GRADE 10 ESSENTIAL
UNIT C - MEASUREMENT

CLASS NOTES

INTRODUCTION

1. You measure things every day of your life, even if it is just approximately. How much further to the bus stop, how long till coffee break, how heavy your backpack feels, ….

Knowing how to measure stuff is evidently important! And rather common.

2. List a few things you have measured in the last few days (or hours)! What approximate (~) measurement was it?

a.

b.

c.

Linear Measurement

3. Measuring the lengths of lines! *Linear* means: 'lines, or one dimension'. Knowing how to measure lengths and distances is part of everyday existence. A line has no width, it is like a skinny imaginary thread between two points in the world; ie: a hair. A **distance** is measured along a line.

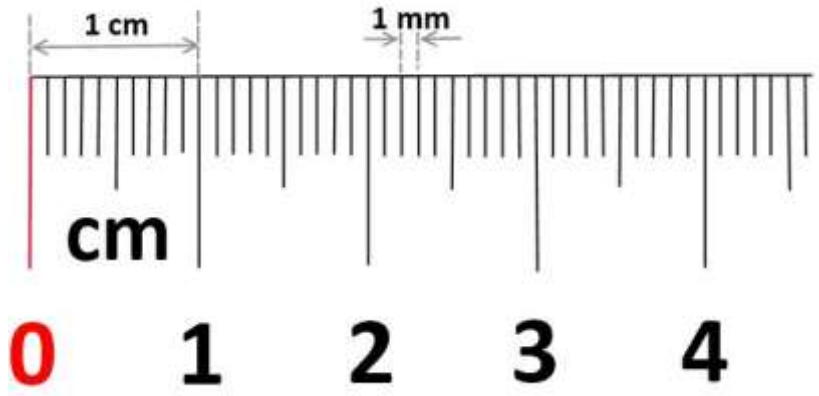
4. Name a few different ‘units’ of linear measurement (*eg*: inch) that you know and give a typical example of something having that length.

5. Can you apply paint to a line or length? _____ . Can a line hold some milk? _____. How much milk will a rectangle hold?_____

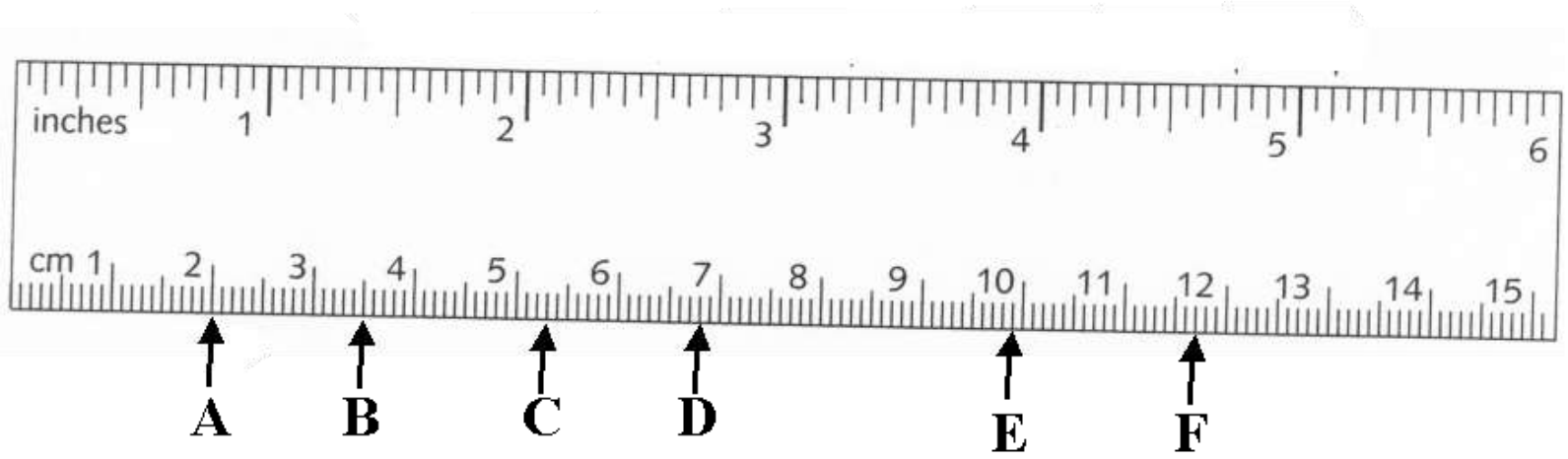
You will learn more about ‘areas’ and ‘volumes’ later.

6. **Reading A Metric Ruler**. Reading metric measures is easy, all units can be broken into tenths and then tenths again if necessary. So, measurements are all decimals (eg: 8.8 cm or 7.62 mm).

7. Markings on a metric ruler marked off in numbered centimetres [cm] and each subdivided into smaller millimetres [mm]:



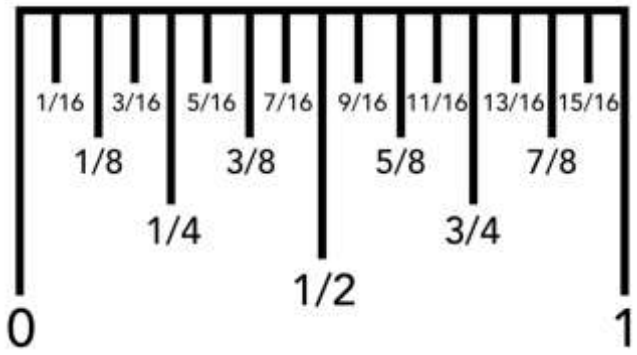
8. What are the readings, to the nearest tenth (0.1) of a cm, on the ruler below indicated by the letters?

