

1A Exam 2 VERSION 1
(Ch 4, 10, 5 thru Calorimetry)

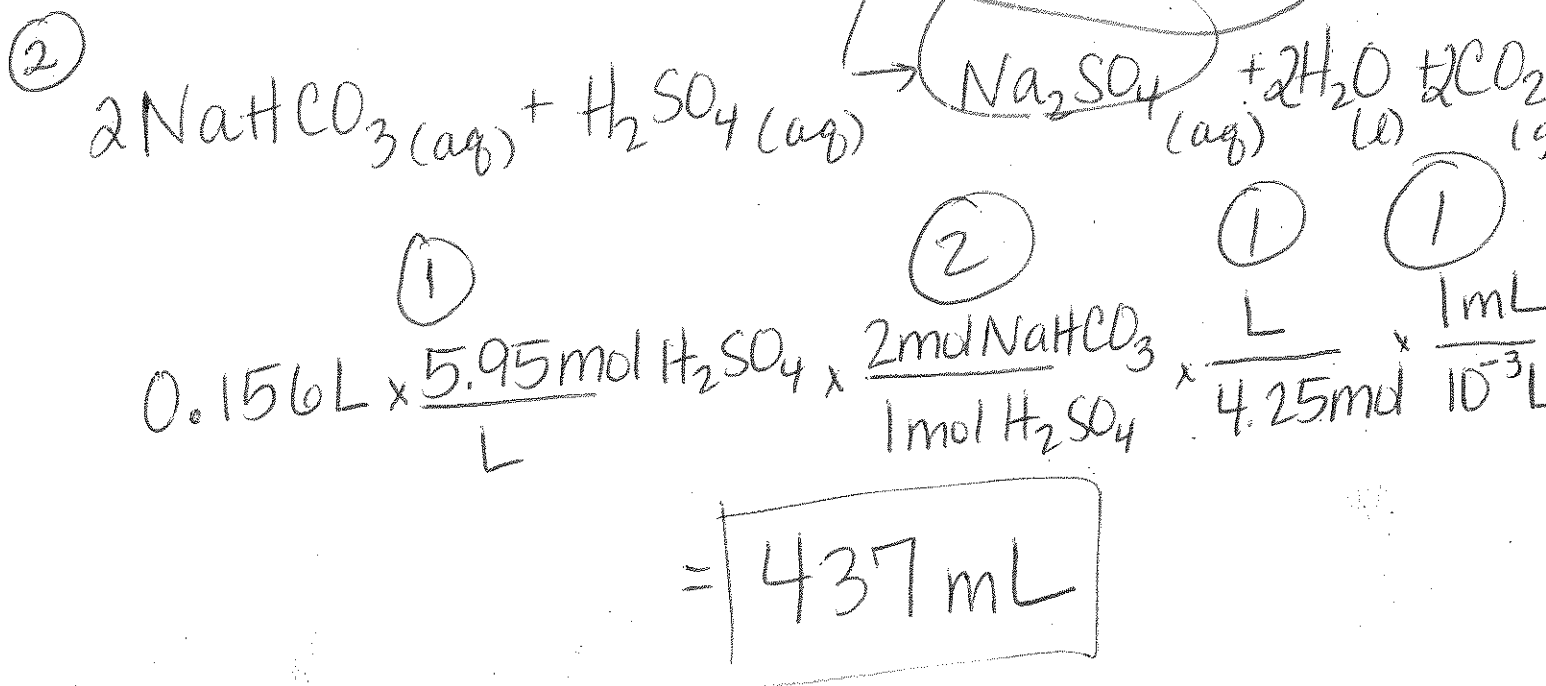
50pts

Name =

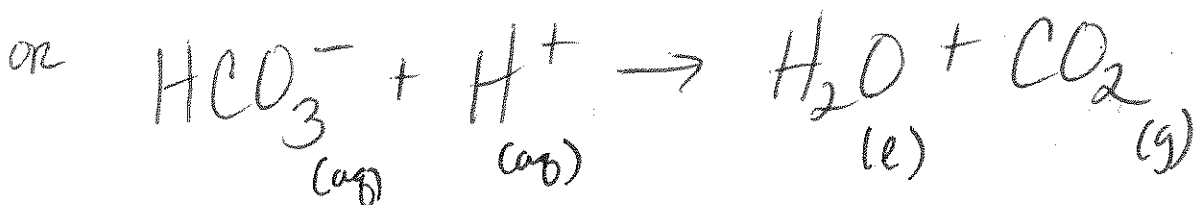
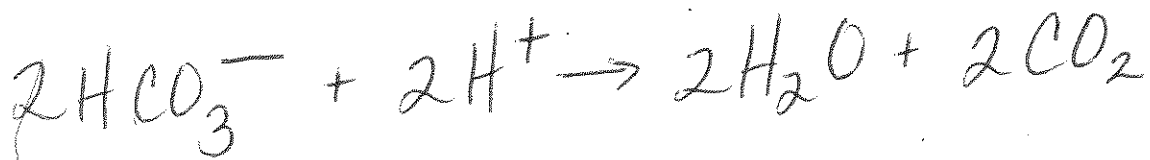
key

