Instruction Sheet	Learning Guide #11

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- Selection of method for obtaining the measurements
- Obtaining accurate measurements in accordance with job requirements
- Conforming and recording measurements according to workplace procedures
- Using alternative measuring tool without sacrificing cost and quality of work

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Select and apply the measurements.
- Obtain to 1mm of accurate measurements.
- Confirm and record measurements according to workplace procedures.
- Use alternative measuring tool.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 20.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1” in page _7_.

5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).

6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Instruction #3.

7. Submit your accomplished Self-check. This will form part of your training portfolio.

8. Read the information written in the “Information Sheet 2”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.

9. Accomplish the “Self-check 2” in page _11_.

10. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 2).

11. Read the information written in the “Information Sheets 3 & 4”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.

12. Accomplish the “Self-check 3 & 4” in page _17 & 20_.

13. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 3 & 4).

14. If you earned a satisfactory evaluation proceed to “Operation Sheet 1” in page 22. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Instruction #3 & 4.

15. Read the “Operation Sheet 1” and try to understand the procedures discussed.

16. Go to your teacher if you need clarification or you want answers to your questions or you need assistance in understanding a particular step or procedure.

17. Do the “LAP test” in page _28_ (if you are ready). Request your teacher to evaluate your performance and outputs. Your teacher will give you feedback and the evaluation will be either satisfactory or unsatisfactory. If unsatisfactory, your teacher shall advice you on additional work. But if satisfactory you can proceed to Learning Guide #3.

Information Sheet-1	Selection of method for obtaining the measurements

2.1 Selection of method for obtaining the measurements

2.1.2 Measurements are to be in metric scale and cover all necessary calculations

Metric scale & its necessary calculation

Metric scales are the measurement scales that are used in the metric system. The metric scale is unlike the American scale.

Conversion of unit is simply multiplying by the correct number.

The following tables show some of the more common measures, the conversion between larger and smaller units, and the relation between metric system and Imperial/USA.

Metric /length & its necessary calculation

Metric			**US or Imperial**
1 millimeter [mm]		→	0.03937 in
1 centimeter [cm]	10 mm	→	0.3937 in
1 meter [m]	100 cm	→	1.0936 yd.
1 kilometer [km]	1000 m	→	0.6214 mile

US or Imperial			Metric
1 inch [in]		→	2.54 cm
1 foot [ft.]	12 in	→	0.3048 m
1 yard [yd.]	3 ft.	→	0.9144 m
1 mile	1760 yd.	→	1.6093 km

How to Convert Lengths

E.g. convert 3 feet lining into meters.

Steps: - Find the correct conversion number

1ft = 0.3048 meters

Steps: - Then just multiply by that number

So, 3ft * 0.3048 m/ft = 0.9144 m

Metric / Area & its necessary calculation

Metric			US or Imperial
1 sq. cm [cm^2]	100 mm^2	→	0.1550 in^2
1 sq. m [m^2]	10,000 cm^2	→	1.1960 yd^2
1 hectare [ha]	10,000 m^2	→	2.4711 acres

US or Imperial			Metric
1 sq. inch [in^2]		→	6.4516 cm^2
1 sq. foot [ft^2]	144 in^2	→	0.0929 m^2
1 sq. yd. [yd^2]	9 ft^2	→	0.8361 m^2
1 acre	4840 yd^2	→	4046.9 m^2
1 sq. mile [$mile^2$]	640 acres	→	2.59 km^2
1 sq. km [km^2]	100 ha	→	0.3861 $mile^2$

How to Convert Area

E.g. Convert 5 square meters into square centimeter

Steps: - Find the correct conversion number

$1m^2 = 10000cm^2$

Steps: - Then just multiply by that number

So, $5m^2 * 10000cm^2/m^2 = \underline{50000cm^2}$

Metric / volume & its necessary calculation

Metric			US Measure	Imperial
1 cu cm [cm^3]		→	0.0610 in^3	
1 cu decimetre [dm^3]	1,000 cm^3	→	0.0353 ft^3	
1 cu metre [m^3]	1,000 dm^3	→	1.3080 yd^3	
1 litre [l]	1 dm^3			

