarity?

**Bonus Answer: Moles of solute divided by liters of solution**

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## 26. CHEMISTRY

**Writer: Andrew Chen (Senior)**

**Toss Up: Multiple Choice**

Given the following ions, Na<sup>+</sup>, Br<sup>-</sup>, Ag<sup>+</sup>, and Cu<sup>2+</sup> which ion has the greatest atomic radius?

W) Na<sup>+</sup>

X) Br<sup>-</sup>

Y) Ag<sup>+</sup>

Z) Cu<sup>2+</sup>

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Name the group of elements with the least electronegativity.

**Bonus Answer: Noble gases (Group 18)**

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## 27. CHEMISTRY

**Writer: Andrew Chen (Senior)**

**Toss Up: Multiple Choice**

Choose the strongest acid from the choices below.

W) Hydrochloric acid

X) Hydrobromic acid

Y) Hydroiodic acid

Z) Hydrofluoric acid

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What are the conjugate bases of HCl, HBr, and HI?

**Bonus Answer: Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>**

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## 28. CHEMISTRY

**Writer: Andrew Chen**

**Toss Up: Multiple Choice**

From what two molecules is an ester synthesized?

W) alcohol and ester

X) alcohol and aldehyde

Y) carboxylic acid and ester

Z) carboxylic acid and alcohol

**Toss Up Answer: Z**

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**Bonus: Short Answer**

If one mole of an acid is dissolved in a liter of water, and the acid has a pK<sub>a</sub> of 10, what is the pH of the solution?

**Bonus Answer: 7**

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## 29. CHEMISTRY

**Writer: Andrew Chen**

**Toss Up: Multiple Choice**

Which of the following exhibits diamagnetism?

W) bronze



- X) water
- Y) liquid oxygen
- Z) diamond

**Toss Up Answer: X**

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**Bonus: Short Answer**

Order the following by second ionization energy, from lowest to highest: Sodium, Magnesium, Aluminum

**Bonus Answer: Magnesium, Aluminum, Sodium**

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**30. CHEMISTRY**

**Writer: Andrew Chen**

**Toss Up: Multiple Choice**

Why is diamond a thermal conductor, even though it isn't an electrical conductor?

- W) heat vibrations can move along the rigid structure
- X) carbon has a low heat capacity
- Y) there are no impurities which increase resistance
- Z) carbon has a high heat capacity

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

Which of the following has the highest carbon content?

- W) wrought iron
- X) cast iron
- Y) pig iron
- Z) slag

**Bonus Answer: Y**

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**31. CHEMISTRY**

**Writer: Ashneel Das**

**Toss Up: Multiple Choice**

Which of the following describes the carbon dioxide molecule?

- W) Polar and Linear
- X) Polar and Bent
- Y) Nonpolar and Linear
- Z) Nonpolar and Bent

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What hybridization is typically found in linear molecules?

**Bonus Answer: sp**

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**32. CHEMISTRY**

**Writer: Ashneel Das**

**Toss Up: Multiple Choice**

In the reaction  $A + B \rightarrow C + D$ , which of the following occurs when reactant B is added?

- W) The concentration of A decreases
- X) The concentration of C decreases
- Y) The concentration of D decreases

Z) The reaction shifts to the left

**Toss Up Answer: W**

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**Bonus: Short Answer**

Given the specific heat capacity of water is 4.18 Joule/gram°C, if you have 20 grams of water and want to heat it from 10 degrees C to 15 degrees C, how many joules must be added?

**Bonus Answer: 418 Joules**

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**33. CHEMISTRY**

**Writer: Ashneel Das**

**Toss Up: Multiple Choice**

The conjugate base of HCl is which of the following?

W) A weak acid

X) A strong acid

Y) A weak base

Z) A strong base

**Toss Up Answer: Y**

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**Bonus: Short Answer**

How many sigma and pi bonds does carbon dioxide have?

**Bonus Answer: 2 sigma, 2 pi**

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**34. CHEMISTRY**

**Writer: Ashneel Das**

**Toss Up: Multiple Choice**

Which of the following substances cannot be decomposed further chemically?

W) Carbon Dioxide

X) Water

Y) Silicon

Z) Ammonia

**Toss Up Answer: Y**

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**Bonus: Short Answer**

If 0.5 moles of NaCl are dissolved in 2 kg of water, what is the molality of the resulting solution?

**Bonus Answer: 0.25 or 1/4**

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**35. CHEMISTRY**

**Writer: Jason Weng**

**Toss Up: Short Answer**

What is the oxidation number of chromium in the dichromate ion?

**Bonus Answer: +6**

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**Bonus: Short Answer**

Name the following:  $\text{CuCr}_2\text{O}_7$ .

**Bonus Answer: Copper (II) dichromate; or Cupric dichromate**

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**36. CHEMISTRY**

**Writer: Jason Weng**

**Toss Up: Multiple Choice**

What is the most reasonable pH of the solution when the salt formed by reacting hydrochloric acid and aluminum

hydroxide is dissolved in water?

W) 7

X) 4

Y) 10

Z) 0

**Toss Up Answer: X**

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**Bonus: Short Answer**

125 mL from a 4M perchloric acid stock solution is reacted with excess sodium hydroxide. How many moles of the salt are formed if the system is 50% efficient?

**Bonus Answer: 0.25 mol; 1/4 mol**

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### 37. CHEMISTRY

**Writer: Jason Weng**

**Toss Up: Short Answer**

How many hydrogen atoms does a molecule of acetone have?

**Bonus Answer: 6**

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**Bonus: Short Answer**

What is the electron configuration of  $\text{Cr}^{3+}$  using noble gas notation?

**Bonus Answer:  $[\text{Ar}]3d^3$**

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### 38. CHEMISTRY

**Writer: Calvin Vuong**

**Toss Up: Multiple Choice**

The relation between pressure and temperature of two ideal gases is stated in

W) Gay-Lussac's Law

X) Boyle's Law

Y) Charles's Law

Z) Avogadro's Law

**Toss Up Answer: W**

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**Bonus: Short Answer**

What are the dimensions of the gas constant R in SI base units?

**Bonus Answer:  $\text{kg m}^2 \text{mol}^{-1} \text{K}^{-1} \text{s}^{-2}$  (accept as a fraction)**

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### 39. CHEMISTRY

**Writer: Olivia Gallager**

**Toss Up: Multiple Choice**

Which of the following describes the reaction that involves a hydrocarbon chain and  $\text{H}_2$  gas yielding two shorter hydrocarbon chains?

W) Synthesis

X) Cracking

Y) Hydrocracking

Z) Substitution

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What electron geometry does ammonia( $\text{NH}_3$ ) have?

**Bonus Answer: tetrahedral, tetrahedron also accepted**

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## 40. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Multiple Choice

Which of the following has the largest ionic radius?

W) Li

X) Be

Y) Na

Z) Mg

Toss Up Answer: X

=====

Bonus: Short Answer

Why does Oxygen have a smaller atomic radius than boron?

Bonus Answer: Effective nuclear charge

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## 41. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Short Answer

What are the numbers of sigma bonds and pi bonds, in ethyne, respectively?

Bonus Answer: 3 sigma bonds, 2 pi bonds

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Bonus: Short Answer

Pi bonds are created by the overlap of what type of orbital?

Bonus Answer: p, p orbitals

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## 42. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

The shape of a  $\text{PCl}_3$  molecule is described as

W) bent

X) trigonal pyramidal

Y) linear

Z) trigonal planar

Toss Up Answer: X

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Bonus: Short Answer

Twenty-five percent of element X exists as  $^{210}\text{X}$  and 75 percent of it exists as  $^{214}\text{X}$ . What is the atomic weight of element X?

Bonus Answer: 211

=====

## 43. CHEMISTRY

Writer: Raafiul Hossain

Toss Up: Short Answer

Is HCL a strong acid?

Bonus Answer: Yes

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Bonus: Short Answer

Is NAOH a strong base?

Bonus Answer: Yes

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## 44. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

Which of the following species is amphoteric?

W)  $\text{Na}_3\text{PO}_4$

X)  $\text{HSO}_4^-$

Y)  $\text{KOH}$

Z)  $\text{HNO}_3$

Toss Up Answer: X

---

Bonus: Short Answer

A 600-milliliter container holds 2 moles of  $\text{O}_2(\text{g})$ , 3 moles of  $\text{H}_2(\text{g})$ , and 1 mole of  $\text{He}(\text{g})$ . Total pressure within the container is 760 torr. What is the partial pressure of  $\text{O}_2$ ?

Bonus Answer: 253 torr

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## 45. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

What is the correct term(s) used to determine if a system has come to equilibrium?

W)  $K_a$  and  $Q$

X)  $K_{sp}$

Y)  $Q$

Z)  $K_c$

Toss Up Answer: Y

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Bonus: Multiple Choice

Chemical equilibrium may be used to describe

W) gas phase chemical reactions

X) acid and based ionization

Y) Solubility

Z) All of the Above

Bonus Answer: Z

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## 46. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

The term(s) most useful in determining the solubility of a substance is (are)

W)  $K_a$  and  $Q$

X)  $K_{sp}$

Y)  $Q$  and Le Chatelier's Principle

Z)  $K_c$

Toss Up Answer: X

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Bonus: Multiple Choice

The effect of temperature on a chemical system is best described using

W)  $K_a$  and  $Q$

X)  $K_{sp}$

Y) Le Chatelier's Principle

Z) Kc

**Bonus Answer: Y**

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## 47. CHEMISTRY

**Writer: Nicholas Adit**

**Toss Up: Multiple Choice**

Which of the following is closest in mass to a proton?

W) Alpha Particle

X) Positron

Y) Neutron

Z) Hydrogen Molecule

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What is the amount of calories of heat transferred to the water is when the temperature of a 20-gram sample of water is increased from 10°C to 30°C?

**Bonus Answer: 400**

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## 48. CHEMISTRY

**Writer: Prangon Ghose**

**Toss Up: Multiple Choice**

Which of the following elements has the largest number of possible oxidation states?

W) Fe

X) Cl

Y) Ca

Z) Mn

**Toss Up Answer: X**

=====

**Bonus: Multiple Choice**

What is the minimum number of electrons needed to balance the following half-reaction with whole number coefficients?

$\text{IO}_3^- \rightarrow \text{I}_2$

W) 1 e-

X) 2 e-

Y) 5 e-

Z) 10 e-

**Bonus Answer: Z**

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## 49. CHEMISTRY

**Writer: Nicholas Adit**

**Toss Up: Short Answer**

In 12.4 hours, a 100 gram sample of an element decays so that its mass is 25 grams. What is the approximate half-life of this radioactive substance?

**Bonus Answer: 6.2 hours**

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**Bonus: Multiple Choice**

Which of the following will raise the boiling point of a sample of water?

- W) Heat the water
- X) Mix gasoline into the water
- Y) Bring the water to a higher altitude
- Z) Dissolve table sugar in the water

**Bonus Answer: Z**

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**50. CHEMISTRY**

**Writer: Prangon Ghose**

**Toss Up: Multiple Choice**

What kind of process is the loss of electrons?

- W) electrolysis
- X) thermodynamically favored
- Y) reduction
- Z) oxidation

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Which of the following metals does not react with water to produce hydrogen?

- W) Zn
- X) Li
- Y) Ca
- Z) Na

**Bonus Answer: W**

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**51. CHEMISTRY**

**Writer: Prangon Ghose**

**Toss Up: Multiple Choice**

Which of the following is not commonly produced by eletrolysis?

- W) NaOCl
- X) Al
- Y) Fe
- Z) NaOH

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

Which of the following pairs of constants are not mathematically related to eachother?

- 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

**Bonus Answer: Z**

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**52. CHEMISTRY**

**Writer: Nicholas Adit**

**Toss Up: Short Answer**

An ideal gas in a closed inflexible container has a pressure of 6 atmospheres and a temperature of 27°C. What will be the new pressure of the gas if the temperature is decreased to -73°C?

