NY Regents Chemistry Samples

1. Which Group 18 element is most likely to form a compound with the element fluorine?

   A. He   B. Ne   C. Ar   D. Kr

2. In which sample is the average kinetic energy of the particles greatest?

   A. 10. mL of HCl(aq) at 25°C

   B. 15 mL of HCl(aq) at 20.°C

   C. 10. mL of $H_2O(\ell)$ at 35°C

   D. 15 mL of $H_2O(\ell)$ at 30.°C

3. Base your answer(s) to the following question(s) on the data table below, which shows the solubility of a solid solute.

   The Solubility of the Solute at Various Temperatures

Temperature (°C)	Solute per 100 g of H_2O(g)
0	18
20	20
40	24
60	29
80	36
100	49

   According to Reference Table G, how many grams of $KClO_3$ must be dissolved in 100 grams of H_2O at 10°C to produce a saturated solution?

4. A binary compound of sodium is

   A. sodium chlorate

   B. sodium chlorite

   C. sodium perchlorate

   D. sodium chloride

5. A neutral atom contains 12 neutrons and 11 electrons. The number of protons in this atom is

   A. 1   B. 11   C. 12   D. 23

6. What is the charge and mass of a proton?

   A. charge of +1 and mass of 1 amu

   B. charge of +1 and mass of $\frac{1}{1836}$ amu

   C. charge of −1 and mass of 1 amu

   D. charge of −1 and mass of $\frac{1}{1836}$ amu

7. Base your answer(s) to the following question(s) on the information below.

   The nucleus of one boron atom has five protons and four neutrons.

   Determine the total charge of the boron nucleus.

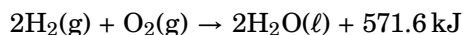8. Base your answer(s) to the following question(s) on the information below.

   A glass tube is filled with hydrogen gas at low pressure. An electric current is passed through the gas, causing it to emit light. This light is passed through a prism to separate the light into the bright, colored lines of hydrogen's visible spectrum. Each colored line corresponds to a particular wavelength of light. One of hydrogen's spectral lines is red light with a wavelength of 656 nanometers.

   Tubes filled with other gases produce different bright-line spectra that are characteristic of each kind of gas. These spectra have been observed and recorded.

   A student measured the wavelength of hydrogen's visible red spectral line to be 647 nanometers. Show a correct numerical setup for calculating the student's percent error.

9. Arsenic and silicon are similar in that they both

   A. have the same ionization energy

   B. have the same covalent radius

   C. are transition metals

   D. are metalloids

10. Base your answer(s) to the following question(s) on the reaction represented by the balanced equation below.

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell) + 571.6\,kJ$$

On the axes below, draw a potential energy diagram for the reaction represented by this equation.

Reaction Coordinate
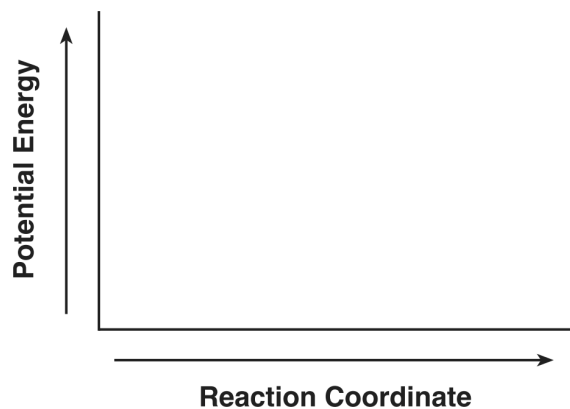
11. Base your answer(s) to the following question(s) on the diagram of a voltaic cell provided below and on your knowledge of chemistry.
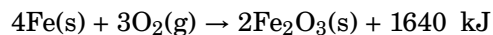
Voltaic Cell
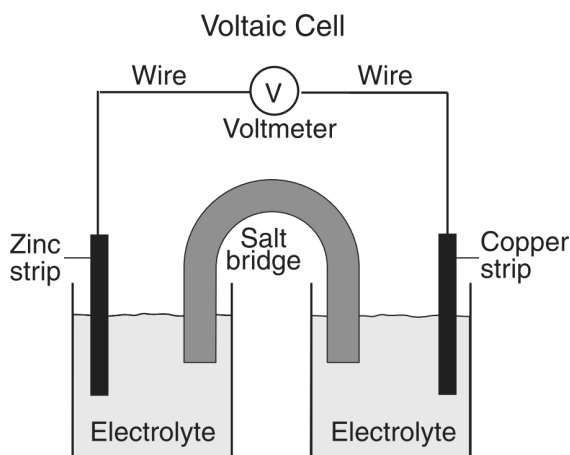
Explain the function of the salt bridge.

