AW Math 10 – UNIT 4 – MEASUREMENT – PART 2

MASS/WEIGHT IN THE IMPERIAL SYSTEM

The words mass and weight are often used interchangeably, but they are technically not the same thing. **Mass** is the amount of matter in an object. Mass never changes, no matter where you go on the Earth. **Weight** is the measure of the force of gravity on the object and it can change depending where you are on the Earth. If you are at sea level, your weight will be more than if you are at the top of Mount Everest. However, for our purposes in this course, we will consider the use of the term weight to be a stable measure.

In the imperial system, the base units for weight are the ton (tn), pound (lb) and ounce (oz). They are related in the following way:

1 ton (tn) = 2000 pounds

1 pound (lb) = 16 ounces (oz)

Example 1: Jennifer needs 1 pound 2 ounces of cheddar cheese, 12 ounces of Gouda cheese, and 11 ounces of Swiss cheese. How many pounds of cheese does she need all together?

Solution: Add the pounds to the pounds and the ounces to the ounces. Regroup the ounces as necessary.

1 pound + 2 ounces
+ 12 ounces
+ 11 ounces
1 pound 25 ounces

Now you must regroup the ounces as 1 pound = 16 ounces.

1 pound 25 ounces
- 16 ounces
2 pounds 9 ounces Jennifer needs 2 pounds 9 ounces of cheese.

You could also change the amount of cheddar cheese all to ounces, add the total ounces from the three cheeses together, and then regroup the weight into pounds and ounces. The answer would be the same.

Example 2: Change 67 oz. into pounds and ounces.

Solution: First, divide the ounces by 16 because there are 16 ounces in a pound.
67 ÷ 16 = 4.1875 lbs. This means there are 4 whole pounds.
Next, multiply 4 lbs. times 16 oz. to see how many ounces are used up.

$4 \times 16 = 64$ oz.

Now subtract that from the original number of ounces

$67 - 64 = 3$ ounces

So, 67 oz. = 4 lbs. 3 oz.

ASSIGNMENT 1 – MASS/WEIGHT IN THE IMPERIAL SYSTEM

1) Calculate the following conversions. Show your work below each question.

a) 54 oz = _____ lb _____ oz

b) 15 lb = _____ oz

c) 648 oz = _____ lb _____ oz

2) Lucy gave birth to twins weighing 6 lb 5 oz and 5 lb 14 oz. What was their total weight?

3) The weight of water is approximately 2 pounds 3 ounces per litre. How much would 8 L of water weigh? Give your answer in pounds and ounces.

4) A basket of raspberries weighs 12 ounces. You need 4 lb to make jam. How many baskets do you need to pick?

MORE MASS/WEIGHT IN THE IMPERIAL SYSTEM

We have looked at the smaller units of weight, ounces and pounds. Now we will look at conversions with the larger base unit, the ton. Remember, the conversion

1 ton (tn) = 2000 pounds

Example: Alex drives a semi truck. The cab weighs 8.7 tons, and the trailer weighs 6.4 tons. When loaded, the gross weight of the whole truck and its cargo is 21.3 tons. What is the weight of the load in tons, and in pounds?

Solution: First find the weight of the load in tons by adding the weight of the cab and the trailer and subtracting from the total. Then convert this weight into pounds.

weight of truck = cab + trailer = 8.7 tn + 6.4 tn = 15.2 tn

weight of load = total weight – weight of truck = 21.3 tn – 15.2 tn = 6.2 tn

Now convert this weight into pounds using a proportion.

$$\frac{\text{lb}}{\text{tn}} \quad \frac{2000}{1} = \frac{x}{6.2} \qquad x = 2000 \times 6.2 \div 1 = 12\,400 \text{ lb}$$

The weight of the load is 6.2 tons or 12 400 pounds.

ASSIGNMENT 2 – MORE MASS/WEIGHT IN THE IMPERIAL SYSTEM

1) Calculate the following conversions. SHOW YOUR WORK!

a) 6790 lb = _____ tn

b) 5.45 tn = _____ lb

The next 2 questions are 2 step conversions. Show both steps below the question.

c) 6 tn = _____ oz

d) 67 200 oz = _____ tn

2) An elevator can carry a maximum load of 1.5 tons. Two constructions workers weighing 195 lb and 210 lb need to load 65 boxes each weighing 42 lb in the elevator with them. Will the elevator safely hold all this weight?

