**ßUNIT 3 – MEASUREMENT – PART 1**

|  |  |  |  |
| --- | --- | --- | --- |
| **Assignment** | **Title** | **Work to complete** | **Complete** |
|  | ***Vocabulary*** | Definitions and examples |  |
| **1** | ***The Metric System*** | Part APart BPart C |  |
| **2** | ***The Imperial System*** | Part APart BPart C |  |
| **3** | ***Converting Measurements Between Systems*** | Converting Measurements Between Systems |  |
| **4** | ***Metric and Imperial Estimation*** | *Metric and Imperial Estimation* |  |
|  | ***Quiz 1*** |  |  |
| **5** | ***Perimeter*** | Perimeter |  |
| **6** | ***Circumference*** | Circumference |  |
| **7** | ***Area*** | Area |  |
| **8** | ***Surface Area*** | Surface Area |  |
|  | ***Quiz 2*** |  |  |
| **9** | ***More Measurement***  | Vernier Calipers  |  |
| **10** | ***More Measurement*** | Micrometers |  |
| **Practice Test** | **Practice Test** How are you doing? | Get this page from your teacher |  |
| **Self-Assessment** | **Self-Assessment*****“Traffic Lights”*** | On the next page, complete the self-assessment assignment. |  |
| **Chapter Test** | **Chapter Test** Show me your stuff! |  |  |
| **Mental Math** | **Mental Math** Non-calculator practice | Get this page from your teacher |  |

**Traffic Lights**

In the following chart, decide how confident you feel about each statement by sticking a red, yellow, or green dot in the box. Then discuss this with your teacher ***BEFORE*** you write the test.

|  |  |
| --- | --- |
| **Statement** | **Dot** |
| After completing this chapter; |
| * I understand the relationship between units in the SI and imperial systems
 |  |
| * I can convert a measurement from SI units to imperial units
 |  |
| * I can convert a measurement from imperial units to SI units
 |  |
| * I can estimate measurements using a referent in both SI and imperial systems
 |  |
| * I can calculate perimeter, circumference, and area in metric and imperial units
 |  |
| * I can calculate the surface area of a three-dimensional object in metric and imperial units
 |  |
| * I can read measurements from a vernier caliper and a micrometer
 |  |

**Vocabulary: Chapter 3**

***MEASUREMENT – PART 1***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **budget**\*this term has been completed for you as an example | Definitionan estimate of the amount of money to be spent on a specific project or over a given time frame | Diagram/Example: A sample of a personal monthly budget:

|  |  |  |  |
| --- | --- | --- | --- |
| **Net Pay** |  |  | **$2500** |
| Rent | $600 | Recreation | $100 |
| Telephone | $75 | Personal Care | $100 |
| Utilities | $75 | Savings | $150 |
| Food | $500 | Spending (CDs…) | $200 |
| Transportation | $500 | Other expenses | $100 |
| Clothing | $100 |  |  |
| **Total** |  |  | **$2,500** |

 |
| **base unit** | Definition | Diagram/Example |
| **foot (ft or ’)** | Definition | Diagram/Example |
| **imperial system** | Definition | Diagram/Example |
| **inch (in or ”)** | Definition | Diagram/Example |
| **micrometer** | Definition | Diagram/Example |
| **mile (mi)** | Definition | Diagram/Example |
| **referent** | Definition | Diagram/Example |
| **surface area** | Definition | Diagram/Example |
| **Système international d’unités (SI)** | Definition | Diagram/Example |
| **Vernier caliper** | Definition | Diagram/Example |
| **yard (yd)** | Definition | Diagram/Example |

 **International System of Units (SI)** ("***S****ystème* ***I****nternational d'Unités*" in French)

|  |  |  |
| --- | --- | --- |
| **PREFIX** | **SYMBOL** | **QUANTITY** |
| tera | T | trillion | 1 000 000 000 000 | 1 000 000 000 000 |
| giga | G | billion | 1 000 000 000 | 1 000 000 000 |
| mega | mg | million | 1 000 000 | 1 000 000 |
| kilo | k | thousand | 1000 | 1 000 |
| hecto | h | hundred | 100 | 100 |
| deca | da | ten | 10 | 10 |
| basic unit |  | one | 1 | 1 |
| deci | d | one-tenth | 0.1 | 1/10 |
| centi | c | one-hundredth | 0.01 | 1/100 |
| milli | m | one-thousandth | 0.001 | 1/1000 |
| micro | µ | one-millionth | 0.000 001 | 1/ 1 000 000  |
| nano | n | one-billionth | 0.000 000 001 | 1/ 1 000 000 000  |
| pico | p | one-trillionth | 0.000 000 000 001 | 1/1 000 000 000 000 |