**Bonus Answer: 4 atmospheres**

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**Bonus: Multiple Choice**

When CO<sub>2</sub> is bubbled through distilled water at 25°C, which of the following is most likely to occur?

- W) Solid carbon will form
- X) The pH of the solution will be reduced
- Y) The water will boil
- Z) Methane gas will be formed

**Bonus Answer: X**

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## 53. CHEMISTRY

**Writer: Prangon Ghose**

**Toss Up: Multiple Choice**

Which would be the easiest way to burn an iron nail?

- W) Hold an iron nail with crucible tongs, and heat strongly in the flame of a bunsen burner.
- X) Use the above method with an oxyacetylene torch to reach highest temperatures.
- Y) Grind the nail into very small, dust-sized particles and spray them into a flame.
- Z) Dissolve the nail in acid to make the oxide.

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

What is a reasonable and safe substitute for zinc in reduction reactions in aqueous solutions?

- W) S
- X) F<sub>2</sub>
- Y) K
- Z) Cd

**Bonus Answer: Z**

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## 54. CHEMISTRY

**Writer: Nicholas Adit**

**Toss Up: Multiple Choice**

Which of the following is a nonpolar molecule?

- W) Carbon dioxide
- X) Water
- Y) Ammonia
- Z) Hydrochloric acid

**Toss Up Answer: W**

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**Bonus: Short Answer**

Which of the following forms of radioactive decay has (or have) no electrical charges? 1) Alpha Decay 2) Beta Decay 3) Gamma Decay

**Bonus Answer: 3 only**

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## 55. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

Which of these gases is expected to condense at the lowest pressure, assuming that the temperature is constant?

- W) Bromomethane
- X) Dibromomethane
- Y) Tetrabromomethane
- Z) They all condense at the same temperature

Toss Up Answer: Y

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Bonus: Short Answer

Which attractive force is the major cause of condensation?

Bonus Answer: London Dispersion Forces (accept: London Forces)

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## 56. CHEMISTRY

Writer: Prangon Ghose

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

The rate of reaction will be large if

- W) delta G is a large negative number
- X) delta S is a large negative number
- Y) delta H is a large negative number
- Z) None of the above

Bonus Answer: Z

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## 57. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

Which of the following can be precisely determined for a chemical substance?

- W) Entropy
- X) Enthalpy
- Y) Free Energy
- Z) All of the Above

Toss Up Answer: W

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Bonus: Short Answer

In a rate law, what are the units of k when the order is 3?

Bonus Answer:  $L^2 \text{ mol}^{-2} \text{ s}^{-1}$

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## 58. CHEMISTRY

Writer: Nicholas Adit

**Toss Up: Multiple Choice**

Which of the following statements is NOT true for the element of sodium?

- W) It has an oxidation state of +1
- X) It forms a basic solution with water
- Y) It gives off a bright red color when burned
- Z) It reacts with a halogen to form a salt

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

Which of the following are products made from the reaction  $\text{H}_2\text{SO}_4(\text{aq}) + \text{Ba}(\text{OH})_2(\text{aq}) \rightarrow ?$  I)  $\text{O}_2(\text{g})$  II)  $\text{H}_2\text{O}(\text{l})$  III)  $\text{BaSO}_4(\text{s})$

**Bonus Answer: II and III**

---

**59. CHEMISTRY**

**Writer: Prangon Ghose**

**Toss Up: Short Answer**

In a rate law, what are the units of k when the order is 1?

**Bonus Answer:  $\text{s}^{-1}$**

---

**Bonus: Short Answer**

In a rate law, what are the units of k when the order is 5?

**Bonus Answer:  $\text{L}^4 \text{mol}^{-4} \text{s}^{-1}$**

---

**60. CHEMISTRY**

**Writer: Prangon Ghose**

**Toss Up: Short Answer**

What is the chemical formula of tetraphosphorus decaoxide?

**Bonus Answer:  $\text{P}_4\text{O}_{10}$**

---

**Bonus: Short Answer**

What is the bond order of the central atom in  $\text{CO}_3^{2-}$ ?

**Bonus Answer:  $4/3$  (accept:  $1 \frac{1}{3}$ )**

---

**61. CHEMISTRY**

**Writer: Nicholas Adit**

**Toss Up: Multiple Choice**

What happens in a hydrogen atom when an electron jumps from an excited energy state to a more stable energy state?

- W) electromagnetic radiation is emitted by the atom
- X) electromagnetic radiation is absorbed by the atom
- Y) the atom becomes a positively charged ion
- Z) the atom becomes a negatively charged ion

**Toss Up Answer: W**

---

**Bonus: Short Answer**

A closed 5-liter vessel contains a sample of neon gas. The temperature inside the container is  $25^\circ\text{C}$ , and the pressure is 1.5 atmospheres. (The gas constant, R, is equal to  $0.08 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K}$ .) If the neon gas in the vessel is replaced with an equal molar quantity of helium gas, which of the following properties of the gas in the container will be changed?

- I. Pressure
- II. Temperature

III. Density

**Bonus Answer: III only**

=====

## 62. CHEMISTRY

**Writer: Nicholas Adit**

**Toss Up: Multiple Choice**

A solution of  $\text{H}_2\text{SO}_3$  is found to have a hydrogen ion concentration of  $1 \times 10^{-3}$  molar at  $25^\circ\text{C}$ . What is the hydroxide ion concentration in the solution?

W)  $1 \times 10^{-1}$

X)  $1 \times 10^{-3}$

Y)  $1 \times 10^{-11}$

Z)  $1 \times 10^{-13}$

**Toss Up Answer: Y**

=====

**Bonus: Short Answer**

If the pH of a solution is changed from 1 to 3 with the addition of an antacid, what percentage of  $[\text{H}^+]$  was neutralized?

**Bonus Answer: 99%**

=====

## 63. CHEMISTRY

**Writer: Siam Muquit**

**Toss Up: Short Answer**

What is the molecular geometry of ammonia ( $\text{NH}_3$ )?

**Bonus Answer: Trigonal Pyramidal**

=====

**Bonus: Multiple Choice**

How many lone pairs are in Xenon tetrafluoride ( $\text{XeF}_4$ )?

W) 0

X) 1

Y) 2

Z) 3

**Bonus Answer: Y**

=====

## 64. CHEMISTRY

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

Which of the following does not exhibit resonance stabilization?

W) Ozone

X)  $\text{SO}_2$

Y)  $\text{NO}_3$

Z)  $\text{H}_2\text{O}$

**Toss Up Answer: Z**

=====

**Bonus: Short Answer**

What is the bond order of  $\text{H}_2\text{O}$ ?

**Bonus Answer: 2**

=====

## 65. CHEMISTRY

**Writer: Ahmad Alnasser**

**Toss Up: Short Answer**

At room temperature, what is the only metal that is in liquid form?

**Bonus Answer: Mercury (Hg)**

---

**Bonus: Multiple Choice**

What is the third most common gas found in the air in the atmosphere?

- W) Argon
- X) Hydrogen
- Y) Oxygen
- Z) Helium

**Bonus Answer: W**

---

## 66. CHEMISTRY

**Writer: Ahmad Alnasser**

**Toss Up: Multiple Choice**

A molecule is considered a lewis acid if

- W) accepts a pair of electrons to form a bond
- X) accepts a proton from water
- Y) donates a pair of electrons to form a bond
- Z) donates a proton to water

**Toss Up Answer: W**

---

**Bonus: Multiple Choice**

Which of the following is a binary compound?

- W) Hydrogen Sulfate
- X) Hydrogen Sulfide
- Y) Ammonium Sulfide
- Z) Ammonium Sulfate

**Bonus Answer: X**

---

## 67. CHEMISTRY

**Writer: Olivia Gallager**

**Toss Up: Short Answer**

What is the name for a molecule with tetrahedral electron geometry but only three substituent groups?

**Bonus Answer: trigonal pyramidal**

---

**Bonus: Multiple Choice**

Which of the following is not an ionic compound?

- W) NaCl
- X) HF
- Y) FeCl<sub>3</sub>
- Z) H<sub>2</sub>SO<sub>4</sub>

**Bonus Answer: X**

---

## 68. CHEMISTRY

**Writer: Olivia Gallager**

**Toss Up: Multiple Choice**

cis 1,2 chloro-ethene and trans 1,2 chloro-ethene differ in which of the following?

- W) electron geometry
- X) enthalpy
- Y) entropy
- Z) boiling point

**Toss Up Answer: Z**

---

**Bonus: Short Answer**

In an acid/base reaction, which (acid or base) is the electrophile?

**Bonus Answer: acid**

---

**69. CHEMISTRY**

**Writer: Jason Mohabir**

**Toss Up: Short Answer**

During glycolysis, electrons removed from glucose are passed to

**Bonus Answer: NAD<sup>+</sup>**

---

**Bonus: Multiple Choice**

A biological redox reaction always involves

- W) an oxidizing agent
- X) a gain of electrons
- Y) a reducing agent
- Z) All of the Above

**Bonus Answer: Z**

---

**70. CHEMISTRY**

**Writer: Jason Mohabir**

**Toss Up: Multiple Choice**

For the unfolding reaction of Protein G,  $\Delta H^\circ = 210.6 \text{ kJ/mol}$ , this means that

- W) unfolding is favored enthalpically
- X) unfolding is favored enthalpically
- Y) the entropy is positive at all temperatures
- Z) the entropy is negative at all temperatures

**Toss Up Answer: X**

---

**Bonus: Multiple Choice**

At the midpoint of a temperature transition curve,

- W) half of the protein is denatured
- X)  $K_{eq} = 1.0$  and  $\Delta G = 0$
- Y)  $[Native] = [Unfolded]$  (Read as concentration of Native = concentration of Unfolded)
- Z) All of these

**Bonus Answer: Z**

---

**71. CHEMISTRY**

**Writer: Jason Mohabir**

**Toss Up: Multiple Choice**

The Standard Gibbs free energy,  $\Delta G^\circ$ , is

- W) the residual energy present in the reactants at equilibrium
- X) the residual energy present in the products at equilibrium
- Y) the energy required to convert one mole of reactants to one mole of products
- Z) the difference in the residual energy of reactants and products at equilibrium

**Toss Up Answer: X**

---

**Bonus: Multiple Choice**

If the enthalpy change for a reaction is zero,  $\Delta G^\circ$  is equal to

- W)  $T\Delta S^\circ$
- X)  $T\Delta S^\circ$
- Y)  $-\Delta H^\circ$
- Z)  $\ln K_{eq}$

**Bonus Answer: X**

---

## 72. CHEMISTRY

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

What is the oxidation state of Manganese in the permanganate ion?

- W) +5
- X) +7
- Y) +2
- Z) -2

**Toss Up Answer: X**

---

**Bonus: Short Answer**

What is the oxidation state of molecular oxygen?

**Bonus Answer: 0**

---

## 73. CHEMISTRY

**Writer: Nicholas Adit**

**Toss Up: Multiple Choice**

Which of the following hydrocarbons have the highest boiling point.

- W)  $\text{CH}_4$
- X)  $\text{C}_2\text{H}_6$
- Y)  $\text{C}_3\text{H}_8$
- Z)  $\text{C}_4\text{H}_{10}$

**Toss Up Answer: Z**

---

**Bonus: Multiple Choice**

Alloys are mixtures of metallic substances. Which of the following pairs are matched INCORRECTLY?

- W) Steel - iron and copper
- X) Brass - copper and zinc
- Y) Pewter - tin, copper, bismuth, and antimony
- Z) Sterling silver - silver and copper

**Bonus Answer: W**

=====

## **74. CHEMISTRY**

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

Which is the strongest type of intermolecular force?

- W) Hydrogen bonding
- X) Dipole-dipole
- Y) Van der Waals
- Z) Metallic bonding

**Toss Up Answer: X**

=====

**Bonus: Short Answer**

By name or number, which of the following elements can form hydrogen bonds?

