

Show all work to receive full credit

Name KEY

- 1) (4 pts) Calculate an answer to the following set of operations. Express your answer in scientific notation and with the proper number of significant figures. Show work that demonstrates the significant figure count. Start by getting the correct answer using your calculator.

$$\frac{[(10.654 \times 10^0) + (23.2 \times 10^{-2})] \cdot 1.32 \times 10^5}{(2.00 \times 10^2 - 1.10 \times 10^2) \cdot 1999} = \frac{[(10.654 \times 10^0) + (0.232 \times 10^0)] \cdot 1.32 \times 10^5}{0.90 \times 10^2 \cdot 1999} =$$

$$\frac{10.886 \times 10^0 \cdot 1.32 \times 10^5}{0.90 \times 10^2 \cdot 1.999 \times 10^3} = \frac{10.886 \cdot 1.32}{0.90 \cdot 1.999} \times \frac{10^0 \cdot 10^5}{10^2 \cdot 10^3} = 7.9_{87} \times 10^0 = \boxed{8.0 \times 10^0}$$

With 999 in the denominator instead of 1999 the answer is $\boxed{1.6 \times 10^1}$

- 2) (8 pts) Mercury (Hg) poisoning is a debilitating disease that is often fatal due to inactivation of vital enzymes. A polluted lake contains 0.4 micrograms of Hg per 1 mL of lake water. Calculate the total mass of Hg in kilograms. Express your answer in scientific notation and with the proper number of significant figures. The volume of the lake is 3.78×10^{-1} cubic miles (mi^3).

- 2.54 cm = 1 inch
- 1 cup = 8 fl. oz (exact)
- 128 fl. oz = 1 gallon (exact)
- 3.785 Liters = 1 gallon
- 2.205 kg = 1 lbs
- 1 cal = 4.184 J (exact)
- 1 mile = 5280 ft (exact)

concentration \times volume = mass

$$\frac{\mu\text{g}}{\text{mL}} \times \text{mi}^3 = \text{kg}$$

$\frac{\mu\text{g}}{\text{mL}}$	$\frac{\cancel{\mu\text{g}}}{\cancel{\text{mL}}}$	$\frac{\text{kg}}{\text{g}}$	$\frac{\text{mL}}{\text{cm}^3}$	$\frac{\text{cm}^3}{\text{in}^3}$	$\frac{\text{in}^3}{\text{ft}^3}$	$\frac{\text{ft}^3}{\text{mi}^3}$	$\frac{\text{mi}^3}{\text{mi}^3} = \text{kg}$
$\frac{\cancel{\mu\text{g}}}{\cancel{\text{mL}}}$	$\frac{\mu\text{g}}{\text{g}}$	$\frac{\text{kg}}{\cancel{\text{g}}}$	$\frac{\cancel{\text{mL}}}{\cancel{\text{cm}^3}}$	$\frac{\text{cm}^3}{\text{in}^3}$	$\frac{\text{in}^3}{\text{ft}^3}$	$\frac{\text{ft}^3}{\text{mi}^3}$	

$0.4 \mu\text{g}$	$1000 \cancel{\text{g}}$	1 kg	$1 \cancel{\text{mL}}$	$(2.54)^3 \cancel{\text{cm}^3}$	$(12)^3 \cancel{\text{in}^3}$	$(5280)^3 \cancel{\text{ft}^3}$	$3.78 \times 10^{-1} \text{ mi}^3$
mL	$10^6 \mu\text{g}$	$10^3 \cancel{\text{g}}$	$1 \cancel{\text{cm}^3}$	$1^3 \cancel{\text{in}^3}$	$1^3 \cancel{\text{ft}^3}$	$1^3 \cancel{\text{mi}^3}$	1
1sf	ex	ex	ex	ex	ex	ex	3sf

$$= 6.3 \times 10^5 \text{ kg} = \boxed{6 \times 10^5 \text{ kg}}$$

2-attempt
 1 - conc x v = mass
 1 - sf, SN
 1 - mass to kg
 3 - 1 for each cubic, .5 for relationship, .5 for cubic

3) (4 pts) A pure aluminum bar with a mass of 5.85 kg has a specific heat capacity of 0.903 J/g • °C.

a) Calculate the quantity of heat, in kilojoules, that could be transferred to water if the bar drops in temperature from 75.0 °C to 41.5 °C when added to water. Be sure to put your answer in scientific notation with the correct number of significant figures.

$$\text{energy}_{\text{lost}} = (\text{mass} \times C_p \times \Delta T)$$

$$\text{energy} = \left[5.85 \text{ kg} \times \frac{0.903 \text{ J}}{\text{g} \cdot ^\circ\text{C}} \times (41.5^\circ\text{C} - 75.0^\circ\text{C}) \right]$$

$$= \frac{5.85 \text{ kg}}{1} \times \frac{0.903 \text{ J}}{\text{g} \cdot ^\circ\text{C}} \times \frac{33.5^\circ\text{C}}{1} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ kJ}}{1000 \text{ J}} = 1.76 \times 10^2 \text{ kJ}$$

$$= \boxed{1.77 \times 10^2 \text{ kJ}}$$

b) Without calculating the answer, is the temperature change (ΔT) for the water larger or smaller than that for the Al bar? Explain.