The Metric System—The International System of Units (SI)

The Metric System is a system of measurement based on multiples of 10, where the **base unit for length is the metre**. Since the 1960s, the International System of Units (SI) ("***S****ystème* ***I****nternational d'Unités*" in French, hence "SI") has been the internationally recognized standard metric system. Metric units are widely used around the world. To convert from one unit to another in the metric system, we multiply or divide by powers of 10 and attach a different prefix to the base unit (metre).

There are a lot of prefixes in the table above that we do not use on a daily basis, but no doubt you will have heard of many of these. My computer’s hard drive is measured in GB – gigabytes. And a common measurement in science is a nanometere – it is very small!

There are some prefixes that you need to know, and the relationship between them. These are the prefixes from kilometre to millimetre (km to mm).

**kilometre hectometre decameter metre decimeter centimeter millimetre**

 **km hm dam m dm cm mm**

**Referents** – objects that represent approximately one unit of measurement. For example:

|  |  |
| --- | --- |
| **km**: distance from school to \_\_\_\_\_\_\_\_\_\_\_**hm**: length of a soccer field**dam**: length of a classroom**m**: length of a pace (2 steps) for a metre |  **dm**: height of a juice-box **cm**: width of an adult baby finger **mm**: thickness of a paperclip  |

There is a little rhyme that might help you remember the order of these units. Each first letter in this phrase represents the first letter in the corresponding unit.

**King Henry died, Mary didn’t cry much.**

Remember, **KHDMDCM**, and that the units are separated by multiples of 10.



The easiest way to convert one unit of measure to another unit of measure is to use this **conversion formula:**

***what I have x units I want***

 ***units I have***

Example: The table is 1.55 metres high; how many centimetres is this?

Step 1: Set it up: 1.55 m x \_\_\_cm (cm is the unit I want)

 m (m is the unit I have)

Step 2: Fill in the conversion information: 1.55m x 100 cm

 1 m

Step 3: Calculate: 1.55 x 100 ÷ 1 = 155cm

 The table is 155 cm high.

Example: Jack lives 150 000cm from school ; how many kilometres is this?

Set it up: 150 000cm x \_\_\_\_\_ m x \_\_\_\_ km

 cm m

Fill it in: 150 000cm x 1 m x 1 km

 100cm 1000m

Calculate: 150 000 x 1 ÷ 100 x 1 ÷ 1000 = 1.5km

Jack lives 1.5 kiometres school.

**ASSIGNMENT 1 – THE METRIC SYSTEM**

**Part A** Choose the most sensible measure. Circle your answer.

1. Length of a small paper clip.

 31 mm 31 cm 31 m 31 km

2. Length of a tennis racket.

 68 mm 68 cm 68 m 68 km

3. Distance around a racetrack.

 2 mm 2 cm 2 m 2 km

4. Length of a canoe

 4 mm 4 cm 4 m 4 km

5. Length of a key.

 54 mm 54 cm 54 m 54 km

6. Height of a woman.

 160 mm 160 cm 160 m 160 km

7. Width of a room.

 8 mm 8 cm 8 m 8 km

8. Distance from Vancouver to Hope.

 125 mm 125 cm 125 m 125 km

9. Length of a bowling alley.

 18 mm 18 cm 18 m 18 km

10. Height of a giant redwood tree.

 67 mm 67 cm 67 m 67 km

11. Length of a safety pin.

 26 mm 26 cm 26 m 26 km

12. Width of a desk.

 75 mm 75 cm 75 m 75 km

13. Long-distance run.

 10 000 cm 10 000 m 10 000 km

**Part B** Convert the following

measurements as indicated.

1. 38 km to m
2. 758 mm to m
3. 8.5 m to mm
4. 2460 mm to cm
5. 155 cm to m
6. 1.6 m to km
7. 16.5 m to cm
8. 2500 mm to km
9. 30 dam to m
10. 67 dm to cm
11. 456 m to dam 13) 7800 hm to km
12. 11 km to dm 14) 920 mm to dm

**Part C**

1) The diameter of a loonie is about 26.5 mm. What is this measurement in centimetres?

2) A tree house is 1.2 m high. If each step is 20 cm high, will seven steps reach the tree house?