Oxygen, Chlorine, Fluorine, Nitrogen, Sulfur

**Bonus Answer: Oxygen, Fluorine, Nitrogen or (1, 3, and 4)**

=====

## **75. CHEMISTRY**

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

What is the principal quantum number of Sodium?

- W) 0
- X) 1
- Y) 2
- Z) 3

**Toss Up Answer: Z**

=====

**Bonus: Short Answer**

What are the possible angular momentum quantum numbers for sodium?

**Bonus Answer: 0, 1, 2**

=====

## **76. CHEMISTRY**

**Writer: George Papastefanou**

**Toss Up: Short Answer**

What is the common name of the chemical with formula  $C_{9}H_{8}O_{4}$ ?

**Bonus Answer: Aspirin**

=====

**Bonus: Short Answer**

What is the molar mass, to the nearest whole number, of three molecules of the above chemical?

**Bonus Answer: 540 g/mol**

=====

## **77. CHEMISTRY**

**Writer: Shihab Karim**

**Toss Up: Multiple Choice**

Which of the one of the following salts is insoluble?

- W)  $NH_4Cl$
- X)  $Ca(NO_3)_2$
- Y)  $BaCO_3$
- Z)  $Na_2S$

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

What is the empirical formula for glucose?

**Bonus Answer: CH<sub>2</sub>O**

---

## **78. CHEMISTRY**

**Writer: Shihab Karim**

**Toss Up: Short Answer**

What is the common oxidation state of Oxygen?

**Bonus Answer: -2**

---

**Bonus: Multiple Choice**

Which of the following elements is a halogen?

W) Lithium

X) Potassium

Y) Neon

Z) Chlorine

**Bonus Answer: Z**

---

## **79. CHEMISTRY**

**Writer: Shihab Karim**

**Toss Up: Multiple Choice**

What is the name given to the equation  $P_1V_1=P_2V_2$ ?

W) Ideal Gas Law

X) Charles's Law

Y) Boyle's Law

Z) Gay-Lussac's Law

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

What are bond angles of a tetrahedral?

**Bonus Answer: 109.5 degrees**

---

## **80. CHEMISTRY**

**Writer: Shihab Karim**

**Toss Up: Short Answer**

What is the hybridization of CH<sub>4</sub>?

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

---

**Bonus: Short Answer**

What intermolecular forces exist in HF?

**Bonus Answer: Hydrogen Bonding**

---

## **81. CHEMISTRY**

**Writer: Shihab Karim**

**Toss Up: Multiple Choice**

How many moles of nitrogen are in 35 grams of nitrogen?

W) 3



X) 3.5

Y) 4

Z) 2.5

**Toss Up Answer: Z**

---

**Bonus: Short Answer**

What group is Magnesium a part of?

**Bonus Answer: Alkaline Earth Metals**

---

## 82. CHEMISTRY

**Writer: Jan Wojcik**

**Toss Up: Multiple Choice**

According to VSEPR theory, which of the following molecules DOES NOT have a trigonal pyramidal geometry?

W) NH<sub>3</sub> (read as: Ammonia)

X) BF<sub>3</sub> (read as: Barium trifluoride)

Y) XeF<sub>3</sub> (read as: Xenon trifluoride)

Z) PCl<sub>3</sub> (read as: Phosphorus trichloride)

**Toss Up Answer: X**

---

**Bonus: Short Answer**

By name of number, which of the following molecules have a bent molecular structure? SO<sub>2</sub>, CO<sub>2</sub>, OF<sub>2</sub>

**Bonus Answer: SO<sub>2</sub> and OF<sub>2</sub> (accept 1 and 3)**

---

## 83. CHEMISTRY

**Writer: Henry Zheng**

**Toss Up: Multiple Choice**

A lead chromate solution is typically what color?

W) blue

X) red

Y) yellow

Z) green

**Toss Up Answer: Y**

---

**Bonus: Multiple Choice**

Which of the following molecules exhibits a dipole moment?

W) CH<sub>4</sub>

X) H<sub>2</sub>S

Y) CO<sub>2</sub>

Z) SO<sub>3</sub>

**Bonus Answer: X**

---

## 84. CHEMISTRY

**Writer: Shihab Karim**

**Toss Up: Short Answer**

List the following atoms in order of increasing electronegativity: fluorine, chlorine, and bromine

**Bonus Answer: Fluorine**

---

**Bonus: Short Answer**

Which element has the highest electronegativity?

**Bonus Answer: Fluorine**

=====

## 85. CHEMISTRY

Writer: Shihab Karim

Toss Up: Short Answer

What term describes the process when a solid phase changes directly to the gas phase?

**Bonus Answer: Sublimation**

-----

**Bonus: Short Answer**

The angle between any two boron-hydrogen bonds in a boron trihydride molecule is how many degrees?

**Bonus Answer: 120 degrees**

=====

## 86. CHEMISTRY

Writer: Henry Zheng

Toss Up: Short Answer

A stable suspension of fine particles in a liquid is called a:

**Bonus Answer: colloid**

-----

**Bonus: Multiple Choice**

Which of the following compounds is used as a fuel additive in what is commonly known as "dry gas" by solubilizing water to reduce its contamination in gasoline?

W) isooctane

X) glycerol

Y) MTBE

Z) isopropyl alcohol

**Bonus Answer: Z**

=====

## 87. CHEMISTRY

Writer: George Papastefanou

Toss Up: Short Answer

Using noble gas abbreviation, what is the electron configuration of a silver atom?

**Bonus Answer: [Kr] 4d<sup>10</sup> 5s<sup>1</sup>**

-----

**Bonus: Short Answer**

What is the most electropositive element in group 1A?

**Bonus Answer: Francium**

=====

## 88. CHEMISTRY

Writer: George Papastefanou

Toss Up: Short Answer

What is the last element of the periodic table to occur naturally on Earth?

**Bonus Answer: Plutonium, element 94**

-----

**Bonus: Short Answer**

Which element is most abundant in the entire Earth?

**Bonus Answer: Iron (do not accept Oxygen, that's just the crust)**

=====

## 89. CHEMISTRY

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

A precipitation reaction is an example of which of the following reactions?

W) Combustion

X) Substitution

Y) Single Displacement

Z) Double Displacement

**Toss Up Answer: Z**

---

**Bonus: Short Answer**

By name or number, which of the following would be a precipitate in aqueous solution? Silver sulfide, Potassium nitrate, Strontium hydroxide, Lead(II) fluoride

**Bonus Answer: Silver sulfide, Lead(II) fluoride OR (1, 4 only)**

---

## 90. CHEMISTRY

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

Which of these is a weak electrolyte?

W) C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>

X) MgCl<sub>2</sub>

Y) NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>

Z) NH<sub>4</sub>OH

**Toss Up Answer: Z**

---

**Bonus: Short Answer**

By name or number, which of the following can conduct electricity in solution? Hydrocarbons, salts, weak acids, strong acids?

**Bonus Answer: Salts, weak acids, strong acids (2, 3, and 4 only)**

---

## 91. CHEMISTRY

**Writer: Seiji Yawata**

**Toss Up: Multiple Choice**

What is the pH of distilled water?

W) 6.5

X) 6.7

Y) 7

Z) Depends on the temperature

**Toss Up Answer: Z**

---

**Bonus: Multiple Choice**

What is one of the hydrolysis product when Magnesium carbide is hydrolysed with water?

W) Propadiene

X) Propyne

Y) Methane

Z) There is insufficient information

**Bonus Answer: Z**

---

## 92. CHEMISTRY

**Writer: Ashneel Das**

**Toss Up: Multiple Choice**

Which of the following molecules has the greatest Van't Hoff factor?

W)  $\text{CaCl}_2$

X)  $\text{NaCl}$

Y)  $\text{C}_6\text{H}_{12}\text{O}_6$

Z)  $\text{KBr}$

**Toss Up Answer: W**

---

**Bonus: Multiple Choice**

Which of the following has the highest melting point?

W)  $\text{NaCl}$

X) Carbon

Y) Water

Z) Helium

**Bonus Answer: X**

---

**93. CHEMISTRY**

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

Which of the following is an example of a strong nucleophile but a weak base?

W)  $\text{CH}_3\text{OH}$

X)  $\text{OH}^-$

Y)  $\text{I}^-$

Z)  $\text{F}^-$

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

By name or number, which of the following are second order reactions?  $\text{S}_\text{N}1$ ,  $\text{S}_\text{N}2$ , E1, E2

**Bonus Answer:  $\text{S}_\text{N}2$  and E2 only (accept 2, 4 only)**

---

**94. CHEMISTRY**

**Writer: Siam Muquit**

**Toss Up: Short Answer**

By name or number, which of the following is associated with inversion of stereochemistry?  $\text{S}_\text{N}1$ ,  $\text{S}_\text{N}2$ , E1, E2

**Bonus Answer:  $\text{S}_\text{N}2$  only (2 only)**

---

**Bonus: Short Answer**

Which rule states that in E1 and E2 reactions, the more substituted double bond is more likely to occur?

**Bonus Answer: Saytzeff rule**

---

**95. CHEMISTRY**

**Writer: Jason Weng**

**Toss Up: Multiple Choice**

If 2 moles of Ar and 5 moles of Xe are placed into one container. What is the partial pressure of Ar if the container is at 14 atm?

W) 2 atm

X) 5 atm

Y) 4 atm

Z) 10 atm

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

How much faster is the effusion of helium gas compared to ammonia gas, to the nearest whole number?

**Bonus Answer: 2**

---

## 96. CHEMISTRY

**Writer: Banpreet Singh**

**Toss Up: Multiple Choice**

What is the second most electronegative element?

W) Fluorine

X) Oxygen

Y) Chlorine

Z) Neon

**Toss Up Answer: X**

---

**Bonus: Multiple Choice**

Which of the following is a weak electrolyte?

W) Ammonium Hydroxide

X) Glucose

Y) Water

Z) Nitric Acid

**Bonus Answer: W**

---

## 97. CHEMISTRY

**Writer: Banpreet Singh**

**Toss Up: Multiple Choice**

Which of the following is insoluble in water?

W) Magnesium Chloride

X) Ammonium Hydroxide

Y) Potassium Carbonate

Z) Barium Sulfate

**Toss Up Answer: Z**

---

**Bonus: Short Answer**

What is the chemical name and formula of the compound that makes up quartz?

**Bonus Answer: Silicon Dioxide SiO<sub>2</sub>**

---

## 98. CHEMISTRY

**Writer: Hanna Yang**

**Toss Up: Multiple Choice**

Which of the following is the lightest element with no stable isotopes?

W) Tellurium

X) Technetium

Y) Promethium

Z) Radon

**Toss Up Answer: X**

---

**Bonus: Multiple Choice**

Which of the following is the strongest intermolecular force?

W) Hydrogen Bonding

X) Ionic Bonding

Y) London Dispersion Force

Z) Covalent Bonding

**Bonus Answer: W**

---

**99. CHEMISTRY**

**Writer: Hanna Yang**

**Toss Up: Short Answer**

Name the most reactive nonmetal.

**Bonus Answer: Fluorine**

---

**Bonus: Short Answer**

Name the transition metal whose carbide is known to be one of the hardest, is used in drills, saws, and lightbulbs, and has the highest melting point of all pure metals.

**Bonus Answer: Tungsten**

---

**100. CHEMISTRY**

**Writer: Hanna Yang**

**Toss Up: Short Answer**

Name the most reactive member of the alkaline earth metals.

**Bonus Answer: Radium**

---

**Bonus: Short Answer**

By name or by number, Identify the ion(s) that has/have the smallest ionic radius?

Ca  $2+$ , Sr  $2+$ , Mg  $2+$ , Na  $+$ , F  $-$

**Bonus Answer: Mg  $2+$**

---

**101. CHEMISTRY**

**Writer: Hanna Yang**

**Toss Up: Multiple Choice**

Which of the following is a polar molecule?