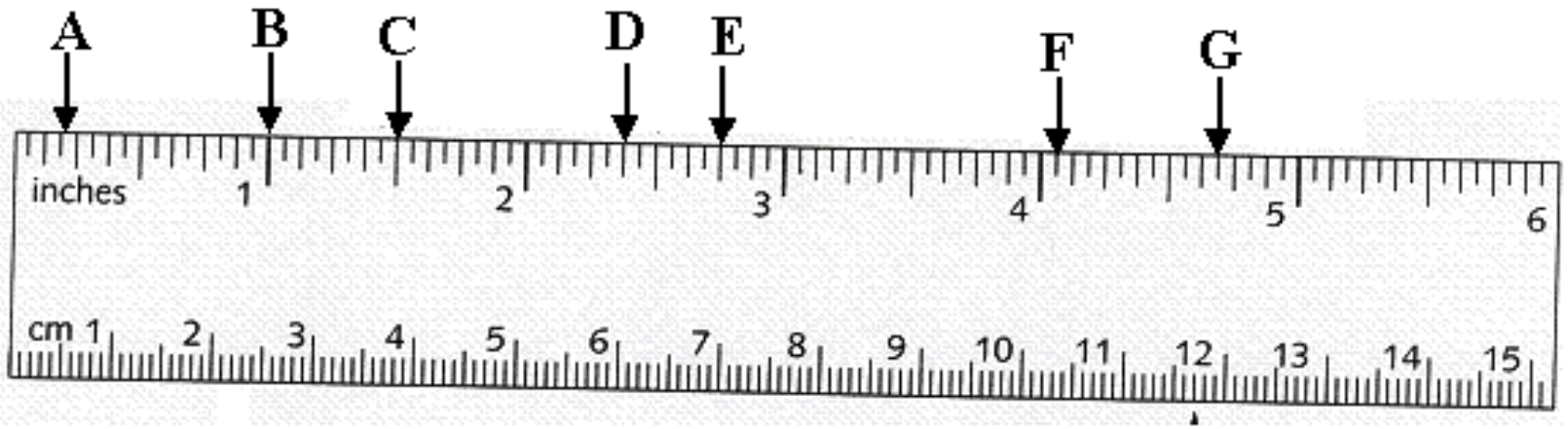


Caution: this ruler here may not be 'accurate', its size was changed for image display purposes. Do not use it to measure anything! lol.

Letter	**A**	**B**	**C**	**D**	**E**	**F**
Measure [cm]						

7. **Reading an Imperial Ruler (inches)**. The **British Imperial** system with inches though is done with fractions of one half. So **½**, **¼**, **1/8th**, **1/16th**, etc. The 'Imperial' (or 'British' or 'American Conventional') system does not use decimal numbers, you *cannot* say:'**1.2 inches**'! The imperial ruler is all about 'halfs' and 'halfs' of 'halfs' and ….





Record below the readings on the lettered positions above on the ruler:

Letter	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Measure [in]							

8. **Larger Linear Units**. There are many other units used to measure distance. Obviously, you would not measure the distance to your home community in inches. You ***could*** measure it in inches, but you would likely choose a unit that was larger so that you got a smaller number value for the measurement, besides measuring in a small unit like inches or centimetres would be overly *precise*! Other linear measurements include: metres, feet, yards, kilometres, miles, cubits, nanometres, lightyears, parsecs….. Being able to estimate a distance is important too. With experience you become familiar with all these units and can estimate pretty well.

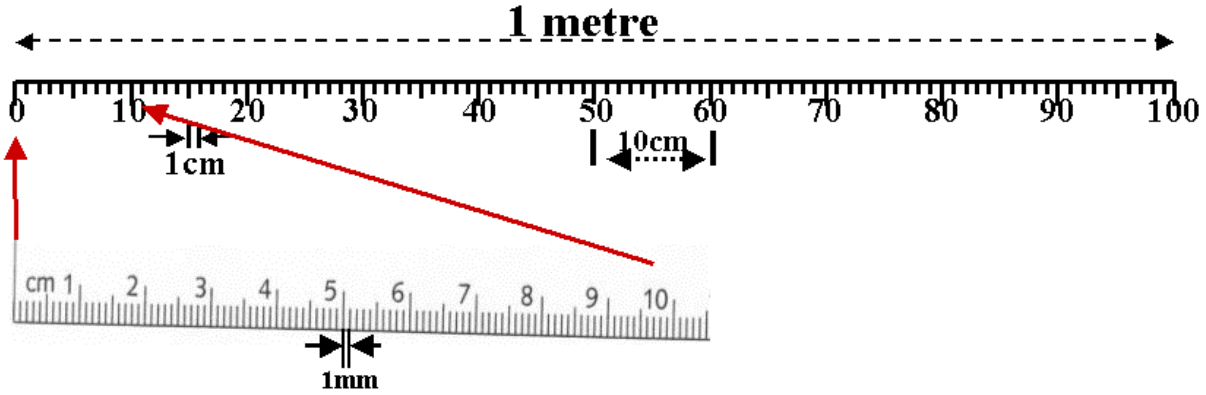
9. Now accurately measure the length, width, and height of your desk and record the measurements below! Be as accurate as possible, *at least* down to the nearest 0.1 cm and nearest 1/4th inch of precision.

Example:
174.6 cm
68 3/4 in

	cm	**in**
Length, l		
Width, w		
Height, h		

10. **Measuring With a Metre Stick**. The metre is a practical and most common unit of measure in all the world (except the USA). It is a metric length unit of the '**Système International**' or **SI** or more commonly the '**Metric System**'. Originally the length of the metre was selected so it was close to an arm's length and close to the English '**yard**'. It was originally defined as being such that *ten million* of them would go from the North Pole to the Equator. Originally there was a 'master' metre stick in a glass case in Paris that countries could copy, the real length of a metre is now determined by the number of wavelengths of a certain colour of a light beam.

The metre is broken into smaller parts. The *centi*metre [cm] and the *milli*metre [mm].



the millimetre is so small we will have to zoom in on the left part of the metre stick.

these rulers not 'to scale', do not use them to measure the height of your sister!

THE SI METRIC SYSTEM

11. We are lucky. Canadians use the Metric System as does 95% of the world. Canada switched over in the mid-70s from the British Imperial System, even the British do not use the Imperial System anymore. Americans are the only country in the world that still use that old crazy British system.

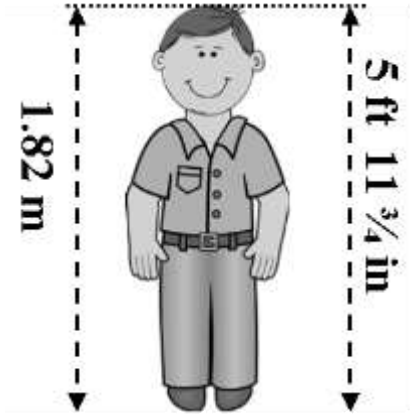
12. The Metric System is properly called the **Système International** or '**SI**' System. It was promoted by the French over 200 years ago.

13. The foremost advantage of the metric system (for some people) is that all the numbers are decimal numbers (*no fractions!*). And all the different sizes of a measure are multiples of ten. So, for example: A ***KILO***metre is **1,000** metres. **Kilo** means 1,000. 1,000 is just three tens multiplied together, $10 \bullet 10 \bullet 10 = 10^3 = 1{,}000$.