3) A small truck weighs 1300 lb. It is loaded with cement pieces that weigh 150 lb each. The maximum combined weight of the truck and its load is 2.75 tons. How many pieces of cement can be loaded in the truck?

4) A contractor poured 2.8 tons of concrete in the foundations of 6 houses. What is this amount in pounds, and then in ounces? Show the 2 conversions.

5) A moving truck can carry a maximum load of 1.1 tons. If you have 80 boxes to move and each box weighs 120 lb, how many trips will be required to move your boxes?

6) A commercial bakery uses 435 lb of flour every day to produce its loaves of bread. How much flour, in tons, will they use during a 5-day work week?

WEIGHT AND COSTS IN THE IMPERIAL SYSTEM

It is possible to use comparisons of weight to calculate unit price like you did in Unit 1. But first, you must change the weights into only one unit – that is, you can't compare the price of ounces to pounds. It is ounces to ounces and pounds to pounds.

Example 1: A 12-ounce can of vegetables costs $1.49 while a 1 lb 2 oz can of the same vegetables costs $2.19. Which is the better buy?

Solution: In both situations, find the cost of 1 ounce.

Can 1: $1.49 ÷ 12 oz = $0.1242 per oz

Can 2: First find the total number of ounces in this can.
1 lb 2 oz = 16 oz + 2 oz = 18 oz
$2.19 ÷ 18 oz = $0.1217 per oz

Can 2 is the better buy because its unit price is lower.

NOTE: The unit price of these two items is very close so more than 2 decimal places – which is standard for money – are necessary for comparison.

Example 2: Victor bought steak for dinner that weighed 4 pounds 6 ounces. It cost $2.74 per pound. He trimmed the excess fat and had only 4 pounds of meat remaining. What was the *true cost* per pound of the steaks?

Solution: Find the total cost of the steak, and then the unit price based on the remaining weight.

To find the total weight, change the ounces into pounds.

$$\frac{\text{lb}}{\text{oz}} \quad \frac{1}{16} = \frac{x}{6} \qquad x = 1 \times 6 \div 16 = 0.375 \text{ lb}$$

The total mass is 4 lb + 0.375 lb = 4.374 lb

To find the total cost of the steak, multiply the weight by the cost.

Total cost of the steak = 4.375 lb × $2.74 / lb = $11.99

Since the remaining weight of the steak was 4 lb, use this to find the unit price.

Cost per pound of remaining steak = total cost ÷ weight of steak
Cost per pound = $11.99 ÷ 4 lb = $3.00 / lb
The cost of the remaining steak was $3.00 per pound.

ASSIGNMENT 3 – WEIGHT AND COSTS IN THE IMPERIAL SYSTEM

1) U-pick organic blueberries sell for $20.00 for a 12 pound box.
   a) How much would 1 pound cost?

   b) How much would 1 ounce cost?

   c) How much would 12 ounces cost?

2) An 18 oz jar of peanut butter costs $3.29, a 28 oz jar costs $4.79, and a 2.5 lb jar costs $5.99. Which is the best buy? Show your work.

3) Alison bought 24 ounces of coffee beans for $28.45, but when she got home, she realized the actual weight was only 22 ounces. What was the true cost per ounce?

4) Mark bought 8 bags of sand for a construction project. Each bag weighed 25 lb and cost $1.68. One bag ripped and completely spilled in transport. What was Mark's true price per pound?

5) Brenda bought 8.75 pounds of strawberries at $1.98 per pound. Unfortunately, 10% of the berries rotted before they could be eaten. What is her true cost per pound of the berries?

MASS/WEIGHT IN THE METRIC SYSTEM

In the SI or metric system of measurement, the base unit for mass is the **kilogram**, but it is commonly used for weight as well. These are the common conversions needed in the metric system:

1000 grams (g) = 1 kilogram (kg)

1000 milligrams (mg) = 1 gram (g)

1 tonne (t) = 1000 kilograms (kg)

The tonne (t) in the metric system is **NOT** the same as the ton (tn) in the imperial system. In the working world, a tonne is often referred to as a metric ton to avoid confusion.

Most of these conversions will be given to you on the Provincial exam.

Example 1: Convert the following weights.

a) 6.7 t = _____ kg b) 2975 kg = _____ t

Solution: Use a proportion and the correct conversions.

a) $\frac{\text{t}}{\text{kg}} \quad \frac{1}{1000} = \frac{6.7}{x}$ $x = 1000 \times 6.7 \div 1 = 6700$ kg

b) $\frac{\text{t}}{\text{kg}} \quad \frac{1}{1000} = \frac{x}{2975}$ $x = 1 \times 2975 \div 1000 = 2.975$ t

Example 2: A recipe requires 650 g of flour, 340 g of cornmeal, and 220 g of sugar. What is the total weight of these dry goods in kilograms?