How to convert volume

E.g. Convert 2 cubic centimeters into cubic inch

Steps: - Find the correct conversion number

1cm3 = 0.0610in3

Steps: - Then just multiply by that number

So, 2cm3* 0.0610in3/cm3 = 0.122in3

Metric/mass & its necessary calculation

Metric			**US or Imperial**
1 milligram [mg]		→	0.0154grain
1 gram [g]	1,000mg	→	0.0353oz
1 kilogram [kg]	1,000g	→	2.2046lb
1 tone [t]	1,000kg		
1 tone [t]	1,000kg		

US or Imperial			**Metric**
1 ounce [oz]	437.5 grain	→	28.35 g
1 pound [lb]	16 oz	→	0.4536kg
1 stone	14 lb	→	6.3503kg

How to convert metric mass

E.g. covert 2gm in to kg

Steps: - Find the correct conversion number

1gm = 0.001kg

Steps: - Then just multiply by that number

So, 2gm * 0.001kg/gm = 0.002kg

Self-Check 1	**Written Test**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is metric scale? (2 point)
2. Identify the relationship between metric & partial system? (2 points)
3. convert 0.5 square meter into square centimeters. (3 points)
4. Convert 320 square centimeters in to square feet. (3 points)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Questions

1._____

_____

_____

_____

2._____

_____

_____

3._____

_____

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4. _____

_____

_____

Information Sheet 2	Obtaining accurate measurements

Accurate of measurement

1. An accurate measurement is the degree to which a measurement represents the actual value

- An accurate instrument is able to give readings close to or almost equal to the actual value of a quantity.

High Accuracy

2. An instrument with 100% accuracy does not exist.

3. The error is the difference between the measured value and the actual or true value

   Example, let actual value = 9.81, measuring value of A = 9.76 & B = 9.62

   Error A = 9.81 – 9.76 = 0.05
   Error B = 9.81 – 9.62 = 0.19

4. The level of accuracy is related to the relative error which is defined as the ratio of the error to the actual value.

$$\text{Relative error} = \frac{\text{Error value}}{\text{Actual value}} \times 100\%$$

5. A measured value with a very small error has a high accuracy. If the relative error is of a small value, the level of accuracy is high and vice versa.

$$\text{Error A} = \frac{0.05}{9.81} \times 100\% = 0.5\% \quad \text{, high accuracy}$$

$$\text{Error B} = \frac{0.19}{9.81} \times 100\% = 1.9\% \quad \text{, low accuracy}$$

6. The measurement is more accurate if its number of significant figures increases.

Measuring instrument	Thickness of a book
Meter rule	5.2cm
Vernier scale	5.22cm
Micrometer screw gauge	5.223cm

7. How to improve the accuracy of a measurement?

   a. Repeated readings are taken and the average value is calculated.
   b. Avoid parallax errors
   c. Avoiding the end errors or zero errors.
   d. Use measuring instruments with a higher accuracy. For example, a vernier caliper is more accurate than a ruler.

Self-Check 2	**Written Test**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers. Write your answers in the sheet provided in the next page.

1. The actual value measuring a length is 6.43, when two students taking the measurement they obtained 6.36 and 6.38. Who is taking an accurate measurement? (7 points)
2. What is the difference b/n accuracy & consistency (precision)? (3 points)
3. How to improve the accuracy of a measurement?

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Questions

1_____

_____

2 _____

_____

Information Sheet 3	Conforming and recording measurements

Recording Measurements

When one reads an instrument (ruler, set square, protractor, Vernier caliper, dial Vernier caliper, etc) expresses the reading as one which is reasonably reliable.

For example, in the accompanying illustration, note the reading marked A. This reading is definitely beyond the 7 cm mark and also beyond the 0.8 cm mark. We read the 7.8 with certainty. We further estimate that the reading is five-tenths the distance from the 7.8 mark to the 7.9 mark. So, we estimate the length as 0.05 cm more than 7.8 cm. All of these have meaning and are therefore significant. We express the reading as 7.85 cm, accurate to three significant figures. All of these figures, 7.85, can be used in calculations. In reading B we see that 9.2 cm is definitely known.

We can include one estimated digit in our reading, and we estimate the next digit to be zero. Our reading is reported as 9.20 cm. It is accurate to three significant figures.

Rules for Zeros

If a zero represents a measured quantity, it is a significant figure. If it merely locates the decimal point, it is not a significant figure.

Zero With in a Number. In reading the measurement 9.04 cm, the zero represents a measured quantity, just as 9 and 4, and is, therefore, a significant number. A zero between any of the other digits in a number is a significant figure.