Compared to the '***old***' system, ie: the **British** system or **Imperial** System (aka the *American Conventional* System) that has 5,280 feet the same as one mile for example! OMG, where the heck does **5,280** come from??? **16** ounces in one **pound**, **12** inches in one foot, …… Thank goodness no one uses that anymore. (*sarcastic?*)

Multiples and divisions of 100 or 1,000 is way easier than dividing by 5,280! Easy to divide by a thousand in your head! (Hopefully you know how to divide by a 1,000 mentally by moving the decimal point three places left). Thank goodness Canada switched to the metric SI system in the 70's.

14. The **SI** system uses decimal numbers in the measurement of values. So, for example, a person can be **1.82 metres** tall; a nice simple decimal value. Computers like decimal numbers!



Compare this to the *same* person who is **5 foot 11 and 3/4 inches** tall in the 'old' British system. OMG! Two different units are used and **fractions** too! *Silly*!(?) Thank goodness nobody uses that system anymore (*l.o.l*).

15. The metric system uses *dec*imals, and it uses powers of 10. As you will see, conversions of measures within the metric system just involve moving a decimal point!

'*dec*' means '10', as in a *dec*ade has 10 years. '*Deci*' means 1 part out of 10, ie: 'one tenth' or $^{1}/_{10}\,th$ .See how the prefixes of words are pretty helpful.

Multiply decimals by multiples of 10. In the event you do not recall, multiplying and dividing decimal numbers by 10 is just a matter of moving the decimal point:

$5 \cdot 100 = 5.00 \cdot 100 = 500.$

$7.3 \cdot 1{,}000 = 7.300. = 7{,}300$

$57 \div 100 = 57/100 = .57$

$= 0.57$

The Powers of 10 and the Metric Prefixes

16. Knowing the following prefixes is **essential** to a ready understanding of the metric system.

Prefix	Means	
Kilo	1,000	0ne thousand
Hecto	100	One Hundred
Deca	10	Ten
Deci	1/10	One Tenth
Centi	1/100	One one-hundredth
Milli	1/1000	One one-thousandth

17. **Memorize these ↑.** You will find that you use them so often already it will be easy to remember. Further it turns out that 99% of the time you will normally only use the bold prefixes above. Jot them down here a few times here, say them to your self as you do it.

In the "old" days we would write something out 50 times! It works!

18. Where have you used the prefixes before? List a few measures you have used. Do you know any other prefixes not listed here? List some of your thoughts ↓.

Curious Fact. When you study science, you will find that everything in our universe can be measured with just **metres** (length), **grams** (mass), and **seconds** (time). In fact, no respectable scientist would measure anything in feet or inches!

REFERENTS

19. A referent is a familiar idea or example you can refer too to get a feel for something. So let us select a referent for a couple common metric measures.

a. **Length**: **one metre [m]**: About a long pace for an average person. Or close to a 'yard' if you are into that old system. We still use yards in golf and football and lacrosse.

b. **Length: one centimetre [cm]**: Technically it is one one-hundredth $\left(1/100\right)$ of a metre! So, if you chopped a metre into 100 equal pieces, each of these pieces would be one centimetre long. The width of your baby fingernail for example (for an adult).

c. **Weight (mass). gram [g]**: The weight of a Smartie! The weight of a dime or a $5 bill.

d. **Weight (mass): kilogram [kg]**: The weight of a *thousand* (kilo) smarties or dimes. Or exactly the weight of one *litre* of milk (the tall skinny carton of milk).

e. **Time: seconds [s].** Everyone knows how long a second is, close to a heartbeat. Curiously enough though we do not measure time using metric system. There is no such measure as a centi-day. Although there still are groups that want to go metric for time as well; "…see you in a milli-day". [Just curious! How many minutes would a *milli-day* be?]

That is all you need to know. You may want to come up with your own *referents* from your own experience.

20. Let's use these basic referents to select an appropriate metric unit to measure common items. What unit of measure would you use to measure the following? Avoid using decimal places. You want to be reasonably precise; you want to use manageable numbers; you would not measure the length of your nose in metres! Estimate:

a. length of a car _____

b. length of your nose: _____

c. weight (mass) of a car: _____

d. mass of your nose: : _____

e. weight of a steak at dinner: _____

f. height of your child: _____

g. length of a flee: _____

h. mass (weight) of a flee: _____

Advanced Thinking. What units would you use to measure the mass of our earth? What sort of unit of measure would you use for the weight of a flee? Do you know what *Scientific Notation* is for really big and really small numbers? You may want to investigate those ideas or ask teacher. The earth weighs 5,972,000,000,000,000,000,000,000 kg

CONVERT BETWEEN METRIC (SI) MEASURES

21. In order to convert metres to kilometres for example one must know how to make ratios and *solve proportions*. Solving proportions is prior learning but we can refresh it here.

22. **Example**: If grandma's secret muffin recipe is ten raisins per one muffin, then how many raisins do you need for six muffins? Her recipe has that secret '*ratio*', 10 for one!

$$\frac{Raisins}{Muffins} \rightarrow \frac{10}{1} \rightarrow \frac{?}{6} \qquad \frac{Raisins}{Muffins} \rightarrow \frac{10}{1} \overset{\text{times 6}}{\rightarrow} \frac{?}{6}$$

So, 10 for one is the same as *what* for 6? You did say '60' I hope. If you make six times as many muffins you better use six times as many raisins if you want to follow the ratio of grandma's recipe.

SIMPLE PRACTICE

a. $\frac{5}{10} = \frac{?}{100}$ **Ans: 50**	b. $\frac{3}{4} = \frac{?}{20}$ **Ans: 15**
c. $\frac{7}{8} = \frac{x}{40}$ **Ans: 35**	d. $\frac{5}{8} = \frac{x}{20}$ *(Toughy!)* **Ans: 12.5**

23. Notice we started to slip in an '***x***' instead of a question mark (?). Just easier to write an *x* than a '?'. Whenever we write '***x***' it means: "some value". BTW: In high school we do not use a cross, ×, for multiply, we use a dot: •

24. That last one was a toughy! $\frac{5}{8} = \frac{x}{20}$. There is a secret way to solve it though! You '*cross multiply*'. The 'cross multiply' method is the best way to solve simple proportions.

Write the proportion: $\frac{5}{8} = \frac{x}{20}$ Now 'Cross Multiply':

Get the unknown amount '*x*' by itself by crossing across the equals sign the number under the 'x'.

$\frac{5}{8} = \frac{x}{20}$ to give $\frac{5*20}{8} = x$. So that $\frac{100}{8} = x$ so that x = **12.5**

← and of course make sure it makes sense!

