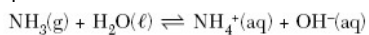


1.

Given the equation representing a reaction at equilibrium:



The  $\text{H}^+$  acceptor for the forward reaction is

- (1)  $\text{H}_2\text{O}(\ell)$                       (3)  $\text{NH}_4^+(\text{aq})$   
(2)  $\text{NH}_3(\text{g})$                         (4)  $\text{OH}^-(\text{aq})$

2.

A 150.-gram liquid sample of stearic acid,  $\text{C}_{17}\text{H}_{35}\text{COOH}$ , is cooled at a constant rate. The temperature of the sample is recorded at 2-minute intervals in the data table below.

**Cooling Data for Stearic Acid**

Time (min)	Temperature ( $^{\circ}\text{C}$ )
0	75.0
2	72.0
4	69.3
6	69.3
8	69.3
10	69.3
12	65.0

Determine the gram-formula mass of stearic acid.

3.

An unsaturated solution is made by completely dissolving 20.0 grams of  $\text{NaNO}_3$  in 100.0 grams of water at  $20.0^{\circ}\text{C}$ .

In the space *below*, show a correct numerical setup for calculating the number of moles of  $\text{NaNO}_3$  (gram-formula mass = 85.0 grams per mole) used to make this unsaturated solution.

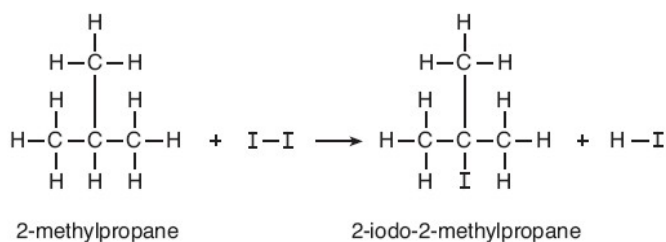
4.

An unsaturated solution is made by completely dissolving 20.0 grams of  $\text{NaNO}_3$  in 100.0 grams of water at  $20.0^{\circ}\text{C}$ .

Determine the minimum mass of  $\text{NaNO}_3$  that must be added to this unsaturated solution to make a saturated solution at  $20.0^{\circ}\text{C}$ .

5.

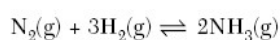
The hydrocarbon 2-methylpropane reacts with iodine as represented by the balanced equation below. At standard pressure, the boiling point of 2-methylpropane is lower than the boiling point of 2-iodo-2-methylpropane.



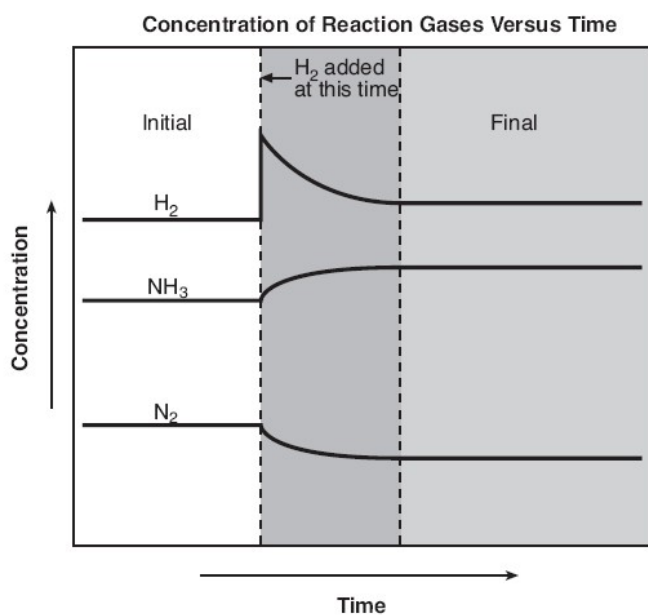
Explain the difference in the boiling points of 2-methylpropane and 2-iodo-2-methylpropane in terms of *both* molecular polarity and intermolecular forces.

6.

Nitrogen gas, hydrogen gas, and ammonia gas are in equilibrium in a closed container at constant temperature and pressure. The equation below represents this equilibrium.



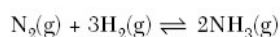
The graph below shows the initial concentration of each gas, the changes that occur as a result of adding  $\text{H}_2(\text{g})$  to the system, and the final concentrations when equilibrium is reestablished.



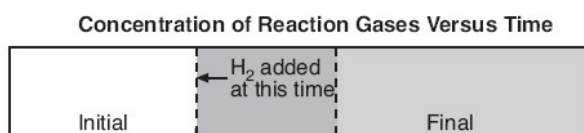
What information on the graph indicates that the system was initially at equilibrium?

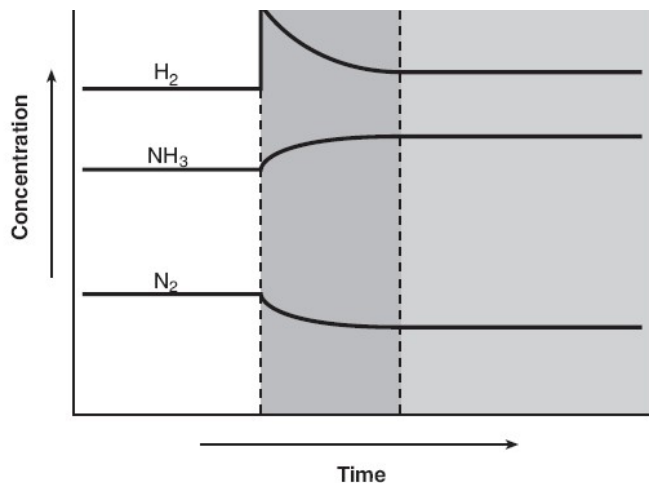
7.