Zero at the Front of a Number. In reading the measurement 0.46 cm, the zero does not represent a measured quantity, but merely locates the decimal point. It is not a significant figure. Also, in the measurement 0.07 kg, the zeros are used merely to locate the decimal point and are, therefore, not significant. Zeros at the first (left) of a number are not significant figures.

Zero at the End of a Number. In reading the measurement 11.30 cm, the zero is an estimate and represents a measured quantity. It is therefore significant. Another way to look at this: The zero is not needed as a placeholder, and yet it was included by the person recording the measurement. It must have been recorded as a part of the measurement, making it significant. Zeros to the right of the decimal point, and at the end of the number, are significant figures.

Zeros at the End of a Whole Number Zeros at the end of a whole number may or may not be significant. If a distance is reported as 1600 feet, one assumes two sig figs. Reporting measurements in scientific notation removes all doubt, since all numbers written in scientific notation are considered significant.

1 600 feet 1.6 x103 feet two significant figures

1 600 feet 1.60 x 103 feet three significant figures

1 600 feet 1.600 x 103 feet four significant figures

Sample Problem #1: Underline the significant figures in the following numbers.

(a) 0.0420 cm answer = 0.0420 cm (c) 2 403 ft. answer = 2 403 ft.

(b) 5.320 in. answer = 5.320 in. (d) 80.5300 m answer = 80.5300 m

Rounding Off Numbers

In reporting a numerical answer, one needs to know how to "round off" a number to include the correct number of significant figures. Even in a series of operations leading to the final answer, one must "round off" numbers. The rules are well accepted rules:

1. If the figure to be dropped is less than 5, simply eliminate it.

2. If the figure to be dropped is greater than 5, eliminate it and raise the preceding figure by 1.

3. If the figure is 5, followed by nonzero digits, raise the preceding figure by 1

4. If the figure is 5, not followed by nonzero digit(s), and proceeded by an odd digit, raise the preceding digit by one

5. If the figure is 5, not followed by nonzero digit(s), and the preceding significant digit is even, the preceding digit remains unchanged

Sample Problem #2: Round off the following to three significant figures.

(a) 3.478 m answer = 3.48 m (c) 5.333 g answer = 5.33 g

(b) 4.8055 cm answer = 4.81 cm (d) 7.999 in. answer = 8.00 in.

Multiplication

In multiplying two numbers, when you wish to determine the number of significant figures you should have in your answer (the product), you should inspect the numbers multiplied and find which has the least number of significant figures. This is the number of significant figures you should have in your answer (the product). Thus the answer to 0.024 x 1244 would be rounded off to contain two significant figures since the factor with the lesser number of significant figures (0.024) has only two such figures.

Sample Problem #3: Find the area of a rectangle 2.1 cm by 3.24 cm.

Solution: Area = 2.1 cm x 3.24 cm = 6.804 cm2

We note that 2.1 contain two significant figures, while 3.24 contain three significant figures. Our product should contain no more than two significant figures. Therefore, our answer would be recorded as 6.8 cm2

Sample Problem #4: Find the volume of a rectangular solid 10.2 cm x 8.24 cm x 1.8 cm

Solution: Volume = 10.2 cm x 8.24 cm x 1.8 cm = 151.2864 cm3

We observe that the factor having the least number of significant figures is 1.8 cm. It contains two significant figures. Therefore, the answer is rounded off to 150 cm3.

Division

In dividing two numbers, the answer (quotient) should contain the same number of significant figures as are contained in the number (divisor or dividend) with the least number of significant figures. Thus the answer to 528 ¸ 0.14 would be rounded off to contain two significant figures. The answer to 0.340 ¸ 3242 would be rounded off to contain three significant figures.

Sample Problem #5: Calculate 20.45 ¸ 2.4

Solution: 20.45/2.4 = 8.52083

We note that the 2.4 has fewer significant figures than the 20.45. It has only two significant figures.

Therefore, our answer should have no more than two significant figures and should be reported as 8.5.

Addition and Subtraction

In adding (or subtracting), set down the numbers, being sure to keep like decimal places under each other, and add (or subtract). Next, note which column contains the first estimated figure. This column determines the last decimal place of the answer. After the answer is obtained, it should be rounded off in this column. In other words, round to the least number of decimal places in you data.