****Relax & Good Luck. Please read carefully! ALL CALCULATIONS MUST BE SHOWN & INCLUDE UNITS.**

- 7pts 1. Calculate the volume (in mL) of a 4.25M NaHCO₃ aqueous solution that is needed to neutralize a 156mL spill of 5.95M H₂SO₄. Be sure to write a balanced equation to start!



- 6pts 2. Write the balanced NET IONIC reaction for the reaction above assuming the sodium product to be soluble. Label phases.



6pts

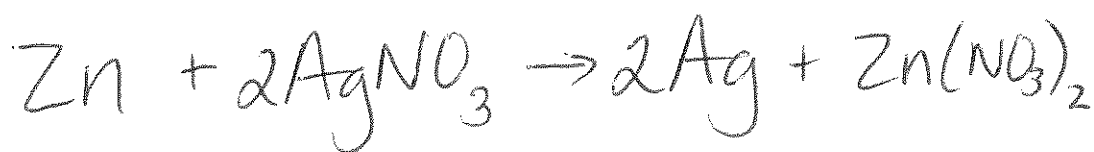
3. Complete the following single replacement reactions assuming they occur:

a. Chlorine reacts with potassium bromide

element + compound → element + compound

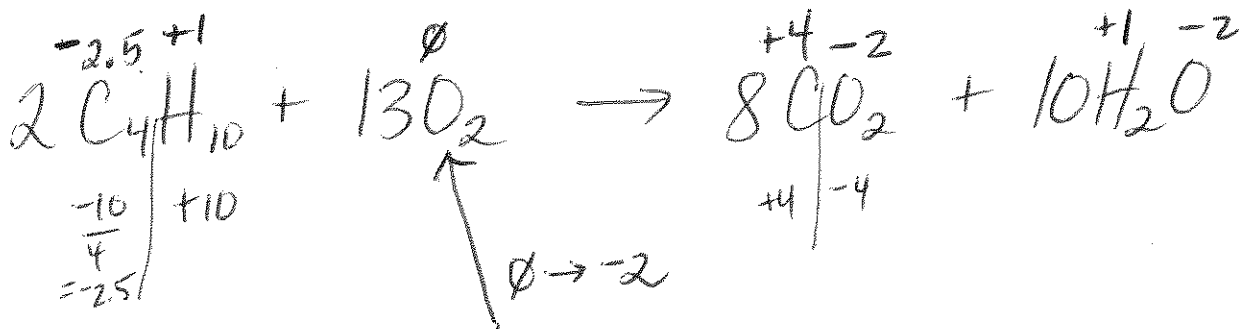
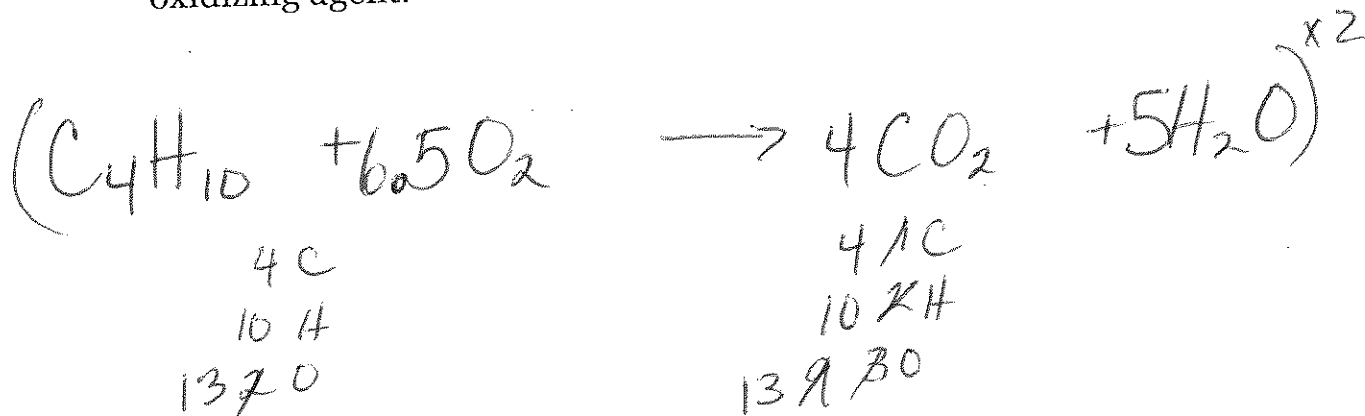


b. Zinc reacts with silver nitrate



6pts

4. Write the balanced reaction for the combustion of butane, C_4H_{10} . Then, assign oxidation states to each atom in the combustion reaction. Explain clearly which atom is the oxidizing agent.