3) Nora needs 35 tiles for a floor. She finds a stack of tiles that is 0.5 m high. If each tile is 1.2 cm thick, are there enough tiles in the stack for her project?

4) William wants to put Christmas lights along the peak and edges of his roof.



a) How many metres of lights will he need?

b) Express this length in cm.

**THE IMPERIAL SYSTEM**

The **Imperial System** of measurement or **Imperial units** is a set of units with **the foot as the base unit**. The units were introduced in the United Kingdom and the Commonwealth countries, but most of these countries now use the metric system. The exception is the United States. It is important to be familiar with imperial measurements because they are still **used in many areas like construction**, and because the US is so close to Canada.

Imperial units for length are **inches, feet, yards** and **miles**.

**Referents**, objects that approximate one unit of measurement, could include:

|  |  |
| --- | --- |
| **Inch (in or ")**: the width of an adult thumb **Foot (ft or ')**: the length of an adult foot  | **Yard (yd)**: the length from the nose to the end of the outstretched fingertip.**Mile (mi)**: the distance from school to \_\_\_\_ |

**1ft = 12in**

**1yd = 3ft = 36in**

**1 mi = 1760yd = 5280 ft**

Just like converting in the metric (SI) system, the easiest way to convert one unit of measure to another unit of measure, is to use the **conversion formula:**

**what I have X units I want**

 **units I have**

Example 1: A wall is 72 inches wide; how many feet is this?

72 in x \_\_\_ft 72 in x 1 ft 72 x 1 ÷ 12 = 6 The wall is 6ft wide.

 in 12 in

Example 2: A lot of land is 0.4 miles long; how many yards is this?

0.4 mi x \_\_\_yd 0.4 mi x 1760 yd 0.4 x 1760 ÷1=704 The lot is 704yd long.

 mi 1 mi

This imperial ruler shows inches which are divided into sixteenths.



**ASSIGNMENT 2 – IMPERIAL SYSTEM**

**Part A**

To measure a length using an imperial ruler, count the whole number of inches, and then count the number of 16th of the next inch until the mark is reached. For example, letter H below is pointing at a measurement of 5 $\frac{5}{16}$ in.

1. State the length (to the closest  th of an inch) for the points A to G on the ruler below.

A B C D E F G H



![MCj04347760000[1]]()2. Find the length of the objects below to the closest th of an inch.

a)



![MPj04140250000[1]]()

b)



![MCj04348720000[1]]()c)



![MPj03847020000[1]]()

d)



3) Convert the following measurements.

 a) 38 ft to in e) 3000 yd to mi

 b) 0.4 mi to yd f) 1000 ft to mi

 c) 7.5 mi to ft g) 8 yd to in

 d) 72 in to ft h) 50 ft to yd

4) Ray is building a fence around his yard using pre-made panels that are sold in 8 ft lengths. The perimeter of the yard is 32 yd. How many fence panels should he buy?

Often Imperial Units are used in combination. These need to be converted to only one unit.

Example:

Jan might say she is 5 ft 10 in tall (feet and inches). How tall is Jan in inches only?

 5ft x 12in = 60 inches 60 in + 10 in = 70 inches tall

 1 ft

How tall is Jan in feet only? 10 in x 1 ft = 0.83 feet 0.83 ft + 5 ft = 5.83 feet tall 12in

**Part B**

5) Convert the following measurements.

1. **7 yd 2 ft** to ft b) **3 yd 1 ft** to in
2. **9 yd 11 ft** to ft d) **5 mi 16 yd 2 ft** to in
3. **7 mi 2 yd** to ft

6) The Olympic Marathon is a running race that is 26 miles 385 yards long. If Sebastian’s stride is about 1 yard long, how many strides will he take in a marathon run?

7) If each board in a fence is 6 inches wide, how many boards will Josée need to fence all 4 sides of a playground that is 60 ft wide by 125 feet long?

8) Riley bought 50 ft of rope. He cut off pieces that total 34’ 8” so far. How much rope does he have left?

9) A circular garden has outside circumference (perimeter of a circle) of 23 feet. If a geranium is planted every 6 inches around the garden, how many geraniums are needed?

10) A pet store has 10 cages for sale. There are 5 cages that are 2’8” wide, 3 cages that are 4’6” wide, and 2 cages that are 1’8” wide. Can these cages fit side by side along a wall that is 30’ long?

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**Imperial measurements are also stated in fraction form**. These types of measurement can be converted to feet and inches. For example:

A staircase has eight steps that are 7 ¼ inches high. What is this height in feet and inches?

