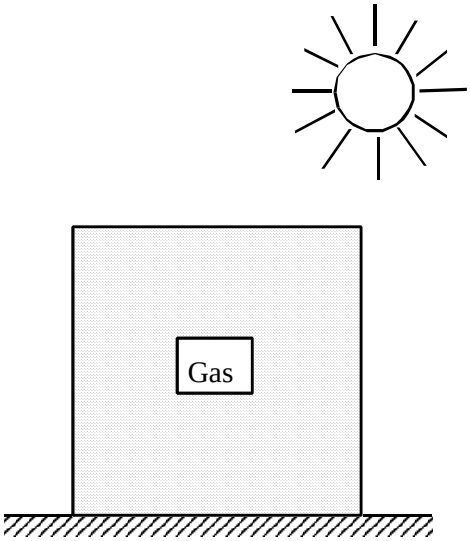
551534 - Chemistry
Pretest 4.2 Group 01

1 A gas is stored in a 1 000 litre tank under a pressure of 303 kPa and a temperature of 10.0°C.

In bright sunlight the tank heats up to 65.0°C.



What will be the pressure of the gas at this temperature?

A) 363 kPa.

B) 919 kPa.

C) 1430 kPa.

D) 1970 kPa

2 Hummingbirds have an extremely rapid metabolic rate. In order to maintain it, they must consume approximately one third their body mass in sugar every day.

Energy is produced when sugar is broken down during cellular respiration.

Cellular respiration occurs according to the following equation:

$$C_6H_{12}O_{6(aq)} + 6\ O_{2(g)} \rightarrow 6\ CO_{2(g)} + 6\ H_2O_{(l)} + \text{energy}$$

If a hummingbird burns 1.00 gram of sugar, $C_6H_{12}O_6$, during cellular respiration, what is the volume of $CO_{2(g)}$ produced at 37.0°C and 101.3 kPa?

3 An unknown acid, $HZ_{(aq)}$, has an equilibrium concentration of 1.0×10^{-2} mol/L.

The concentration of H^+ ions in the solution is 1.0×10^{-3} mol/L.

If the dissociation is as shown below, what is the $\mathbf{K_a}$ value of this acid?

$$HZ_{(aq)} \leftrightarrow H^+_{(aq)} + Z^-_{(aq)}$$

A) 1.0×10^{-7}

B) 1.0×10^{-6}

C) 1.0×10^{-5}

D) 1.0×10^{-4}

4 Two tanks filled with gas are under the same conditions of temperature and pressure. One is filled with hydrogen H_2 and the other with nitrogen N_2.

According to Avogadro's law, which of the following statements is true?

A) Nitrogen molecules are more numerous than hydrogen molecules.

B) Nitrogen molecules are as numerous as hydrogen molecules.

C) The two tanks contain equal masses of gases.

D) Nitrogen molecules are less numerous than hydrogen molecules.

5 As part of a lab exam, a student was asked to set up an electrochemical cell in order to obtain a maximum voltage.

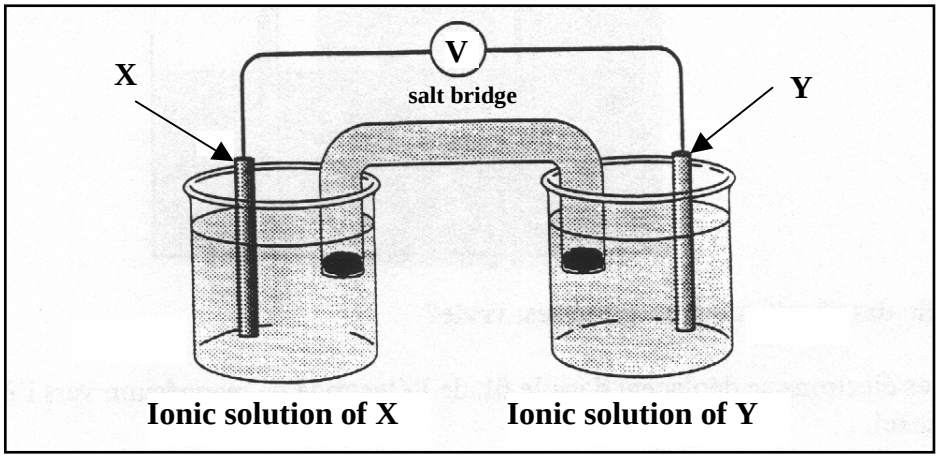
The student has a choice of the following electrodes:

Silver(Ag)
Cobalt (Co)
Lead (Pb)
Magnesium (Mg)

1. Write the balanced redox equation for the cell that will produce the maximum voltage.

2. Determine the cell potential, $E°$.

3. What would be the reducing agent?



6 A 1.00-L volumetric flask contains 600 mL of distilled water to which a student adds 0.40 g of sodium hydroxide, $NaOH_{(s)}$. Once the $NaOH_{(s)}$ has dissolved, he adds distilled water until the flask is filled, keeping the temperature at 25.0°C. He then seals the flask. The ionization constant of distilled water is 1.0×10^{-14} at 25.0°C.

What is the pH of the resulting solution?