oxid. agent = reduced = gains e^-

- 6pts 5. A fixed amount of oxygen gas is held in a 2.500 L tank at a pressure of 15.68 atm. The tank is connected to an empty 5.50 L tank by a tube with a valve. After this valve has been opened and the oxygen is allowed to flow freely between the two tanks at a constant temperature, calculate the pressure of the gas now.

$$V_1 = 2.500 \text{ L} \quad * \quad V_2 = 2.500 + 5.50 = 8.00 \text{ L} \leftarrow 2 \text{ pts!}$$

$$P_1 = 15.68 \text{ atm} \quad P_2 = ?$$

$$\frac{P_1 V_1}{V_2} = \frac{P_2 V_2}{V_2}$$

$$\frac{(15.68 \text{ atm})(2.500 \cancel{\text{L}})}{8.00 \cancel{\text{L}}} = \boxed{4.9 \text{ atm}} \quad P \downarrow \text{ as } V \uparrow$$

- 6pts 6. Calculate the density, in g/L, of xenon gas at 182°C and 605 torr.

$$\overbrace{131.29 \text{ g}}^{\text{mol}}$$

Other algebra possible!

②

$$\frac{131.29 \text{ g}}{\text{mol}} \times \frac{0.0213 \text{ mol}}{\text{L}} = \frac{2.80 \text{ g}}{\text{L}}$$

$$\frac{\text{g}}{\text{mol}} \times \frac{\text{mol}}{\text{L}} = \frac{\text{g}}{\text{L}}$$

solve for $\frac{n}{V}$

$$\frac{PV}{RT} = \frac{nRT}{RT}$$

$$T = 182 + 273.15$$

$$\text{①} = 455.15 \text{ K}$$

$$P = 605 \text{ torr} \times \frac{1 \text{ atm}}{760 \text{ torr}}$$

$$\text{①} = 0.796 \text{ atm}$$

$$\text{②} \quad \frac{0.0213 \text{ mol}}{\text{L}} = \frac{P}{RT} = \frac{n}{V} = \frac{0.796 \text{ atm}}{(0.08206 \frac{\text{atm} \cdot \text{L}}{\text{mol} \cdot \text{K}})(455.15 \text{ K})}$$

7 pts

7. When a 1.23 g sample of the rocket fuel hydrazine, N_2H_4 , is burned in a bomb calorimeter, the temperature of the calorimeter rises from $24.62^\circ C$ to $28.16^\circ C$. If the heat capacity for the bomb is $840 J/^\circ C$, calculate the enthalpy of combustion in $kJ/mole$. Label as endo- or exo-thermic.

N_2H_4 combusts
 $1.23 g \times \frac{mol}{32.05 g}$
 $\frac{kJ}{mol} ?$
 $\frac{mol}{mol} ?$

calorimeter
 $T_i = 24.62^\circ C$
 $T_f = 28.16^\circ C$
 $C = 840 J/^\circ C$

$q = C\Delta T$
 $q_{calorimeter} = \frac{840 J}{^\circ C} \times 3.54^\circ C$
 $= 2973.6 J$ 2 pts

Switch signs = 2 pts

$\ominus 2973.6 J$

$= \ominus \frac{2973.6 J}{0.0384 mol} = \ominus \frac{77.4 kJ}{mol}$

exothermic!
 (burning/combustion)

6 pts

8. Calculate the number of times a 135 lbs person must jump up 25 cm in order to burn off the 299 Calorie hamburger they just ate. ($2.21 lbs/kg$; $10^3 cal = 1 Cal$; $4/184 J = 1 cal$)

$PE = mgh = 61.1 kg \times 9.8 m/s^2 \times 0.25 m = 149.7 J$ per jump

$135 lbs \times \frac{kg}{2.21 lbs} = 61.1 kg$ ①

$25 cm \times \frac{10^{-2} m}{1 cm} = 0.25 m$ ①

$299 Cal \times \frac{1000 cal}{1 Cal} \times \frac{4.184 J}{1 cal} = \frac{1251016 J \text{ eaten}}{149.7 J/jump} = 8357 \text{ jumps}$ ②

1A Exam 2 VERSION (2) (Ch 4, 10, 5 thru Calorimetry)

Name =

key 2

**Relax & Good Luck. Please read carefully! ALL CALCULATIONS MUST BE SHOWN & INCLUDE UNITS.

6pts

1. A fixed amount of oxygen gas is held in a 1.500 L tank at a pressure of 9.68 atm. The tank is connected to an empty 2.50 L tank by a tube with a valve. After this valve has been opened and the oxygen is allowed to flow freely between the two tanks at a constant temperature, calculate the pressure of the gas now.