Convert 7 ¼ in to 7.25 in (1÷ 4 = 0.25)

8 stairs x 7.25in = 58 inches

58 in x 1 ft = 4.833ft Now change 0.83ft to inches: 0.833ft x 12in = 10inches 12in 1ft

The staircase would be 4ft 10in high.

**Part C**

11) Convert the following measurements.

a) 6 ¼ yd to ft c) 2 ¾ mi to ft

b) ¼ ft to in d) ¾ mi to yd

**CONVERTING MEASUREMENTS BETWEEN SYSTEMS**

Below are some of the common conversions available for units of length. Note that the sign “≈” means approximately. These conversions are approximate values, and used nationally and internationally.

 **1 inch ≈ 2.54 centimetres**

 **1 foot ≈ 0.3048 metres**

 **1 yard ≈ 0.9144 metres**

 **1 mile ≈ 1.609 kilometres**

Use the good ol’ conversion formula!

Example 1: 24 ft = \_\_\_\_\_\_\_ m 24ft x 0.3048 m = 7.32m

 1 ft

Example 2: Andrea’s height is 5’8”. What is her height in centimetres?

First state Andrea’s height in then, 68in x 2.54cm = 172.72 or 173 cm

inches only (or feet only). 1 in

5’ × 12 = 60” + 8” = 68”

Example 3:

I need 10.75m of fabric; 10.75m x 1 yd = 11.756 or 11.76 yd

how many yards is this? 0.9144m

**ASSIGNMENT 3 – CONVERTING MEASUREMENTS BETWEEN SYSTEMS**

1) Convert the following measurements.

1. 8 in to cm b) 9.5 mi to km
2. 25 yd to m d) 67 ft to m

e) 24 ft to cm f) 145 m to in

g) 1.5 m to ft h) 123 km to mi

i) 27 cm to in j) 55 cm to ft

2) Mount Logan is Canada’s highest mountain. It measures 19 551 ft. What is that height in metres?

3) The Capilano Suspension Bridge in North Vancouver is 173 m across and 70 m above the river. What are these distances in feet?

4) Jiri’s boat and trailer is 20 ft 6 in. long. His garage is 6.2 m long. Will the boat and trailer fit in his garage?

5) Charlie drove from Calgary to Saskatoon. If this distance is 620 km, how far is this in miles?

6) Carla needs 3.5 m of cloth. However, the cloth she wants to buy costs $9.79 per yard. How much will this cloth cost?

7) A nickel is 1.95 mm thick. About how long is a $2.00 roll of nickels in inches? Round your answer to the nearest whole inch. Hint: How many nickels (5¢) are in $2.00?

8) An airline has size limits for checked baggage. The length, width and height of all luggage must add up to no more than 157 cm. Will the airline accept a suitcase that measures 17 in. by 26 in. by 14 in.?

9) A plumber cuts a 6m pipe into 15 equal size pieces. Calculate the length of each piece, in centimetres.

10) Eight foot long, 2 X 4 lumber used in building picnic tables is cut according to a pattern. A 4’4” length is cut, then a 1’3” length and then a 1’9” length. Each cut makes a 1/8” kerf (a kerf is the width of the groove or cut-line made by a saw). What is the length of wood remaining after the three lengths have been cut?**ASSIGNMENT 4 – Metric and Imperial Estimation**

Different units are appropriate to be used when estimating or stating the size of something. For example, you wouldn’t say that the desk you are sitting at is so many kilometres long, or the distance you live from school is that many millimetres. These are not appropriate units.

1. Complete the following chart by writing the appropriate **units** for each measurement. Choose from the following:

metric – mm cm, m, km

imperial – in., ft., mi. (yds are used in football and golf!)

|  |  |  |
| --- | --- | --- |
| Item | Metric | Imperial |
| Length of a Translink bus |  |  |
| Length of a $20 bill |  |  |
| Height of a 1-story building |  |  |
| Width of your pencil |  |  |
| Size of your big screen TV |  |  |

2. **Estimate the length** of each item in both metric and imperial units.

|  |  |  |
| --- | --- | --- |
| Item | Metric | Imperial |
| Length of a your desk |  |  |
| Length of a pencil |  |  |
| Height of a flagpole |  |  |
| Width of an eraser |  |  |
| Distance from Surrey to Vancouver |  |  |

**PERIMETER**

The distance around any geometric shape is known as the **perimeter**. To calculate the perimeter, simply add the lengths of all the sides together. Perimeter is always in linear units: cm, in, ft, m, etc.