A) 2.0
B) 7.0
C) 12.0
D) 12.2

7 Which of the following defines enthalpy?

A) The energy absorbed or released during a chemical reaction
B) The change in potential energy that results from a chemical or physical change
C) The energy required to start a chemical reaction
D) The internal energy stored in a substance during its formation

8 Which of the following is the best definition of enthalpy?

A) It is the average kinetic energy of molecules.
B) It is the amount of heat absorbed or released in reaction.
C) It is the total energy within a substance.
D) It is the heat of the products minus the heat of the reactants.

9 In the laboratory, the following material is made available to you :

- Electrodes of Pb, Al and Ni; 36 m × 12 cm
- Beakers
- 1 voltmeter
- Conducting wires

- Three solutions :
  - Lead nitrate $Pb(NO_3)_2$, with concentrations of 1 mol/L, 0.5 mol/L and 0.1 mol/L
  - Aluminum nitrate $Al(NO_3)_3$, with concentrations of 1 mol/L, 0.5 mol/L and 0.1 mol/L
  - Nickel nitrate $Ni(NO_3)_2$, with concentrations of 1 mol/L, 0.5 mol/L and 0.1 mol/L

- An electrolytic bridge

Design and sketch the cell which will give the greatest potential difference using the materials provided. Justify your choice of materials and solutions.

Show all your work.

10 A solution is made by dissolving 0.50 mol of acetic acid (CH_3COOH) in 2.00 L of water.

$$CH_3COOH_{(aq)} \leftrightarrow CH_3COO^-_{(aq)} + H^+_{(aq)}$$

The K_a of this system is 1.8×10^{-5}.

What is the pH of the acetic acid?

Show all your work.

11 Examine the following four equilibrium systems.

1. $CH_3OH_{(g)} \leftrightarrow CO_{(g)} + 2\ H_{2(g)}$
2. $4\ HCl_{(aq)} + O_{2(g)} \leftrightarrow 2\ H_2O_{(l)} + 2\ Cl_{2(g)}$
3. $N_{2(g)} + 2\ O_{2(g)} \leftrightarrow 2\ NO_{2(g)}$
4. $N_{2(g)} + 3\ H_{2(g)} \leftrightarrow 2\ NH_{3(g)}$

According to Le Chatelier's Principle, which systems will favour the products if the pressure is increased?

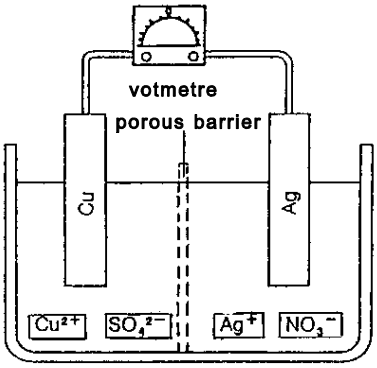
A) 1 and 2
B) 1 and 4
C) 2 and 3
D) 3 and 4

12 In which of the following equilibrium systems would an increase in pressure favour the formation of products?

1. $CH_3OH_{(g)} \leftrightarrow CO_{(g)} + 2\ H_{2(g)}$
2. $2\ H_2O_{(l)} + 2\ Cl_{2(g)} \leftrightarrow 4\ HCl_{(g)} + O_{2(g)}$
3. $N_{2(g)} + 2\ O_{2(g)} \leftrightarrow 2\ NO_{2(g)}$
4. $H_{2(g)} + ½\ O_{2(g)} \leftrightarrow H_2O_{(g)}$

A) 1 and 2
B) 1 and 4
C) 2 and 3
D) 3 and 4

13 The diagram below illustrates a standard $Cu/Cu^{2+}//Ag/Ag^{+}$ cell.



The electrolytic solutions have a concentration of 1 mol/L and are kept at 25°C.

Calculate the potential difference of this cell.

Show your work

14 The concentration of an unknown acid $HB_{(aq)}$ is 0.1 mol/L.

An analysis of the solution indicates that the concentration of $H^{+}_{(aq)}$ ions is 1×10^{-4} mol/L.

Using the data in the table below, identify the unknown acid and indicate whether its force is weak or strong.

Standard : 2/2

Equilibrium constants for acids in aqueous solutions

$HB + H_2O \leftrightarrow H_3O^{+} + B^{-}$

Acid - Base pair		Relative strength of acid	Relative strength of base	$k_A = \frac{[H_3O^{+}][B^{-}]}{[HB]}$
Acid	Base			
HCl	Cl^{-}	▼ Very strong	▲ Very Weak	Very large
HNO_3	NO_3^{-}	▼ Strong	▲	Very large
H_2SO_4	HSO_4^{-}	▼ Weak	▲	Large
HSO_4^{-}	SO_4^{2-}			1.3×10^{-2}
HF	F^{-}			6.7×10^{-4}
CH_3COOH	CH_3COO^{-}			1.8×10^{-5}
H_2CO_3	HCO_3^{-}			4.4×10^{-7}
H_2S	HS^{-}			1.0×10^{-7}
NH_4^{+}	NH_3			5.7×10^{-10}
HCO_3^{-}	CO_3^{2-}			4.7×10^{-11}
HS^{-}	S^{2-}	▼ Very Weak	▲ Weak	1.3×10^{-13}
H_2O	OH^{-}		▲ Strong	1.8×10^{-16}