Nitrogen gas, hydrogen gas, and ammonia gas are in equilibrium in a closed container at constant temperature and pressure. The equation below represents this equilibrium.



The graph below shows the initial concentration of each gas, the changes that occur as a result of adding  $\text{H}_2(\text{g})$  to the system, and the final concentrations when equilibrium is reestablished.

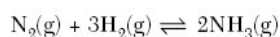




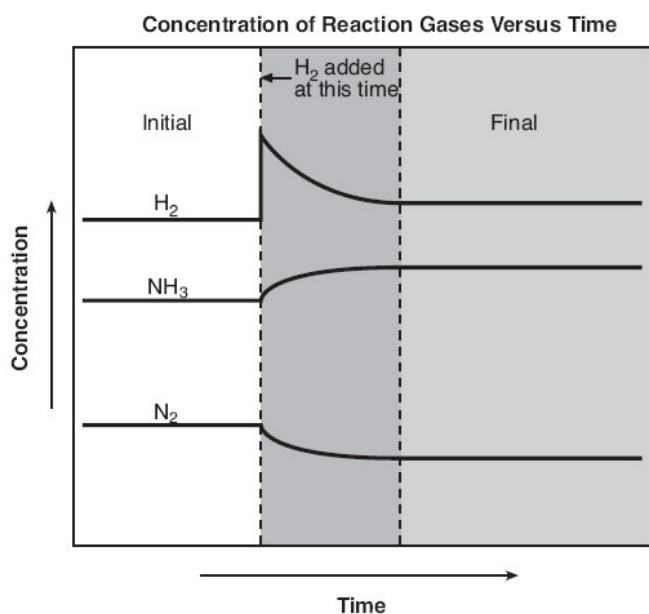
Explain, in terms of LeChatelier's principle, why the final concentration of  $\text{NH}_3(\text{g})$  is greater than the initial concentration of  $\text{NH}_3(\text{g})$ .

8.

Nitrogen gas, hydrogen gas, and ammonia gas are in equilibrium in a closed container at constant temperature and pressure. The equation below represents this equilibrium.



The graph below shows the initial concentration of each gas, the changes that occur as a result of adding  $\text{H}_2(\text{g})$  to the system, and the final concentrations when equilibrium is reestablished.



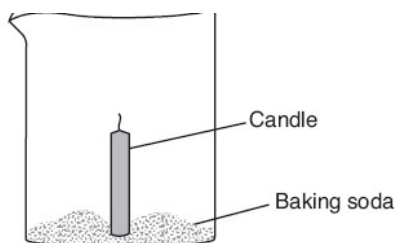
Explain, in terms of collision theory, why the concentration of  $\text{H}_2(\text{g})$  begins to decrease immediately after more  $\text{H}_2(\text{g})$  is added to the system.

9.

Base your answers to the questions on the information below.

An unlit candle is secured to the bottom of a 200-milliliter glass beaker. Baking soda (sodium hydrogen carbonate) is added around the base of the candle as shown below.





The candle is lit and dilute ethanoic acid is poured down the inside of the beaker. As the acid reacts with the baking soda, bubbles of  $\text{CO}_2$  gas form. After a few seconds, the air in the beaker is replaced by 0.20 liter of  $\text{CO}_2$  gas, causing the candle flame to go out. The density of  $\text{CO}_2$  gas is 1.8 grams per liter at room temperature.

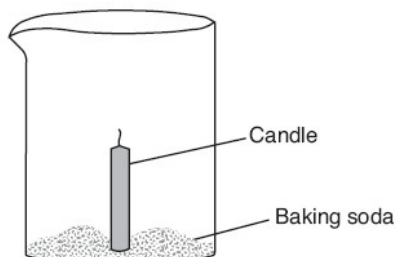
Write the chemical formula for baking soda.

---

10.

Base your answers to the questions on the information below.

An unlit candle is secured to the bottom of a 200-milliliter glass beaker. Baking soda (sodium hydrogen carbonate) is added around the base of the candle as shown below.



The candle is lit and dilute ethanoic acid is poured down the inside of the beaker. As the acid reacts with the baking soda, bubbles of  $\text{CO}_2$  gas form. After a few seconds, the air in the beaker is replaced by 0.20 liter of  $\text{CO}_2$  gas, causing the candle flame to go out. The density of  $\text{CO}_2$  gas is 1.8 grams per liter at room temperature.

In the space *below*, draw a structural formula for the acid that was poured into the beaker.

---

11.

A 150.-gram liquid sample of stearic acid,  $\text{C}_{17}\text{H}_{35}\text{COOH}$ , is cooled at a constant rate. The temperature of the sample is recorded at 2-minute intervals in the data table below.