$V_1 = 1.500\text{L}$ $V_2 = 1.500\text{L} + 2.50\text{L} = 4.00\text{L}$ (2pts)
 $P_1 = 9.68\text{atm}$ $P_2 = ?$

$$\frac{P_1 V_1}{V_2} = \frac{P_2 V_2}{V_2} \quad \frac{(9.68\text{atm})(1.500\text{L})}{4.00\text{L}} = \boxed{3.63\text{atm}}$$

$P \downarrow$ as $V \uparrow$

6pts

2. Calculate the density, in g/L, of argon gas at 282°C and 505 torr.

(2) $\frac{39.948\text{g}}{\text{mol}} \times \frac{0.0146\text{mol}}{\text{L}} = \frac{0.583\text{g}}{\text{L}}$

$\frac{\text{g}}{\text{mol}} \times \frac{\text{mol}}{\text{L}} = \frac{\text{g}}{\text{L}}$

$\frac{39.948\text{g}}{\text{mol}}$

other algebra possible

$T = 282^\circ\text{C} + 273.15 = 555.15\text{K}$ (1)

$P = 505\text{ torr} \times \frac{1\text{atm}}{760\text{torr}}$

$= 0.664\text{atm}$ (1)

And from $PV = nRT \rightarrow \frac{n}{V} = \frac{P}{RT}$

(2)

$= \frac{0.664\text{atm}}{RT}$

$\frac{(0.664\text{atm})}{(0.08206\text{atm}\cdot\text{L}/\text{mol}\cdot\text{K})(555.15\text{K})} = \frac{0.0146\text{mol}}{\text{L}}$

- 7 pts 3. When a 2.23 g sample of the rocket fuel hydrazine, N_2H_4 , is burned in a bomb calorimeter, the temperature of the calorimeter rises from $24.62^\circ C$ to $35.16^\circ C$. If the heat capacity for the bomb is $840 J/^\circ C$, calculate the enthalpy of combustion in $kJ/mole$. Label as endo- or exo-thermic.

$2.23g \times \frac{mol}{32.05g}$ $= 0.0696 mol$	<p>Calorimeter</p> $T_i = 24.62^\circ C$ $T_f = 35.16^\circ C$ $C = \frac{840 J}{^\circ C}$	$q = C\Delta T$ $q_{calorim.} = \frac{840 J}{^\circ C} \times 10.54^\circ C$ $= 8853.6 J$
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$\frac{kJ?}{mol?}$

$\ominus 8853.6 J$

switch signs 2 pts

$2 = \frac{\ominus 8.8536 kJ}{0.0696 mol} = \ominus 127 \frac{kJ}{mol}$ exothermic

- 6 pts 4. Calculate the number of times a 255 lbs person must jump up 45 cm in order to burn off the 299 Calorie hamburger they just ate. ($2.21 lbs/kg$; $10^3 cal = 1 Cal$; $4/184 J = 1 cal$)

$PE = mgh$

$255 lbs \times \frac{1 kg}{2.21 lbs} = 115.4 kg$ (1)

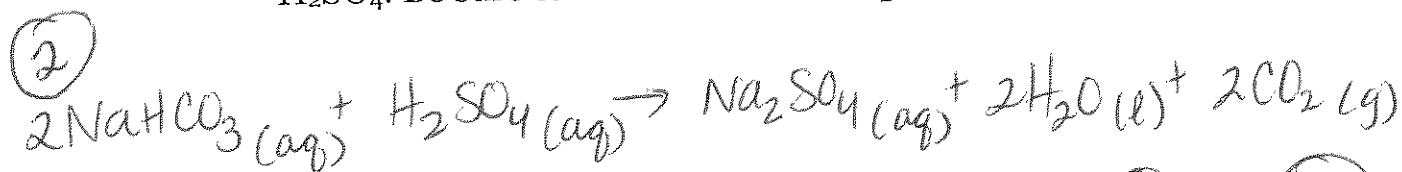
$45 cm \times \frac{10^{-2} m}{1 cm} = 0.45 m$ (1)

