

**1.** In a bomb calorimeter that has a heat capacity of  $1340 \text{ J/}^\circ\text{C}$  and contains  $500.0 \text{ g}$  of water,  $0.1946 \text{ g}$  of magnesium "Mg" metal is burned. The temperature rise is  $1.40^\circ\text{C}$ . Given the specific heat of water as  $4.184 \text{ J/g }^\circ\text{C}$ , the molar heat of combustion of magnesium in  $\text{kJ/mol}$  is:

A) 620

**B) 610**

C) 600

D) 580

**2.** A glass containing 500.0 g of water at 23°C was placed into a refrigerator. As the water cools to a constant temperature it loses 31.38 kJ of heat. Given the specific heat of water as 4.184 J/g °C, the new temperature of water in °C is:

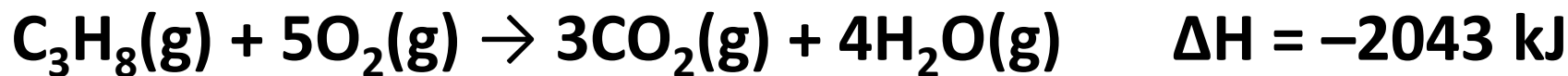
A) 10

B) 5

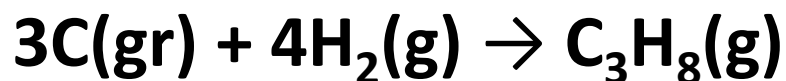
C) 6

D) 8

**3.** Given the following thermochemical equations:



Find  $\Delta\text{H}_{\text{rxn}}$  (in kJ) for:



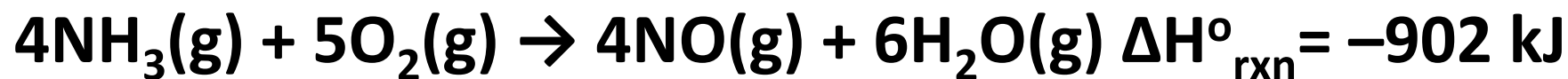
A) -132

B) -118

**C) -107**

D) -99

**4.** Given the following thermochemical reaction:



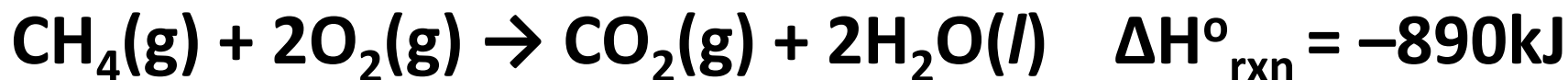
and knowing that  $\Delta H^\circ_{\text{rxn}}$  for:  $\text{NO}(\text{g}) = 91 \text{ kJ}\cdot\text{mol}^{-1}$  and

for  $\text{H}_2\text{O}(\text{g}) = -242 \text{ kJ}\cdot\text{mol}^{-1}$

Therefore,  $\Delta H^\circ_{\text{rxn}} \text{NH}_3(\text{g})$  in  $\text{kJ}\cdot\text{mol}^{-1}$  is:

- A) -120.5    B) -90.8    C) -65.4    **D) -46.5**

**5.** The combustion of natural gas (methane gas "CH<sub>4</sub>") produces heat energy according to:



the mass of methane gas (in g) needed to be burned in order to supply 62692 kJ of heat energy is:

- A) 1150      B) 1130      **C) 1120**      D) 1100

**6. 7.0 L of a gas is supplied by 476 J of heat and is allowed to expand to 15.0 L volume against an external pressure of 0.76 atm. The change in the internal energy  $\Delta E$  ( $\Delta U$ ) for this gas system (in J) is:**

**A) -180**

**B) +180**

**C) -140**

**D) -160**

**7. The mass (in g) of nitrogen gas "N<sub>2</sub>" that dissolves in 80.0 L of water at 25°C and under nitrogen gas partial pressure of 0.79 atm is: (The value of Henry's law constant for nitrogen gas in water at 25°C =  $6.8 \times 10^{-4}$  mol/L.atm)**