Solution: Add the weights together, and then convert to kilograms

Total weight = 650 + 340 + 220 = 1210 g

To convert to kilograms, use a proportion.

$\frac{\text{g}}{\text{kg}} \quad \frac{1000}{1} = \frac{1210}{x}$ $x = 1 \times 1210 \div 1000 = 1.21$ kg

The total weight is 1210 g or 1.21 kg

ASSIGNMENT 4 – MASS/WEIGHT IN THE METRIC SYSTEM

1) Convert the following weights. SHOW YOUR WORK!

a) 2.8 kg = _____ g

b) 125 g = _____ kg

a) 3.6 t = _____ kg

b) 654 kg = _____ t

2) Irene needs 1.6 kg of tomatoes. She has baskets of tomatoes that weigh 256 g, 452 g, 158 g, and 320 g. How many more grams of tomatoes does she need?

3) A truck weighs 2.6 tonnes. It is loaded with 15 boxes that weigh 210 kg each. What is the total weight of the truck and its contents, in tonnes?

4) Karen is making a pot of potato soup. She needs 8 potatoes and each potato weighs about 375 g. How many kg of potatoes does she need?

WEIGHT CONVERSIONS BETWEEN MEASURING SYSTEMS

You have converted measures of weight from one unit to another within the SI (metric) and within the imperial system. In this section you will work with conversions between the SI units and the imperial units of weight.

The conversion to use between the systems for weight is:

1 kilogram = 2.2 lb

Example 1: Lorraine is using a recipe that required 6 pounds of apples. How many kilograms of apples does she need?

Solution: Convert the weight using a proportion.

$$\frac{\text{lb}}{\text{kg}} \quad \frac{2.2}{1} = \frac{6}{x} \qquad x = 1 \times 6 \div 2.2 = 2.7272 \text{ kg}$$

The total weight is 2.7 kg

Example 2: A recipe requires 150 g of sugar. How much is this in ounces?

Solution: Change the g to oz. using a proportion.

$$\frac{\text{g}}{\text{oz.}} \quad \frac{1}{28.35} = \frac{150}{x} \qquad x = 150 \times 28.35 \div 1 = 5.3 \text{ oz.}$$

The sugar has a weight of 5.3 oz.

Example 3: Express 6.7 t in lb.

Solution: Change the tonne (t) to lb using 2 steps: tonne to kg and kg to lb. This is a 2-step conversion.

$$\frac{\text{t}}{\text{kg}} \quad \frac{1}{1000} = \frac{6.7}{x} \qquad \frac{\text{kg}}{\text{lb}} \quad \frac{1}{2.2} = \frac{6700}{x}$$

$x = 1000 \times 6.7 \div 1 = 6700$ kg $\qquad x = 2.2 \times 6700 \div 1 = 14\,740$ lb

6.7 tonnes equals 14 740 pounds.

Example 4: The cost of bananas at one store is $0.49/lb. At another store, bananas are on sale for $1.05/kg. Which is the better buy?

Solution: Convert the price of bananas at the first store into kilograms.

The cost of 1 lb is $0.49, but 1 kg is 2.2 times bigger than 1 lb.
So, 1 kg costs 2.2 times more than 1 lb.

$0.49 × 2.2 = $1.08

One kilogram of bananas costs $1.08 at the first store but only $1.05 at the second store, so the sale at the second store is the better buy.

ASSIGNMENT 5 – WEIGHT CONVERSIONS BETWEEN MEASURING SYSTEMS

1) Convert the following weights. SHOW YOUR WORK!

a) 67.5 kg = _____ lb

b) 125 lb = _____ kg

c) 3.6 t = _____ lb

d) 30 000 lb = _____ t

2) Chen weighs 68 kg. How much does he weigh in pounds?

3) A baby weighs 7 pounds 12 ounces at birth. How much did it weigh in grams?

4) The smallest bag at the store is 600 g. How much is this in ounces?

5) How much does 1 pound of hamburger cost if the store sells it for $9.74/kg? Hint: change kg to lb and find the unit cost.

6) Which is the better buy: 200 g of coffee beans at $3.85 or 1 pound for $9.60?