12. According to the Arrhenius theory, a substance that yields hydrogen ions as the only ion in an aqueous solution is

   A. a salt   B. a base

   C. an acid   D. a nonelectrolyte

13. Given the balanced equation:

$$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s) + 1640\ kJ$$

Which phrase best describes this reaction?

   A. endothermic with $\Delta H = +1640$ kJ

   B. endothermic with $\Delta H = -1640$ kJ

   C. exothermic with $\Delta H = +1640$ kJ

   D. exothermic with $\Delta H = -1640$ kJ

14. Which two fundamental tendencies favor a chemical reaction occurring spontaneously?

   A. toward higher energy and less randomness

   B. toward higher energy and greater randomness

   C. toward lower energy and less randomness

   D. toward lower energy and greater randomness

15. A sample of gas has a volume of 12 liters at $0\,^\circ$C and 380 torr. What will be its volume when the pressure is changed to 760 torr at constant temperature?

   A. 24 L   B. 18 L   C. 12 L   D. 6.0 L

16. Which radioactive isotope is often used as a tracer to study organic reaction mechanisms?

   A. carbon-12   B. carbon-14

   C. uranium-235   D. uranium-238

RELATIVE STRENGTHS OF ACIDS IN AQUEOUS SOLUTION at 1 atm AND 298 K

Conjugate Pairs		K_a
ACID	**BASE**	
$HI \longrightarrow H^+ + I^-$		very large
$HBr \longrightarrow H^+ + Br^-$		very large
$HCl \longrightarrow H^+ + Cl^-$		very large
$HNO_3 \longrightarrow H^+ + NO_3^-$		very large
$H_2SO_4 \longrightarrow H^+ + HSO_4^-$		large
$H_2O + SO_2 \longrightarrow H^+ + HSO_3^-$		1.7×10^{-2}
$HSO_4^- \longrightarrow H^+ + SO_4^{2-}$		1.3×10^{-2}
$H_3PO_4 \longrightarrow H^+ + H_2PO_4^-$		7.1×10^{-3}
$Fe(H_2O)_6^{3+} \longrightarrow H^+ + Fe(H_2O)_5(OH)^{2+}$		6.0×10^{-3}
$HF \longrightarrow H^+ + F^-$		6.7×10^{-4}
$HNO_2 \longrightarrow H^+ + NO_2^-$		5.1×10^{-4}
$Cr(H_2O)_6^{3+} \longrightarrow H^+ + Cr(H_2O)_5(OH)^{2+}$		1.0×10^{-4}
$CH_3COOH \longrightarrow H^+ + CH_3COO^-$		1.8×10^{-5}
$Al(H_2O)_6^{3+} \longrightarrow H^+ + Al(H_2O)_5(OH)^{2+}$		1.0×10^{-5}
$H_2O + CO_2 \longrightarrow H^+ + HCO_3^-$		4.4×10^{-7}
$H_2S \longrightarrow H^+ + HS^-$		1.0×10^{-7}
$H_2PO_4^- \longrightarrow H^+ + HPO_4^{2-}$		6.3×10^{-8}
$HSO_3^- \longrightarrow H^+ + SO_3^{2-}$		6.2×10^{-8}
$NH_4^+ \longrightarrow H^+ + NH_3$		5.7×10^{-10}
$HCO_3^- \longrightarrow H^+ + CO_3^{2-}$		4.7×10^{-11}
$HPO_4^{2-} \longrightarrow H^+ + PO_4^{3-}$		4.4×10^{-13}
$HS^- \longrightarrow H^+ + S^{2-}$		1.3×10^{-13}
$H_2O \longrightarrow H^+ + OH^-$		1.0×10^{-14}
$OH^- \longrightarrow H^+ + O^{2-}$		$< 10^{-36}$
$NH_3 \longrightarrow H^+ + NH_2^-$		very small

17. According to Reference Table J, which ion is amphiprotic?

A. $Br^-(aq)$

B. $HS^-(aq)$

C. $S^{2-}(aq)$

D. $CO_3^{2-}(aq)$

18. Given the reaction at STP:

$$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$$
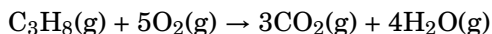
What is the total volume of $H_2O(g)$ formed when 2.5 liters of $O_2(g)$ is completely reacted?

