**UNIT 4 – MEASUREMENT – PART 2**

|  |  |  |  |
| --- | --- | --- | --- |
| **Assignment** | **Title** | **Work to complete** | **Complete** |
| **1** | ***Volume*** |  |  |
| **2** | ***Capacity*** |  |  |
| **3** | ***Mass/Weight, Imperial System*** |  |  |
| **4** | ***More Mass/Weight in the Imperial System*** |  |  |
| **5** | ***Weight and Costs, Imperial***  |  |  |
| **6** | ***Mass/Weight, Metric System*** |  |  |
|  | ***Quiz*** |  |  |
| **7** | ***Weight Conversions Between Measuring System*** |  |  |
| **8** | ***Conversions Between Measurements of Volume and Weight*** |  |  |
| **9** | ***Working With Temperature*** |  |  |
| **Mental Math** | Non-calculator practice |  |  |
| **Practice Test** | How are you doing? |  |  |
| **Self-Assessment** | On the next page, complete the self-assessment. |  |  |
| **Chapter Test** | **Chapter Test** Show me your stuff! |  |  |

**Self Assessment**

On the following chart, indicate how confident you feel about each statement.

**1 – I need more help 2 – I need more practice 3 – I could teach it !**

Discuss this with your teacher ***before*** you write the test!

|  |  |
| --- | --- |
| **Statement** | **1, 2 or 3** |
| After completing this chapter; |
| * I can calculate the volume of a three-dimensional object in metric and imperial units
 |  |
| * I can understand the difference between mass and weight, and understand why we often use the terms interchangeably
 |  |
| * I can calculate mass and weight in both the SI and the Imperial systems
 |  |
| * I can convert mass and weight within the SI system and the Imperial system
 |  |
| * I can convert mass and weight between the SI and the Imperial system and vice versa
 |  |
| * I can use conversion factors to convert between volume and mass
 |  |
| * I understand the difference between the Celsius and the Fahrenheit temperature scales
 |  |
| * I can convert from degrees Celsius to degrees Fahrenheit and vice versa
 |  |

**Vocabulary:**

|  |  |
| --- | --- |
| capacityCelsiusFahrenheitgramkilogrammassounce | poundtemperaturetontonneweightvolume |

**VOLUME**

The volume of an object is the amount of space it occupies. There are specific formulas used to find the volume of different geometric solids. Just as area is expressed in square units, volume is ALWAYS expressed in cubic units ( cm3, in3, m3, etc)

In equations, the symbol for volume is a capital v 🡪 **V**.

Example 1: Calculate the volume of the rectangular solid below.

Solution:

Volume for this rectangular solid is calculated by multiplying length times width times height.

**V = *l* × *w* × *h***

 **V = *l* × *w* × *h***

 = 15 × 6 × 12

 = 1080 m3 12 m

 6 m

 15 m

Example 2: Bob runs a landscaping business. He needs to cover a garden that is 10.8 m by 9.5 m with 10 cm of topsoil. What is the volume of topsoil he needs? If soil costs $18.75/m3, and Bob must buy whole m3, how much will it cost Bob?

Solution: 1) Calculate the volume needed. To do this, convert the depth of the topsoil from centimetres to metres and then calculate the volume for the garden.

 10 cm x  = 0.1 m

 Volume = 10.8 m × 9.5 m × 0.01 m

 = 10.26 m3

 2) Calculate the cost of this volume of topsoil.

 10.26 m3 rounds to 11 m3

11 m3 × $18.75 = **$206.25**

As with square units, cubic units for volume can be converted within a measurement system (metric or imperial).

1000

mm3

1 000 000

cm3

1

cm3

1m3

 = and =

 (10mm x 10mm x 10mm) (100cm x 100cm x 100cm)

46 656

in3

1

yd3

27

ft3

1728

 in3

1 ft3

 = and = =

 (12in x 12in x 12in) (3ft x 3ft x 3ft) (36in x 36in x 36in)

Example 1: A bale of hay measures 15” by 24” by 36”. What is the volume of a bale of hay in **cubic inches and cubic feet**?

Solution:

|  |  |
| --- | --- |
| To calculate the volume in cubic inches:V = l x w x h = 15 in × 24 in × 36 in  = **12 960 in3** | To calculate the volume in cubic feet, change the dimensions from inches to feet:15in x = 1.25ft, 24in x = 2ft; 36in x = 3ftV = l x w x h = 1.25 x 2 x 3 = **7.5 ft3**or **12 960 in3** x $\frac{1ft^{3}}{1728in^{3}}$ = **7.5 ft3** |

Example 2: An aquarium is 17 cm wide and 35 cm long. If it is filled 23 cm deep, what is the volume of the water in the aquarium **in cm3 and m3**?