Check! 5/8 = 0.625 ; 12.5/20 = 0.625 ✓

25. You try a few; solve these *proportions* to find the unknown amount '***x***':

a. $\frac{5}{6} = \frac{x}{21}$ Ans: 17.5	b. $\frac{4}{15} = \frac{x}{35}$ *Ans: 9.33*
c. $\frac{4}{7} = \frac{x}{20}$ Ans: 11.43	d. $\frac{100}{1} = \frac{x}{35}$ Ans: 3,500

Don't forget to check!

And does your solution make sense?

26. Easy eh!

Try this: $\frac{3}{4} = \frac{9}{x}$! *Ooopsy*. Somebody put the '**x**' in the bottom. Well, who says it has to be 3 girls for every 4 boys, isn't 4 boys for every 3 girls the same thing? Well just flip the entire equation upside down! $\frac{4}{3} = \frac{x}{9}$ then it is obvious that '**x**' is 12.

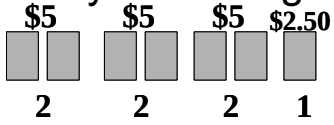
Word Problem Example

27. If you can get 5 pokes in the eye for $12, how much will it cost you for 8 pokes in the eye? Hint: set up the ratios so the proportion has the unknown on the top. So $ values in the top, poke values in the bottom.

$\frac{\$12}{5\ pokes} = \frac{\$x}{8\ pokes}$; therefore $\frac{\$12*8}{5} = \$x$ therefore $\frac{\$96}{5} = \$x$ therefore
using a calculator **x = $19.2** (of course the old manual long dividing works too!)

So, **8** pokes in the eye will cost you **$19.20**

28. If Phyllis sells her bannock at two bannock for $5.00, how much will 7 bannock cost? Hint our unknown '*x*' amount is some amount of money according to the question.
Show your equation and solution:



← me, I like drawings!

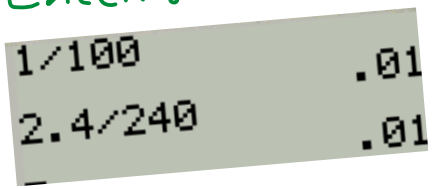
Ans: $17.50

METRIC SYSTEM CONVERSION RATIOS

29. If there is **100** centimetres [cm] for every **1 metre** [m] then **240 cm** is the same as how many metres? *Hint: unknown in top of proportion.*

$\frac{1\ m}{100\ cm} = \frac{x}{240 cm}$; therefore $\frac{1\ m*240\ cm}{100\ cm} = x$, therefore x = **2.4 m**

Check?



30. It looks like converting units in the metric system is no different than selling bannock or making muffins!

If there is 1 kilogram [kg] for every 1,000 grams[g] then how many kg is 530 grams?

$\frac{\mathbf{1}\ \boldsymbol{kg}}{\mathbf{1{,}000}\ \boldsymbol{g}} = \frac{\boldsymbol{x}\ \boldsymbol{kg}}{\mathbf{530}\ \boldsymbol{g}}$, $\therefore$ x = 0.53 kg [!! Make sure any values you give include units otherwise it would not make any sense!]

35. So now you just need to **memorize** a bunch of equivalent ratios for the metric measures and you can convert anything! Yes, you really must memorize them! But wait, what did we say the first page!?? '***kilo***' means **1,000**, '***centi***-' means **1/100** and '***milli-***' means **1/1000**.

There your memorization is pretty much done! But say it to yourself, out loud 50 times! (not on the bus!) Then your ears remember, your lips remember, …..Just looking at something is not a normal way to learn, you have to engage the idea!

Curious Fact: In French or Italian or Spanish **cent** means 100 and **mille** means 1,000.
And a Million is a thousand thousand.

36. Study the pattern! Look for *kilo*, *centi*, *milli*.

1 hectare = 10,000 m^2

Length		
1000 metres [m]	=	1 **kilo**metre [km]
100 centimetres [cm]	=	1 metre [m]
1,000 millimetres	=	1 metre [m]
Mass (weight)		
1000 grams [g]	=	1 **kilo**gram [kg]
100 centigrams [cg]	=	1 gram [g]
1,000 milligrams [mg]	=	1 metre [m]
Volume (litres)		
1000 litres [L]	=	1 **kilo**litre [kL]
100 centilitres [cl]	=	1 litre [L]
1,000 millilitres [mL]	=	1 litre [L]

36. My wife says I have 25 centi-brains. How much brain do I have?

Ans: **0.25** brains, or **25/100**, or ¼ of a brain if you want to get fancy.

That's ok, ….I call her a '*mega*b****'.

Mega: million **Giga**: billion **Tera**: Trillion **micro**: million*th* nano: billion*th*

37. We have lots of these other prefixes too that you will certainly use if you ever get into science.

38. **PRACTICE METRIC CONVERSIONS. You do these; show work of course**

a. 3.5 km = _____ m Ans: 3,500 m	b. 4.53 kg = _____ g Ans: 4,530 g
c. 1,236 g = _____ kg Ans: 1.236 kg	d. 456 m = _____ km Ans: 0.456 km
e. 2,130 mL of water = _____ L of water Ans: 2.13 L	f. 4,200 mm = _____ cm Ans: 420 cm

39. Did you get that last one? → 4,200 mm = _____ cm ?

I never got you to memorize millimetres **to** centimetres! Just do a double conversion! Turn the millimetres into metres then the metres back into centimetres.

4,200 mm = 4.2 m *and then* **4.2 m = 420 cm**. ∴ 4,200 mm = 420 cm

It is a ***two-step*** conversion! Of course, if you recall fractions: $\frac{\mathbf{4{,}200}}{\mathbf{1{,}000}} = \frac{\mathbf{420}}{\mathbf{100}}$ but fractions seem to be rather weak for many people these days.

FYI. There are other and more useful ways to do conversions but for now this is more than sufficient.

FYI 2. Have you ever noticed in life that a **few big** things are the same as a **lot of little** things? So a **lot of little cm s** is going to be a **smaller number of bigger metres**. *Such wisdom we learn in math*.

MrF

40. **Try these *two step* conversions using the basic conversions above: SHOW WORK!! For you!**

Don't forget to check! And does it sound about right?

a. 230 cm = _____ mm **Ans: 2,300 mm**	b. 340 mg = _____ cg **Ans: 34 cg**
c. 4.5 km = _____ cm **Ans: 450,000 cm**	d. 0.53 kL = _____ cL **Ans:** 53, 000 cL **you won't see **kL** used very often except in Asia***

Of course, especially if you become a tradesperson these will just instantly happen in your head after you do a couple thousand conversions! Doing these conversions the wrong way around can be seriously deadly! Make sure you think of your referents and does the answer make sense. If it turns out that a flee weighs the same as 3.2 litres of milk, then you are likely doing the conversion wrong!