$PE = 115.4 kg \times \frac{9.8 m}{s^2} \times 0.45 m$
 $= 508.9 J$ per jump

$299 Cal \times \frac{1000 cal}{1 Cal} \times \frac{4.184 J}{1 cal} = 1251016 J$ eaten (2)

$\frac{1251016 J}{508.9 J \text{ per jump}} = 2458 \text{ jumps}$ (2)

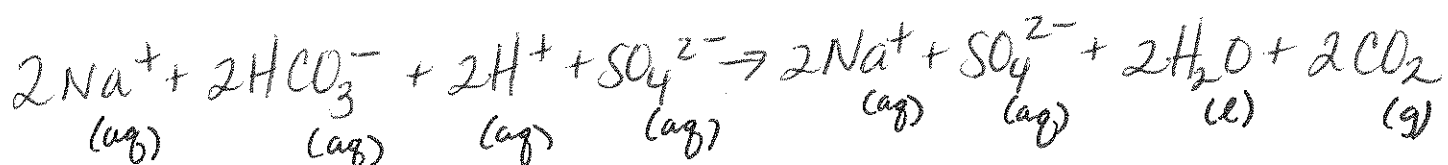
- 7 pts 5. Calculate the volume (in mL) of a 7.35M NaHCO₃ aqueous solution that is needed to neutralize a 356mL spill of 4.95M H₂SO₄. Be sure to write a balanced equation to start!



$$0.356 \text{ L} \times \frac{\textcircled{1} 4.95 \text{ mol H}_2\text{SO}_4}{\text{L}} \times \frac{\textcircled{2} 2 \text{ mol NaHCO}_3}{1 \text{ mol H}_2\text{SO}_4} \times \frac{\textcircled{1} \text{ L}}{7.35 \text{ mol}} \times \frac{\textcircled{1} 1 \text{ mL}}{10^{-3} \text{ L}}$$

$$= \boxed{480. \text{ mL}}$$

- 6 pts 6. Write the balanced TOTAL IONIC reaction for the reaction above assuming the sodium product to be soluble. Label phases.



6pts

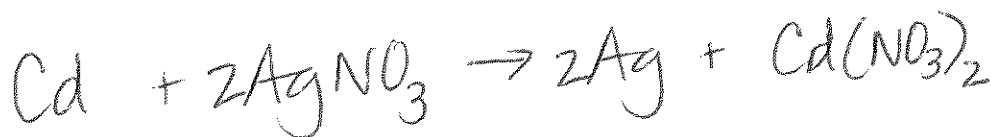
7. Complete the following single replacement reactions assuming they occur:

element + compound \rightarrow element + compound

a. Fluorine reacts with potassium bromide

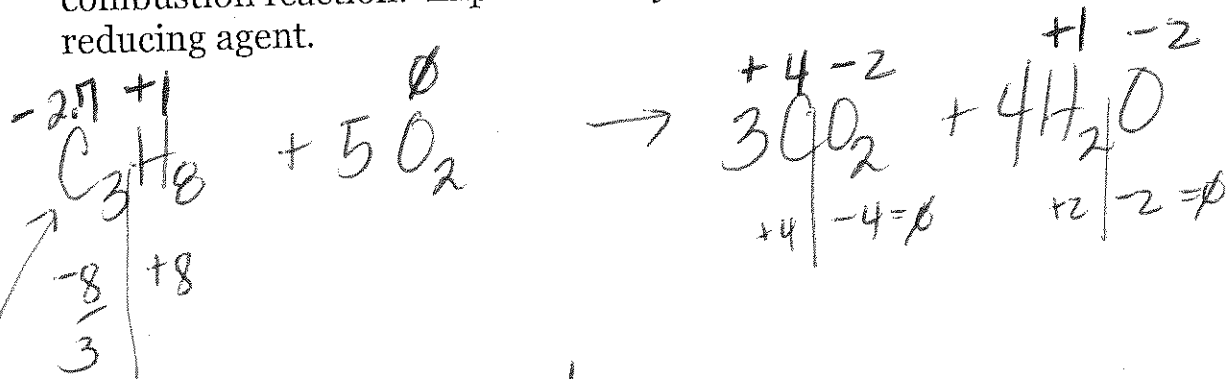


b. Cadmium reacts with silver nitrate



6pts

8. Write the balanced reaction for the combustion of propane, C_3H_8 . Then, assign oxidation states to each atom in the combustion reaction. Explain clearly which atom is the reducing agent.



$-2.7 \rightarrow +4$

reducing agent = oxidized = lose e^-