**Cooling Data for Stearic Acid**

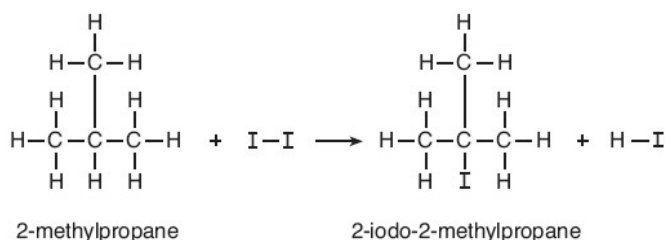
Time (min)	Temperature ( $^{\circ}\text{C}$ )
0	75.0
2	72.0
4	69.3
6	69.3
8	69.3
10.	69.3
12	65.0

Identify the physical change occurring during the time interval 4 minutes to 10. minutes.

---

12.

The hydrocarbon 2-methylpropane reacts with iodine as represented by the balanced equation below. At standard pressure, the boiling point of 2-methylpropane is lower than the boiling point of 2-iodo-2-methylpropane.



To which class of organic compounds does this organic product belong?

---

13.

The health of fish depends on the amount of oxygen dissolved in the water. A dissolved oxygen (DO) concentration between 6 parts per million and 8 parts per million is best for fish health. A DO concentration greater than 1 part per million is necessary for fish survival.

Fish health is also affected by water temperature and concentrations of dissolved ammonia, hydrogen sulfide, chloride compounds, and nitrate compounds. Most freshwater fish thrive in water with a pH between 6.5 and 8.5.

A student's fish tank contains fish, green plants, and 3800 grams of fish-tank water with  $2.7 \times 10^{-2}$  gram of dissolved oxygen. Phenolphthalein tests colorless and bromthymol blue tests blue in samples of the fish-tank water.

When the fish-tank water has a pH of 8.0, the hydronium ion concentration is  $1.0 \times 10^{-8}$  mole per liter. What is the hydronium ion concentration when the water has a pH of 7.0?

---

14.

The Balmer series refers to the visible bright lines in the spectrum produced by hydrogen atoms. The color and wavelength of each line in this series are given in the table below.

**Balmer Series for Hydrogen**

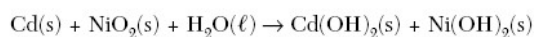
Color	Wavelength (nm)
red	656.3
blue green	486.1
blue	434.1
violet	410.2

Explain, in terms of **both** subatomic particles and energy states, how the Balmer series is produced.

---

15.

A flashlight can be powered by a rechargeable nickel-cadmium battery. In the battery, the anode is Cd(s) and the cathode is NiO<sub>2</sub>(s). The unbalanced equation below represents the reaction that occurs as the battery produces electricity. When a nickel-cadmium battery is recharged, the reverse reaction occurs.



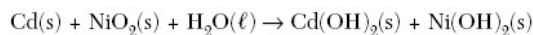
Determine the change in oxidation number for the element that makes up the anode in

the reaction that produces electricity.

---

16.

A flashlight can be powered by a rechargeable nickel-cadmium battery. In the battery, the anode is Cd(s) and the cathode is NiO<sub>2</sub>(s). The unbalanced equation below represents the reaction that occurs as the battery produces electricity. When a nickel-cadmium battery is recharged, the reverse reaction occurs.



Explain why Cd would be above Ni if placed on Table J.

---

17.

A battery-operated smoke detector produces an alarming sound when its electrical sensor detects smoke particles. Some ionizing smoke detectors contain the radioisotope americium-241, which undergoes alpha decay and has a half-life of 433 years. The emitted alpha particles ionize gas molecules in the air. As a result, an electric current flows through the detector. When smoke particles enter the detector, the flow of ions is interrupted, causing the alarm to sound.

State **one** scientific reason why Am-241 is a more appropriate radioactive source than Fr-220 in an ionizing smoke detector.

---

18.

A battery-operated smoke detector produces an alarming sound when its electrical sensor detects smoke particles. Some ionizing smoke detectors contain the radioisotope americium-241, which undergoes alpha decay and has a half-life of 433 years. The emitted alpha particles ionize gas molecules in the air. As a result, an electric current flows through the detector. When smoke particles enter the detector, the flow of ions is interrupted, causing the alarm to sound.

Explain, in terms of particle behavior, why smoke particles cause the detector alarm to sound.

---

19.

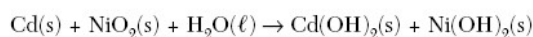
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Complete the nuclear equation **in the space below** for the decay of Am-241. Your response must include the symbol, mass number, and atomic number for **each** product.

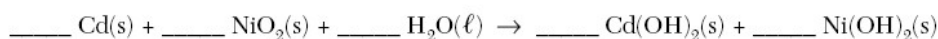


20.

A flashlight can be powered by a rechargeable nickel-cadmium battery. In the battery, the anode is Cd(s) and the cathode is NiO<sub>2</sub>(s). The unbalanced equation below represents the reaction that occurs as the battery produces electricity. When a nickel-cadmium battery is recharged, the reverse reaction occurs.



Balance the equation **in the space below** for the reaction that produces electricity, using the smallest whole-number coefficients.



21.

The health of fish depends on the amount of oxygen dissolved in the water. A dissolved oxygen (DO) concentration between 6 parts per million and 8 parts per million is best for fish health. A DO concentration greater than 1 part per million is necessary for fish survival.

Fish health is also affected by water temperature and concentrations of dissolved ammonia, hydrogen sulfide, chloride compounds, and nitrate compounds. Most freshwater fish thrive in water with a pH between 6.5 and 8.5.