W) SO<sub>2</sub>

X) CH<sub>4</sub>

Y) SF<sub>6</sub>

Z) BF<sub>4</sub>

**Toss Up Answer: W**

---

**Bonus: Short Answer**

Fill in the blanks in the following statement to make it true. Ionic compounds are \_\_\_\_ conductors in their solid state, but \_\_\_\_ conductors when dissolved in water.

**Bonus Answer: poor; good**

---

**102. CHEMISTRY**

**Writer: Nten Nylam**

**Toss Up: Multiple Choice**

Which scientist performed an experiment in which he fired alpha particles at a thin sheet of gold foil?

W) Niels Bohr

X) Ernest Rutherford

Y) J.J. Thomson

Z) Max Planck

**Toss Up Answer: X**

---

**Bonus: Multiple Choice**

What is the name of the compound FeO?

W) iron monoxide

X) iron oxide

Y) iron (I) oxide

Z) iron (II) oxide

**Bonus Answer: Z**

---

## 103. CHEMISTRY

**Writer: Nten Nylam**

**Toss Up: Multiple Choice**

Which of the following is amphoteric?

W) hydrogen fluoride

X) ammonia

Y) water

Z) magnesium oxide

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

What is the molecular geometry of nitrogen trichloride?

**Bonus Answer: trigonal pyramidal (also accept trigonal pyramid)**

---

## 104. CHEMISTRY

**Writer: Kerwin Chen**

**Toss Up: Short Answer**

Which group of elements produce colored ions?

**Bonus Answer: Transition metals**

---

**Bonus: Short Answer**

Which scientist won a Nobel prize in Physics in 1918, whose constant is used to determine the amount of energy, given the wavelength of a wave?

**Bonus Answer: Max Planck, Planck**

---

## 105. CHEMISTRY

**Writer: Andrew Chen (Senior)**

**Toss Up: Multiple Choice**

Certain atoms exhibit paramagnetic or diamagnetic bonding. Of the following below which choice is classified as paramagnetic?

W) Zinc (Zn)

X) Krypton (Kr)

Y) Helium (He)

Z) Oxygen (O)

**Toss Up Answer: Z**

---

**Bonus: Short Answer**

Melting point is effected by bond strength. Order the following compounds in increasing order of melting point: graphite, methane, lithium, sodium chloride.

**Bonus Answer: Methane, lithium, sodium chloride, graphite (2, 3 , 4, 1)**

---

**106. CHEMISTRY**

**Writer: Janine Goh**

**Toss Up: Short Answer**

What activates pepsinogen to change into pepsin?

**Bonus Answer: Hydrochloric acid**

---

**Bonus: Short Answer**

What is the pH of gastric juice?

**Bonus Answer: 1.5 to 2.5 (or any number in between)**

---

**107. CHEMISTRY**

**Writer: Janine Goh**

**Toss Up: Short Answer**

What colour does Xenon release when energised?

**Bonus Answer: White light (all colours)**

---

**Bonus: Short Answer**

What is the difference between electronegativity and electron affinity?

**Bonus Answer: Electron affinity: the amount of energy in kJ/mol needed to add an electron to an element**

**Electronegativity: how much an atom wants an electron (no unit)**

---

**108. CHEMISTRY**

**Writer: Andrew Chen (Senior)**

**Toss Up: Short Answer**

Each element has its own electron configuration. What is the electron configuration of chromium (Cr).

**Bonus Answer: [Ar] 3d<sup>5</sup> 4s<sup>1</sup> (Also accept 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>2</sup> 3p<sup>6</sup> 3d<sup>5</sup> 4s<sup>1</sup>)**

---

**Bonus: Multiple Choice**

There are various numbers of pi and sigma bonds in certain compounds. Which of the choices below best describes the number of pi and sigma bonds ethyne (acetylene) has?

W) 2 pi bonds and 1 sigma bonds

X) 3 pi bonds and 2 sigma bonds

Y) 2 pi bonds and 3 sigma bonds

Z) 4 pi bonds

**Bonus Answer: Y**

---

**109. CHEMISTRY**

**Writer: Janine Goh**

**Toss Up: Multiple Choice**



Who discovered electronegativity?

- W) Linus Pauling
- X) Ernest Rutherford
- Y) Harold Urey
- Z) Carl Bosch

**Toss Up Answer: W**

---

**Bonus: Short Answer**

List 2 gases used in the Miller-Urey experiment

**Bonus Answer: Hydrogen, Water, Ammonia, Methane**

---

## 110. CHEMISTRY

**Writer: Olivia Gallager**

**Toss Up: Short Answer**

In organisms, the bonds in polypeptide chains are formed between which two ends of the amino acid?

**Bonus Answer: Carboxyl, amino OR the side with the NH<sub>2</sub> group, the side with the COOH group**

---

**Bonus: Short Answer**

Fatty acids have three carbon chains attached to what type of molecule?

**Bonus Answer: glycerol**

---

## 111. CHEMISTRY

**Writer: Olivia Gallager**

**Toss Up: Multiple Choice**

Which of the following is a strong nucleophile?

- W) ethanol
- X) butanol
- Y) Bromide
- Z) t-butoxide

**Toss Up Answer: Y**

---

**Bonus: Multiple Choice**

What causes Coordination compounds to be different colors

- W)  $\Delta E$
- X) s orbital overlap
- Y) VESPR
- Z) p orbital overlap

**Bonus Answer: W**

---

## 112. CHEMISTRY

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

The modified form of the Ideal Gas Law includes which of the following?

- W) Higher pressure, Higher Volume
- X) Higher pressure, Lower volume
- Y) Lower Pressure, Higher volume
- Z) Lower pressure, Lower volume

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

Rank the following gases in order from least ideal to most ideal: He, N<sub>2</sub>, HCl, SF<sub>6</sub>

**Bonus Answer:** He, N<sub>2</sub>, SF<sub>6</sub>, HCl (accept 1,2,4,3)

---

**113. CHEMISTRY**

**Writer:** Ivan Zhang

**Toss Up:** Multiple Choice

Which of the following is the most electronegative element?

W) Carbon

X) Vanadium

Y) Selenium

Z) Fluorine

**Toss Up Answer:** Z

---

**Bonus: Short Answer**

What is the name given to the hybrid orbital created with a steric number of 3?

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

---

**114. CHEMISTRY**

**Writer:** Ivan Zhang

**Toss Up:** Multiple Choice

Which of the following forces is the only force that bonds noble gases?

W) Dipole-Dipole

X) Ionic

Y) Covalent

Z) London Dispersion Forces

**Toss Up Answer:** Z

---

**Bonus: Short Answer**

What term is used to describe the energy released by the bonding of gaseous ions to form one mole of a substance?

**Bonus Answer:** lattice energy

---

**115. CHEMISTRY**

**Writer:** Ivan Zhang

**Toss Up:** Multiple Choice

Which of the following elements has the highest reflectivity?

W) Gold

X) Silver

Y) Mercury

Z) Gallium

**Toss Up Answer:** X

---

**Bonus: Short Answer**

What is Avogadro number to the nearest ten-thousandths?

**Bonus Answer:** 6.0221 \* 10<sup>23</sup>

---

**116. CHEMISTRY**

**Writer:** Ivan Zhang

**Toss Up:** Multiple Choice

Which element breaks the octet rule?

- W) Ga
- X) Xe
- Y) Cu
- Z) F

**Toss Up Answer: X**

---

**Bonus: Short Answer**

What is the empirical formula of C<sub>6</sub>H<sub>11</sub>?

**Bonus Answer: C<sub>6</sub>H<sub>11</sub>**

---

## 117. CHEMISTRY

**Writer: Olivia Gallager**

**Toss Up: Short Answer**

For E<sub>2</sub> reactions to occur, the Hydrogen has to be what to the leaving group?

**Bonus Answer: antiperiplanar**

---

**Bonus: Short Answer**

List the following formations in order of lowest stability to highest: Trans, Geminal, Cis

**Bonus Answer: cis, geminal, trans**

---

## 118. CHEMISTRY

**Writer: Andrew Chen (Senior)**

**Toss Up: Multiple Choice**

In the following redox reaction: CH<sub>4</sub> + 2O<sub>2</sub> → CO<sub>2</sub> + 2H<sub>2</sub>O which compound is the oxidizing agent?

- W) O<sub>2</sub>
- X) CH<sub>4</sub>
- Y) CO<sub>2</sub>
- Z) H<sub>2</sub>O

**Toss Up Answer: W**

---

**Bonus: Short Answer**

Given the organic molecule C<sub>6</sub>H<sub>14</sub> how many different structural isomers can be formed?

**Bonus Answer: Five**

---

## 119. CHEMISTRY

**Writer: Andrew Chen (Senior)**

**Toss Up: Multiple Choice**

Certain compounds are insoluble in solution. Which of the following choices below is soluble in aqueous solution?

- W) BaSO<sub>4</sub>
- X) AgCl
- Y) AgNO<sub>3</sub>
- Z) NiCO<sub>3</sub>

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

There is a variety of lab techniques that could be used to separate precipitates from the supernatant liquid. Which of the following lab techniques: centrifuge, distillation, chromatography, and titration can be used to separate them.

**Bonus Answer: Centrifuge (1)**

---

## 120. CHEMISTRY

Writer: Andrew Chen (Senior)

Toss Up: Short Answer

Please balance the given equation  $\text{CO}_3^{2-} + 2\text{H}^+ \rightarrow \text{H}_2\text{O} + \text{CO}_2$

Bonus Answer: 1,1,1

---

Bonus: Multiple Choice

There are various pieces of chemical equipment. What is a piece of glassware designed specifically for usage in creating solutions?

W) Erlenmeyer flask

X) Florence flask

Y) Volumetric flask

Z) Graduated cylinder

Bonus Answer: Y

---

## 121. CHEMISTRY

Writer: Banpreet Singh

Toss Up: Multiple Choice

Under what conditions would 1.0 mol of  $\text{CO}_2(\text{g})$  behave most like an ideal gas?

W) 100 K and 100 atm

X) 800 K and 0.1 atm

Y) 800 K and 1 atm

Z) 800 K and 100 atm

Toss Up Answer: X

---

Bonus: Short Answer

A sample of 9.00 grams  $\text{Al}(\text{s})$  is added to excess  $\text{HCl}(\text{aq})$ . What is the volume of the hydrogen gas produced at STP?

Bonus Answer: 11.2 L

---

## 122. CHEMISTRY

Writer: Banpreet Singh

Toss Up: Multiple Choice

As the temperature is raised from 20 degrees Celsius to 40 degrees Celsius, the average energy of a sample of neon atoms changes by a factor of

W) 1/2

X)  $\sqrt{313/293}$

Y) 313/293

Z) 2

Toss Up Answer: Y

---

Bonus: Short Answer

A sample of oxygen gas occupies 8.00 L at 127 degrees Celsius and 775 mmHg. It is heated at constant pressure and expands to 20.00 L. In Celsius what is the new temperature?

Bonus Answer: 727 degrees celsius

---

## 123. CHEMISTRY

Writer: Banpreet Singh

Toss Up: Multiple Choice

Which gas effuses at approximately one half as fast as ammonia?

- W) He
- X) CO<sub>2</sub>
- Y) Cl<sub>2</sub>
- Z) CH<sub>4</sub>

**Toss Up Answer: Y**

---

**Bonus: Multiple Choice**

For which of two gases are the rates of effusion 2:1?

- W) Ne and Kr
- X) He and O<sub>2</sub>
- Y) H<sub>2</sub> and He
- Z) N<sub>2</sub> and Ar

**Bonus Answer: W**

---

**124. CHEMISTRY**

**Writer: Banpreet Singh**

**Toss Up: Short Answer**

At what temperature Kelvin does water freeze?

**Bonus Answer: 273 K**

---

**Bonus: Short Answer**

Who came up with the caloric theory?

