Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

Which of the following is a fundamental challenge in the design of complex systems?

A. Feedback mechanisms in complex systems decrease the overall stability of the system.

B. The more parts and connections that a complex system has, the more ways the system can fail.

C. The cost of designing complex systems is excessive.

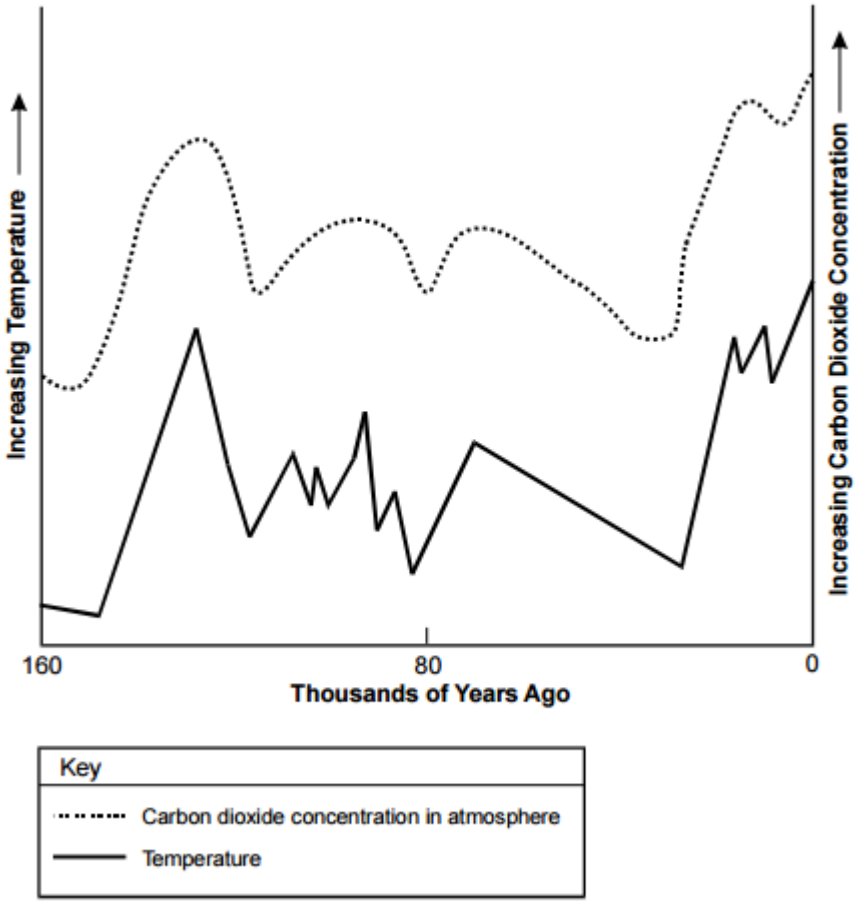
D. The construction of complex systems is time consuming.

B Understand and apply knowledge of the concepts, principles, and processes of technological design.

Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

Use the graph below to answer the question that follows.



The graph above shows the variation in the concentration of carbon dioxide in the atmosphere over the past 160,000 years and the average global temperature change during that same period. Which of the following is the best logical conclusion that can be drawn relying exclusively on these two data sets?

A. Increased global temperatures correlate with increases in atmospheric carbon dioxide, suggesting a connection between the two phenomena.

B. Increased atmospheric carbon dioxide promotes a general warming of the global climate through its role as a greenhouse gas.

C. Increased global temperatures increase the production of carbon dioxide from a variety of natural sources, including photosynthesis and erosion of carbonate rocks.

D. Increased carbon dioxide concentrations in the atmosphere are not related to the warming in the global climate.

A Understand and apply knowledge of science as inquiry.

Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

Newton's laws are considered laws and not theories because:

A. they describe natural phenomena with unvarying uniformity under certain conditions.

B. they can be used to explain the outcome of natural phenomena.

C. over time, theories become laws.

D. they are all true for all frames of reference discovered so far.

A Understand and apply knowledge of accepted practices of science.

Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

Major breakthroughs in science and technology during the nineteenth century were primarily the result of:

A. inventions designed to solve a specific problem.

B. basic research into the workings of the physical and natural world.

C. accidental discoveries made when conducting research on other topics.

D. grant-funded research projects seeking to reach a particular goal.

B Understand and apply knowledge of the interactions among science, technology, and society.

Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

For an unordered system, such as a mixture of salt and pepper, to become more ordered, which of the following is required?

A. the addition of heat

B. an increase in the size of the system

C. the expenditure of energy

D. a decrease in the pressure in the system

C Understand and apply knowledge of the major unifying concepts of all sciences and how these concepts relate to other disciplines.

Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

When hydrochloric acid reacts with calcium carbonate in a flask, the flask becomes noticeably warm to the touch. Which of the following best describes why this occurs?

A. The high rate at which the chemical reaction occurs generates infrared radiation.

B. The number of protons in the products is greater than the number of protons in the reactants.

C. The friction produced by the agitation of the reactants creates thermal energy.

D. The bond energies of the reactants are greater than the bond energies of the products.

D Understand and apply knowledge of the nature and properties of energy in its various forms.

Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

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

$$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$$

Which of the following formulas represents the approximate number of grams of CO required to react completely with 200 g of Fe_2O_3?

A. $\frac{(200)(3)}{(28)(160)}$ g

B. $\frac{(200)(3)(28)}{160}$ g

C. $\frac{(200)(28)}{(3)(160)}$ g

D. $\frac{160}{(200)(28)(3)}$ g

B Understand and apply knowledge of the structure and properties of matter.

Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

Element X reacts with chlorine gas to produce the ionic compound XCl_2. Which of the following electron configurations for element X is consistent with this chemical property?

A. $1s^2 2s^2 2p^6 3s^2 3p^1$

B. $1s^2 2s^2 2p^6 3s^2 3p^2$

C. $1s^2 2s^2 2p^6 3s^1$

D. $1s^2 2s^2 2p^6 3s^2$

D Understand and apply knowledge of periodic relationships and the nature of matter.

Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

Which of the following ratios is most important with respect to the stability of a nucleus?

A. neutrons : electrons

B. protons : electrons

C. neutrons : protons

D. nucleons : nonnucleons

C Understand and apply knowledge of the development and central concepts of atomic theory and structure, including the quantum mechanical model.

Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

What is the relative rate of diffusion of sulfur dioxide gas to bromine gas at the same pressure and temperature?

A. 0.401:1

B. 0.633:1

C. 1.58:1

D. 2.50:1

C Understand and apply knowledge of the kinetic molecular theory and the nature and properties of molecules in the gaseous, liquid, and solid states.

Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

A sample of solid iodine crystals has been contaminated by solid NaCl crystals. To purify the iodine, a process of dissolving, filtering, collecting the filtrate, and allowing the solvent to evaporate will be carried out. Which of the following would be the most appropriate solvent for this purification process?

A. C_6H_{14}

B. HCl

C. H_2O

D. C_2H_5OH

A Understand and apply knowledge of the interactions of particles in solution and the properties of solutions.

Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

Magnesium and hydrochloric acid react according to the equation below.

$$Mg(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$$

If 1.0 g of Mg is reacted with 10.0 mL of 6.0 *M* HCl, what volume of hydrogen gas will be produced at 25°C and 1.0 atm? ($R = 0.0821$ L•atm/mol•K)

A. 0.062 L

B. 0.73 L

C. 1.0 L

D. 1.5 L

B Understand and apply knowledge of the concepts and principles of chemical equations and stoichiometry.

Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

Use the information below to answer the question that follows.

$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$

$K_c = 0.0182$ at 698 K for the reaction above. Which of the following correctly describes the relationship between the initial rate of the forward reaction and the initial rate of the reverse reaction if the initial concentration of HI is 0.5 *M* and the initial concentrations of H_2 and I_2 are 0.1 *M* each?

A. $\frac{\text{Rate}_{\text{forward}}}{\text{Rate}_{\text{reverse}}} > 1$

B. $\frac{\text{Rate}_{\text{forward}}}{\text{Rate}_{\text{reverse}}} < 1$

C. $\frac{\text{Rate}_{\text{forward}}}{\text{Rate}_{\text{reverse}}} = 1$

D. $\frac{\text{Rate}_{\text{forward}}}{\text{Rate}_{\text{reverse}}} = K_c$

B Understand and apply knowledge of thermodynamics and their applications to chemical systems.

Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

If an electric current is passed through molten sodium chloride using two electrodes, which substance will be produced at the cathode?

A. sodium metal

B. sodium ions

C. chlorine molecules

D. chloride ions

A Understand and apply knowledge of electrochemistry.