A student's fish tank contains fish, green plants, and 3800 grams of fish-tank water with  $2.7 \times 10^{-2}$  gram of dissolved oxygen. Phenolphthalein tests colorless and bromthymol blue tests blue in samples of the fish-tank water.

State how an increase in the temperature of the fish-tank water affects the solubility of oxygen in the water.

---

22.

The health of fish depends on the amount of oxygen dissolved in the water. A dissolved oxygen (DO) concentration between 6 parts per million and 8 parts per million is best for fish health. A DO concentration greater than 1 part per million is necessary for fish survival.

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Determine if the DO concentration in the fish tank is healthy for fish. Your response must include:

- a correct numerical setup to calculate the DO concentration in the water in parts per million
  - the calculated result
  - a statement using your calculated result that tells why the DO concentration in the water is or is not healthy for fish
- 

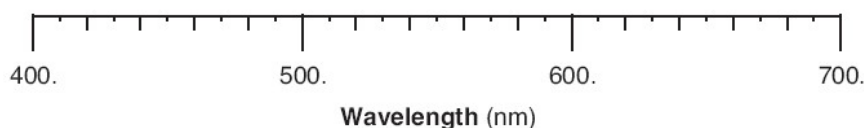
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**Balmer Series for Hydrogen**

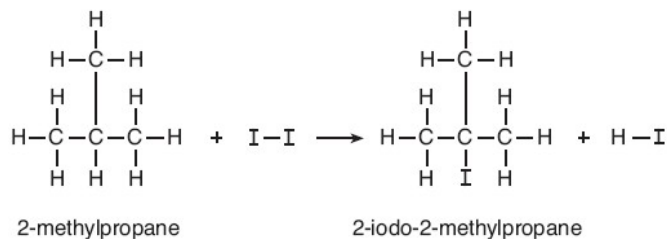
Color	Wavelength (nm)
red	656.3
blue green	486.1
blue	434.1
violet	410.2

On the diagram below, draw **four** vertical lines to represent the Balmer series.



24.

The hydrocarbon 2-methylpropane reacts with iodine as represented by the balanced equation below. At standard pressure, the boiling point of 2-methylpropane is lower than the boiling point of 2-iodo-2-methylpropane.



Explain, in terms of bonding, why the hydrocarbon 2-methylpropane is saturated.

25.

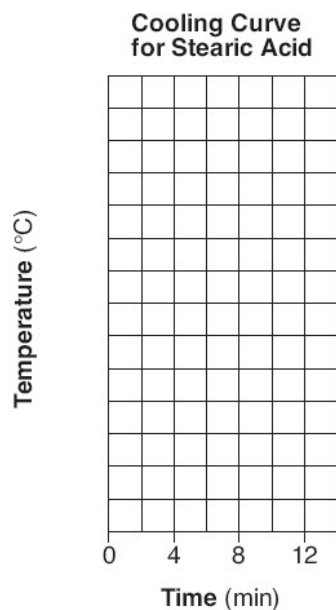
A 150.-gram liquid sample of stearic acid,  $\text{C}_{17}\text{H}_{35}\text{COOH}$ , is cooled at a constant rate. The temperature of the sample is recorded at 2-minute intervals in the data table below.

**Cooling Data for Stearic Acid**

Time (min)	Temperature ( $^{\circ}\text{C}$ )
0	75.0
2	72.0
4	69.3
6	69.3
8	69.3
10.	69.3
12	65.0

On the grid *in the space below* :

- Mark an appropriate scale on the axis labeled "Temperature ( $^{\circ}\text{C}$ )."
- Plot the data from the data table. Circle and connect the points.

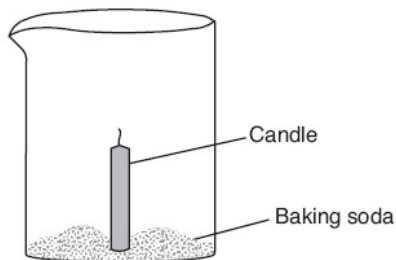




26.

Base your answers to the questions on the information below.

An unlit candle is secured to the bottom of a 200-milliliter glass beaker. Baking soda (sodium hydrogen carbonate) is added around the base of the candle as shown below.



The candle is lit and dilute ethanoic acid is poured down the inside of the beaker. As the acid reacts with the baking soda, bubbles of  $\text{CO}_2$  gas form. After a few seconds, the air in the beaker is replaced by 0.20 liter of  $\text{CO}_2$  gas, causing the candle flame to go out. The density of  $\text{CO}_2$  gas is 1.8 grams per liter at room temperature.

Calculate the mass of the  $\text{CO}_2$  gas that replaced the air in the beaker. Your response must include *both* a correct numerical setup and the calculated result.

---

27.

The health of fish depends on the amount of oxygen dissolved in the water. A dissolved oxygen (DO) concentration between 6 parts per million and 8 parts per million is best for fish health. A DO concentration greater than 1 part per million is necessary for fish survival.

Fish health is also affected by water temperature and concentrations of dissolved ammonia, hydrogen sulfide, chloride compounds, and nitrate compounds. Most freshwater fish thrive in water with a pH between 6.5 and 8.5.