**Bonus Answer: Antoine Lavoisier**

---

**125. CHEMISTRY**

**Writer: Olivia Gallager**

**Toss Up: Multiple Choice**

Which of the following has a coordinate covalent bond?

- W) butanol
- X) CO<sub>2</sub>
- Y) Methane
- Z) NH<sub>4</sub><sup>+</sup>

**Toss Up Answer: Z**

---

**Bonus: Short Answer**

What is the formal charge of Nitrogen in an ammonia molecule?

**Bonus Answer: 0**

---

**126. CHEMISTRY**

**Writer: Seiji Yawata**

**Toss Up: Multiple Choice**

Which of the following compounds does not exist?

- W) PF<sub>5</sub>
- X) P<sub>4</sub>O<sub>10</sub>
- Y) P<sub>4</sub>O<sub>6</sub>
- Z) PH<sub>5</sub>

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

Order the following hydrogen halides from the one with the lowest boiling point to one with the highest: HI, HCl, HBr, HF

**Bonus Answer:** HCl, HBr, HI, HF (2, 3, 1, 4)

=====

**127. CHEMISTRY**

**Writer:** Seiji Yawata

**Toss Up:** Multiple Choice

Which of the following is the most acidic?

W) o-methoxy benzoic acid

X) benzoic acid

Y) m-methoxy benzoic acid

Z) p-methoxy benzoic acid

**Toss Up Answer:** W

=====

**Bonus: Short Answer**

What is the equivalent weight of HNO<sub>3</sub> in the reaction: Cu reacts with HNO<sub>3</sub>, forming Cu(NO<sub>3</sub>)<sub>2</sub>, NO and water.

**Bonus Answer:** 84

=====

**128. CHEMISTRY**

**Writer:** Seiji Yawata

**Toss Up:** Multiple Choice

The last electron of lanthanum enters in the:

W) d orbital

X) s orbital

Y) p orbital

Z) f orbital

**Toss Up Answer:** W

=====

**Bonus: Multiple Choice**

Which of the following is true for B<sub>3</sub>N<sub>3</sub>H<sub>6</sub>

W) Its name is Nitroborane

X) All the atoms are sp-hybridised

Y) It has 3 lone pairs of electrons

Z) It is isostructural with benzene

**Bonus Answer:** Z

=====

**129. CHEMISTRY**

**Writer:** Seiji Yawata

**Toss Up:** Multiple Choice

Which of the following statements is true?

W) Hydrogen peroxide has a planar structure

X) Tritium is radioactive and emits alpha particles

Y) H<sub>2</sub> is insoluble in water

Z) Hydrogen constitutes 70% of the Earth's crust by mass

**Toss Up Answer:** Y

=====

**Bonus: Multiple Choice**

Which of the following gas mixtures is not applicable to Dalton's law of Partial Pressures?

- W) CO<sub>2</sub> and N<sub>2</sub>
- X) CO<sub>2</sub> and CO
- Y) SO<sub>2</sub> and O<sub>2</sub>
- Z) N<sub>2</sub> and CO

**Bonus Answer: Y**

=====

**130. CHEMISTRY**

**Writer: Andrew Chen (Senior)**

**Toss Up: Short Answer**

Given the equation  $\text{HCl (aq)} + \text{NaOH (aq)} \rightarrow \text{NaCl (aq)} + \text{H}_2\text{O (l)}$  and that 10.00 mL of 1.5 M HCl was reacted with 20.00 mL of 0.80 M of NaOH, which compound is the limiting reactant?

**Bonus Answer: HCl ( Hydrochloric acid)**

=====

**Bonus: Multiple Choice**

In organic chemistry what is the name of the functional group consisting of a central carbon singly bonded to two carbon atoms and doubly bonded to an oxygen atom?

- W) amine
- X) amide
- Y) ether
- Z) ketone

**Bonus Answer: Z**

=====

**131. CHEMISTRY**

**Writer: Olivia Gallager**

**Toss Up: Short Answer**

How many sigma and pi bonds does 1,3 butdiene have, respectively?

**Bonus Answer: 3 sigma, 2 pi**

=====

**Bonus: Short Answer**

S orbital overlap has what shape?

**Bonus Answer: spherical, sphere**

=====

**132. CHEMISTRY**

**Writer: Mohammed Haque**

**Toss Up: Short Answer**

What is the electron configuration for Fluorine?

**Bonus Answer: 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>5</sup>**

=====

**Bonus: Short Answer**

What is the noble gas configuration of Fluorine ?

**Bonus Answer: [He]2s<sup>2</sup> 2p<sup>5</sup>**

=====

**133. CHEMISTRY**

**Writer: Ahmad Alnasser**

**Toss Up: Short Answer**

Which element is the more electronegative?

**Bonus Answer: Flourine**

---

**Bonus: Short Answer**

Name all the atoms that are diatomic.

**Bonus Answer: Hydrogen (H<sub>2</sub>)**

Nitrogen (N<sub>2</sub>)

Oxygen (O<sub>2</sub>)

Fluorine (F<sub>2</sub>)

Chlorine (Cl<sub>2</sub>)

Iodine (I<sub>2</sub>)

Bromine (Br<sub>2</sub>)

---

### 134. CHEMISTRY

**Writer: Mohammed Haque**

**Toss Up: Short Answer**

How did Mendeleev arrange the elements of the periodic table?

**Bonus Answer: In order of increasing atomic mass.**

---

**Bonus: Short Answer**

How did Moseley change the periodic table?

**Bonus Answer: He arranged the elements in increasing atomic numbers.**

---

### 135. CHEMISTRY

**Writer: Ahmad Alnasser**

**Toss Up: Short Answer**

What is the word that describes a substance that reacts with both strong acids and strong bases?

**Bonus Answer: Amphoteric**

---

**Bonus: Multiple Choice**

The triple bond between the carbon atoms causes acetylene, C<sub>2</sub>H<sub>2</sub>, to have which of the following shapes?

W) Trigonal planar (pron: try-gon-al)

X) Linear

Y) Tetrahedral

Z) Trigonal bipyramidal

**Bonus Answer: X**

---

### 136. CHEMISTRY

**Writer: Calvin Aw**

**Toss Up: Short Answer**

Find the molecular geometry for a NH<sub>3</sub> ion

**Bonus Answer: Trigonal Pyramidal**

---

**Bonus: Short Answer**

State all the group numbers which consist of the representative elements.

**Bonus Answer: 1,2,13,14,15,16,17, and 18 (Accept 1-2, 13-18)**

---

### 137. CHEMISTRY

**Writer: Ahmad Alnasser**

**Toss Up: Short Answer**



What is the name of a cyclic molecule with 6 carbons?

**Bonus Answer: cyclohexane**

---

**Bonus: Multiple Choice**

Which of the following compounds contains a double bond?

- W) butene
- X) acetylene
- Y) butane
- Z) butyne

**Bonus Answer: W**

---

## 138. CHEMISTRY

**Writer: Ahmad Alnasser**

**Toss Up: Multiple Choice**

What is the name given to the non-superimposable mirror image forms of chiral compounds?

- W) Diastereomers
- X) Stereoisomers
- Y) Enantiomers
- Z) Cis-trans isomers

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

What metal is used as a reducing agent to obtain iron from iron oxide in the Thermite process?

**Bonus Answer: Aluminum**

---

## 139. CHEMISTRY

**Writer: Elias Milborn**

**Toss Up: Multiple Choice**

Which of the following elements, in gaseous state, has the highest electron affinity?

- W) Fluorine
- X) bromine
- Y) sulfur
- Z) chlorine

**Toss Up Answer: W**

---

**Bonus: Multiple Choice**

In order to calculate the heat of fusion for a piece of ice placed in warm water, you must know:

- W) The energy released by the warm water and the mass of the water
- X) The energy released by the warm water and the mass of the ice
- Y) the energy released by the ice and the mass of the warm water
- Z) the energy released by the ice and the mass of the ice

**Bonus Answer: X**

---

## 140. CHEMISTRY

**Writer: Elias Milborn**

**Toss Up: Multiple Choice**

What is the mass of an electron relative to a proton?

W)  $9.1 \times 10^{-31}$

X)  $8.2 \times 10^{-14}$

Y) 1/1836

Z) 0.51

**Toss Up Answer: Y**

---

**Bonus: Multiple Choice**

Which of the following is not a component of a phospholipid?

W) water

X) glycerol

Y) fatty acid

Z) phosphate group

**Bonus Answer: W**

---

## 141. CHEMISTRY

**Writer: Elias Milborn**

**Toss Up: Short Answer**

What is the IUPAC name for  $\text{SnCl}_2 \cdot 6\text{H}_2\text{O}$ ?

**Bonus Answer: Tin (II) Chloride Hexahydrate**

---

**Bonus: Multiple Choice**

Which of the following elements has the valence electron configuration of  $3s^2 3p^3$ ?

W) Phosphorous

X) Oxygen

Y) Bromine

Z) Nitrogen

**Bonus Answer: W**

---

## 142. CHEMISTRY

**Writer: Elias Milborn**

**Toss Up: Multiple Choice**

Which of the following is a weak electrolyte?

W) ammonia

X) dilute sulfuric acid

Y) 1 Molar sulfuric acid

Z) dilute perchloric acid

**Toss Up Answer: W**

---

**Bonus: Short Answer**

What is the most common name for the conformation for the ring structure of cyclohexane adopts to reach a strain-free value?

**Bonus Answer: Chair**

---

## 143. CHEMISTRY

**Writer: Shantanu Jha**

**Toss Up: Multiple Choice**

Which quantum number describes the specific orbital of an electron within a subshell?

W) Spin Projection

X) Magnetic

Y) Principal

Z) Azimuthal

**Toss Up Answer: X**

---

**Bonus: Short Answer**

What scientist disproved the caloric theory, which stated that an invisible gas transferred heat between objects?

**Bonus Answer: James Prescott Joule (accept: James Joule)**

---

## 144. CHEMISTRY

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

What is the net ionic reaction for the reaction between silver nitrate and potassium chloride?

**Bonus Answer:  $\text{Ag}^+ + \text{Cl}^- \rightarrow \text{AgCl}$**

---

**Bonus: Short Answer**

Which of the following compounds are insoluble in water: potassium nitrate, barium chromate, nickel(II) hydroxide, and magnesium chloride?

**Bonus Answer: Barium chromate and nickel(II) hydroxide**

---

## 145. CHEMISTRY

**Writer: Shanjeed Ali**

**Toss Up: Multiple Choice**

How many elements are diatomic?

W) 5

X) 6

Y) 7

Z) 8

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

Which elements are liquid at room temperature?

**Bonus Answer: Mercury, Bromine**

---

## 146. CHEMISTRY

**Writer: Aaron Gee**

**Toss Up: Multiple Choice**

Which of the following is NOT a colligative property?

W) vapor pressure

X) osmotic pressure

Y) boiling point elevation

Z) color of solution

**Toss Up Answer: Z**

---

**Bonus: Multiple Choice**

Which of the following is a type of colloid that is classified as a

sol at room temperature?

W) gelatin

X) milk

Y) whipped cream

Z) marshmallow

**Bonus Answer: W**

=====

## 147. CHEMISTRY

**Writer: Aryan Bhatt**

**Toss Up: Multiple Choice**

Which of the following is NOT a strong acid?

W) hydrobromic acid (HBr)

X) perchloric acid (HClO<sub>4</sub>)

Y) hydroiodic acid (HI)

Z) chloric acid (HClO<sub>3</sub>)

**Toss Up Answer: Y**

=====

**Bonus: Short Answer**

33mL of 3M Hydrochloric acid is titrated with sodium hydroxide to form water and sodium chloride. How many mols of 11M sodium hydroxide are needed to balance this reaction?

**Bonus Answer: 9 mols**

=====

## 148. CHEMISTRY

**Writer: Brian Lim**

**Toss Up: Multiple Choice**

Which best describes a sample that is boiling?