 4 m 5m

 6 m 6 m

 4 m

The perimeter of this figure is:

*P* = 4 + 5 + 6 + 4 + 6 = 25 m

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A rectangle has a special formula that can be used to calculate its perimeter. The perimeter is two of the length plus two of the width. It doesn’t matter which side is called the length and which one is called the width. In math terms, this means two times the length plus two times the width.

*P* = **2 × *l +* 2 *× w***

 4 cm

 6 cm

*P* = **2 × *l +* 2 *× w***

*P* = 2 x 6 + 2 x 4

*P* = 12 + 8

*P* = 20 cm

The perimeter of **EVERY** figure is always calculated in the units given in the question. If the units in the figure are cm, the perimeter is cm; if it is in inches, the perimeter is in inches, and so on.

**When solving word problems, ALWAYS draw a diagram to help you!**

**ASSIGNMENT 5 – PERIMETER**

Calculate the perimeter of the following figures. Show your work and include the proper units in your answer.

1a)

 18.3 cm

 8.5 cm

b)

c)

2) Darlene is adding lace to the edge of a tablecloth. The tablecloth is 210 cm by 180 cm. How many centimetres does she need to go all the way around the tablecloth?

3) Chandra is building a fence around her swimming pool to completely surround it. The pool is 25 feet long and 12 feet wide. There is a 6 ft walkway around the entire pool. How much fencing will she need?

4) A rectangular city pool is 40 ft wide and has a perimeter of 230 ft. What is the length of the pool?

 *l*

 40 ft P = 230 ft

**CIRCUMFERENCE**

The perimeter of a circle has a special name and formula as it is impossible to “measure” a circle’s sides! The special name for perimeter of a circle is the **circumference**.

The formula for circumference of a circle is:

 **C = 2π*r***  OR **C = π*d***  where ***r*** = radius of a circle

***d*** = diameter of a circle

π = pi, a constant found on your calculator.

 It has a value of approximately 3.14159

 The diameter is ***twice*** the size of the radius, or the radius is ***half*** the size of the diameter. In this circle, the diameter d = 14 m so the radius = 7 m.

 ***d* = 14 m**

 ***r* = 7 m** Thus the circumference calculation is:

  **C = 2π*r*** OR **C = π*d***

 **C = 2 x π x 7 C = π x 14**

 **C = 43.98 m C = 43.98 m**

 Use the **π** button on your calculator. If you have difficulty finding it, please ask your teacher.

Just like straight edged shapes, the perimeter of circles is always calculated in the units given in the question. If the units in the figure are cm, the perimeter is cm; if it is in inches, the perimeter is in inches.

**ASSIGNMENT 6 – CIRCUMFERENCE**

Use the π button on your calculator. Include the proper units in your answer. Round each answer to one decimal place. SHOW YOUR WORK! Question 5 guides your thoughts.

tunnel

5) Simon works for Surrey Water Department. He is ordering the liner for

a new overflow tunnel at the pumping station. The tunnel is shown to the right.

 a) What is the radius of the tunnel? 24 ft

 Radius = diameter ÷ 2

 = \_\_\_\_\_\_\_ ft ÷ 2

 = \_\_\_\_\_\_\_ ft

 b) What is the circumference of the tunnel?

 Circumference = 2 × π × radius Circumference = π × diameter

 = 2 × π × \_\_\_\_\_\_\_\_\_ ft = π × \_\_\_\_\_\_\_\_\_ ft

 = \_\_\_\_\_\_\_\_\_\_\_\_ ft = \_\_\_\_\_\_\_\_\_ ft

 The circumference of the tunnel liner should be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ft.

6) A circular fountain has a radius of 10.6 m. What is its circumference?

7) Michelle is a cake decorator. Her icing bag holds enough icing to make 22 cm

a line 4.6 m long. She wants to draw circles around the top edges on some

cakes like seen here.

a) What is the circumference of this cake?

b) How many whole cakes like this one can Michelle draw these circles on with one full icing bag?

8) The sides of a flower garden are shown in the diagram below. What is the perimeter of the flower garden?



9) Mike sells tires. A customer told him the circumference of the wheel rim on his tires, but Mike needs the diameter to get the correct tire size. If the circumference of the customer’s rim is 66 in., what is the diameter?