Question Source:

ILTS (Illinois) Science: Chemistry Sample Test

The following data were collected during the room temperature decomposition of chlorine oxide according to the reaction $2ClO(g) \longrightarrow Cl_2(g) + O_2(g)$.

Time (s)	[ClO] (*M*)
2.24	5.79×10^{-3}
4.00	4.77×10^{-3}

What would be the rate of appearance of oxygen gas during this reaction?

A. 2.90×10^{-4} *M*/s

B. 5.80×10^{-4} *M*/s

C. 1.02×10^{-3} *M*/s

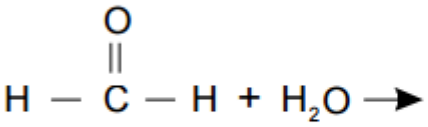
D. 1.16×10^{-3} *M*/s

A Understand and apply knowledge of the mechanisms of chemical reactions and the theory and practical applications of reaction rates.

Question Source:

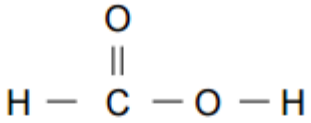
ILTS (Illinois) Science: Chemistry Sample Test

Use the diagram below to answer the question that follows.

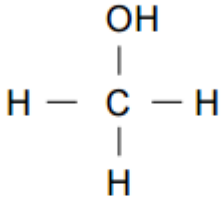


Which of the following molecules would be the primary product of the reaction shown above?

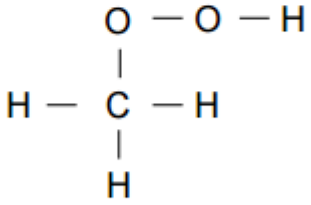
A.



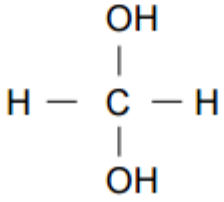
B.



C.



D.

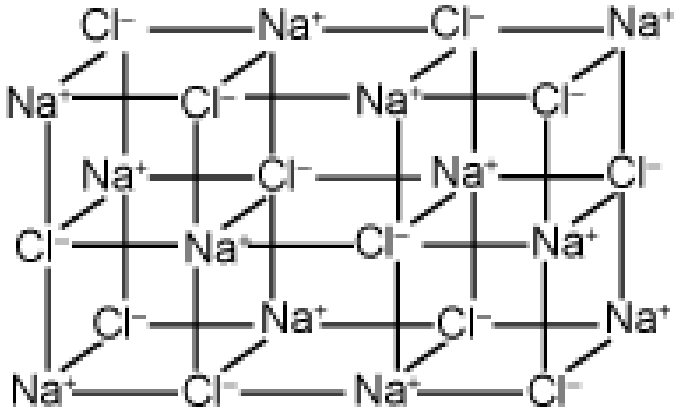


D Understand and apply knowledge of major aspects of organic chemistry.

Question Source:

ILTS (Illinois) Middle Level Science Sample Test

Use the structural model of solid sodium chloride shown below to answer the question that follows.



As shown in the model, solid sodium chloride has an extended three-dimensional network structure composed of equal numbers of sodium ions, Na^+, and chloride ions, Cl^-. This extended structure is maintained by attractive forces resulting from the:

a. transfer of electrons from chlorine atoms to sodium atoms.

b. unequal sharing of electrons between sodium cations.

c. charge difference between the two types of ions.

d. crosslinking of protons and electrons within each ion.

Correct Response: C.
Ions with opposite charges are attracted to one another. In sodium chloride, the force of attraction between the positively charged sodium ions (Na^+) and the negatively charged chloride ions (Cl^-) produces an extended three-dimensional network structure.

Question Source:

ILTS (Illinois) Middle Level Science Sample Test

Which of the following characteristics of water is primarily responsible for water's ability to dissolve a wide range of ionic compounds?

a. Water is composed of three nonmetal atoms.
b. Water has a neutral pH at room temperature.
c. Water molecules have polar covalent bonds.
d. Water is liquid over a wide range of temperatures.

Correct Response: C.
In a water molecule, a slight charge differential exists between the oxygen atom and the two hydrogen atoms. The oxygen atom has a slight negative charge and each hydrogen atom has a slight positive charge. Positive and negative ions are attracted to these slight charges, which is why water is an effective solvent for ionic compounds.