

Question Source:

## Ohio Assessments for Educators Chemistry Sample Test

Which of the following is best accomplished using a mass spectrometer?

- A. determining the percent abundance of an element's natural isotopes
- B. determining the triple point of an unknown substance
- C. determining the reaction rate for a chemical reaction involving a gas
- D. determining the electronegativity value of an element

**Correct Response: A.** This question requires the examinee to demonstrate knowledge of the equipment used in chemistry. A mass spectrometer measures the masses and relative abundance of atomic or molecular ions in a sample. These numerical values can be used to calculate the percent abundance of an element's natural isotopes.

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## Ohio Assessments for Educators Chemistry Sample Test

DNA → RNA → protein

Which of the following biological processes does the pathway shown above summarize?

- A. mitosis
- B. cellular respiration
- C. meiosis
- D. gene expression

**Correct Response: D.**

This question requires the examinee to demonstrate knowledge of major contemporary concepts in biology. DNA is a molecule that stores genetic information in cells. The pathway shows the translation of genetic information from DNA to RNA to protein, a process that leads to the active expression of genetic information.

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# Ohio Assessments for Educators Chemistry Sample Test

Flexible polyurethane foams are used in many commercial products, such as upholstered furniture, bedding, automobile seats, and sponges. An important component in the manufacturing of flexible polyurethane foams are polyols, which are typically derived from petroleum products. In 2007, Cargill, Incorporated, was awarded a Presidential Green Chemistry Challenge Award from the Environmental Protection Agency (EPA) for its research into polyols made from renewable biological resources. The quality and performance of the polyurethane foam made from these non-petroleum-based polyols proved comparable to the quality and performance of the polyurethane foam made from petroleum-based polyols.

The passage above illustrates which of the following about the relationships among science, technology, and society?

- A. Private industry is reluctant to comply with EPA standards without strict government oversight.
- B. Chemistry research can play a significant role in solving major environmental problems.
- C. Environmentally friendly technologies can only be competitive with government support.
- D. Applied chemistry research is increasing due to a decrease in public funding for basic research.

**Correct Response: B.**

This question requires the examinee to analyze the interrelationships among science, technology, and society. Knowledge of chemistry can be used to assess existing manufacturing protocols and to propose alternative procedures. These new procedures can play a significant role in mitigating the environmental problems facing society.

Question Source:

Ohio Assessments for Educators Chemistry Sample Test

Which of the following elements is the most electronegative?

- A. hydrogen
- B. fluorine
- C. radon
- D. francium

**Correct Response: D.**

This question requires the examinee to demonstrate knowledge of the characteristics of radioactive materials. Chemical and physical changes do not involve changes within the nucleus of an atom and therefore would not lead to a reduction in an element's atomic number. This type of change would only result from a nuclear change.



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## Ohio Assessments for Educators Chemistry Sample Test

Which of the following only occurs during a nuclear change?

- A. Valence electrons are raised to higher energy levels
- B. Two or more types of atoms are combined.
- C. Energy is released to the surroundings.
- D. An element's atomic number is reduced.

**Correct Response: B.**

This question requires the examinee to demonstrate knowledge of the periodic table and its usefulness in predicting the relative reactivity of given elements. The electronegativity of elements in the periodic table tends to increase from bottom to top within a group and from left to right across a period. Of the given elements, fluorine is in the uppermost position on the right-hand side of the periodic table.

## Question Source:

## Ohio Assessments for Educators Chemistry Sample Test

A gas occupies a volume of 1.25 liters at a pressure of 825 mm Hg. What will be the final pressure of this gas if it is compressed into a volume of 725 mL at constant temperature?

- A. 479 mm Hg
- B. 748 mm Hg
- C.  $1.30 \times 10^3$  mm Hg
- D.  $1.42 \times 10^3$  mm Hg

**Correct Response: D.**

This question requires the examinee to solve a problem involving the gas laws. If the temperature and number of moles of a gas are held constant, the relationship between initial pressure and initial volume and a new pressure and a new volume is  $P_1V_1 = P_2V_2$ . This relationship can be used to calculate the new pressure when the initial pressure, initial volume, and new volume are known.

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### Ohio Assessments for Educators Chemistry Sample Test

A 4.75 g sample of solid NaOH is dissolved in 50.5 g of H<sub>2</sub>O in a constant-pressure calorimeter having a heat capacity of 18.5 J/°C. The temperature rises from 21.1°C to 33.6°C. Assuming that the solution has a specific heat capacity of 4.184 J/g·°C and negligible heat loss from the calorimeter, how much heat is produced in the solution process?