Sample Problem #6: Add 42.56 g + 39.460 g + 4.1g

Solution: 42.56 g

39.460 g

4.1 g

Sum = 86.120 g

Since the number 4.1 only extends to the first decimal place, the answer must be rounded to the first decimal place, yielding the answer 86.1 g.

Average Readings

The average of a number of successive readings will have the same number of decimal places that are in their sum.

Sample Problem #7: A graduated cylinder was weighed three times and the recorded weighting's were 12.523 g, 12.497 g, 12.515 g. Calculate the average weight.

Solution: 12.523 g

12.497 g

12.515 g

37.535 g

In order to find the average, the sum is divided by 3 to give an answer of 12.51167. Since each number extends to three decimal places, the final answer is rounded to three decimal places, yielding a final answer of 12.512 g. Notice that the divisor of 3 does not affect the rounding of the final answer. This is because 3 is an exact number - known to an infinite number of decimal places.

Self-Check 2	**Written Test**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers. Write your answers in the sheet provided in the next page.

1. Explain about parallax errors (5 points)

2. Underline the significant figures in the following numbers (10 points)

(1) 10 lb. answer = 10 N.
(2) 0.020 ml answer = 0.020 ml
(3) 200. g answer = 200 g
(4) 2.4 x 103 kg answer = 2.4 x 103 kg

Note: **Satisfactory rating - 12 points points** **Unsatisfactory - below 12**

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Questions

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

Information Sheet 4	**Using alternative measuring tool without sacrificing cost and quality of work**

Using alternative measuring tools

It means using different types of tools to measure the same object such as we can measure the leather thickness gauge by using dial & digital thickness gauge and by which we will selecting appropriate tool

Tools used for measurement

- Measuring tape
- Ruler
- Vernier caliper
- Thread gauge
- Micrometer
- Dial indicator

Examples, which one is the measuring tool to measure outside diameter of button?

a. Ruler
b. Measuring tape
c. Dial vernier caliper

Answer:

We can use all the three tools mentioned above to measure outside diameter of ring but vernier caliper is the most appropriate tools than the other two. Because, the first reasons is vernier caliper built to measure inside & outside diameter of ring and second it is the most accurate instrument than the other two.

Self-Check 4	**Written Test**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: read the following questions and write your answers in the answer sheet provided:

1. What is an appropriate tool mean? (5 points)
2. Which measuring tool we use to take body measure? (5 points)
3. what are the different types of measuring tools?

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Questions

1. _____

_____

2. _____

_____

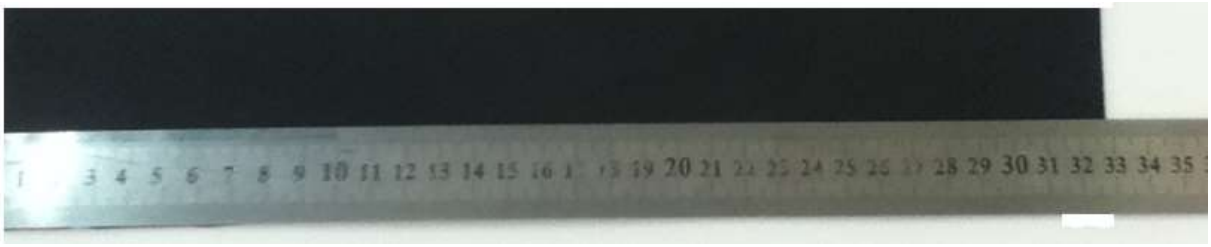
3. _____

_____

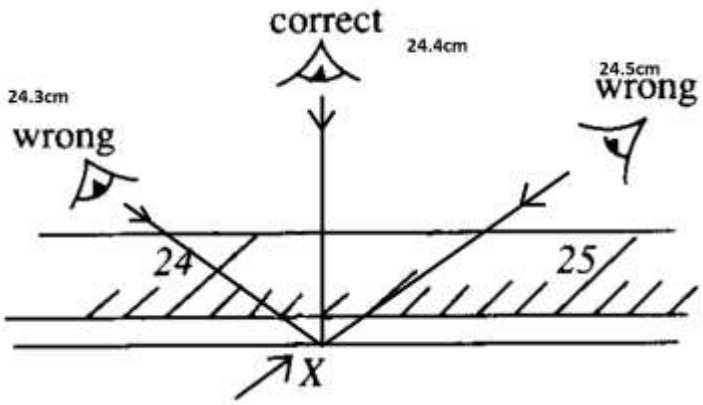
Operation Sheet 1	**Procedures in using alternative measuring tools**