BRITISH IMPERIAL SYSTEM OF MEASURES

41. **The Imperial Linear Measurements**. The *Imperial System* (the old English system only really used officially in the USA anymore) has some pretty bizarre measurements.

a. A **foot** (like the length of a normal man's foot) is 12 inches.

FYI: $1 \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{16}$

Inches are subdivided into halves, and quarters (1/4^{ths}) and 1/8^{ths}, and 1/16^{ths}, etc.

b. Three feet is a **yard**. A yard is conveniently pretty close to a metre. Of course, we all know yards from football and golf and lacrosse!

c. 1,760 yards is a mile. And of course, 1,760 yards is really 5,280 feet (if you multiply by 3). So, a mile is really 5,280 feet. However, that is a *statute mile*, there is another kind of mile too, but let's not confuse things….!

42. The British Imperial Units are *crazy* compared to the international **SI** metric units. You need to be rather good with fractions with Imperial units. Further, the British Imperial system will mix different units in one measurement, so someone might be 5 foot, 10 and a quarter inches [$5\ ft\ 10\ ^{1}/_{4}\ in$], or a baby might be 7 pounds and 9 and a half ounces, *7 lb 9½ oz*. **Crazy**! So, the 'old' system usually used a *big* unit, then a *smaller* unit for more accuracy, and then a *fraction* of a small unit for even more accuracy.

43. You may want to research for yourself the history of the British Imperial system. Suffice it to say there was for a long time no **standard** size units. A foot was the length of *your* foot, an acre was how much land your horse could plow in a day. Consequently, the measures depended on your foot size and the health of your horse. A mile was the distance a Roman soldier could walk in 1,000 paces as they conquered England, etc. The units weren't overly exact or standardized and sometimes varied from country to country or town to town even.

We have internationally agreed **standard** measurements now so that a metre is the same length everywhere, a kg is the same weight everywhere, etc.

Standards!
Did you Rnow 100 years ago we did not even agree what the date was! Oct 1 for us was Oct 15 in Russia!

Referents for Imperial Measures

45. Referents for the Imperial System include:

a. **Inch**: the width of your thumb

b. **Foot**. A long as a man's normal foot!

c. **Yard**. The length of an adult male's outstretched arm to centre of chest, or a large pace.

d. **Mile**. The distance between gravel roads out in the prairie country (exactly)

e. **Pound**. A bit more than the weight of a full *can of pop*. ~ Weight of a football

f. **Ton**. Weight of a small car.

g. **Quart**. Close to a metric litre. We used to go to the store to get a quart of milk, very close in volume to a litre.

h. **Ounce**. A slice of bread ways an ounce, or five quarters (coins)

Selected British Imperial (American Conventional) System Conversions

Length Conversions		
1 mile [mi]	=	1,760 yards [yd]
1 yard [yd]	=	3 feet [ft]
1 foot [ft]	=	12 inches [in]

Mass (Weight) Conversions		
1 ton [t]	=	2,000 pounds [lb]
1 pound [lb]	=	16 ounces [oz]

Volume Conversions		
8 gallons [gal]	=	1 bushel
1 gallon	=	160 ounces [oz]
1 pint	=	0.125 gallons
or 8 pints	=	1 gallon [gal]
1 quart [qt]	=	0.25 gallons
or 4 qt	=	1 gal
1 pint	=	0.5 quarts

Volume (USA vs Imperial)		
1 gallon (US)	=	0.832 gallons (English)
1 gallon (US)	=	128 ounces oz (US)
Really gets confusing with two different gallons depending on your country!		

*Caution: Ounces of **weight** (a slice of bread) are different from ounces of **volume** (a shot of whisky)!!! So very confusing!*

And of course, there is cups and pecks and tablespoons and teaspoons and firkins and hogsheads, nautical miles, ….omg!! Thank goodness we went metric!

You will of course be given a sheet of these conversion factors for tests and exams, you will likely want to memorize a few of them regardless. In my day we had to memorize everything! *Lol*.

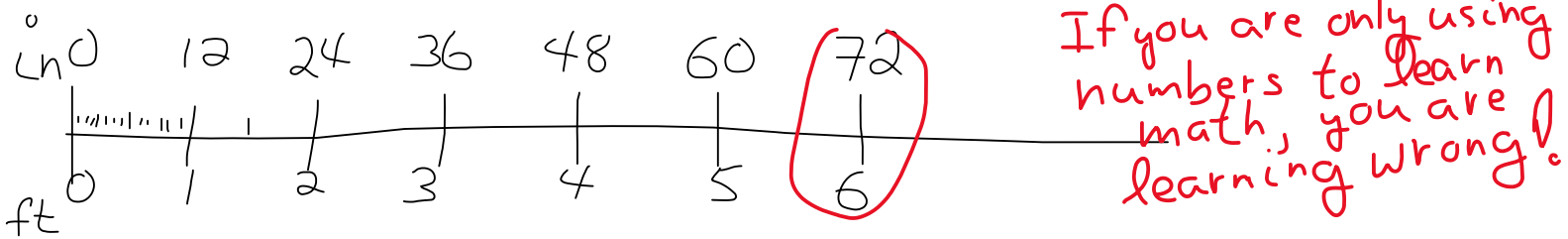
CONVERTING WITHIN THE BRITISH IMPERIAL SYSTEM

46. The procedure to convert in the British Imperial System is identical to metric conversion method of course. It is just different units of measure and way stranger unit conversion numbers.

47. **Example Conversion**. Convert **6 feet** into inches given the unit ratio **12 inches is one foot**.

$\frac{12in}{1ft} = \frac{x}{6ft}$; so: $\frac{12*6}{1} = x$ so: x = 72 inches

Me! I draw things! And you really should do! Numbers are silly way to explain things!



If you are only using numbers to learn math, you are learning wrong!

You Do! Show work of course, step by step; for you!:

a. 96 inches is how many feet? **Ans: 8 ft**	b. 35 yds = _____ feet **Ans: 105 ft**
c. 8 gallons = _____ quarts **Ans: 32 qt**	d. 6 lbs = _____ oz **Ans: 96 oz**
e. 27 inches = _____ ft (and inches) **Ans: 2 ft 3 in or 2' 3"** *Notice in the Imperial System we often use two units combined: a big unit and the next smaller unit.*	f. 4 lbs 8 oz = _____ oz Ans: 64 oz

BTW: we do not pluralize abbreviations of units

Notice e. above. The answer is expressed in ft and if there are any remaining inches you just say so. 27 inches is 2 feet and 3 inches. You **do not say 27.25 feet** because we do not break out our Imperial rules into tenths and hundredths, we break it out into **twelfths** (called an inch)! There is 'technically' no such thing as a decimal amount of foot!!