A. 5.0 L   B. 2.0 L   C. 2.5 L   D. 4.0 L

19. Which aqueous solution has the lowest freezing point?

A. $1.0 M C_6H_{12}O_6$ B. $1.0 M C_2H_5OH$

C. $1.0 M CH_3COOH$ D. $1.0 M NaCl$

20. A mixture of sand and table salt can be separated by filtration because the substances in the mixture differ in

A. boiling point

B. density at STP

C. freezing point

D. solubility in water

21. Which statement describes the particles of an ideal gas, based on the kinetic molecular theory?

A. The motion of the gas particles is orderly and circular.

B. The gas particles have no attractive forces between them.

C. a homogeneous mixture

D. a heterogeneous mixture

22. Base your answer(s) to the following question(s) on the information below and on your knowledge of chemistry.

The diagram below represents three elements in Group 13 and three elements in Period 3 and their relative positions on the Periodic Table.

| Al	Si	P
Ga		
In		

Some elements in the solid phase exist in different forms that vary in their physical properties. For example, at room temperature, red phosphorus has a density of $2.16\,g/cm^3$ and white phosphorus has a density of $1.823\,g/cm^3$.

Identify the element from the diagram that will react with chlorine to form a compound with the general formula XCl_4.
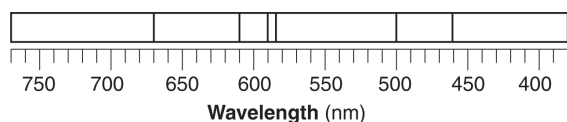
23. Element X forms the compounds XCl_3 and X_2O_3. In the Periodic Table, element X would most likely be found in Group

    A. 1 (IA)   B. 2 (IIA)

    C. 13 (IIIA)   D. 14 (IVA)

24. The bright-line spectra produced by four elements are represented in the diagram below.

Bright-Line Spectra of Four Elements
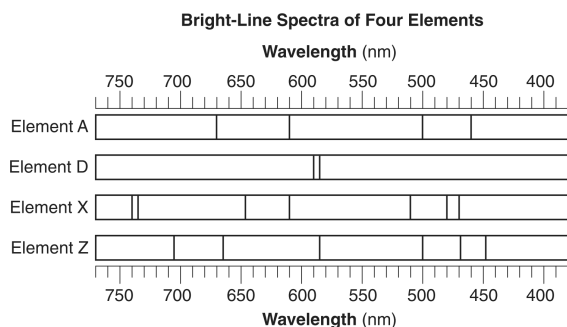
Given the bright-line spectrum of a mixture formed from two of these elements:

Which elements are present in this mixture?

    A. *A* and *D*   B. *A* and *X*

    C. *Z* and *D*   D. *Z* and *X*

25. An excited potassium atom emits a specific amount of energy when one of its electrons moves from

    A. the first shell to the fourth shell

    B. the second shell to the fourth shell

    C. the fourth shell to the fifth shell

    D. the fourth shell to the second shell

26. Which of the following ions has the *smallest* radius?

   A. Na^+ B. K^+ C. Mg^{2+} D. Ca^{2+}

27. Potassium phosphate, K_3PO_4, is a source of dietary potassium found in a popular cereal. According to the Nutrition-Facts label shown on the boxes of this brand of cereal, the accepted value for a one-cup serving of this cereal is 170. milligrams of potassium. The minimum daily requirement of potassium is 3500 milligrams for an adult human.

Compare the radius of a potassium ion to the radius of a potassium atom.

28. A molecule must be nonpolar if the molecule

    A. is linear

    B. is neutral

    C. has ionic and covalent bonding

    D. has a symmetrical charge distribution

29. Which electron-dot structure represents a nonpolar molecule?
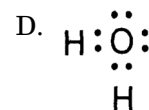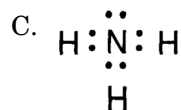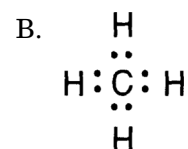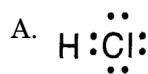
30. Which type of reaction occurs when an Arrhenius acid reacts with an Arrhenius base to form a salt and water?

    A. combustion   B. decomposition

    C. neutralization   D. saponification

31. At STP, which sample contains the same number of molecules as 3.0 liters of $H_2(g)$?

    A. 1.5 L of $NH_3(g)$ B. 2.0 L of $CO_2(g)$

    C. 3.0 L of $CH_4(g)$ D. 6.0 L of $N_2(g)$