- A. 2.64 kJ
- B. 2.89 kJ
- C. 3.12 kJ
- D. 4.27 kJ

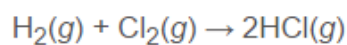
**Correct Response: C.**

This question requires the examinee to analyze the results of a calorimetry experiment. The total heat produced in the given solution process is equal to the heat absorbed by the solution plus the heat absorbed by the calorimeter. The heat absorbed by the solution is calculated using the equation  $q = m \times s \times \Delta T$ . The heat absorbed by the calorimeter is equal to  $C_{\text{calorimeter}} \times \Delta T$ .

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Bond	Bond Enthalpy (kJ/mol)
H—H	436.4
H—Cl	431.9



$$\Delta H^\circ_{\text{rxn}} = -184.6 \text{ kJ}$$

Given the information shown above, what is the best estimate of the bond enthalpy for the Cl—Cl bond?

- A. 189.1 kJ/mol
- B. 242.8 kJ/mol
- C. 256.3 kJ/mol
- D. 585.1 kJ/mol

**Correct Response: B.**

This question requires the examinee to analyze energy changes due to the formation or breaking of chemical bonds. The enthalpy change for a chemical reaction is equal to the sum of the enthalpy changes involved in breaking existing bonds minus the sum of the enthalpy changes involved in forming new bonds. The bond enthalpy for the Cl—Cl bond can be calculated using this relationship and the given bond enthalpies for H—H and H—Cl.

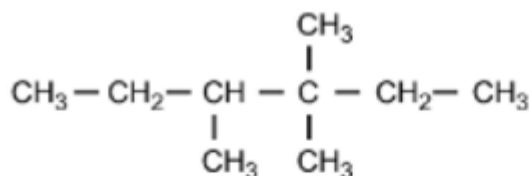


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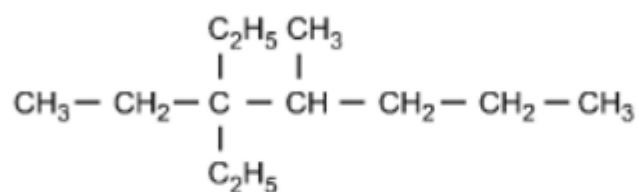
## Ohio Assessments for Educators Chemistry Sample Test

Which of the following structural formulas represents 4-ethyl-3, 3-dimethylhexane?

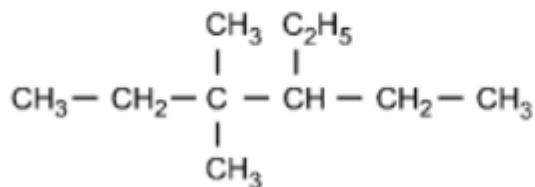
A.



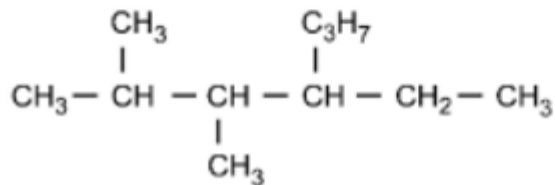
B.



C.



D.



**Correct Response: C.**

This question requires the examinee to apply the International Union of Pure and Applied Chemistry (IUPAC) rules of nomenclature. 4-ethyl-3, 3-dimethylhexane is an alkane consisting of six continuous carbon atoms. An ethyl group ( $\text{C}_2\text{H}_5$ ) is attached to the number 4 carbon and two methyl groups ( $\text{CH}_3$ ) are attached to the number 3 carbon.

Question Source:

## Ohio Assessments for Educators Chemistry Sample Test

The high melting point of diamond is due to:

- A. strong covalent bonds between carbon atoms.
- B. an irregular, three-dimensional crystal structure.
- C. delocalized, highly mobile bonding electrons.
- D. extensive van der Waals forces between carbon atoms.

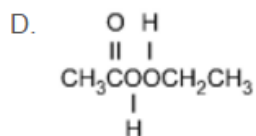
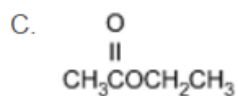
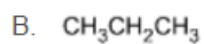
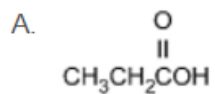
**Correct Response: A.**

This question requires the examinee to relate the properties of substances to their atomic bonds. Diamond is a covalent-network crystalline solid. The carbon atoms in this network are linked by covalent bonds. This strong bonding between carbon atoms is responsible for the high melting point of diamond.