Procedures to measure the length of one of the components of the leather jacket by using ruler

Steps 1 placing the meter rule on the edge of component to be measured so that the scale is touching it



Steps 2 placing the eye vertically (perpendicularly) above the marking on the scale to be read

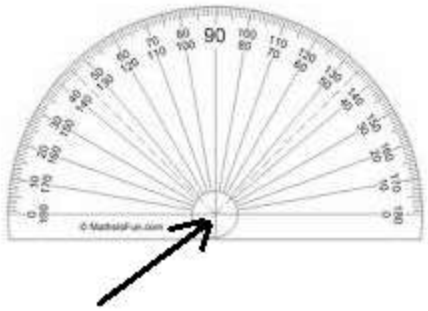


Steps 3 read the measurer value (32.7cm)

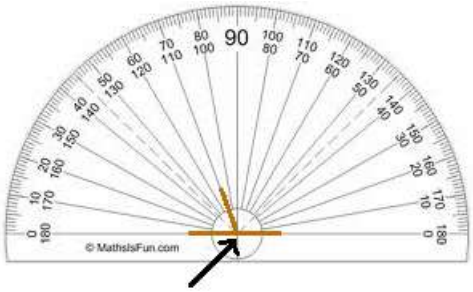
Note: One of the most common errors when we use ruler or measuring tape is when the eye is not in line with the object being measured. This is shown in the diagram above.

- Procedures to measure the angle by using Protractor

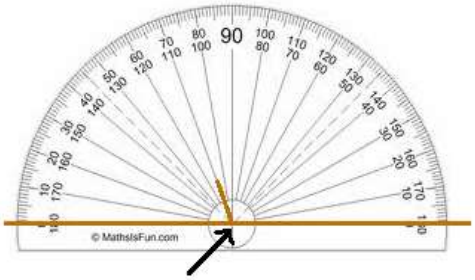
Step 1 Find the center hole on the straight edge of the Protractor.



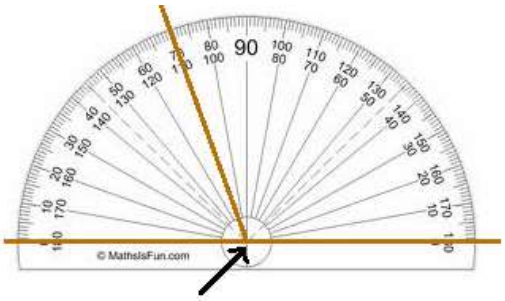
Step 2 Place the hole over the vertex, or point, of the angle you need to measure.



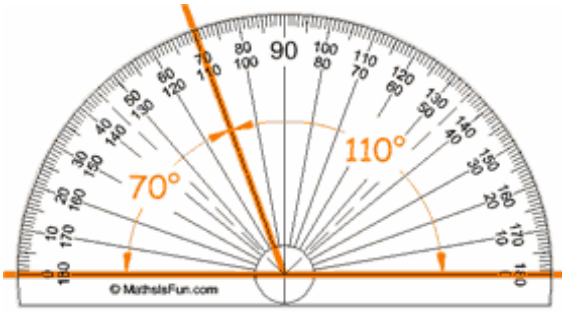
Step 3 Line up the zero on the straight edge of the protractor with one of the sides of the angle.



Step 4 Find the point where the second side of the angle intersects the curved edge of the protractor.