**A) 1.8**

**B) 1.6**

**C) 1.4**

**D) 1.2**

**8.** Three separate aqueous solutions. Each is prepared by dissolving 200.0 g of a nonvolatile and nonelectrolyte solute in 750.0 g of water. These solutes are either sucrose " $C_{12}H_{22}O_{11}$ ", glucose " $C_6H_{12}O_6$ " or urea " $H_2NCONH_2$ ". At the same temperature, which of the following statements is true:

- A) The sucrose solution will have the highest vapor pressure.**
- B) The glucose solution will have the highest vapor pressure.**
- C) The urea solution will have the highest vapor pressure.**
- D) The three solutions will have the same vapor pressure.**



**9.** The freezing point of an aqueous 0.05 m  $\text{CaCl}_2$  solution is  $-0.27^\circ\text{C}$ . The Vant's Hoff factor (i) for this  $\text{CaCl}_2$  solution is: ( $K_f$  water =  $1.86^\circ\text{C}/\text{m}$ )

A) 2.6

B) 2.7

C) 2.8

**D) 2.9**

**10.** The osmotic pressure (in atm) of a solution containing 24.5 g of glycerin " $\text{C}_3\text{H}_8\text{O}_3$ " (a nonvolatile and nonelectrolyte) in 250 mL of aqueous solution at  $25^\circ\text{C}$  is:

A) 15

B) 21

**C) 26**

D) 28

**11.** A solution containing 50.0 g of heptane " $C_7H_{16}$ " and 50.0 g of octane " $C_8H_{18}$ " at 25°C. Knowing that at 25°C the vapor pressure of pure heptane is 45.8 torr and that of pure octane is 10.9 torr, and assuming ideal behavior, the total vapor pressure (in torr) above the solution is:

A) 32.7

**B) 29.5**

C) 27.7

D) 25.3

**12.** A hypothetical reaction:  $A \rightarrow B$  follows a first order kinetics. Which of the following statements is true regarding the half life period " $t_{1/2}$ " for such reaction?

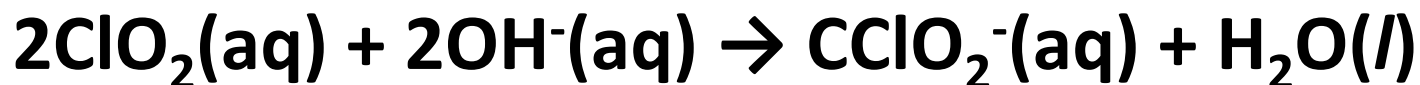
A)  $t_{1/2}$  increases as the magnitude of  $[A]_0$  increases.

B)  $t_{1/2}$  increases as the temperature increases.

**C)  $t_{1/2}$  increases as the temperature decreases.**

D)  $t_{1/2}$  is always constant for the first order reaction and never changes with either the temperature or the magnitude of  $[A]_0$ .

**13.** Given the following reaction:



and the following initial rates of the reaction have been measured for the given reagent concentrations:

Exp.	$[\text{ClO}_2]$ (M)	$[\text{OH}^-]$ (M)	Initial rate (M/s)
1	0.060	0.03	0.0243
2	0.020	0.03	0.0027
3	0.020	0.09	0.0081

The rate law for this reaction is

**A) rate =  $k [\text{ClO}_2]^2 [\text{OH}^-]$**

**B) rate =  $k [\text{ClO}_2]^2 [\text{OH}^-]^2$**

**C) rate =  $k [\text{ClO}_2]^3 [\text{OH}^-]$**

**D) rate =  $k [\text{ClO}_2]^3 [\text{OH}^-]^2$**

**14.** A first order reaction has a rate constant of  $7.5 \times 10^{-3} \text{ s}^{-1}$ . The time (in seconds) required for the reaction to be 60% complete is:

A) 116

B) 118

**C) 122**

D) 112

**15.** The isomerization of cyclopropane follows first order kinetics. The rate constant at 700 K is  $6.2 \times 10^{-4}$  and at 760 K is  $2.4 \times 10^{-2}$ . The activation energy (in kJ) for this reaction is:

A) 465.8

B) 325.6

C) 312.7

**D) 269.5**

