ADV Chemistry **Name:** Key

U9M2 Practice WS

*Watch your sigfigs!

1.) **Given that 1 calorie (cal) = 4.184 Joules (J), Convert the following:**

a. 1.69 Joules to calories 0.404 cal

$\frac{1.69\text{ J} \mid 1\text{ cal}}{\mid 4.184\text{ J}} = 0.403919\ldots\text{ cal}$

b. 20.0 cal to J 83.7 J

$\frac{20.0\text{ cal} \mid 4.184\text{ J}}{\mid 1\text{ cal}} = 83.68\text{ J}$

For each of the following problems, first determine whether the problem uses:

A) specific heat equation [q = C x m x ΔT] or

B) phase change equation [energy, Q = ΔH x n (in mols) or Q = ΔH x m (in grams)

C) Both (as in the case of multiple points on the heating curve of a substance)

Then, record your answer in the blank.

1990 J 2.) How much heat energy (in J) is required to raise the temperature of 21.2 g of liquid water from 16.8 °C to 39.2 °C? (C_{H2O} = 4.184 J/g•°C)

$q = ?$

$m = 21.2\text{g}$

$C = 4.184\text{ J/g°C}$

$\Delta T = (39.2°C - 16.8°C) = 22.4°C$

$q = mC\Delta T$

$q = (21.2\cancel{g})\left(\frac{4.184\text{ J}}{\cancel{g}\cancel{°C}}\right)(22.4\cancel{°C})$

$q = 1986.897\ldots\text{ J}$ (3sf)

159 °C 3.) What is the final temperature when 85.0 g of lead (Pb) originally at 200°C loses 450. J of energy? (C_{Pb} = 0.129 J/ g•°C)

$q = 450.\text{ J}$

$m = 85°C$

$C = 0.129\text{ J/g°C}$

$\Delta T = ?$

$q = mC\Delta T$

$\Delta T = \frac{q}{mC}$

$\Delta T = \frac{(450.\cancel{J})}{(85.0\cancel{g})} \cdot \frac{\cancel{g}°C}{0.129\cancel{J}} = 41.0°C$

$T_{initial} = 200°C$

$T_{Final} = ?$ ← must be less than T_I

$\Delta T = 41.0°C$

$T_F = T_I - \Delta T = 200°C - 41.0°C = 159°C$

0.131 J/g°C 4.) If it takes 41.72 J to heat a piece of gold (Au) that masses 18.69 g from 10.0°C to 27.0°C, what is the specific heat of gold?

$q = 41.72\text{ J}$

$m = 18.69\text{g}$

$\Delta T = (27.0°C - 10.0°C) = 17.0°C$

$C = ?$

$q = mC\Delta T$

$C = \frac{q}{m\Delta T}$

$C = \frac{41.72\text{ J}}{(18.69\text{g})(17.0°C)} = 0.131306\ldots\text{ J/g°C}$

↑ 3sf

1.5×10^4g OR 15kg 5.) A sample of water is heated with 1.0×10^5 calories, raising its temperature from 22.0°C to 28.5°C. Find the mass of the water. (C= 1.00 cal/g•°C)

$q = 1.0\times10^5\text{ cal}$

$m = ?$

$C = 1.00\text{ cal/g°C}$

$\Delta T = (28.5°C - 22.0°C) = 6.5°C$

$q = mC\Delta T$

$m = \frac{q}{C\Delta T}$

$M = \frac{1.0\times10^5\text{ cal}}{6.5°C} \cdot \frac{g°C}{1.00\text{ cal}} = 15384.615\text{ g}$ or $15.384615\ldots\text{ kg}$

↑ 2sf

514 g ____ 6.) Find the mass (in g) of CCl_4 (carbon tetrachloride) that gains 8.92×10^3 J of energy when it melts at –23.0°C. The molar heat of fusion (ΔH_{fus}) for CCl_4 is 2.67 kJ/mol.

no ΔT in a phase change

$m = ?$
$q = 8.92 \times 10^3$ J
$\Delta H = 2.67$ kJ/mol

$q = \Delta H \cdot n$ n b/c mol in ΔH

$n = \frac{q}{\Delta H}$

$n = \left(\frac{8.92 \times 10^3 \text{ J}}{} \Big| \frac{1 \text{kJ}}{1000 \text{ J}}\right) \cdot \frac{\text{mol}}{2.67 \text{kJ}} = 3.34$ mol

units need to be able to cancel!

mass = n · MM

Molar Mass CCl_4 = 12.01 g/mol + 4(35.45 g/mol) = 153.81 g/mol

$\text{Mass} = \frac{3.34 \text{mol}}{} \Big| \frac{153.81 \text{ g}}{\text{mol}} = 513.852\ldots$ g

3sf

16200 J ____ 7.) Find the energy given off (in J) when 9.00 moles of neon gas (Ne) condenses at –246°C. The molar heat of vaporization (ΔH_{vap}) is 1.80 kJ/mol.

$q = ?$
$n = 9.00$ mol
$\Delta H = 1.80$ kJ/mol

$q = \Delta H \cdot n$

$q = \frac{1.80 \text{kJ}}{\text{mol}} \cdot 9.00 \text{ mol} \cdot \frac{1000 \text{ J}}{1 \text{kJ}} = 16200$ J

Question asked for J!

3sf

20.4 kJ/mol ____ 8.) Find the molar heat of vaporization (ΔH_{vap}) for chlorine gas (Cl_2) if 1235 g of gas absorbs 355 kJ of energy when chlorine vaporizes at –34°C.

kJ/mol

$q = 355$ kJ
$m = 1235$ g
$\Delta H = ?$

$q = \Delta H \cdot m$
$\Delta H = \frac{q}{m}$

$\Delta H = \frac{355 \text{kJ}}{1235 \text{g}} \cdot \frac{70.90 \text{g}}{1 \text{mol}} = 20.380\ldots$ kJ/mol

3sf

$MM_{Cl_2} = 35.45$ g/mol · 2
$= 70.90$ g/mol

248 J ____ 9.) How many joules of energy would be required to heat 15.9 g of diamond from 23.6°C to 54.2°C? (Specific heat capacity of diamond = 0.5091 J/g °C.)

$q = ?$
$m = 15.9$ g
$c = 0.5091$ J/g°C
$\Delta T = (54.2°C - 23.6°C)$
$= 30.6$ °C

$q = mc\Delta T$
$q = (15.9 \text{g})\left(\frac{0.5091 \text{ J}}{\text{g°C}}\right)(30.6 \text{°C})$

$q = 247.6975\ldots$ J

3sf

13300 J ____ 10.) A layer of copper welded to the bottom of a skillet weighs 125 g. How much heat is needed to raise the temperature from 25°C to 300°C? The specific heat capacity of copper is 0.387 J/g °C.

$q = ?$
$m = 125$ g
$c = 0.387$ J/g°C
$\Delta T = (300°C - 25°C)$
$= 275°C$

$q = mc\Delta T$
$q = (125 \text{g})\left(\frac{0.387 \text{ J}}{\text{g°C}}\right)(275 \text{°C})$

$q = 13303.125$ J

3sf