A student's fish tank contains fish, green plants, and 3800 grams of fish-tank water with  $2.7 \times 10^{-2}$  gram of dissolved oxygen. Phenolphthalein tests colorless and bromthymol blue tests blue in samples of the fish-tank water.

Based on the test results for the indicators phenolphthalein and bromthymol blue, what is the pH range of the fish-tank water?

---

28.

An unsaturated solution is made by completely dissolving 20.0 grams of  $\text{NaNO}_3$  in 100.0 grams of water at  $20.0^\circ\text{C}$ .

Identify *one* process that can be used to recover the  $\text{NaNO}_3$  from the unsaturated solution.

---

29.

An original sample of K-40 has a mass of 25.00 grams. After  $3.9 \times 10^9$  years, 3.125 grams of the original sample remains unchanged. What is the half-life of K-40?

- (1)  $1.3 \times 10^9$  y                      (3)  $3.9 \times 10^9$  y  
(2)  $2.6 \times 10^9$  y                      (4)  $1.2 \times 10^{10}$  y
- 

30.

In a titration, 15.65 milliliters of a  $\text{KOH}(\text{aq})$  solution exactly neutralized 10.00 milliliters of a 1.22 M  $\text{HCl}(\text{aq})$  solution.

Complete the equation *in the space below* for the titration reaction by writing the formula of *each* product.



---

31.

In a titration, 15.65 milliliters of a KOH(aq) solution exactly neutralized 10.00 milliliters of a 1.22 M HCl(aq) solution.

*In the space below*, show a correct numerical setup for calculating the molarity of the KOH(aq) solution.

---

32.

The modern model of the atom is based on the work of

- (1) one scientist over a short period of time
  - (2) one scientist over a long period of time
  - (3) many scientists over a short period of time
  - (4) many scientists over a long period of time
- 

33.

Which statement is true about the charges assigned to an electron and a proton?

- (1) Both an electron and a proton are positive.
  - (2) An electron is positive and a proton is negative.
  - (3) An electron is negative and a proton is positive.
  - (4) Both an electron and a proton are negative.
- 

34.

In the wave-mechanical model, an orbital is a region of space in an atom where there is

- (1) a high probability of finding an electron
  - (2) a high probability of finding a neutron
  - (3) a circular path in which electrons are found
  - (4) a circular path in which neutrons are found
- 

35.

What is the charge of the nucleus in an atom of oxygen-17?

- (1) 0
  - (2) -2
  - (3) +8
  - (4) +17
- 

36.

Which pair of symbols represents a metalloid and a noble gas?

- (1) Si and Bi
  - (2) As and Ar
  - (3) Ge and Te
  - (4) Ne and Xe
- 

37.

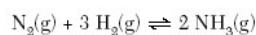
Which statement describes a chemical property of iron?

- (1) Iron can be flattened into sheets.
- (2) Iron conducts electricity and heat.
- (3) Iron combines with oxygen to form rust.
- (4) Iron can be drawn into a wire.

---

38.

Given the reaction:



What is the mole-to-mole ratio between nitrogen gas and hydrogen gas?

- (1) 1:2
- (2) 1:3
- (3) 2:2
- (4) 2:3

---

39.

What is the percent by mass of oxygen in propanal,  $\text{CH}_3\text{CH}_2\text{CHO}$ ?

- (1) 10.0%
- (2) 27.6%
- (3) 38.1%
- (4) 62.1%

---

40.

Covalent bonds are formed when electrons are

- (1) transferred from one atom to another
- (2) captured by the nucleus
- (3) mobile within a metal
- (4) shared between two atoms

---

41.

Which type of molecule is  $\text{CF}_4$ ?

- (1) polar, with a symmetrical distribution of charge
- (2) polar, with an asymmetrical distribution of charge
- (3) nonpolar, with a symmetrical distribution of charge
- (4) nonpolar, with an asymmetrical distribution of charge

---

42.

Which change occurs when a barium atom loses two electrons?

- (1) It becomes a negative ion and its radius decreases.
- (2) It becomes a negative ion and its radius increases.
- (3) It becomes a positive ion and its radius decreases.
- (4) It becomes a positive ion and its radius increases.

---

43.

Conductivity in a metal results from the metal atoms having

- (1) high electronegativity
- (2) high ionization energy
- (3) highly mobile protons in the nucleus
- (4) highly mobile electrons in the valence shell

---

44.

Which of these elements has the *least* attraction for electrons in a chemical bond?

- (1) oxygen
  - (2) fluorine
  - (3) nitrogen
  - (4) chlorine
- 

45.

Recovering the salt from a mixture of salt and water could best be accomplished by

- (1) evaporation
  - (2) filtration
  - (3) paper chromatography
  - (4) density determination
- 

46.

The average kinetic energy of water molecules is greatest in which of these samples?

- (1) 10 g of water at 35°C
  - (2) 10 g of water at 55°C
  - (3) 100 g of water at 25°C
  - (4) 100 g of water at 45°C
- 

47.

Helium is most likely to behave as an ideal gas when it is under

- (1) high pressure and high temperature
  - (2) high pressure and low temperature
  - (3) low pressure and high temperature
  - (4) low pressure and low temperature
- 

48.

At STP, the element oxygen can exist as either O<sub>2</sub> or O<sub>3</sub> gas molecules. These two forms of the element have

- (1) the same chemical and physical properties
  - (2) the same chemical properties and different physical properties
  - (3) different chemical properties and the same physical properties
  - (4) different chemical and physical properties
- 

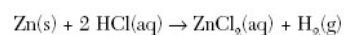
49.