7) If a 10 lb bag of grass seed costs $75.45, how much does the seed cost per kilogram?

CONVERSIONS BETWEEN MEASUREMENTS OF VOLUME AND WEIGHT

You have now converted measures of weight from one unit to another within the SI (metric) and within the imperial system, and converted between the SI units and the imperial units of weight. In this section you will learn about converting from a unit of volume to a unit of weight.

Grain is often measured in **bushels**, which is a volume measure. But the grain's weight is needed to judge whether it is safe for a truck to carry. Each different grain has a different weight, so conversions between bushels and weight are different for each grain. These conversions depend on individual conversion factors.

Example 1: How many bushels (bu) of flax seed are there in 2.4 tonnes if the conversion factor is 39.368 bushels/tonne?

Solution: A conversion factor of 39.368 means that there are 39.368 bushels of flax seed in each tonne. To find the number of bushels in 2.4 t, use a proportion with English words.

$$\frac{\text{bushels}}{\text{tonnes}} \quad \frac{39.368}{1} = \frac{x}{2.4} \qquad x = 39.368 \times 2.4 \div 1 = 94.5 \text{ buschels}$$

ASSIGNMENT 6 – CONVERSIONS BETWEEN MEASUREMENTS OF VOLUME AND WEIGHT

1) How many bushels of white beans are there in 67 tonnes if the conversion factor is 36.744 bushels/tonne?

2) How many tonnes of rye are there in 900 bushels if there are 39.368 bushels/tonne?

3) If George gets $195.76 per tonne for wheat, how much does he earn per bushel? (conversion factor of 36.744 bu/t) Note: this is a unit cost problem.

4) Laila bought 45 bushels of sunflower seeds. If the conversion factor is 73.847 bu/t, what is the weight of the sunflower seeds she bought:

a) in tonnes?

b) in kilograms?

c) in pounds?

WORKING WITH TEMPERATURE

If you travel to the United States, you will notice that the temperature scale is different there. The U.S. uses the Fahrenheit scale (^{0}F) of the imperial system, while Canada uses the Celsius scale (^{0}C) of the SI or metric system.

In the SI system, water freezes at 0^0C and boils at 100^0C. In the imperial system, water freezes at 32^0F and boils at 212^0F. Since water freezes at 0^0C and 32^0F, the relationship between the two temperature systems can be calculated with the following formulas, where C represents degrees Celsius and F represents degrees Fahrenheit.

$$\mathbf{C = \frac{5}{9}(F - 32) \quad or \quad F = \frac{9}{5}C + 32}$$

Example 1: In Seattle, someone said it was 42^0F. What is this temperature in degrees Celsius?

Solution: Use the proper formula and convert, substituting 42^0 for F.

$C = \frac{5}{9}(F - 32)$ means $5 \div 9 \times (F - 32)$

*****Remember to use the brackets in your calculation.*****

$C = 5 \div 9 \times (42 - 32)$

$= 5.6^0$C

Example 2: On a hot summer day, the temperature of tar heated to pave a road was 48^0C. What is this temperature in degrees Fahrenheit?

Solution: Use the proper formula and convert, substituting 48 for C.

$F = \frac{9}{5}C + 32$ means $9 \div 5 \times C + 32$

***Remember to calculate the dividing and multiplying before adding 32.

$F = 9 \div 5 \times 48 + 32$

$= 118.4^0$F

ASSIGNMENT 7 – WORKING WITH TEMPERATURE

1) Convert the following temperatures **to** degrees Fahrenheit.

a) 35^0C

b) -8^0C

c) 167^0C

d) 21^0C

e) -40^0C

f) 202^0C

2) Convert the following temperatures **to** degrees Celsius.

a) -20^0F

b) 80^0F

c) 375^0F

d) 2^0F

e) 0^0F

f) -2^0F

3) A cake recipe says to bake at 350^0F, but your oven only shows temperature in degrees Celsius. At what temperature should you set your oven?

4) The normal temperature for a dog is between 99^0F and 102^0F. Ashley's dog has a temperature of 40^0C. Convert this to Fahrenheit to see if the dog's temperature is normal.

5) Roger is painting the outside of his home. The instructions on the paint say he should not use the paint if the temperature is below 45^0F. The temperature is 9^0C. Is it safe to paint his home?

6) In 1992, the temperature in Pincher Creek, Alberta rose from -19^0C to 22^0C in just one hour due to a chinook wind. What are these temperatures in degrees Fahrenheit?