![MP900305738[1]]()

**AREA**

In geometry, area refers to the measure of a region. It is ALWAYS in square units – cm2, in2, m2, etc. The area of a geometric figure is the number of square units needed to cover the interior of that figure. The following formulas are used to find area. These formulas are provided for you on a sheet similar to the one at the end of this booklet for the provincial exam.

In equations, the symbol for area is a capital a 🡪 **A**.

Rectangle:

Area is the length (or base) times the width (or height). Both terms are used depending on author.

**A = *l* × *w* or A= b × h**

Example:

 **A = *l* × *w***

 = 15 × 6

 = 90 m2 6 m

 15 m

Square:

In a square, all the sides have the same length. So the area is the side times side, or side squared.

**A = *s* × *s* or A= *s2***

Example:

 **A= *s2***

 = 7 × 7 7 cm

 = 49 cm2

 7 cm

Triangle:

A triangle is any 3 sided figure. It can have any other combination of angles. The area is base times the height divided by 2. The height is always perpendicular (at right angles or 900) to the base.

**A= (b × h) which means A= b × h ÷ 2**

Example:

**A= b × h ÷ 2**

 = 6 × 9 ÷ 2

 = 27 cm2

 9 cm

 6 cm

These are other shapes of triangles that still follow this formula.

 5 cm

 5 in

 4 cm

 9 in

Circle:

In a circle, there are no “sides”. So the area is calculated using the length of the radius in the following formula. Remember, the radius goes from the centre of the circle to touch the circle at any place. Use the **π** button on your calculator.

**A = π*r2* which means A = π × *r* × *r***

Example:

 **A = π*r2***

 **= π × 6 × 6**

 **= 113.10 cm2**

 r = 6 cm

Remember, if given the diameter, divide that number by 2 before calculating the area because the radius is half the length of the diameter.

 ***r = d ÷* 2**

 ***= 18 ÷* 2**

 **= 9 in**

 d = 18 in

 **A = π*r2***

 **= π × 9 × 9**

 **= 254.47 in2**

When completing area calculations between metric and imperial units, it is best to change the linear dimensions to the new unit *before* calculating the area.

Example:

Kuldeep must tile a floor that measures 4.4 m by 3.8 m.

a) What is the area he must cover in square inches?

 First, change the dimensions of the floor into inches.

= 173.23in and = 149.61

 Area (floor)= 173.23 × 149.61 = 25 916.94 in2 🡪 25 917 in2

 b) The tiles are 9” by 9”. How many full tiles will he need?

 First, find the area of the tiles.

 Area (tile) = 9” × 9” = 81 in2

 Next, divide the area of the floor by the area of the tile.

 25 917 in2 ÷ 81 in2 = 319.96 tiles 🡪 320 tiles

Note, sometimes, area must be changed **from one square unit to another**.

Consider the square to the right. It has side lengths of 10 mm or 1 cm.

When finding the area of this face, we could use either measurement.

 Area = s × s

 = 10mm × 10mm

 = 100 mm2 10 mm = 1 cm

 But the following is also true

 Area = 1cm ×1 cm

 = 1 cm2

 **Therefore, 1 cm2 = 100 mm2**

Based on this example, the following relationships are also true:

 **1 m2 = 10 000 cm2 1 yd2 = 9 ft2**

**1 km2 = 1 000 000 m2 1 ft2 = 144 in2**

**ASSIGNMENT 7 – AREA**

1) Leonard is laying grass in a yard measuring 38 ft by 20 ft. What is the yard’s area in square yards?

2) Suzanne needs to buy grass seed for the park. The park is 150 m by 210 m. Grass seed is sold by the square foot. How many square feet are in the park?

3) A room measures 12’8” by 10’9”.

a) What is the area of this room in square metres?

b) Carpeting costs $45.98/m2. What is the cost of the carpeting for this room?

**SURFACE AREA**

The surface area of a three-dimensional object is the area of the entire outer surface. There are specific formulas used to find the surface area of different geometric solids. These formulas are in your Data Booklet as well as being explained here. Just as area is expressed in square units, surface area is also ***ALWAYS*** expressed in square units; – cm2, in2, m2, etc.

Rectangular Solid:

Surface area is calculated by finding the area of each of the three faces by multiplying length times width for the face, and then adding these areas of all 6 surfaces together.

**SA = 2*lw* + 2*lh* + 2*wh* or SA = 2 × *l × w* + 2 × *l × h* + 2 × *w × h***

This representsthe top & bottom, the front & back, and both ends.