So nasty. [Can you think about why maybe they did that?]

CONVERTING BETWEEN SYSTEMS

50. Converting back and forth from the British Imperial System to the Metric System is no different than any conversions we have done already. You just need a table of unit conversion ratios.

MrF

Converting between systems

3.28 is usually sufficient

Conversions SI to Non-SI Length		
1 metre m	=	3.2808 feet ft
1 metre m	=	39.370 inches in
1 kilometre km	=	0.6214 miles mi
2.54 cm		1 inch

Conversions Non-SI Imperial – Mass		
1 kilogram kg	=	2.205 pounds lb
1 tonne	=	1.1 ton

2.2 is usually good enough

Conversions SI to Non-SI Volume		
1 gallon (English)	=	4.546 litres
1 gallon (US)	=	3.785 litres
1 gallon (English)	=	4,546 cm^3
1 gallon (US)	=	3,785 cm^3

Conversions SI to Non-SI Area		
1 sq mile	=	259 hectares
1 sq mile	=	2,589,988 m^2
1 square metre	=	10.76 ft^2
1 square metre	=	1,550 in^2
1 hectare	=	2.47 acres

EXAMPLE CONVERSION BETWEEN IMPERIAL AND METRIC

51. **Easy Example**. Convert 22 feet into metres.

$$\frac{1\ m}{3.2808 ft} = \frac{x\ m}{22 ft} \quad \therefore \quad \frac{1 * 22}{3.2808} = x \cong 6.71 \text{ m}$$

when I round off an answer I like to show that it is an approximate answer

52. **Crazy Example**. Convert 15 metres into feet and inches. This is way nastier if you do not like fractions!

$$\frac{3.2808\,ft}{1\,m}=\frac{x}{15\,m} \quad \therefore \quad \frac{3.2808*15}{1}=x=49.21\,feet$$

but *wait*! There is **no such thing** as 0.21 feet. The next unit down is inches, so 0.21 feet is the same as 2.52 inches!

But *wait again!….* no such thing as 0.52 of an inch, that is pretty much 1/2 an inch.
So, the Imperial Measure is actually **49ft 2½** inches. Or **49' 2½"** and rounded a bit.

Aren't you glad we don't use the Imperial System any more!

Another Crazy Example

53. Your cousin in the USA said she had a baby that weighed **5 lbs 6 oz**. You want to convert that to a proper Canadian weight measure in **kg**.

5 lb 6 oz means $5\,lb+\frac{6}{16}\,lb$ which means $5\frac{6}{16}\,lb$ since there are 16 oz in one lb which as a decimal would be 5.375 lbs. So now you convert:

$$\frac{\mathbf{1}kg}{\mathbf{2.205}\ lb}=\frac{x}{\mathbf{5.375}\ lb} \quad \therefore \quad \frac{\mathbf{1}*\mathbf{5.375}}{\mathbf{2.205}}=x \cong \mathbf{2.44\ kg}$$

You will see me use "∴" often! It means "therefore"

CHALLENGE! Now you try to convert that 2.44 kg back to the original Imperial!

Two Three Step Conversions

55. Sometimes you may need two-step or multi-step conversions if you don't have a unit conversion given to you! Or if you don't have an app or web page that does it for you!

How many inches in 4 km? ← OMG! mega lots! lol.

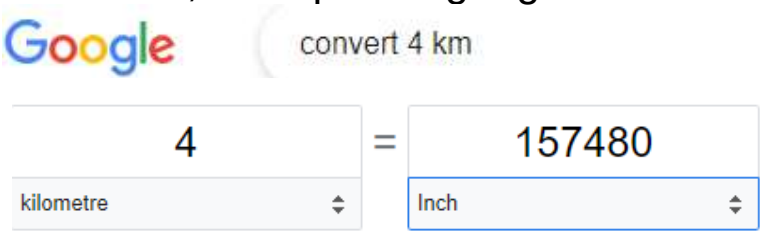
Convert the km → miles, the miles → feet , the feet → inches.

$\frac{0.621mi}{1km} = \frac{x}{4\ km}$; therefore x = 2.484 mi. *(notice you should avoid rounding till the very end)*

$\frac{5280ft}{1mi} = \frac{x}{2.484\ mi}$; therefore x = 13115.52 ft

$\frac{12\ \ in}{1\ ft} = \frac{x}{13115.52\ ft}$; therefore x = 157,386 inches. We probably round to the nearest hundred anyway in this case and just call it 158,400 inches. In Grade 11 we will learn properly when it is appropriate to round and to what place value.

Of course, if desperate google knows the answer:



You are not allowed to google the answer in math! You show your work! Curious! Google gives a slightly different answer! Why?

56. For now, the proportion method this is sufficient. There does exist a much easier way to do multi-step conversions; the science way. Watch this↓: How many inches in 4 km?

$4km = 4km * \frac{0.621\ mi}{1\ km} * \frac{5280\ ft}{1\ mi} * \frac{12\ in}{1\ ft}$, notice how units in the top cancel units in the bottom.

$$4km = 4\cancel{km} * \frac{0.621\ \cancel{mi}}{1\ \cancel{km}} * \frac{5280\ \cancel{ft}}{1\ \cancel{mi}} * \frac{12\ in}{1\ \cancel{ft}}$$

$$= \frac{4*0.621*5280*12}{1} = 157{,}386.24\ in$$

Notice how if the units cancel out you can be confident you probably did it right

VOLUME (CAPACITY)

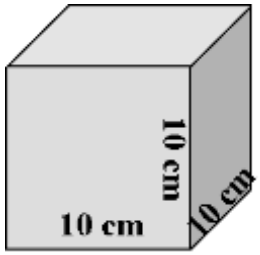
57. We have used the litre in a couple calculations but what is a litre?

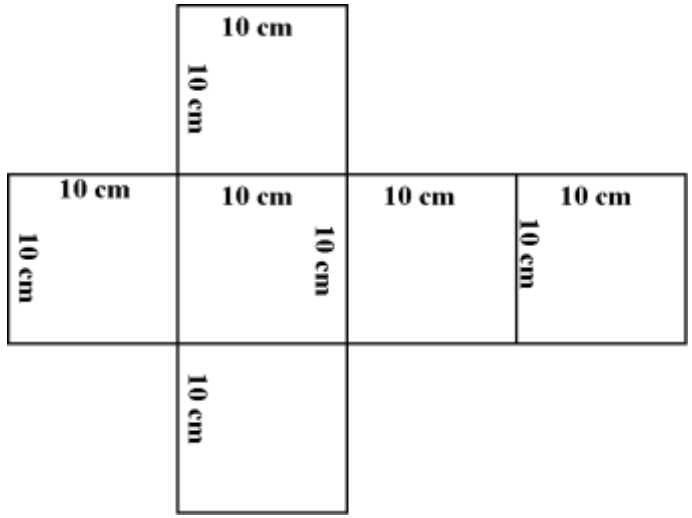
A litre is how much material or fluid a hollow 3-D object will hold. When I lived in Nova Scotia I used to buy apples by the bushel, you still hear about the price of wheat measured in bushels on the news. I used to buy my beer by the 'firkin' in England.

