

1. Match the following words with the correct definition. (8 pts)

Unit C Potential Energy A Thermodynamics D Kinetic Energy B

- Energy due to position or composition.
- Energy due to motion.
- Defines a basic quantity of mass, volume, time, temperature, distance.
- The study of energy and its interconversions.

2. Conversion Factors (20 pts)

Length	Volume	Energy
100 cm = 1 m	1 gal = 4 qt	1000 cal = 1 kcal = 1 Cal
1000 mm = 1 m	1 qt = 2 pints	1 cal = 4.18 J
1 km = 1000 m	1 qt = 32 ounces	1000 J = 1 kJ
1 ft = 12 in	1 gal = 3.78 L	
1 mi = 5280 ft	1000 mL = 1 L	
2.54 cm = 1 in	1 mL = 1 cm ³ = 1 cc	

a. How many mm are in 3 cm?

$$3 \text{ cm} \times \frac{10 \text{ mm}}{1 \text{ cm}} = 30 \text{ mm}$$

b. How many mL are in a gallon of milk?

$$1 \text{ gal} \times \frac{3.78 \text{ L}}{1 \text{ gal}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 3780 \text{ mL}$$

c. An adult male burns 310 nutritional calories per hour on a stationary bike. How many watts (joules per second) are burned during the workout?

$$310 \frac{\text{kcal}}{1 \text{ hr}} \times \frac{1000 \text{ cal}}{1 \text{ kcal}} \times \frac{4.18 \text{ J}}{1 \text{ cal}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times \frac{1 \text{ min}}{60 \text{ s}} = 360 \text{ Watts}$$

d. A car averages 26.7 miles per gallon of gasoline. How many miles can the car drive with a full 10 gallon tank of gasoline before it runs out of gas?

$$10 \text{ gal} \times \frac{26.7 \text{ mi}}{\text{gal}} = 267 \text{ miles}$$

3. Convert the following to 3 significant figures in scientific notation: (12 pts)

a. -0.32286

b. 32476

-3.23×10^{-1}

3.25×10^4

c. -10000

d. 0.000482

-1.00×10^4

4.82×10^{-4}

4. A liquid has a mass of 32.13 g and a volume of 37.26 cm³. What is the density of this liquid in grams per milliliter? *Assuming the measurements are accurate to the 100th place, report the final answer in correct significant figures to receive full credit.* (10 pts)

$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{32.13 \text{ g}}{37.26 \text{ cm}^3} = \frac{32.13 \text{ g}}{37.26 \text{ mL}} = \mathbf{0.86 \text{ g/mL}}$$

5. Assuming the density of water is 0.9887 g/mL, what is the specific gravity of the liquid in problem 4? (5 pts)

$$\text{Specific Gravity} = \frac{d_{\text{solution}}}{d_{\text{water}}} = \frac{0.86}{0.9887} = \mathbf{0.87}$$

6. How many kilocalories are in a serving of Quaker Oats oatmeal if each serving contains the following: (12 pts)

Fat	3 g	$\times 9 \text{ kcal/g} = 27 \text{ kcal}$
Carbohydrate	27 g	$\times 4 \text{ kcal/g} = 108 \text{ kcal}$
Protein	5 g	$\times 4 \text{ kcal/g} = 20 \text{ kcal}$

155 kcal

7. Fill in the following Table. (20 pts)

Element	Protons	Neutrons	Electrons	Charge
${}^7\text{Li}^+$	3	4	2	+1
${}^{31}\text{P}$	15	16	15	0
${}^{19}\text{F}^-$	9	10	10	-1
${}^{40}\text{Ar}$	18	22	18	0
${}^{108}\text{Ag}^+$	47	61	46	+1

8. How many nutritional calories (Cal) are in a serving of Skippy peanut butter if the combustion of 1 serving of peanut butter in 2000 g of water gave a temperature change of 95°C. (Specific Heat of water = 1.00 cal/g °C) Report the answer in Cal per serving. (10 pts)

$$Q = m \times S \times \Delta T$$

$$Q = 2000 \text{ g} \times 1.00 \frac{\text{cal}}{\text{g}^\circ\text{C}} \times 95^\circ\text{C} = 190000 \text{ cal}$$

$$190000 \text{ cal} \times \frac{1 \text{ Cal}}{1000 \text{ cal}} = 190 \text{ Cal}$$

9. Convert the following temperatures: (3 pts) °F = 1.8 (°C) + 32

a. 12 °F to °C

$$^\circ\text{C} = \frac{^\circ\text{F} - 32}{1.8} = \frac{12 - 32}{1.8} = -11^\circ\text{C}$$

b. 211 K to °C

$$^\circ\text{C} = \text{K} - 273 = 211 - 273 = -62^\circ\text{C}$$

10. (Extra Credit) Is the freezing of water an exothermic or endothermic process? (5 pts)

Exothermic