Example:

**SA = 2*lw* + 2*lh* + 2*wh***

 = 2×15×6 + 2×15×12 + 2×6×12 12 m

 = 180 + 360 + 144

 = 684 m2 6 m

 15 m

Cube:

A cube is a special rectangular solid that has all the sides have the same length. So the surface area is side times side multiplied by 6 sides.

**SA = *s* × *s* × 6 or SA= 6*s2***

Example:

 **SA= 6*s2***

 = 6 × 7 × 7 7 cm

 = 294 cm2

 7 cm

 7 cm

Cylinder:

The surface area of a cylinder is a two part formula found. The first part multiplies2 times **π** times the radius times the height for the side of the cylinder. This represents the area of side of the cylinder (it’s a rectangle). Then the top and bottom circles must be added. The area of each of these is **π** times the radius, times the radius or radius squared (***r2***). As there are 2 circles, this must be multiplies twice.

**SA = 2π*r*h + 2π*r2*** which means **SA = 2 × π × *r* × *h* + 2 × π × *r* × *r***

 side top & bottom

Example:

 **SA = 2π*r*h + 2π*r2***

 = 2 **× π × 3 × 9 +** 2 **× π × 3 × 3**

 = **169.65 + 56.55**

 = **226.2 in2** r = 3 in

 h = 9 in

Cylinders can be tall like this can, or short and fat like the diagram below. Either way the radius is measured on the round part and the height between each circle.

 r

 h

Remember, if you are given the diameter of the cylinder, divide it by 2 to get the radius.

 d = 14 cm

r = d ÷ 2

r = 14 cm ÷ 2

r = 7 cm

Cone:

The surface area of a cone a two part formula found by multiplying **π** times the radius times the slant height plus **π** times radius times radius.

**SA = π*rs +* π*r2*** which means **A = π × *r* × *s +*  π × *r* × *r***

 side base



Example:

 **SA = π*rs +* π*r2***

 = **π × 6 × 9 + π × 6 × 6**

 = 169.65 + 113.10 9 cm7cm

 = 282.75 cm2

 6cm

NOTE: If the base is not included, omit the circle part of the formula for the base: **π*r2***

Sphere:

The surface area of a sphere is found by multiplyingfour times **π** times the radius times the radius.

**SA = 4π*r2*** which means **SA = 4 × π × *r* × *r***

Example:

 **SA = 4π*r2***

 **= 4 × π × 5 × 5**

 **= 314.16 m2**

 5m

Pyramid:

The surface area of a pyramid is found by multiplying2 timesthe base edge of the pyramid (***b***)times the slant height (**s**) plus the base edge of the pyramid (***b***)times the base edge of the pyramid (***b***).

**SA = 2*bs + b*2** which means **SA = 2 × *b* × *s + b* × *b***



Example:

 **SA = 2*bs + b*2**

 **= 2 × 12 × 9 *+* 12× 12** 9 m

 **= 215 + 144**

 **= 259 m2**

 = 12 m

Be careful to use the slant height of the pyramid in this formula, not the height. The height goes from the vertex at the top to the middle of the base while the slant height of a face goes from the vertex at the top to the middle of the bottom of one of the sides.

**ASSIGNMENT 8 – SURFACE AREA**

Part A

Calculate the surface area of the figures shown below. Show all your work.

1) 5 cm

 12 cm



2) 15 in

 45 in.



3) 6.5 cm



4)

 25 in.

 20 in.

 20 in.

Part B

1) Jim is making a toy box. The box is 24 in. long, 18 in. deep and 36 in. tall.

 a) Draw a labelled sketch to represent this toy box.

 b) Calculate the surface area of the toy box in square inches.

2) Vicki has a new shower stall. It has an acrylic floor and a glass door. She will tile the three walls. The dimensions of the shower stall are 35” by 35” by 8 feet tall. What is the surface area she will be tiling?

3) Sanjiv designs a cylindrical container to hold tennis balls. Four tennis balls will fit inside, stacked on top of each other. The tennis balls have a diameter of 3 ¼ inches each.

 a) Draw a sketch to represent this container.

 b) Calculate the surface area of the container.

4) A paper cup in the shape of a cone has a slant height of 3 1/8 inches and a diameter of 3 inches. How much paper is needed to make the cup?

5) Denise has a hexagonal (6-sided) fish tank. The tank is 4 feet tall and each piece of glass is 1 ½ feet wide. How much glass is in the fish tank?