Which sample contains particles in a rigid, fixed, geometric pattern?

- (1) CO<sub>2</sub>(aq)
  - (2) HCl(g)
  - (3) H<sub>2</sub>O(l)
  - (4) KCl(s)
- 

50.

Given the reaction at 25°C:



The rate of this reaction can be increased by using 5.0 grams of powdered zinc instead of a 5.0-gram strip of zinc because the powdered zinc has

- (1) lower kinetic energy
- (2) lower concentration
- (3) more surface area
- (4) more zinc atoms

---

51.

Which statement about a system at equilibrium is true?

- (1) The forward reaction rate is less than the reverse reaction rate.
- (2) The forward reaction rate is greater than the reverse reaction rate.
- (3) The forward reaction rate is equal to the reverse reaction rate.
- (4) The forward reaction rate stops and the reverse reaction rate continues.

---

52.

A catalyst increases the rate of a chemical reaction by

- (1) lowering the activation energy of the reaction
- (2) lowering the potential energy of the products
- (3) raising the temperature of the reactants
- (4) raising the concentration of the reactants

---

53.

Which element must be present in an organic compound?

- (1) hydrogen
- (2) oxygen
- (3) carbon
- (4) nitrogen

---

54.

Which compound is a saturated hydrocarbon?

- (1) hexane
- (2) hexene
- (3) hexanol
- (4) hexanal

---

55.

Given the reaction:



This reaction is an example of

- (1) fermentation
- (2) saponification
- (3) hydrogenation
- (4) esterification

---

56.

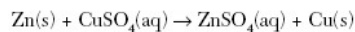
Which of these compounds has chemical properties most similar to the chemical properties of ethanoic acid?

- (1)  $\text{C}_3\text{H}_7\text{COOH}$
- (2)  $\text{C}_2\text{H}_5\text{OH}$
- (3)  $\text{C}_2\text{H}_5\text{COOC}_2\text{H}_5$
- (4)  $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$

---

57.

Given the reaction that occurs in an electrochemical cell:



During this reaction, the oxidation number of Zn changes from

- (1) 0 to +2
  - (2) 0 to -2
  - (3) +2 to 0
  - (4) -2 to 0
- 

58.

A voltaic cell spontaneously converts

- (1) electrical energy to chemical energy
  - (2) chemical energy to electrical energy
  - (3) electrical energy to nuclear energy
  - (4) nuclear energy to electrical energy
- 

59.

Which pair of formulas represents two compounds that are electrolytes?

- (1) HCl and CH<sub>3</sub>OH
  - (2) HCl and NaOH
  - (3) C<sub>5</sub>H<sub>12</sub> and CH<sub>3</sub>OH
  - (4) C<sub>5</sub>H<sub>12</sub> and NaOH
- 

60.

Hydrogen chloride, HCl, is classified as an Arrhenius acid because it produces

- (1) H<sup>+</sup> ions in aqueous solution
  - (2) Cl<sup>-</sup> ions in aqueous solution
  - (3) OH<sup>-</sup> ions in aqueous solution
  - (4) NH<sub>4</sub><sup>+</sup> ions in aqueous solution
- 

61.

Which compound could serve as a reactant in a neutralization reaction?

- (1) NaCl
  - (2) KOH
  - (3) CH<sub>3</sub>OH
  - (4) CH<sub>3</sub>CHO
- 

62.

Which of these particles has the greatest mass?

- (1) alpha
  - (2) beta
  - (3) neutron
  - (4) positron
- 

63.

In a nuclear fusion reaction, the mass of the products is

- (1) less than the mass of the reactants because some of the mass has been converted to energy
- (2) less than the mass of the reactants because some of the energy has been converted to mass
- (3) more than the mass of the reactants because some of the mass has been converted to energy

(4) more than the mass of the reactants because some of the energy has been converted to mass

---

64.

Which of these types of radiation has the greatest penetrating power?

- (1) alpha
  - (2) beta
  - (3) gamma
  - (4) positron
- 

65.

How many electrons are contained in an  $\text{Au}^{3+}$  ion?

- (1) 76
  - (2) 79
  - (3) 82
  - (4) 197
- 

66.

Which electron configuration represents the electrons of an atom in an excited state?

- (1) 2-4
  - (2) 2-6
  - (3) 2-7-2
  - (4) 2-8-2
- 

67.

In comparison to an atom of  $^{19}_9\text{F}$  in the ground state, an atom of  $^{12}_6\text{C}$  in the ground state has

- (1) three fewer neutrons
  - (2) three fewer valence electrons
  - (3) three more neutrons
  - (4) three more valence electrons
- 

68.

Element X is a solid that is brittle, lacks luster, and has six valence electrons. In which group on the Periodic Table would element X be found?

- (1) 1
  - (2) 2
  - (3) 15
  - (4) 16
- 

69.

What is the empirical formula for the compound  $\text{C}_6\text{H}_{12}\text{O}_6$ ?

- (1)  $\text{CH}_2\text{O}$
  - (2)  $\text{C}_2\text{H}_4\text{O}_2$
  - (3)  $\text{C}_3\text{H}_6\text{O}_3$
  - (4)  $\text{C}_6\text{H}_{12}\text{O}_6$
- 

70.