## Question Source:

## Ohio Assessments for Educators Chemistry Sample Test

Which of the following products is formed by an esterification reaction between acetic acid ( $\text{CH}_3\text{CO}_2\text{H}$ ) and ethanol ( $\text{CH}_3\text{CH}_2\text{OH}$ )?

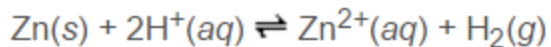


**Correct Response: C.**

This question requires the examinee to analyze different types of chemical reactions. In the esterification reaction between acetic acid and ethanol, the OH group from acetic acid and the H attached to the O in ethanol combine to form water. The remaining portions of the acetic acid and ethanol molecules combine to form the ester, ethyl acetate.

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Which of the following is the equilibrium constant expression for the equation shown above?

- A.  $\frac{[\text{Zn}^{2+}] [\text{H}_2]}{[\text{Zn}] [\text{H}^+]}$
- B.  $\frac{[\text{Zn}^{2+}] + (P_{\text{H}_2})}{[\text{Zn}] + 2[\text{H}^+]}$
- C.  $\frac{[\text{Zn}^{2+}]}{2[\text{H}^+]}$
- D.  $\frac{[\text{Zn}^{2+}] (P_{\text{H}_2})}{[\text{H}^+]^2}$

**Correct Response: D.**

This question requires the examinee to solve problems involving equilibrium constants. When writing equilibrium constant expressions, pure solid and pure liquid compounds are omitted and the pressure of gaseous compounds can be used in place of concentration. The equilibrium constant expression for this reaction is equal to the concentration of  $\text{Zn}^{2+}(aq)$   $\times$  the pressure of  $\text{H}_2(g)$  each raised to a power equal to its stoichiometric coefficient, divided by the concentration of  $\text{H}^+(aq)$  raised to a power equal to its stoichiometric coefficient.



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Which of the following explains why nitric acid ( $\text{HNO}_3$ ) is a stronger acid than nitrous acid ( $\text{HNO}_2$ )?

- A. The additional oxygen present in nitric acid increases the polarity of the O—H bond.
- B. The extent of ionization is directly related to molecular weight when comparing related compounds.
- C. The anion formed by removing  $\text{H}^+$  from nitrous acid is more stable than the anion formed by removing  $\text{H}^+$  from nitric acid.
- D. The O—H bond in nitrous acid is weaker than the O—H bond in nitric acid.

**Correct Response: A.**

This question requires the examinee to demonstrate knowledge of the relationship between molecular structure and acid strength. The strength of an acid is a function of its tendency to ionize. For oxoacids with the same central atom, acid strength increases as the oxidation number of the central atom increases because of the resulting increase in polarity of the O—H bond. The oxidation number of nitrogen in  $\text{HNO}_3$  is +5 and in  $\text{HNO}_2$  it is +3, thus the O—H bond in  $\text{HNO}_3$  is more polar and ionizes more readily.

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Automobile mechanics measure the density of the electrolyte solution of lead storage batteries to determine the amount of charge remaining. Which of the following statements describes the cause of the change in electrolyte density as the battery's charge decreases?

- A. The sulfuric acid electrolyte is consumed and water is formed.
- B. Water evaporates and the electrolyte concentration increases.
- C. The lead and lead(IV) oxide migrate from the solution to the electrodes.
- D. Lead in the electrolyte solution precipitates out of the solution.

**Correct Response: A.**

This question requires the examinee to demonstrate knowledge of the applications of electrochemistry. During the normal operation of a lead storage battery, sulfuric acid is consumed and water is produced. The density of the electrolyte solution is related to how much of each of these substances is present in the solution.

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Which of the following is equivalent to  $1.42 \times 10^{23}$  atoms?

- A. 25.0 g Br
- B. 15.0 g Cu
- C. 19.0 g Sn
- D. 23.0 g Mn

**Correct Response: B.**

This question requires the examinee to demonstrate knowledge of the mole concept. The number of moles of an element is equal to the product of the mass of the element  $\div$  the molar mass of the element  $\times$  Avogadro's number.