**MORE MEASUREMENT**

Rulers, metre sticks, and measuring tapes can give measurements to the nearest millimetre, or to the nearest 0.1 cm. Other measuring instruments can more accurately be measure to the nearest tenth of a millimetre, or 0.01 cm, or even to the nearest one thousandth of a millimetre or 0.001 mm depending on their scales.

The two measuring instruments you will be learning about in the booklet are the **caliper** and the **micrometer**.

**PART A – Vernier Calipers**

A Vernier caliper is an instrument used for making accurate linear measurements. It was invented by a French engineer named Pierre Vernier in 1613. It is a common tool used ion laboratories and other industries that require precise measurements. Manufacturing of aircraft, buses, and scientific instruments are a few examples of industries in which precision measurements are essential.

A vernier caliper (or it is often just called a “vernier” or “caliper”) is a convenient tool to use when measuring the length of a small object, or the outer or inner diameter of a round object like a pipe or hole. A vernier caliper can measure accurately to 0.01 cm, or 0.1 mm.



Reading a vernier caliper is not difficult. Once the jaws of the vernier are in place, the scales are set and the reading can be made.

**Steps to Read a Caliper:**

**Step 1:** Find the 0 on the moving scale.

**Step 2:** On the fixed scale, find the value that is aligned or just to the left of the 0 on the moving scale.

**Step 3:** Looking at the moving scale, look to right of the 0 and find the line that EXACTLY lines up with a line on the fixed scale.



 step 3

2. \_\_\_ \_\_\_ cm.

A good video to watch to help you read a vernier caliper is at: <http://phoenix.phys.clemson.edu/labs/cupol/vernier/vernier8.mpg>

Other sites that will help you if you are having any trouble are the following:

<http://www.physics.smu.edu/~scalise/apparatus/caliper/>

<http://www.upscale.utoronto.ca/PVB/Harrison/Vernier/Vernier.html>

**ASSIGNMENT 9 – Vernier Calipers**

Write their measurements down underneath each caliper.



1. \_\_\_\_\_ . \_\_\_\_ \_\_\_\_\_ cm



2. \_\_\_\_\_ . \_\_\_\_ \_\_\_\_\_ cm

3. \_\_\_\_\_ . \_\_\_\_ \_\_\_\_\_ cm



4. \_\_\_\_\_ . \_\_\_\_ \_\_\_\_\_ cm

**PART B – MICROMETERS**

Micrometers are another tool that can be used for making small, precise lengths. In fact, micrometers can make even smaller and more precise measurements than a vernier caliper can! Micrometers often measure things like the thickness of the walls of a pipe, nuts and bolts, washers, and nails. While vernier calipers can measure accurately to the nearest tenth of a millimetre (0.1 mm), a micrometer can measure to the nearest hundredth of a millimetre (0.01 mm).



Reading SI (Metric) Micrometers

When an object is placed in the jaws of a micrometer between the anvil and the spindle, the thimble is turned in order to make the object fit.

To read any length, first look at the top of the barrel reading. This scale is in millimetres. Simply count from the zero to where the thimble cuts across the barrel. In this example, the thimble crosses the barrel just past 8 mm. So this is our starting reading.

Now it is necessary to read the thimble on the micrometer. The thimble reading is made where the line from the barrel crosses the thimble. In this diagram, the thimble reads 12. However, this is NOT 12 mm but 0.12 mm. Now the readings are added together to get the final reading:

 8 mm + 0.12 mm = 8.12 mm

Notice on the bottom of the scale in the barrel that there are also divisions. These are half millimetre divisions. They come into play when the thimble is only partly turned between whole millimetre marks as shown in the second micrometer below:

While the top of the sale on the barrel is still showing 8 mm, there is a tick mark now showing on the bottom of the scale before the thimble. If this is the situation, you must add 0.5 mm to the top reading before reading the thimble. So this reading would be:

 8 mm + 0.5 mm + 0.12 mm = 8.62 mm

While measuring with a vernier caliper, there might be some room for error depending on which lines match the best, with the micrometer, there is only one right answer. Therefore, micrometers are much more precise and accurate than vernier caliper are.

Other sites that will help you if you are having any trouble are the following:

<http://members.shaw.ca/ron.blond/Micrometer.APPLET/>

<http://www.upscale.utoronto.ca/PVB/Harrison/Micrometer/Micrometer.html>

**ASSIGNMENT 10 – MICROMETERS**

Write the measurements indicated on each micrometer. Show your steps when applicable.

1.

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2.

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3.

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4.

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5.

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6.

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_