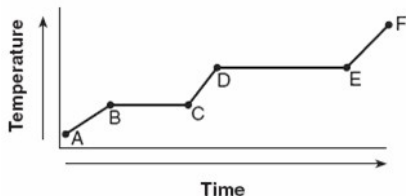
The bonds between hydrogen and oxygen in a water molecule are classified as

- (1) polar covalent

- (2) nonpolar covalent
- (3) ionic
- (4) metallic

71.

The graph below represents the uniform heating of a substance, starting with the substance as a solid below its melting point.



Which line segment represents an increase in potential energy and no change in average kinetic energy?

- (1) AB
- (2) BC
- (3) CD
- (4) EF

72.

Using your knowledge of chemistry and the information in Reference Table H, which statement concerning propanone and water at 50°C is true?

- (1) Propanone has a higher vapor pressure and stronger intermolecular forces than water.
- (2) Propanone has a higher vapor pressure and weaker intermolecular forces than water.
- (3) Propanone has a lower vapor pressure and stronger intermolecular forces than water.
- (4) Propanone has a lower vapor pressure and weaker intermolecular forces than water.

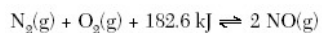
73.

A solution that is at equilibrium must be

- (1) concentrated
- (2) dilute
- (3) saturated
- (4) unsaturated

74.

Given the reaction:



Which change would cause an immediate increase in the rate of the forward reaction?

- (1) increasing the concentration of NO(g)
- (2) increasing the concentration of N<sub>2</sub>(g)
- (3) decreasing the reaction temperature
- (4) decreasing the reaction pressure

75.

Which 10-milliliter sample of water has the greatest degree of disorder?

- (1) H<sub>2</sub>O(g) at 120°C
- (2) H<sub>2</sub>O(l) at 80°C
- (3) H<sub>2</sub>O(l) at 20°C
- (4) H<sub>2</sub>O(s) at 0°C



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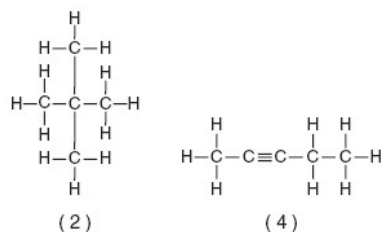
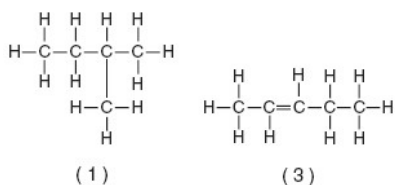
76.

Which pH indicates a basic solution?

- (1) 1
  - (2) 5
  - (3) 7
  - (4) 12
- 

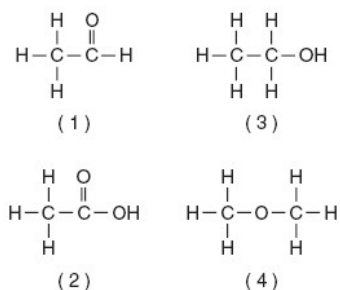
77.

Which structural formula represents 2-pentyne?



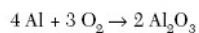
78.

Which structural formula represents an ether?



79.

Given the reaction for the corrosion of aluminum:



Which half-reaction correctly represents the oxidation that occurs?

- (1)  $\text{Al} + 3\text{e}^- \rightarrow \text{Al}^{3+}$
  - (2)  $\text{Al} \rightarrow \text{Al}^{3+} + 3\text{e}^-$
  - (3)  $\text{O}_2 + 4\text{e}^- \rightarrow 2 \text{O}^{2-}$
  - (4)  $\text{O}_2 \rightarrow 2 \text{O}^{2-} + 4\text{e}^-$
- 

80.

Based on Reference Table N, what fraction of a sample of gold-198 remains radioactive after 2.69 days?

- (1)  $\frac{1}{4}$

$$(2) \frac{1}{2}$$

$$(3) \frac{3}{4}$$

$$(4) \frac{7}{8}$$

---

81.

**Note that this question has only three choices.**

As the elements of Group 1 on the Periodic Table are considered in order of increasing atomic radius, the ionization energy of each successive element generally

(1) decreases

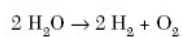
(2) increases

(3) remains the same

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82.

Base your answers to the following questions on the balanced chemical equation below.

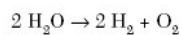


What type of reaction does this equation represent? [1]

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83.

Base your answers to the following questions on the balanced chemical equation below.



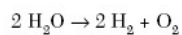
How does the balanced chemical equation show the Law of Conservation of Mass? [1]

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84.

Base your answers to the following questions on the balanced chemical equation below.



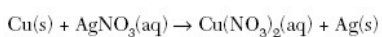
What is the total number of moles of  $\text{O}_2$  produced when 8 moles of  $\text{H}_2\text{O}$  are completely consumed? [1]

\_\_\_\_\_ mol

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85.

Base your answers to the following questions on the unbalanced redox reaction below.



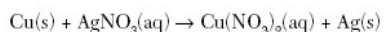
Write the reduction half-reaction. [1]

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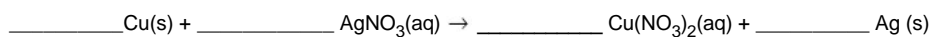
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86.

Base your answers to the following questions on the unbalanced redox reaction below.



