EXAM 2
PRACTICE PROBLEMS

CHEMISTRY 161A // FALL 2019

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PRACTICE PROBLEM 1.1

Complete the following chart by calculating the concentration specified in square brackets [ ] in units of M.

— answer —

	Information	[Species]	Concentration (M)
A)	64.7 g LiCl in 250.0 mL water	[LiCl]	
B)	0.200 mol $CaCl_2$ in 2.00 L water	$[Cl^-]$	
C)	6.42×10^{-2} mM KNO_3	$[KNO_3]$	
D)	0.200 mol Na_2CO_3 in 200.0 g water	$[Na_2CO_3]$	
		$[Na^+]$	
		$[CO_3^{2-}]$	
		[ions]	
E)	1.25 M H_3PO_4	$[H^+]$	

PRACTICE PROBLEM 1.2

You have 2.50 mL of a 0.559 M solution of Cl^-. How much water do you need to add to make a solution that is 116 mM Cl^-?

— answer —

PRACTICE PROBLEM 1.3

Which of the following has the greatest concentration of total dissolved ions?

0.25 M NaBr

0.25 M Na_2SO_4

0.25 M Na_3PO_4

— answer —

PRACTICE PROBLEM 2.1

For each reaction, write out the balanced molecular, overall/total/complete ionic, and net ionic equations:

(a) An iron(II) sulfate solution is mixed with a potassium hydroxide solution.

(b) A lead(II) nitrate solution is mixed with a solution of potassium bromide.

(c) Aqueous nitric acid is mixed into a solution of sodium hydroxide.

— answer —

PRACTICE PROBLEM 2.2

You mix a 1.00 L of a 0.174 M solution of lead(II) nitrate with 1.00 L of a 0.130 M solution of potassium bromide. What mass (in grams) of solid precipitate will be formed?

— answer —

PRACTICE PROBLEM 2.3

What volume of a 0.500 M NaOH solution would be required to completely neutralize 40.0 mL of 0.400 M H_2SO_4?

— answer —

PRACTICE PROBLEM 3.1

Give the oxidation state/number for each element in each flask.

— answer —

A
0.010 mol SF_6
{146.1 g/mol}
300 K

B
0.5 mol CO_2
{44.0 g/mol}
600 K

C
3.0 atm F_2
{38.0 g/mol}
273 K

D
1.0 atm NO
{30.0 g/mol}
200 K

PRACTICE PROBLEM 3.2

Balance the following redox equation using the half-reactions method in aqueous acidic medium.

$$Mn^{2+}\,(aq) + BiO_3^-\,(aq) \rightarrow MnO_4^-\,(aq) + Bi^{3+}\,(aq)$$

— answer —

PRACTICE PROBLEM 4.1

In a calorimeter at constant pressure and 25.2 °C, you mix solutions of potassium carbonate and barium nitrate, which releases 196 kJ of heat. If the total volume of the solution is 1.20 L, what is the final temperature of the solution after the reaction is complete?

Molar heat capacity H_2O (*l*) = $75.3 \frac{J}{mol \cdot K}$

— answer —

PRACTICE PROBLEM 4.2

Determine the standard heat of formation (ΔH_f^o) of CO_2 (*g*) using the following thermochemical data.

$$C\ (s) + \tfrac{1}{2}\ O_2\ (g) \rightarrow CO\ (g) \qquad \Delta H_{rxn} = -111\ \text{kJ/mol}$$

$$CO\ (g) + \tfrac{1}{2}\ O_2\ (g) \rightarrow CO_2\ (g) \qquad \Delta H_{rxn} = -283\ \text{kJ/mol}$$

— answer —

PRACTICE PROBLEM 5.1

Consider the combustion of ammonia in air: $4\ NH_3\ (g) + 5\ O_2\ (g) \rightarrow 4\ NO\ (g) + 6\ H_2O\ (g)$

Calculate the heat of the reaction (ΔH^{o}_{rxn}) using the following standard heats of formations.

$$\Delta H^{o}_{f}\ [NH_3\ (g)] = -46.1\ \text{kJ/mol} \qquad \Delta H^{o}_{f}\ [H_2O\ (g)] = -241.8\ \text{kJ/mol} \qquad \Delta H^{o}_{f}\ [NO\ (g)] = 90.3\ \text{kJ/mol}$$

– answer –

PRACTICE PROBLEM 5.2

Consider the combustion of ammonia in air: $4\ NH_3\ (g) + 5\ O_2\ (g) \rightarrow 4\ NO\ (g) + 6\ H_2O\ (g)$

4.00 moles of NH_3 are combusted in a 10.0 L water bath and the temperature of the water rises by 28.0 °C. Calculate the heat of the reaction (ΔH^{o}_{rxn}) from the calorimetry data if the molar heat capacity H_2O (*l*) is 75.3 J/mol·K.