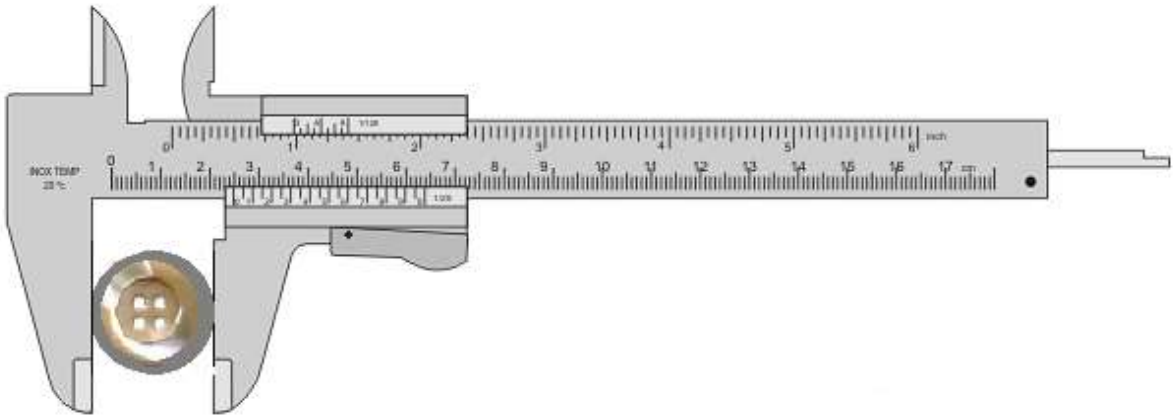


Step 5 Read the number that is written on the protractor at the point of intersection. This is the measure of the angle in degrees.

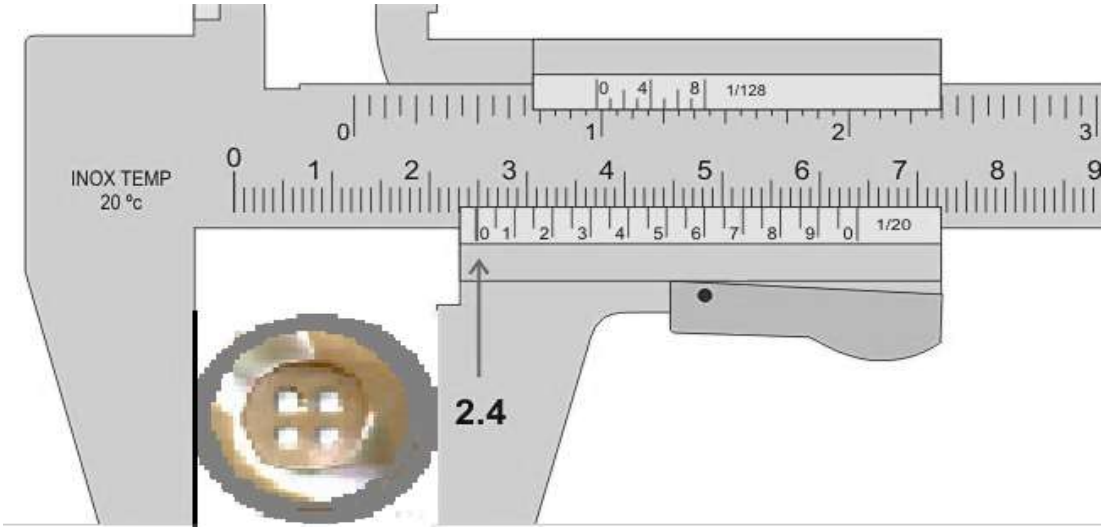


- procedure to measure the outside diameter of the button by using Vernier caliper

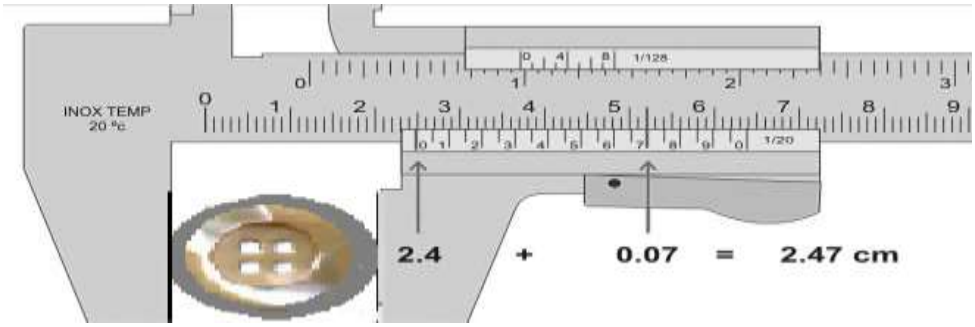
Step 1: Hold the button using the outside jaws of the calipers.



Step 2: Read the last division on the main scale that has passed the zero line of the vernier scale (2.4).



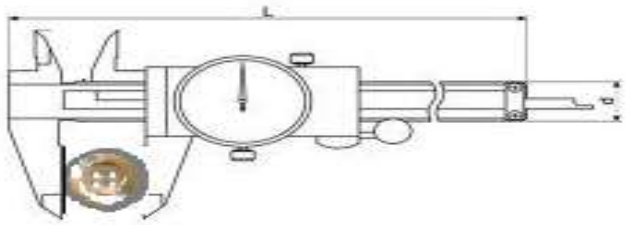
Step 3: Look for a line on the vernier scale which is exactly opposite to any line on the main scale, count this line, starting from the zero-line (of the vernier scale). This number is the next decimal place in your answer.