Balance the redox equation, using the smallest whole-number coefficients. [1]



87.

Base your answers to the following questions on the information below.

A student titrates 60.0 mL of HNO<sub>3</sub>(aq) with 0.30 M NaOH(aq). Phenolphthalein is used as the indicator. After adding 42.2 mL of NaOH(aq), a color change remains for 25 seconds, and the student stops the titration.

What color change does phenolphthalein undergo during this titration? [1]

\_\_\_\_\_ to \_\_\_\_\_

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88.

Base your answers to the following questions on the information below.

A student titrates 60.0 mL of HNO<sub>3</sub>(aq) with 0.30 M NaOH(aq). Phenolphthalein is used as the indicator. After adding 42.2 mL of NaOH(aq), a color change remains for 25 seconds, and the student stops the titration.

In the space provided below, show a correct numerical setup for calculating the molarity of the HNO<sub>3</sub>(aq). [1]

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89.

Base your answers to the following questions on the information below.

A student titrates 60.0 mL of HNO<sub>3</sub>(aq) with 0.30 M NaOH(aq). Phenolphthalein is used as the indicator. After adding 42.2 mL of NaOH(aq), a color change remains for 25 seconds, and the student stops the titration.

According to the data, how many significant figures should be present in the calculated molarity of the HNO<sub>3</sub>(aq)? [1]

\_\_\_\_\_

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90.

Base your answers to the following questions on the data table below, which shows three isotopes of neon.

Isotope	Atomic Mass (atomic mass units)	Percent Natural Abundance
<sup>20</sup> Ne	19.99	90.9%

$^{21}\text{Ne}$	20.99	0.3%
$^{22}\text{Ne}$	21.99	8.8%

In terms of *atomic particles*, state one difference between these three isotopes of neon. [1]

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91.

Base your answers to the following questions on the data table below, which shows three isotopes of neon.

Isotope	Atomic Mass (atomic mass units)	Percent Natural Abundance
$^{20}\text{Ne}$	19.99	90.9%
$^{21}\text{Ne}$	20.99	0.3%
$^{22}\text{Ne}$	21.99	8.8%

Based on the atomic masses and the natural abundances shown in the data table, in the space provided below, show a correct numerical setup for calculating the average atomic mass of neon. [1]

---

92.

Base your answers to the following questions on the data table below, which shows three isotopes of neon.

Isotope	Atomic Mass (atomic mass units)	Percent Natural Abundance
$^{20}\text{Ne}$	19.99	90.9%
$^{21}\text{Ne}$	20.99	0.3%
$^{22}\text{Ne}$	21.99	8.8%

Based on natural abundances, the average atomic mass of neon is closest to which whole number? [1]

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93.

Based on the Periodic Table, explain why Na and K have similar chemical properties. [1]

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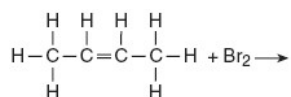
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94.

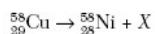
In the space to the right of the reactants and arrow provided in diagram below, draw the structural formula for the product of the reaction shown. [1]



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95.

Given the nuclear equation:



What nuclear particle is represented by X? [1]

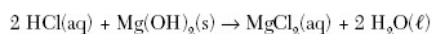
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96.

Base your answers to the following questions on the information and equation below.

Antacids can be used to neutralize excess stomach acid. Brand A antacid contains the acid neutralizing agent magnesium hydroxide, Mg(OH)<sub>2</sub>. It reacts with HCl(aq) in the stomach, according to the following balanced equation:



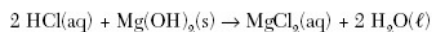
In the space provided below, show a correct numerical setup for calculating the number of moles of Mg(OH)<sub>2</sub> (gram-formula mass = 58.3 grams/mole) in an 8.40-gram sample. [1]

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97.

Base your answers to the following questions on the information and equation below.

Antacids can be used to neutralize excess stomach acid. Brand A antacid contains the acid neutralizing agent magnesium hydroxide, Mg(OH)<sub>2</sub>. It reacts with HCl(aq) in the stomach, according to the following balanced equation:



If a person produces 0.050 mole of excess HCl in the stomach, how many moles of Mg(OH)<sub>2</sub> are needed to neutralize this excess hydrochloric acid? [1]

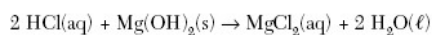
\_\_\_\_\_ mol

---

98.

Base your answers to the following questions on the information and equation below.

Antacids can be used to neutralize excess stomach acid. Brand A antacid contains the acid neutralizing agent magnesium hydroxide, Mg(OH)<sub>2</sub>. It reacts with HCl(aq) in the stomach, according to the following balanced equation:



Brand B antacid contains the acid-neutralizing agent sodium hydrogen carbonate. Write the chemical formula for sodium hydrogen carbonate. [1]

---

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99.

Base your answers to the following questions on the information below.

Naphthalene, a nonpolar substance that sublimates at room temperature, can be used to protect wool clothing from being eaten by moths.

Explain, in terms of *intermolecular forces*, why naphthalene sublimates. [1]

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100.

Base your answers to the following questions on the information below.

Naphthalene, a nonpolar substance that sublimates at room temperature, can be used to protect wool clothing from being eaten by moths.

Explain why naphthalene is *not* expected to dissolve in water. [1]

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