W) Potential energy increases and kinetic energy stays the same

X) Both potential and kinetic energy increase

Y) Potential energy stays the same and kinetic energy increases

Z) Potential energy decreases and kinetic energy increases

**Toss Up Answer: W**

=====

**Bonus: Short Answer**

What is the IUPAC name for FeCr<sub>2</sub>O<sub>7</sub>?

**Bonus Answer: Iron(II) Dichromate**

=====

## 149. CHEMISTRY

**Writer: Andrew Chen**

**Toss Up: Multiple Choice**

Heating ferrite above 1000 kelvin yields what phase of steel?

W) cementite

X) austenite

Y) martensite

Z) ceramic steel

**Toss Up Answer: X**

=====

**Bonus: Short Answer**

Cooling white tin below 13 degrees Celsius turns it into what?

**Bonus Answer: gray tin**

---

## 150. CHEMISTRY

Writer: Andrew Chen

Toss Up: Short Answer

What is the term for a substance that yields a mechanical response upon application of electricity?

Bonus Answer: piezoelectric

---

Bonus: Multiple Choice

At the yield point of a material, what happens?

W) the material breaks into two pieces

X) the material cracks

Y) the material begins to deform plastically

Z) the material begins to neck, or narrow

Bonus Answer: Y

---

## 151. CHEMISTRY

Writer: Andrew Chen

Toss Up: Short Answer

What is the flame test result of boric acid?

Bonus Answer: green

---

Bonus: Multiple Choice

Which of the following metal ions appears green in solution?

W) nickel two

X) iron three

Y) copper two

Z) silver

Bonus Answer: W

---

## 152. CHEMISTRY

Writer: Andrew Chen

Toss Up: Multiple Choice

Which element reacts vigorously with water, producing a purple color?

W) sodium

X) chromium

Y) potassium

Z) barium

Toss Up Answer: Y

---

Bonus: Multiple Choice

Which of the following doesn't dissolve in aqua regia?

W) lead

X) gold

Y) titanium

Z) zinc

Bonus Answer: Y

=====

## 153. CHEMISTRY

Writer: Andrew Chen

Toss Up: Multiple Choice

Which of the following is a weaker oxidizer than oxygen?

- W) ozone
- X) carbon dioxide
- Y) hydrogen peroxide
- Z) dioxygen difluoride

Toss Up Answer: X

=====

Bonus: Short Answer

What is the coordination number of the hexagonal close packed crystal structure?

Bonus Answer: 12

=====

## 154. CHEMISTRY

Writer: Andrew Chen

Toss Up: Short Answer

Rank the following by conductivity: copper, bronze, silver, gold

Bonus Answer: silver copper gold bronze, or 3 1 4 2

=====

Bonus: Multiple Choice

A sophomore is doing a chemistry lab and mixes a sodium salt solution with a nitrate salt solution. A white precipitate forms. What could it be?

- W) silver chloride
- X) iron iodide
- Y) iron nitrate
- Z) potassium chlorate

Bonus Answer: W

=====

## 155. CHEMISTRY

Writer: Andrew Chen

Toss Up: Multiple Choice

Which transition metal has the lowest electronegativity?

- W) gold
- X) scandium
- Y) actinium
- Z) zinc

Toss Up Answer: Y

=====

Bonus: Short Answer

Which functional group is necessary for saponification?

Bonus Answer: ester

=====

## 156. CHEMISTRY

Writer: Andrew Chen

Toss Up: Short Answer

In what hybridization is the carbon atom in an aldehyde?

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

---

**Bonus: Short Answer**

What is the most stable nucleus?

**Bonus Answer: nickel 62**

---

**157. CHEMISTRY**

**Writer: Andrew Chen**

**Toss Up: Short Answer**

What element is most commonly added in the vulcanization of rubber?

**Bonus Answer: sulfur**

---

**Bonus: Multiple Choice**

Which of the following elements wasn't first isolated through electrolysis?

W) potassium

X) antimony

Y) fluorine

Z) lithium

**Bonus Answer: X**

---

**158. CHEMISTRY**

**Writer: Andrew Chen**

**Toss Up: Short Answer**

Rank the following by increasing polarizability: hexane, benzene, methane

**Bonus Answer: methane benzene hexane**

---

**Bonus: Multiple Choice**

What is the main ingredient of cement?

W) silica

X) alumina

Y) calcium oxide

Z) aluminum sulfate

**Bonus Answer: Y**

---

**159. CHEMISTRY**

**Writer: Andrew Chen**

**Toss Up: Short Answer**

What is the common name of the simplest molecule with a carbonyl group?

**Bonus Answer: formaldehyde**

---

**Bonus: Multiple Choice**

What would be the best indicator for the titration of a weak base with a strong acid?

W) phenolphthalein

X) bromothymol blue

Y) methyl yellow

Z) methyl violet

**Bonus Answer: Y**

---

## 160. CHEMISTRY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

What suggests that metal, M, is not in Group I of the Periodic Table?

W) M has a bright, silvery appearance and is a good conductor of electricity.

X) M is hard and difficult to cut

Y) M produces an alkaline solution when it reacts with water.

Z) M produces hydrogen gas when it reacts with water.

Toss Up Answer: X

---

Bonus: Multiple Choice

Lactic acid,  $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H}$ , causes pain when it builds up in muscles.

Which reagent reacts with both of the  $-\text{OH}$  groups in lactic acid?

W) acidified potassium dichromate(VI)

X) ethanol

Y) sodium

Z) sodium hydroxide

Bonus Answer: Y

---

## 161. CHEMISTRY

Writer: Mohammed Jamil

Toss Up: Short Answer

What is the chemical equation(s) for the reversible reaction(s) in the contact process

Bonus Answer:  $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$

---

Bonus: Multiple Choice

Which set of conditions would promote the fastest rate for the converter reaction in the contact process?

W) No catalyst, high pressure, low temperature. Catalyst, high pressure, high temperature. Catalyst, low pressure, low temperature. Catalyst, low pressure, high temperature.

X) Catalyst, high pressure, high temperature.

Y) Catalyst, low pressure, low temperature

Z) No catalyst, high pressure, low temperature. Catalyst, high pressure, high temperature. Catalyst, low pressure, low temperature. Catalyst, low pressure, high temperature.

Bonus Answer: X

---

## 162. CHEMISTRY

Writer: Jason Weng

Toss Up: Multiple Choice

According to the VSEPR theory, what shape does methane assume?

W) Trigonal pyramid

X) Linear

Y) Tetrahedron

Z) Octahedron

Toss Up Answer: Y

---

Bonus: Multiple Choice



How many pi and sigma bond are present in hexene, respectively?

- W) 17 pi, 1 sigma
- X) 1 pi, 17 sigma
- Y) 2 pi, 16 sigma
- Z) 16 pi, 2 sigma

**Bonus Answer: X**

=====

## 163. CHEMISTRY

**Writer: Jason Weng**

**Toss Up: Multiple Choice**

How much heat, in kJ, is needed to heat 1 kg of water 1 Kelvin if the specific heat of water is 4.18?

- W) 4.18 kJ
- X) 41.8 kJ
- Y) 418 kJ
- Z) 4180 kJ

**Toss Up Answer: Z**

-----

**Bonus: Multiple Choice**

What is the molecular geometry of phosphorous trifluoride according to the VSEPR theory?

- W) Bent
- X) Seesaw
- Y) Trigonal pyramid
- Z) T-shape

**Bonus Answer: Y**

=====

## 164. CHEMISTRY

**Writer: Hanna Yang**

**Toss Up: Short Answer**

What characteristic of water causes its temperature to change slowly in response to the environment?

**Bonus Answer: High Specific Heat**

-----

**Bonus: Short Answer**

What is the most abundant molecule in the human body?

**Bonus Answer: Water**

=====

## 165. CHEMISTRY

**Writer: Hanna Yang**

**Toss Up: Short Answer**

Name the polyatomic ion with formula  $\text{SO}_4^{2-}$

**Bonus Answer: Sulfate**

-----

**Bonus: Multiple Choice**

Which of the following is a base?

- W)  $\text{C}_6\text{H}_{12}\text{O}_6$
- X)  $\text{NaOH}$
- Y)  $\text{HCl}$
- Z)  $\text{PO}_4$

Bonus Answer: X

=====

## 166. CHEMISTRY

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following reactions is expected to produce a precipitate?

W)  $\text{CdSO}_4 + \text{K}_2\text{S} \rightarrow \text{CdS} + \text{K}_2\text{SO}_4$

X)  $\text{CoCl}_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{CoSO}_4 + \text{NaCl}$

Y)  $\text{HI} + \text{Zn}(\text{NO}_3)_2 \rightarrow \text{ZnI} + \text{H}(\text{NO}_3)_2$

Z)  $\text{Pb}(\text{NO}_3)_2 + \text{K}_2\text{SO}_4 \rightarrow 2\text{KNO}_3 + \text{PbSO}_4$

Toss Up Answer: W

=====

Bonus: Short Answer

Name the precipitate for the following reaction:  $3\text{CaCl}_2 + 2\text{Na}_3\text{PO}_4 \rightarrow ? + ?$

Bonus Answer:  $\text{Ca}_3(\text{PO}_4)_2$  (Calcium Phosphate)

=====

## 167. CHEMISTRY

Writer: Hanna Yang

Toss Up: Short Answer

What element is mixed with gold to make rose gold / pink gold?

Bonus Answer: Copper

=====

Bonus: Short Answer

What two elements are mixed with gold to make white gold?

Bonus Answer: Silver and Copper

=====

## 168. CHEMISTRY

Writer: Nten Nylam

Toss Up: Multiple Choice

Which of these is not an amorphous solid?

W) sodium chloride

X) polystyrene

Y) potassium nitrate

Z) benzoic acid

Toss Up Answer: X

=====

Bonus: Short Answer

What is the amount of heat (in joules) needed to raise 5 grams of aluminum by 20 degrees, considering the specific heat of aluminum is 0.900 J/ g x Celsius?

Bonus Answer: 90 joules

=====

## 169. CHEMISTRY

Writer: Josh Tish

Toss Up: Multiple Choice

A 20.0 g sample of mercury(II) oxide is heated strongly, causing it to decompose to metallic Hg and O<sub>2</sub> gas. What volume of O<sub>2</sub> gas is produced (measured at STP)?

W) 1.03 L

X) 2.07 L

Y) 4.14 L

Z) 14.0 L

**Toss Up Answer: W**

---

**Bonus: Multiple Choice**

When 30.0 mL of 0.10 M AgNO<sub>3</sub> is added to 30.0 mL of 0.10 M NaCl, aqueous NaNO<sub>3</sub> and solid AgCl are formed. How much solid AgCl is produced?

W) 0.0030 mol

X) 0.0060 mol

Y) 0.030 mol

Z) 0.060 mol

**Bonus Answer: W**

---

**170. CHEMISTRY**

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

How much Sr(OH)<sub>2</sub> • 8 H<sub>2</sub>O (M = 265.76) is needed to prepare 250.0 mL of solution in which [OH<sup>-</sup>] = 0.100 M?

W) 3.32 g

X) 6.64 g

Y) 9.97 g

Z) 13.3 g

**Toss Up Answer: W**

---

**Bonus: Multiple Choice**

A 10.00 g sample of a compound containing only carbon, hydrogen, and oxygen forms 23.98 g CO<sub>2</sub> and 4.91 g H<sub>2</sub>O upon complete combustion. What is the empirical formula of the compound?

W) C<sub>2</sub>H<sub>2</sub>O

X) C<sub>3</sub>H<sub>3</sub>O

Y) C<sub>6</sub>H<sub>3</sub>O<sub>2</sub>

Z) C<sub>6</sub>H<sub>6</sub>O

**Bonus Answer: X**

---

**171. CHEMISTRY**

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

Which of the following is a nonelectrolyte in aqueous solution?