Solution:

|  |  |
| --- | --- |
| To calculate the volume in cubic centimetres:V = l x w x h = 17 cm × 35 cm × 23 cm  = **13 685 cm3** | To calculate the volume in cubic metres:V = l x w x h = 0.17m x 0.35m x 0.23m  = **0.013685 m3**or Calculate how many cm3 are in a m3 (100 x 100 x 100) and convert.13 685 cm3  x $\frac{1m^{3}}{1 000 000cm^{3}}$ = **0.13685 m3** |

**ASSIGNMENT 1 – VOLUME**

1) Calculate the volume of this rectangular prism: 18 in

a) in cubic inches (in3)

 24 in

 30 in

b) in cubic feet (ft3)

2) A box 3 in. × 4 in. × 6 in. is filled with paper clips. Will the contents of this box fit into a cube that has sides of 4 in. each? Hint: find the volume of each box.

3) The volume of Samantha’s hockey bag is 8288 cubic inches (in3). What is the volume in cubic feet (ft3), to the nearest whole cubic foot?

4) Ryan is using a wheelbarrow that holds 3 cubic feet of soil.

 a) How many cubic yards will his wheelbarrow hold?

b) If Ryan takes 32 loads with his wheelbarrow, how many cubic yards of soil will he move?

**CAPACITY**

Capacity is the maximum amount that a container can hold. It is related to volume in that the capacity of a container can be the volume of the container. But capacity is most often used with liquid measurements.

The **metric system** (the **System International, SI**) is used in Canada (and most of the world) for measuring capacity:

 1mL = 1cm3 = 1cc (**c**ubic **c**entimetre)

 **1 L = 1000 mL** = 1000 cc

The **Imperial System is** used in the US; because US is Canada’s neighbour, we need to know the basics of how their measuring system works:

 **Imperial Approximate Metric Conversions:**

 **1 teaspoon 1 tsp = 5 mL**

 **1 tablespoon = 3 tsp 1 tbsp = 15 mL**

 **1 fluid ounce = 2 tbsp 3.38 fl oz (US) = 100mL**

 **3.52 fl oz (UK) = 100mL**

 **1 cup = 8 fl oz 1 c = 250 mL**

 **1 pint = 2 cups**

 **1 quart = 2 pt 1.06 qt (US) = 1L**

 **1 gallon (US) = 4 quarts (US) 0.26 gal (US) = 1L**

 **1 bushel = 8 gal**

Note, there are two different sizes for a gallon: a US gallon (see above) and a British (UK) gallon. The UK gallon is a bit larger than a US gallon:

 **1.2 gal US = 1 gal UK**

**Example 1:** Convert the following measurements using one-step conversions:

a) 500 mL into cups Solution: $500ml x \frac{1c}{250ml}=2c$

b) 1.25 mL into teaspoons Solution: $1.25ml x \frac{1tsp}{5ml}$ = 0.25tsp

c) 5 fl oz (US) into cups Fill in blanks: $5fl oz x \frac{ c}{ fl oz}=0.625 c$

d) 25 L into gal (US) Fill in blanks: $25L x \frac{ }{ }=6.5gal$

**Example 2:** Convert the following measurements using two-step conversions:

a) 1000 mL into pints Solution: $1000ml x \frac{1c}{250ml} x \frac{1pt}{2c}=2pts$

b) 500 mL to fl oz Fill in blanks: $500mL x \frac{ }{} x \frac{ }{}=16fl oz$$500mL x \frac{ }{} x \frac{ }{}=16fl oz$

**ASSIGNMENT 2 – CAPACITY**

1) Convert the following measurements.

a) 5 cups to fl oz (US) b) 2 gal to pt

c) 6.7 gal (US) to L d) 3 L to qt (US)

e) 15.5 L to gal (UK) f) 8 bu to gal

2) My gas tank holds 45 L. If I fill up in Anchorage, Alaska, how many American gallons will my tank hold?

3) If I were to fill up my tank in London, England, how many UK gallons would my 45 L tank hold?

4) Ann was making a cake at her aunt’s house in California. Her recipe was in metric units but she only has imperial measuring devices. Convert the measurement for her.

 30 mL to tablespoons 625 mL to cups 250 mL to fl oz

**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 use the term weight and assume that it is a stable measure.

In the imperial system, the base units for weight are t**he ounce (oz), the pound (lb) and the ton (tn)**. This is how they are related:

 **1 pound (lb) = 16 ounces (oz) 1 ton (tn) = 2000 pounds**

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 pounds** and the **ounces to 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.

Note: 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.

**ASSIGNMENT 3 – MASS/WEIGHT in the Imperial System: oz and lb**

1) Calculate the following conversions.

a) 54 oz = \_\_\_\_\_lb \_\_\_\_\_ oz b) 15 lb = \_\_\_\_\_\_ oz

c) 648 oz = \_\_\_\_\_lb \_\_\_\_\_ oz d) 8 ½ 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?