— answer —

PRACTICE PROBLEM 5.3

Consider the combustion of ammonia in air: $4\ NH_3\ (g) + 5\ O_2\ (g) \rightarrow 4\ NO\ (g) + 6\ H_2O\ (g)$

Calculate the heat of the reaction (ΔH^{o}_{rxn}) using Hess's Law and following thermochemical data for related reactions.

– answer –

$$2\ NH_3\ (g) \rightarrow N_2\ (g) + 3\ H_2\ (g) \qquad \Delta H_{rxn} = +92.2\ \text{kJ/mol}$$

$$2\ NO\ (g) \rightarrow N_2\ (g) + O_2\ (g) \qquad \Delta H_{rxn} = -180.6\ \text{kJ/mol}$$

$$2\ H_2O\ (g) \rightarrow 2\ H_2\ (g) + O_2\ (g) \qquad \Delta H_{rxn} = +571.6\ \text{kJ/mol}$$

PRACTICE PROBLEM 6.1

A bulb with a volume of 500.0 mL is filled with a gas at STP. How many moles of gas are in the bulb?

— answer —

PRACTICE PROBLEM 6.2

A 5.00 L rigid container is initially filled with 0.2044 mol of C_9H_8O gas at 1.00 atm and 25.0 °C. What is the pressure inside the container if the temperature is lowered to 5 °C?

– answer –

PRACTICE PROBLEM 7.1

Which of the following 1.00 L containers has the largest number of moles of gas?

— answer —

A
0.010 mol SF_6
{146.1 g/mol}
300 K

B
0.5 mol CO_2
{44.0 g/mol}
600 K

C
3.0 atm F_2
{38.0 g/mol}
273 K

D
1.0 atm NO
{30.0 g/mol}
200 K

PRACTICE PROBLEM 7.2

Which of the following 1.00 L containers has the greatest pressure?

— answer —

A
0.010 mol SF_6
{146.1 g/mol}
300 K

B
0.5 mol CO_2
{44.0 g/mol}
600 K

C
3.0 atm F_2
{38.0 g/mol}
273 K

D
1.0 atm NO
{30.0 g/mol}
200 K

PRACTICE PROBLEM 7.3

In which container would effusion of the gas the slowest?

— answer —

A
0.010 mol SF_6
{146.1 g/mol}
300 K

B
0.5 mol CO_2
{44.0 g/mol}
600 K

C
3.0 atm F_2
{38.0 g/mol}
273 K

D
1.0 atm NO
{30.0 g/mol}
200 K

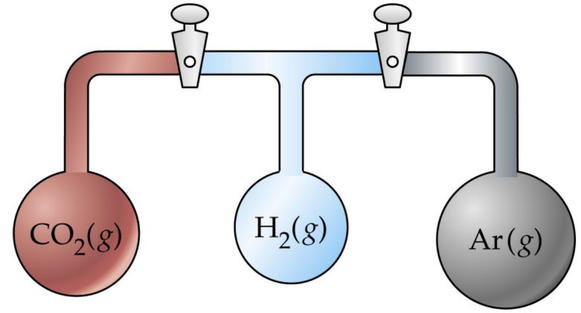
PRACTICE PROBLEM 8

Consider the diagram to the right, where three containers of gas are connected by stopcocks.

What is the partial pressure of each gas if the stopcocks are opened?

Assume no reaction between the gases.

— answer —



$P = 2.13$ atm
$V = 1.50$ L

$P = 0.861$ atm
$V = 1.00$ L

$P = 1.15$ atm
$V = 2.00$ L

PRACTICE PROBLEM 9

You react 2.00 L of F_2 gas (at 20.0 °C and 1.00 atm) with 1.50 L of H_2 gas (at −20.0 °C and 1.50 atm), which react to form gaseous HF (molar mass = 20.01 g/mol). What is the mass of HF gas that forms?

– answer –