The Litre is a much easier unit. You can make your own Litre with just a metric ruler.

Make Your Own Litre Measuring Cup

60. Make a cube with all edges 10 cm long!





It holds exactly one litre! That is how they **defined** the litre!

AND!!! If you fill it with pure water it weighs exactly one Kg.

For Fun. Have teacher show you how to make a *millilitre* cube with a ruler!

TEMPERATURE MEASUREMENT

61. Temperature is a measure of how fast molecules are jostling around inside a substance. Technically it can be measured with just metres, kilograms, and seconds (how much stuff is moving how quickly)

62. Most scientists use a mercury thermometer to measure temperature. The most common kind is a mercury thermometer although there are electronic transducers that can do the same electronically.

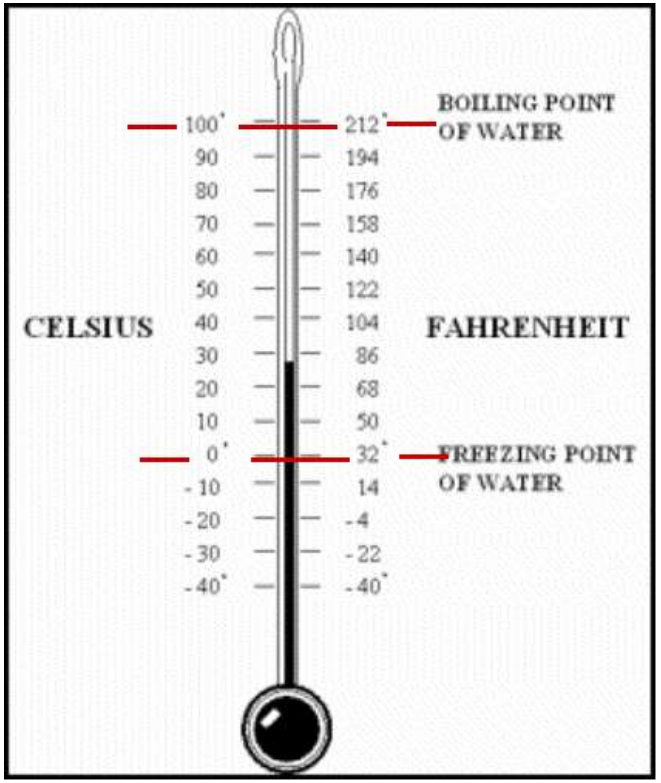
63. When scientists (Mr. Fahrenheit) originally started to measure temperature using a tube of mercury. He found where on the tube water froze and where it boiled. He did not want to call freezing 'zero' because then some cold winter mornings would be below zero outside and people would not understand a temperature being below zero; a 'negative' number. So, Fahrenheit picked 32 as a number where water froze.

64. Then he made some evenly spaced tick marks going up the tube to where water boiled and he found that the smallest interval he could make and still read the instrument was 180 tick marks.

So, he said that water boils at 32°F + 180°F or **212**° F.

Of course, later, a scientist named **Celsius** proposed we just make things simpler and say that water **freezes at zero** and **boils at 100**. We call that the **Celsius** scale. Most of the world now uses the Celsius Scale (except the USA!)

Water freezes at 0°C and boils at 100°C.



Temperature Referent.

65. The human body has a fairly constant temperature of 37°C which is close 98.6°F.

Room temperature is generally from 19 to 21°C or *about* 66 to 70°F.

Temperature Conversion

66. The relationship between the two scales has already been described and can be mathematically expressed as

F = (C * 9/5) + 32; where F is the temperature in degrees Fahrenheit and C is the temperature in degrees Celsius.

67. In the event you want to figure out the C given the F, the formula can be readily re-arranged as:

C = (F – 32) * 5/9 where F is the temperature in degrees Fahrenheit and C is the temperature in degrees Celsius.

Jot those formulae down on your two-page reference notes (Cheat Sheet) for sure.

Example Converting Temperature

68. Your aunt's old cookbook says to cook a turkey at **625°F**, but *your* oven works in Celsius (I hope you noticed!). What Celsius temperature do you set your oven to?

Write down the formula: **C = (F – 32) * 5/9**
Plug in the known values: **C = (625 – 32) * 5 / 9**
of course on your calculator it will probably look like this when you enter it:
C = (625 – 32) * 5 ÷ 9; *don't forget the brackets!!!!*

Answer: **C = 329°C** . So, you would probably set the stove to **330°C**.

Careful! I think most ovens still use the Fahrenheit temperature though! Do not mess with that button on your stove! It could be a burnt supper! Fortunately, most cooking instructions and recipes give the oven temperature in both **°F** and **°C**

69. **You Try**. Convert as indicated. (*check the answers on the thermometer diagram above*)

a. 100°C = _____ °F Boiling H_2O Ans: 212°F	b. 932°C = _____ °F A jet engine! Ans: 1,710°F
c. 35°F = _____ °C Ans: 1.7°C	d. 92°F = _____ °C A hot day Ans: 33°C
e. $^{-}$40°C = _____ °F Ans: $^{-}$40°F (the same)	f. 15°C = _____ °F Ans: 59°F

OPERATIONS WITH MEASUREMENTS (ADDING AND SUBTRACTING)

70. Adding and subtracting metric units is easy

1.2 m + 4.6 m = 5.8 m; 5°C + 12°C = 17 °C; 4.9 kg + 0.3 kg = 5.2 kg

But you can't add oranges to bananas they have to be the same units!