W) H<sub>2</sub>SO<sub>4</sub>

X) NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>

Y) K<sub>2</sub>CO<sub>3</sub>

Z) CH<sub>2</sub>O

**Toss Up Answer: Z**

---

**Bonus: Multiple Choice**

An aqueous solution of potassium sulfate has a freezing point of  $-2.24\text{ }^{\circ}\text{C}$ . What is its molality?

( $K_f = 1.86\text{ }^{\circ}\text{C}\cdot\text{m}^{-1}$ )

W)  $0.401\text{ m}$

X)  $0.602\text{ m}$

Y)  $1.20\text{ m}$

Z)  $4.17\text{ m}$

**Bonus Answer: W**

=====

**172. CHEMISTRY**

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

Dissolution of which salt in water results in a decrease in the temperature of the solution?

W)  $\text{KHSO}_4$

X)  $\text{NaOH}$

Y)  $\text{AlCl}_3$

Z)  $\text{NH}_4\text{NO}_3$

**Toss Up Answer: Z**

=====

**Bonus: Multiple Choice**

What is observed when equal volumes of  $0.1\text{ M}$  aqueous  $\text{HCl}$  and  $0.01\text{ M}$  aqueous  $\text{Na}_2\text{SO}_3$  are mixed?

W) Colorless solution and a white precipitate

X) Colored solution and a white precipitate

Y) Colorless solution and a colored precipitate

Z) Colorless solution, no precipitate, and gas evolution

**Bonus Answer: Z**

=====

**173. CHEMISTRY**

**Writer: Kerwin Chen**

**Toss Up: Short Answer**

How many neutrons are in an alpha particle?

**Bonus Answer: 2**

=====

**Bonus: Short Answer**

Which scientist working in Canada discovered the alpha particle?

**Bonus Answer: Rutherford, Ernest Rutherford**

=====

**174. CHEMISTRY**

**Writer: Kerwin Chen**

**Toss Up: Short Answer**

What is the atomic number of uranium?

**Bonus Answer: 92**

=====

**Bonus: Short Answer**

Which scientist discovered the element uranium?

**Bonus Answer: Klaproth, Martin Klaproth, Martin Heinrich Klaproth**

=====

## 175. CHEMISTRY

**Writer: Ivan Zhang**

**Toss Up: Multiple Choice**

Given the pressure and temperature of gas A and the temperature of gas B, which law would be most efficient in determining the pressure of gas B?

W) Gay-Lussac's Law

X) Boyle's Law

Y) Charles's Law

Z) Combined Gas Law

**Toss Up Answer: W**

-----

**Bonus: Short Answer**

What is the metric equivalence of 760 mm Hg?

**Bonus Answer: 101325 Pascals**

=====

## 176. CHEMISTRY

**Writer: Larry Wong**

**Toss Up: Short Answer**

What is the geometric configuration of HF?

**Bonus Answer: Linear**

-----

**Bonus: Multiple Choice**

For which of the following compounds is cis-trans isomerism possible?

W) hept-1-ene

X) but-1-ene

Y) 2-methylpropene

Z) but-2-ene

**Bonus Answer: Z**

=====

## 177. CHEMISTRY

**Writer: Ivan Zhang**

**Toss Up: Multiple Choice**

Which of the following has the greatest entropy?

W) Gaseous Substances

X) Gases

Y) Liquids

Z) Solids

**Toss Up Answer: X**

-----

**Bonus: Short Answer**

What is the name of the equation used to determine if a reaction is spontaneous or not?

**Bonus Answer: Gibbs-Free Energy Equation**

=====

## 178. CHEMISTRY

**Writer: Larry Wong**

**Toss Up: Multiple Choice**

Which of the following statements about catalysts is true?

- W) They increase the value of the equilibrium constant.
- X) They increase the amount of product present at equilibrium.
- Y) They increase the concentration of the reactants.
- Z) They reduce the activation energy of the reaction.

**Toss Up Answer: Z**

---

**Bonus: Multiple Choice**

What is the product of water and pentyl ethanoate under acidic conditions?

- W) Ethanoic acid and pentanol
- X) Butanol and water
- Y) Ethanoic acid, two equivalents
- Z) Pentanol, two equivalents

**Bonus Answer: W**

---

## 179. CHEMISTRY

**Writer: Ivan Zhang**

**Toss Up: Short Answer**

What is the name given to the point at which a substance can exist in all 3 phases of matter?

**Bonus Answer: Triple Point**

---

**Bonus: Short Answer**

What is the name given to group 16 elements?

**Bonus Answer: Chalcogens**

---

## 180. CHEMISTRY

**Writer: Ivan Zhang**

**Toss Up: Multiple Choice**

Which of the following element is not a newly named (as of November 2016) element?

- W) nihonium
- X) paostinism
- Y) moscovium
- Z) tennessine

**Toss Up Answer: X**

---

**Bonus: Multiple Choice**

Who reorganized the periodic table based on atomic number?

- W) Mendeleev
- X) Moseley
- Y) Pablo
- Z) Escobar

**Bonus Answer: X**

---

## 181. CHEMISTRY

**Writer: Larry Wong**

**Toss Up: Multiple Choice**

Which alcohol will most easily react with HCl to form an alkyl halide?

- W) Primary alcohol
- X) Secondary alcohol
- Y) Tertiary alcohol
- Z) Quaternary alcohol

**Toss Up Answer: Y**

---

**Bonus: Multiple Choice**

The mass defect for an isotope was found to be 0.410 amu/atom. Calculate the binding energy in kJ/mol of atoms.

- W)  $3.69 \times 10^{10}$  kJ/mol
- X)  $1.23 \times 10^{20}$  kJ/mol
- Y)  $3.69 \times 10^{13}$  kJ/mol
- Z)  $1.23 \times 10^3$  kJ/mol

**Bonus Answer: W**

---

## 182. CHEMISTRY

**Writer: Larry Wong**

**Toss Up: Multiple Choice**

A Geiger-Muller tube is a

- W) gas ionization detector
- X) cloud chamber
- Y) fluorescence detector
- Z) spectrophotometer

**Toss Up Answer: W**

---

**Bonus: Short Answer**

The principle that states: If you disturb a system at equilibrium, the equilibrium moves in the direction that tends to reduce the disturbance is called?

**Bonus Answer: Le Chatelier's Principle**

---

## 183. CHEMISTRY

**Writer: Nten Nylam**

**Toss Up: Multiple Choice**

Which of the following is true regarding activation energy?

- W) Activation energy is dependent on the pressure of a system
- X) Catalysts increase the activation energy of a reaction
- Y) The reaction rate decreases as the activation energy increases
- Z) If the activation energy of the forward reaction is greater than that of the reverse reaction then the reaction is exothermic

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

What types of covalent bonds are present in  $\text{CH}_2\text{O}$ ?

**Bonus Answer: Single and double covalent bonds**

---

## 184. CHEMISTRY

**Writer: Brian Lim**

**Toss Up: Multiple Choice**

Iron is in which category of elements?

W) alkali metals

X) alkaline metals

Y) transition metals

Z) metalloids

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

What is the term for the temperature and pressure at which a substance exists at three phases at once in thermal equilibrium?

**Bonus Answer: triple point**

---

## 185. CHEMISTRY

**Writer: Nten Nylam**

**Toss Up: Short Answer**

Boyle's Law describes the relationship between what qualities of a gas/container?

**Bonus Answer: Pressure and volume (accept in any order)**

---

**Bonus: Short Answer**

What are acids with more than 2 ionizable hydrogens called?

**Bonus Answer: polyprotic acids**

---

## 186. CHEMISTRY

**Writer: Brian Lim**

**Toss Up: Short Answer**

What is the term for the conditions at which a substance begins to behave as a supercritical fluid?

**Bonus Answer: critical point**

---

**Bonus: Multiple Choice**

For a sample of a liquid, what is true about the relationship between temperature and vapor pressure?

W) the relationship depends on the substance

X) vapor pressure increases with temperature

Y) vapor pressure decreases with temperature

Z) vapor pressure is unaffected by changes in temperature

**Bonus Answer: X**

---

## 187. CHEMISTRY

**Writer: Mohammed Jamil**

**Toss Up: Short Answer**

Copper sulfate can be made by warming copper oxide with sulfuric acid. The equation for the reaction is:



Calculate the maximum mass of copper oxide which can react with 9.8 g of sulfuric acid in this reaction.

(Relative atomic masses: H=1, O=16, Cu=64)

**Bonus Answer: 8g**

---

**Bonus: Short Answer**

It takes 83ml of a 0.45M NaOH solution to neutralize 235mL of an HCl solution. What is the concentration of the HCl solution ?

**Bonus Answer: 0.16 M**



=====

## 188. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the electron configuration of Mg(2+)?

Bonus Answer: 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup>

=====

Bonus: Short Answer

What is the electron configuration of Cu(2+)?

Bonus Answer: 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>2</sup> 3p<sup>6</sup> 3d<sup>9</sup>

=====

## 189. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

What do the Neon, Fluorine(1-) and Magnesium(2+) have in common?

W) They are isotopes of each other

X) They are isomers of each other

Y) They are isoelectronic with each other

Z) They have nothing in common

Toss Up Answer: Y

=====

Bonus: Multiple Choice

The half-life of francium-212 is 19 minutes. How many minutes will it take for 1 gram of this isotope to decay to 0.125 grams?

W) 4.75 min

X) 9.5 min

Y) 38 min

Z) 57 min

Bonus Answer: Z

=====

## 190. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the element formed by the beta decay of Carbon-14?

Bonus Answer: Nitrogen-14

=====

Bonus: Short Answer

If the abundance of Lithium-6 (6.0 amu) is 7.500% and the abundance of Lithium-7 (7.0 amu) is 92.500%, what is the average atomic mass to the tenth place?

Bonus Answer: 6.9 amu

=====

## 191. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the correct formula for Aluminum Oxide?

Bonus Answer: Al<sub>2</sub>O<sub>3</sub> (accept: Aluminum 2 Oxygen 3)

=====

Bonus: Short Answer

What is the formal charge of oxygen in  $\text{H}_3\text{O}^+$ ?

**Bonus Answer: +1 (do not accept 1)**

=====

## 192. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the empirical formula of glucose?

**Bonus Answer:  $\text{CH}_2\text{O}$**

-----

**Bonus: Short Answer**

What is the shape of an Acetylene ( $\text{C}_2\text{H}_2$ ) molecule?

**Bonus Answer: Linear**

=====

## 193. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What two chemical elements are found in sphalerite?

**Bonus Answer: Zinc and Sulfur (accept: Zn and S)**

-----

**Bonus: Short Answer**

What two chemical elements are found in periclase?

**Bonus Answer: Magnesium and Oxygen (accept: Mg and O)**

=====

## 194. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

Who is credited with the discovery of the neutron in 1932?

**Bonus Answer: James Chadwick (accept: Chadwick)**

-----

**Bonus: Short Answer**

Who patented the common dry cell?

**Bonus Answer: GEORGES LECLANCHÉ (accept: LECLANCHÉ)**

=====

## 195. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the common oxidation state of Radium?

**Bonus Answer: +2 (don't accept 2)**

-----

**Bonus: Short Answer**

List the following atoms in order of increasing electron affinity: oxygen, boron, and fluorine.

**Bonus Answer: (1) BORON, (2) OXYGEN, (3) FLUORINE**

=====

## 196. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What element is in all alloys classified as amalga?

**Bonus Answer: Mercury (accept: Hg)**

-----

**Bonus: Short Answer**

You have a solution of 5 molar Sodium Phosphate and n to prepare a solution of 500 millimolar Sodium Phosphate. How much water would you add to 100 milliliter of the original 5 molar solution to produce the 500 millimolar solution?

**Bonus Answer: 900 MILLILITERS (or 0.9 LITERS)**

=====

## 197. CHEMISTRY

**Writer: Prangon Ghose**

**Toss Up: Short Answer**

What is the most abundant element in the human body by mass?