Since water has a larger specific heat capacity compared to that of Al its ΔT will be smaller. Water can hold its "heat" longer or "better" than a metal.

4) (10 points) Complete the isotope table using numbers (not masses). The isotope symbols must contain the element symbol, the mass number, the atomic number, and the charge. If the atom is neutral there is no need to write a charge = 0.



Symbol	$^{75}_{33}\text{As}^{3-}$	$^{68}_{30}\text{Zn}$	$^{54}_{24}\text{Cr}^{6+}$	$^{15}_7\text{N}$
Protons (p^+)	33	30	24	7
Electrons (e^-)	36	30	18	7
Neutrons (n)	42	38	30	8
Atomic Number	33	30	24	7
Mass Number	75	68	54	15

5) (1.5 points) What would occur if:

a) two neutrons were pushed toward each other. No attraction and no repulsion

b) a sodium cation was pushed toward a chloride ion (an anion). Attraction

c) two electrons were pushed toward each other. Repulsion

6) (1 point) You here someone say, "The carbon atom weighs 12.011 u." Do you agree with this statement? Explain.

No, the weighted average mass of all the carbon isotopes ($^{12}_6\text{C}$, $^{13}_6\text{C}$) is 12.011 u.

7) (1.5 points) Circle the correct description

boron is a metal metal non-metal metalloid
 titanium is a metal non-metal metalloid
 fluorine is a metal non-metal metalloid

Sc metal
 Ge metalloid Xe non-metal

Extra Credit:

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1) A white solid with a melting point of $730\text{ }^{\circ}\text{C}$ is melted. When electricity is passed through the resultant liquid, a brown gas and a liquid metal are produced. Neither the metal or gas can be broken down into anything simpler by chemical means. Classify each the white solid, the brown gas, the liquid metal - as a mixture, a compound, or an element.

2) If the mass of water in question 3 is ~~50.0~~ ^{800.0g} g and it's initial temperature was $25\text{ }^{\circ}\text{C}$, calculate the final temperature of the water.

- 1) white solid - compound
 brown gas - element
 liquid metal - element

2) $1.76_{96} \times 10^2 \text{ kJ} = \text{mass of water} \times C_{p \text{ H}_2\text{O}} \times \Delta T_{\text{H}_2\text{O}}$

$1.76_{96} \times 10^2 \text{ kJ} = 50.0 \text{ g} \times \frac{1.00 \text{ cal}}{\text{g} \cdot ^{\circ}\text{C}} \times (T_f - 25.0^{\circ}\text{C})$

↓ convert to calories

$1.76_{96} \times 10^2 \text{ kJ}$	1000 J	1 cal
1	1 kJ	4.184 J
3sf	ex	ex

↓

$4.22_{96} \times 10^4 \text{ cal} = 50.0 \text{ g} \times \frac{1.00 \text{ cal}}{\text{g} \cdot ^{\circ}\text{C}} \times (T_f - 25.0^{\circ}\text{C})$

$(T_f - 25.0^{\circ}\text{C}) = \frac{4.22_{96} \times 10^4 \text{ cal}}{\cancel{50.0 \text{ g}} \cdot 800.0 \text{ g} \cdot 1.00 \text{ cal}} = 5.287 \times 10^1 \text{ }^{\circ}\text{C}$

$T_f - 25.0^{\circ}\text{C} = \frac{5.287 \times 10^1 \text{ }^{\circ}\text{C}}{8.45_{92} \times 10^0 \text{ }^{\circ}\text{C}}$

$T_f = \frac{5.287 \times 10^1 \text{ }^{\circ}\text{C}}{8.45_{92} \times 10^0 \text{ }^{\circ}\text{C}} + \frac{2.50 \times 10^1 \text{ }^{\circ}\text{C}}{1.00 \times 10^0 \text{ }^{\circ}\text{C}}$

$T_f = \frac{7.787 \times 10^1 \text{ }^{\circ}\text{C}}{8.70_{92} \times 10^0 \text{ }^{\circ}\text{C}} = \boxed{87.87 \text{ }^{\circ}\text{C}}$

Clearly this can't happen with H₂O. I should have put 800. g of H₂O instead of 50.0 g.