

Question Source:

Missouri Educator Gateway Assessment 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. 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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Use the pathway below to answer the question that follows.

DNA → RNA → protein

Which of the following biological processes does the pathway summarize?

- a. mitosis
- b. cellular respiration
- c. Meiosis
- d. gene expression

Correct Response: D. 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.

Question Source:

Missouri Educator Gateway Assessment Chemistry Sample Test

Use the passage below to answer the question that follows.

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 illustrates which of the following statements about the relationships between science, technology, and human activity?

- 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. Knowledge of chemistry can be used to assess existing manufacturing protocols and to propose alternate procedures. These new procedures can play a significant role in mitigating the environmental problems facing society.

Question Source:

Missouri Educator Gateway Assessment Chemistry
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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: D. 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.

Question Source:

Missouri Educator Gateway Assessment Chemistry
Sample Test

Which of the following elements is the most electronegative?

- a. hydrogen
- b. fluorine
- c. radon
- d. francium

Correct Response: B. 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.

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Sample Test

A gas occupies a volume of 1.25 L 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. 1.30×10^3 mm Hg
- d. 1.42×10^3 mm Hg

Correct Response: D. 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 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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Use the information below to answer the question that follows.

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



$$\Delta H_{\text{rxn}}^{\circ} = -184.6 \text{ kJ}$$

According to the information shown, what is the best estimate of the bond enthalpy for the Cl – Cl bond?

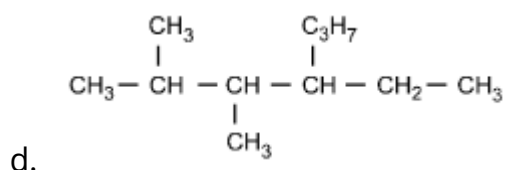
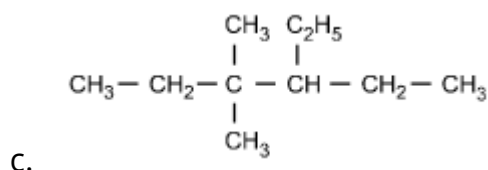
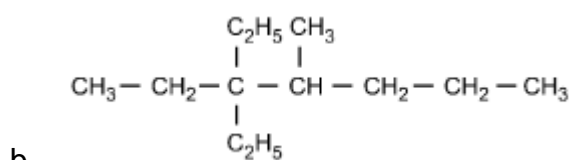
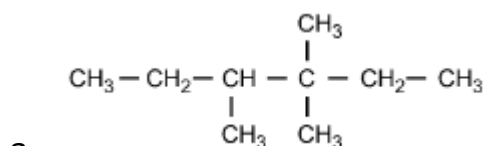
- a. 189.1 kJ/mol
- b. 242.8 kJ/mol
- c. 256.3 kJ/mol
- d. 585.1 kJ/mol

Correct Response: B. 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.

Question Source:

Missouri Educator Gateway Assessment Chemistry Sample Test

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



Correct Response: C. 4-ethyl-3, 3-dimethylhexane is an alkane consisting of six continuous carbon atoms. An ethyl group (C_2H_5) is attached to the number 4 carbon and two methyl groups (CH_3) are attached to the number 3 carbon.

Question Source:

Missouri Educator Gateway Assessment Chemistry
Sample Test

The high melting point of diamond is due to:

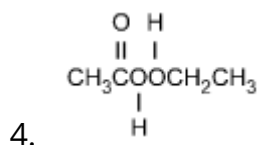
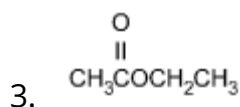
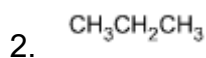
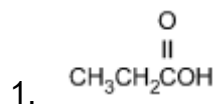
- a. strong covalent bonds between carbon atoms.
- b. an irregular, three-dimensional crystal structure.
- c. delocalized, highly mobile bonding electrons.
- d. extensive van der Waals forces between carbon atoms.

Correct Response: A. 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:

Missouri Educator Gateway Assessment 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. 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.

Question Source:

Missouri Educator Gateway Assessment Chemistry
Sample Test

Use the chemical equation below to answer the question that follows.



Which of the following is the equilibrium constant expression for the reaction shown?

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. 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 $\text{Zn}^{2+}(\text{aq})$ \times the pressure of $\text{H}_2(\text{g})$, each raised to a power equal to its stoichiometric coefficient, divided by the concentration of $\text{H}^+(\text{aq})$ raised to a power equal to its stoichiometric coefficient.

Question Source:

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Sample Test

Which of the following explains why nitric acid (HNO_3) is a stronger acid than nitrous acid (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 H^+ from nitrous acid is more stable than the anion formed by removing 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. 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 HNO_3 is +5 and in HNO_2 it is +3, thus the O – H bond in HNO_3 is more polar and ionizes more readily.

Question Source:

Missouri Educator Gateway Assessment Chemistry Sample Test

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. 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.

Question Source:

Missouri Educator Gateway Assessment Chemistry
Sample Test

Use the chemical equation below to answer the question that follows.



According to the equation, how much NH_3 is formed when 823 g of N_2 are combined with 145 g of H_2 ?