**Bonus Answer: Oxygen**

-----

**Bonus: Short Answer**

What naturally occurring radioactive element is so common in homes that testing for its presence is often advisable?

**Bonus Answer: Radon (accept: Rn)**

=====

## 198. CHEMISTRY

**Writer: Shantanu Jha**

**Toss Up: Multiple Choice**

What term describes a particular way that ions and molecules bind metal ions?

- W) Chelation
- X) Supposition
- Y) Coordination
- Z) Fluxing

**Toss Up Answer: W**

-----

**Bonus: Multiple Choice**

Crystals which acquire a charge when compressed, twisted or distorted are said to be what?

- W) Ceramic
- X) Transduced
- Y) Magnetostricted
- Z) Piezoelectric

**Bonus Answer: Z**

=====

## 199. CHEMISTRY

**Writer: Ashneel Das**

**Toss Up: Multiple Choice**

How many neutrons does carbon-14 have?

- W) 14
- X) 8
- Y) 6
- Z) 2

**Toss Up Answer: X**

-----

**Bonus: Multiple Choice**

Which of the following is the decay mode of Uranium-238?

- W) Alpha
- X) Beta
- Y) Gamma

Z) Proton Emission

**Bonus Answer: W**

=====

## 200. CHEMISTRY

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

Mixing 250 mL of 2.0 M sulfuric acid with 2 liters of 0.5 M sodium hydroxide will produce a solution with what pH?

**Bonus Answer: 7**

-----

**Bonus: Short Answer**

Which of the following are strong bases: lithium hydroxide, strontium hydroxide, cesium hydroxide, barium hydroxide?

**Bonus Answer: All except cesium hydroxide**

=====

## 201. CHEMISTRY

**Writer: Shanjeed Ali**

**Toss Up: Multiple Choice**

Which of the following is least reactive with water at room temperature?

W) Sodium

X) Potassium

Y) Rubidium

Z) Cesium

**Toss Up Answer: W**

-----

**Bonus: Short Answer**

What is the most abundant alkali metal on earth?

**Bonus Answer: Sodium**

=====

## 202. CHEMISTRY

**Writer: Ashneel Das**

**Toss Up: Short Answer**

What intermolecular force is responsible for the high melting point and boiling point of water?

**Bonus Answer: Hydrogen bonds**

-----

**Bonus: Short Answer**

What is the pOH of a solution with hydrogen ion concentration of  $1.0 \times 10^{-6}$

**Bonus Answer: 8**

=====

## 203. CHEMISTRY

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

What will happen solubility of oxygen gas as temperature increases?

**Bonus Answer: Decrease**

-----

**Bonus: Short Answer**

Which elements are found in the form of diatomic gases at room temperature?

**Bonus Answer: Hydrogen, oxygen, fluorine, chlorine, nitrogen**

=====

## 204. CHEMISTRY

**Writer: Ashneel Das**

**Toss Up: Short Answer**

Convert 25 degrees Celsius to Kelvin

**Bonus Answer: 298**

---

**Bonus: Short Answer**

What is the molecular geometry of methane?

**Bonus Answer: Tetrahedral**

---

**205. CHEMISTRY**

**Writer: Shanjeed Ali**

**Toss Up: Multiple Choice**

Which element has the highest ionization energy?

W) Chlorine

X) Bromine

Y) Selenium

Z) Technetium

**Toss Up Answer: W**

---

**Bonus: Short Answer**

What are the periodic table trends for ionization energy?

**Bonus Answer: Increases left to right and decreases from the top to the bottom**

---

**206. CHEMISTRY**

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

What is the energy level and orbital of the outermost electrons in a ground state sulfur atom?

**Bonus Answer: 3p**

---

**Bonus: Short Answer**

What is the maximum number of covalent bonds sulfur can form?

**Bonus Answer: 6**

---

**207. CHEMISTRY**

**Writer: Ashneel Das**

**Toss Up: Short Answer**

What is the hybridization of methane?

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

---

**Bonus: Short Answer**

How many sigma bonds does methane have?

**Bonus Answer: 4**

---

**208. CHEMISTRY**

**Writer: Ashneel Das**

**Toss Up: Short Answer**

What is the name of the molecule containing 4 carbon and 10 hydrogen atoms?

**Bonus Answer: Butane**

---

**Bonus: Multiple Choice**

Which of the following has the highest Van't Hoff factor?

- W) NaCl
- X) CaCl<sub>2</sub>
- Y) H<sub>2</sub>O
- Z) CH<sub>4</sub>

**Bonus Answer: Y**

=====

## 209. CHEMISTRY

**Writer: Olivia Gallager**

**Toss Up: Short Answer**

Given 2,3-dichloropentane, what is the resulting molecule if potassium hydroxide is reacted with it at 200 degrees celsius?

**Bonus Answer: 2 pentyne**

-----

**Bonus: Short Answer**

Which single atom is the difference between an organic acid functional group and an aldehyde functional group?

**Bonus Answer: O, Oxygen**

=====

## 210. CHEMISTRY

**Writer: Ahmad Alnasser**

**Toss Up: Multiple Choice**

Boyle's Law relates:

- W) pressure to volume
- X) pressure to mols
- Y) volume to mols
- Z) temperature to volume

**Toss Up Answer: W**

-----

**Bonus: Short Answer**

A container holds 500. mL of CO<sub>2</sub> at 20.° C and 742 torr. What will be the volume of the CO<sub>2</sub> if the pressure is increased to 795 torr?

**Bonus Answer: 467 ml**

=====

## 211. CHEMISTRY

**Writer: Ahmad Alnasser**

**Toss Up: Short Answer**

Write the formula name for the strongest acid?

**Bonus Answer: H<sub>2</sub>SO<sub>4</sub>**

-----

**Bonus: Short Answer**

List in order of strength the following strong acid: (1) H<sub>3</sub>PO<sub>4</sub> (2) HBr (3) HCl (4) H<sub>2</sub>SO<sub>4</sub>

**Bonus Answer: 1 3 2 4**

=====

## 212. CHEMISTRY

**Writer: Olivia Gallager**

**Toss Up: Short Answer**

Mass spectrometers shoot which subatomic particle at a sample to ionize it?

**Bonus Answer: electrons**

-----

**Bonus: Multiple Choice**

Radium-226 is most likely to undergo which type of nuclear decay?

- W) electron capture
- X) alpha
- Y) beta
- Z) positron

**Bonus Answer: X**

=====

## 213. CHEMISTRY

**Writer: Nicholas Parker Ng**

**Toss Up: Multiple Choice**

Permalloy steel is an alloy which is 21.2% Fe by mass. How many grams of Fe are present in 1 kg of steel?

- W) 212 g
- X) 21.2 g
- Y) 4.7 g
- Z) .212 g

**Toss Up Answer: W**

=====

**Bonus: Short Answer**

Astatine, having atomic number 85 on the periodic table, is a radioactive member of the halogens. Give the full electron configuration of At. Arrange the orbitals in order of increasing energy. (Do not use noble gas abbreviations, such as [Xe], for this problem.)

**Bonus Answer: 1s22s22p63s23p64s23d104p65s24d105p66s24f145d106p5**

=====

## 214. CHEMISTRY

**Writer: Nicholas Parker Ng**

**Toss Up: Multiple Choice**

Identify the INCORRECT statement below:

- W) In the most fundamental sense, the properties of the elements are periodic functions of their atomic weight.
- X) The vertical columns of the periodic chart are called groups, sharing similar properties.
- Y) Elements with atomic numbers of 9, 17, 35, and 53 are members of the halogen family, meaning "salt formers."
- Z) Elements Li, B, N and F are all in the same period.

**Toss Up Answer: W**

=====

**Bonus: Multiple Choice**

All of the following statements are true EXCEPT:

- W) the enthalpy change of an endothermic reaction is positive.
- X) at constant pressure the heat flow for a reaction equals the change in enthalpy.
- Y)  $\Delta H$  for a reaction is equal in magnitude but opposite in sign to  $\Delta H$  for the reverse reaction.
- Z) enthalpy change is dependent upon the number of steps in a reaction.

**Bonus Answer: Z**

=====

## 215. CHEMISTRY

**Writer: Nicholas Parker Ng**

**Toss Up: Multiple Choice**

In which of the lists below are the atoms arranged in order of increasing size (increasing atomic radius)?

- W) Si In Ge N

- X) N In Ge Si  
Y) In Ge N Si  
Z) N Si Ge In

**Toss Up Answer: Z**

---

**Bonus: Multiple Choice**

Which of the following matched pairs of name and formula has an error?

- W)  $\text{H}_3\text{PO}_4$ , phosphoric acid  
X)  $\text{H}_2\text{SO}_3$ , sulfurous acid  
Y)  $\text{HNO}_3$ , nitrous acid  
Z)  $\text{HClO}_4$ , perchloric acid

**Bonus Answer: Y**

---

**216. CHEMISTRY**

**Writer: Nicholas Parker Ng**

**Toss Up: Multiple Choice**

The longest wavelength absorption in the UV visible spectrum of acetone,  $\text{CH}_3\text{COCH}_3$ , occurs at 335 nm. Predict the energy required to excite an electron from a lone pair orbital on the oxygen atom to an antibonding orbital centred on the carbonyl group.

- W) 3.7 eV  
X) .27 eV  
Y) 2.99 eV  
Z) 1.67 eV

**Toss Up Answer: W**

---

**Bonus: Multiple Choice**

The Pauling electronegativities of fluorine and chlorine are 4.0 and 3.0 respectively. Estimate the dipole moment of chlorine monofluoride, ClF.

- W) 4 D  
X) 3 D  
Y) 1.6 D  
Z) 1 D

**Bonus Answer: Z**

---

**217. CHEMISTRY**

**Writer: Nicholas Parker Ng**

**Toss Up: Multiple Choice**

The hydrolysis of t-bromobutane,  $\text{C}_4\text{H}_9\text{Br}$ , by hydroxide,  $\text{OH}^-$ , ions in aqueous solution follows an  $\text{S}_\text{N}1$  reaction mechanism in which the rate-determining step is the loss of a bromide,  $\text{Br}^-$ , ion, followed by rapid reaction with hydroxide ions. Which of the following rate laws is consistent with this mechanism?

- W)  $\text{Rate} = k[\text{C}_4\text{H}_9\text{Br}]$   
X)  $\text{Rate} = k[\text{C}_4\text{H}_9\text{Br}][\text{OH}^-]$   
Y)  $\text{Rate} = k[\text{C}_4\text{H}_9\text{Br}]^2$   
Z)  $\text{Rate} = k[\text{OH}^-]$

**Toss Up Answer: W**



---

**Bonus: Multiple Choice**

Which of the following would be correct units for the rate constant of a reaction that is second order overall?

W)  $\text{s}^{-1}$

X)  $\text{mol}^{-1} \text{dm}^3 \text{s}^{-1}$

Y)  $\text{mol cm}^{-3} \text{s}^{-1}$

Z)  $\text{mol}^{-2} \text{dm}^6 \text{s}^{-1}$

**Bonus Answer: X**

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**218. CHEMISTRY**

**Writer: Nicholas Parker Ng**

**Toss Up: Multiple Choice**

Radiation from a mercury lamp source is of energy 2.845 eV. Calculate the wavelength of the radiation.

W) 579 nm

X) 355 nm

Y) 405 nm

Z) 436 nm

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

The force constant of the bond in a hydrogen chloride, HCl, molecule is  $516 \text{ N m}^{-1}$ . Calculate the vibrational potential energy of an HCl molecule with a bond that is extended from its equilibrium length by  $0.11 \text{ \AA}$ .

W)  $3.1 \times 10^{-20} \text{ J}$

X)  $6.2 \times 10^{-20} \text{ J}$

Y)  $1.5 \times 10^{-20} \text{ J}$

Z)  $2.6 \times 10^{-20} \text{ J}$

**Bonus Answer: W**

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