Example 2: 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? 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: $6.2tn x \frac{2000lb}{1tn}= 12 400lb$

**ASSIGNMENT 4 – MASS/WEIGHT in the Imperial System: lb and tn**

1) Calculate the following conversions:

a) 6790 lb to tn b) 5.45 tn to lb

2) Kurt is planting wheat on his farm. He is using 28 800 pounds of wheat. How many tons is this?

3) An elevator can carry a maximum load of 1.5 tons. Two construction 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? Show your calculations.

4) 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 tn. How many pieces of cement can be loaded in the truck?

**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. You must compare ounces to ounces or 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 steaks 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:

 $6oz x \frac{1lb}{16oz }=0.375lb$

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

 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

 = $11.99 ÷ 4 lb

 = **$3.00 / lb**

**ASSIGNMENT 5 – 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?

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 pounds 12 ounces 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? Show your calculations.

**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 milligrams (mg) = **1 gram (g)**

 1000 grams (g) = **1 kilogram (kg)**

 1000 kilograms (kg) = **1 tonne (t)**

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.

NOTE: You are expected to learn these conversions as they will not be given to you on the provincial exam.

Example 1: Convert the following weights:

a) 6.7t to kg Solution: $6.7t x \frac{1000kg}{1t}=6700kg$

b) 2975kg to t Fill in blanks: $2975kg x \frac{}{ }$ = 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

 Then, $1210g x \frac{1kg}{1000g}$ = 1.21*kg*

**ASSIGNMENT 6 – MASS/WEIGHT IN THE METRIC SYSTEM**

1) Convert the following weights.

a) 2.8kg to g b) 125g to kg

c) 3.6t to kg d) 654kg to 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 METRIC AND IMPERIAL SYSTEMS**

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 **1 oz = 28.35g**

**2.2 lb = 1 kilogram**

Example 1: Lorraine is using a recipe that required 6 pounds of apples. The bag of apples she bought at Safeway only shows the weight in kilograms. How many kilograms of apples does she need?

Solution: $ 6lb x \frac{1kg}{2.2lb}=2.7272kg$ The total weight is 2.7 kg.

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

Solution: $150g x \frac{ 1 oz }{ 28.35 g} = $ = 5.29 *oz*

 The sugar has a weight of 5.3 oz.

Example 3: 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.

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

**ASSIGNMENT 7 – WEIGHT CONVERSIONS BETWEEN MEASURING SYSTEMS**

1) Convert the following weights.

a) 67.5 kg to lb b) 125 lb to kg

c) 3.6 t to lb d) 30 000 lb to 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 of spinach 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?

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

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 & 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: $2.4t x \frac{b39.368u}{1t}=94.48bu$ There are 94.5 bushels of flax seed.

**ASSIGNMENT 8 – CONVERSIONS BETWEEN 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)?

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 (0F) of the imperial system, while Canada uses the Celsius scale (0C) of the SI or metric system.

In the SI system, water freezes at 00C and boils at 1000C. In the imperial system, water freezes at 320F and boils at 2120F. Since water freezes at 00C and 320F, the relationship between the two temperature systems can be calculated with the following formulas, where C represents degrees Celsius and F represents degrees Fahrenheit.

 C = $\frac{5}{9}$ (F – 32) or F = $\frac{9}{5}$ C + 32

Example 1: In Seattle, it was 420F. What is this temperature in degrees Celsius?

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

 C =  *means 5 ÷ 9 × (F – 32)*

 \*\*\**Remember to calculate the bracket before dividing or multiplying*.

 C = $\frac{5}{9}(42-32)$

 = 

 = 5.60C

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Example 2: On a hot summer day, the temperature of tar heated to pave a road was 480C. What is this temperature in degrees Fahrenheit?

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

 F =  *means 9 ÷ 5 × C + 32*

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

 F = 

 = 86.4 + 32

 = 118.40F

**ASSIGNMENT 9 – WORKING WITH TEMPERATURE**

1) Convert the following temperatures to degrees Fahrenheit.

a) 350C b) -80C

c) 1670C d) 210C

e) -400C f) 2020C

2) Convert the following temperatures to degrees Celsius.

a) -200F b) 800F

c) 3750F d) 20F

e) 00F f) -20F

3) A cake recipe says to bake at 3500F, 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 990F and 1020F. Ashley’s dog has a temperature of 400C. 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 can say he should not use the paint if the temperature is below 450F. The temperature is 90C. Is it safe to paint his home?

6) In 1992, the temperature in Pincher Creek, Alberta, rose from -190C to 220C in just one hour due to a chinook wind. What are these temperatures in degrees Fahrenheit?

7) Which is hotter: a blowtorch at 13000C or a candle flame at 18300F? Calculate each on the other’s scale.