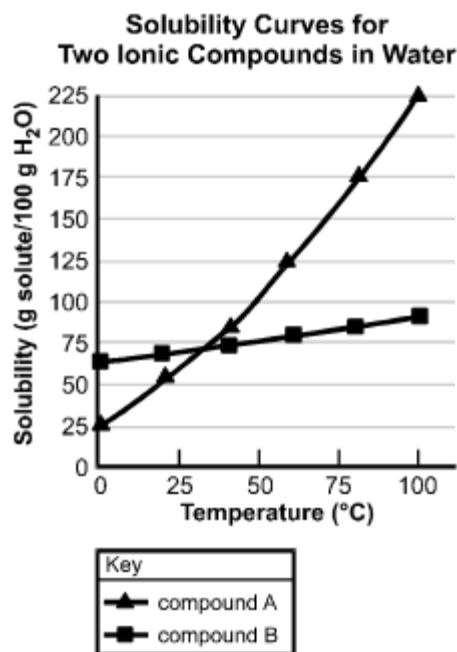
- a. 58.8 g
- b. 96.7 g
- c. 815 g
- d. 1650 g

Correct Response: C. By calculating the number of moles of each reactant and analyzing the stoichiometric relationship between them, H_2 can be identified as the limiting reactant. From the stoichiometric relationship between H_2 and NH_3 , the number of moles of product formed can be calculated. This mole quantity can then be converted into mass using the molar mass of NH_3 .

Question Source:

Missouri Educator Gateway Assessment Chemistry Sample Test

Use the diagram below to answer the question that follows.



According to the solubility curves shown, which of the following procedures will be most effective in isolating the greatest amount of pure compound A from a mixture consisting of 200 g of compound A and 15 g of compound B?

- a. dissolving the mixture in 100 g of water and then heating to the solution's boiling point
- b. dissolving the mixture in 100 g of water at 100°C and then decreasing the temperature to 0°C
- c. dissolving the mixture in 100 g of water at 75°C, filtering the solution, and then retaining the filtrate
- d. dissolving the mixture in 100 g of water and then slowly increasing the temperature to 100°C

Correct Response: B. According to the solubility curves provided, both compound A and compound B will be completely in solution when dissolved in 100 g of water at 100°C. As the temperature of the solution is decreased to 0°C, 175 g of compound A will come out of the solution, while all of compound B will remain in the solution. This is the procedure that yields the greatest amount of pure compound A.

Question Source:

Missouri Educator Gateway Assessment MS Science Sample Test

In working out the theory of evolution, Charles Darwin was strongly influenced by which of the following developments in the sciences?

- a. the hypothesis that Earth had changed gradually over long periods of time
- b. the discovery that cells are the basic unit of living organisms
- c. the recognition that Earth's crust is composed of shifting tectonic plates
- d. the discovery that ancient humans lived in Africa millions of years ago

Correct Response: A. Darwin's theory of evolution by natural selection requires a long time frame over which to work. The work of two geologists, James Hutton and Charles Lyell, suggested that Earth had changed gradually over long periods of time, supporting Darwin's theory.

Question Source:

Missouri Educator Gateway Assessment MS Science Sample Test

In which of the following scenarios does the U.S. government most directly affect the work of scientists?

- a. The Food and Drug Administration evaluates the efficacy of a new medical device.
- b. Politicians running for office debate the potential risks to humanity of global warming.
- c. The governor of a large state announces new energy conservation measures for public buildings.
- d. Congress votes to support increased funding for research at the National Institutes of Health.

Correct Response: D. Government funding for research influences the work of scientists by encouraging them to work in funded areas of science and by providing funds for scientists to continue their work.

Question Source:

Missouri Educator Gateway Assessment MS Science Sample Test

Which of the following elements is the most electronegative?

- a. hydrogen
- b. fluorine
- c. Radon
- d. francium

Correct Response: B. 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:

Missouri Educator Gateway Assessment MS Science Sample Test

Use the balanced chemical equation below to answer the question that follows.



What is the mass of calcium oxide (CaO) that is produced when 80.0 g of calcium carbonate (CaCO₃) is heated and decomposes completely?

- a. 44.8 g
- b. 47.7 g
- c. 65.9 g
- d. 70.2 g

Correct Response: A. Since the reaction is already written in balanced form, one mole of CaO is produced for each mole of CaCO₃ that reacts. The molecular weight of CaCO₃ is the sum of the atomic weights of the atoms in CaCO₃. The molecular weight of CaCO₃ is $1(40.1 \text{ amu}) + 1(12.01 \text{ amu}) + 3(16.00 \text{ amu}) = 100.1 \text{ amu}$. This means that CaCO₃ has a mass of 100.1 g per mole. Therefore, 80.0 g of CaCO₃ represents 0.799 mole of CaCO₃ and must produce 0.799 mole of CaO. CaO has a molecular weight of $1(40.1 \text{ amu}) + 1(16.00 \text{ amu}) = 56.1 \text{ amu}$, and 0.799 mole of CaO has a mass of $(0.799) \times (56.1)$, or 44.8 g.