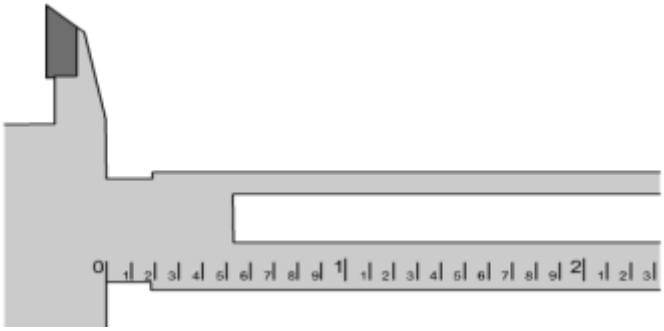
- procedures to measure How to use dial caliper

Getting accurate measurement by using dial caliper

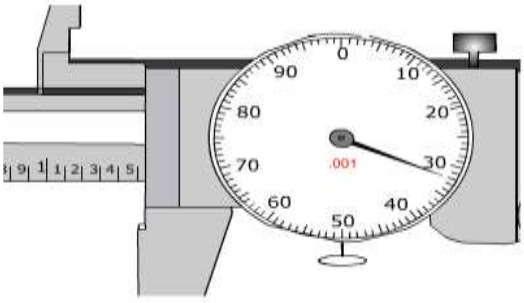
Step 1 Hold the button using the outside jaws of the calipers



Steps 2 Read the scale at the index.



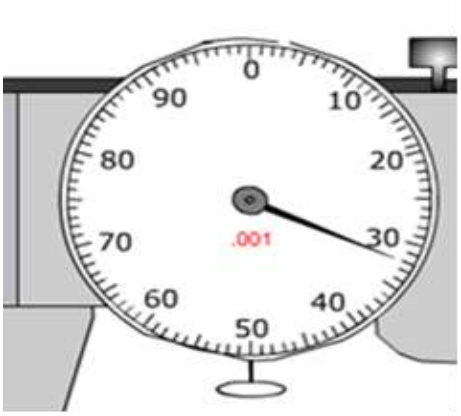
The index fall b/n scale graduations 1 & b/n 5 & 6.



In this case the scale reading 1.5

Step 3 Add the reading on the dial to the measurement

Where the 0.001 on the face of the dial tells you that each dial graduation is 0.001which means the dial reads 0.032.



Step 3 the calipers read 1.5 on the scale & 0.032 on the dial, and then the dial caliper reads 1.532unit.

- procedure to measure the thickness of the leather by using dial thickness gauge

Steps 1 Depressing the lever at the top of the indicator causes the anvil to rise

Steps 2 insert the leather to be measured

Steps 3 the measured values are read directly on the dial gauge.

Steps 4since the anvil and the contact point are adjusted for parallelism, accurate measured values are obtained.

Here the reading is 2.3mm it is because of the systematic error that is the dial is not start from 0, it is starting 1.9mm. Therefore, the reading on the dial 4.2mm – 1.9mm = 2.3mm

- Procedures to measure the thickness of the leather by using Digital thickness gauge

Except the first 3 steps and the reading system they are identical

Steps: 1. Before measuring, press the ON/OFF button to switch on power.

2. Press the mm/inch button to select a unit system needed.

3. Press the zero buttons to set zero.

4. Press the lever of the digital gauge to open the anvil

5. Insert the object to be measured.

6. The measured values are read directly on the digital gauge

LAP Test	**Practical Demonstration**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given answer sheet, workshop, dial & digital thickness gauge and leather you are required to perform the following tasks within 3 hours.

Task 1: Clean the given tools and material.

Task 2: Using the given paper, write the necessary steps to measure the thickness of the given leather

Task 3: perform your activities step by step and then put the result for each step on the paper.

Task 4: compare the result getting by two different measuring tools

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REFERNCES

https://www.dummies.com/health/how-to-get-your-body-measurements/

Kirch, Wilhelm, ed. (2008). "Level of measurement". Encyclopedia of Public Health. . Springer. p. 81. ISBN 978-0-321-02106-9.