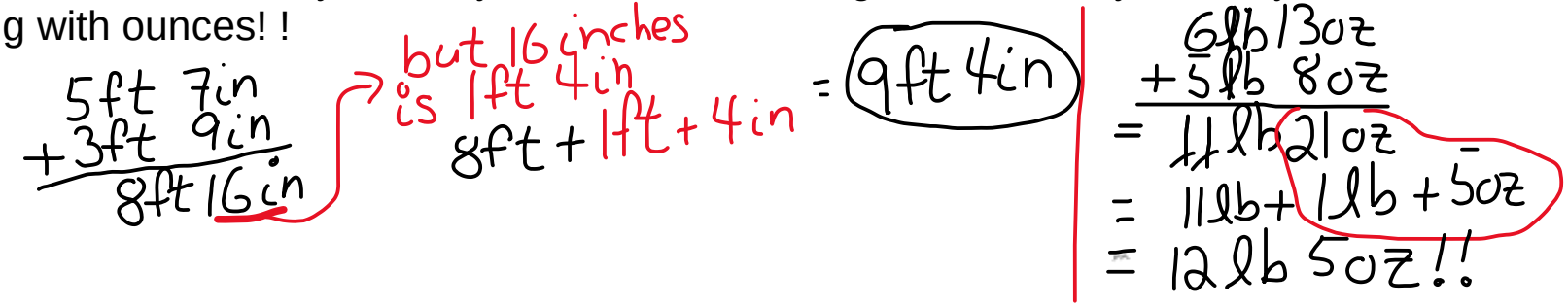
143 cm + 1.2 m = 1.43 m + 1.2 m = 2.63 m or 263 cm

560 g + 4.32 kg = 0.56 kg + 4.32 kg = 4.88 kg or 4,880 g

71. But how do you do add and subtract the old Imperial, British, now American Conventional system?

5 ft 7 in + 3 ft 9 in = 9 ft 4 in! 6 lb 13 oz + 5 lb 8 oz = 12 lb 5 oz!

You did remember that you 'carry' at 12 when working with inches; you 'carry' at 16 when working with ounces! !



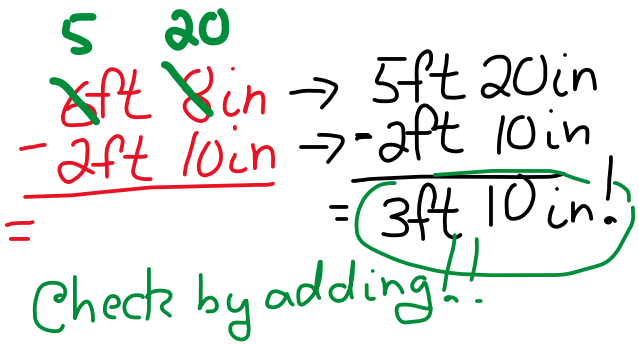
72. And the same idea when subtracting! Except you **borrow** from 12 if using feet and inches and you **borrow** from 16 if using pounds and ounces

If you have a board that is 6 ft 8 inches and your boss asks you to cut off 2 ft 4 inches; how long is the board?

6 ft 8 in – 2 ft 4 in = 4 ft 4 in! EASY!

But what if the boss asks you to cut off 2 ft 10 inches?

6 ft 8 in – 2 ft 10 in = 3 ft 10 in ; WTH!



We will do a few worksheets on this idea for sure! So, for example, what is 1 hr 45 min plus 3 hr 35 min? Did you get 5 hr 20 min?

CONCLUSION

75. You have completed the main ideas of the unit. There are a dozen practice sheets and a workbook you can work on as your instructor guides **YOU** through **YOUR** Learning.

See the attached Appendices for amplifying and enhanced material.

Make sure you are assembling the many ideas you have learned into a nice concise set of notes that will fit all of Grade 10 Essential Math onto both sides of a single piece of paper.

APPENDIX A
TO GRADE 10 ESSENTIAL UNIT C MEASUREMENT
ENHANCED LESSONS

1. This Appendix provides the opportunity to present some prior learning review and enhanced learning. The prior and enhanced learning here includes:

   a. Scientific Notation (introduction / review as the case may be)

   b. Converting units by conversion factors and multi-step conversions

   c. Adding fractions (introduction / review as the case may be)

   d. Measuring devices: calipers and micrometers

SCIENTIFIC NOTATION (REVIEW)

2. Scientific notation is critical if you plan on doing any science someday.

It is surprisingly easy; in fact convenient! It relies on you understanding **Exponents**.

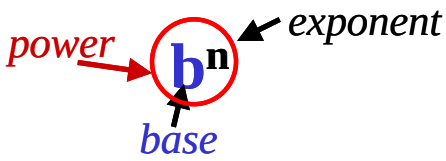
Exponents

2 + 2 + 2 + 2 + 2 is often more conveniently written as 2 * 5. It is called multiplying, a bunch of the same number added together.

3. So how do you more conveniently write 2 * 2 * 2 * 2 * 2 ? This is a bunch of the same number multiplied together. We write it like this:

$$2^5$$

Simple! The little 'superscript' number 5 squirted into the upper-right corner is called the exponent. The 2 here is called the base. The entire thing is called a 'power'



The most common base is 10, like in the Metric System.

POWERS OF BASE 10				
Power	Expansion	Value	Written	Prefix
$1 * 10^0$	1	1	one	
$1 * 10^1$	1 * 10	10	ten	Deca
$1 * 10^2$	1 * (10 * 10)	100	one hundred	Hecto
$1 * 10^3$	1 * (10*10*10)	1,000	one thousand	***Kilo***
$1 * 10^4$	1* (10*10*10*10)	10,000	ten thousand	-
$1 * 10^5$	….etc	100,000	one hundred thousand	-
$1 * 10^6$	….	1,000,000	1 million	Mega
$1 * 10^9$	….	1,000,000,000	1 billion	Tera

Properties of Exponents

4. Certain properties of exponents make handing very large numbers and very small number very easy.

5. **Demonstration**. If there are **3,000** bean plants growing on each square metre of soil, then how many are there on 10,000 square meters?

3,000 * 10,000 = 30,000,000

Pretty soon the number gets so big your calculator can't even display them!
Besides who want to write all those zeroes??
So we write in Scientific Notation:

$3 * 10^7$

Saying **$3 * 10^7$** *means* 3 * 10 * 10 * 10 * 10 * 10 * 10 * 10, or 30 million.

I suppose you could say 30 Mega-plants (but nobody does for some reason, I *wonder* why)

Recall: **10,000 square metres** [m^2] is what we call a **hectare** of land. Bit more than a couple **acres**.

6. The smart way to do a large number like this is to do this math ↓

3,000 is the same as **$3 * 10^3$** and **10,000** is the same as **$1 * 10^4$**.

So 3,000 * 10,000 is $3 * 10^3 * 1*10^4$
which is: $3*1*10^3*10^4$
which is: $3 * 1 * (10 * 10 * 10) * (10 * 10 *10 *10)$
which is: **$3 * 10^7$**

omg! all you had to do was **add** the **exponents**

$10^3 * 10^4 = 10^{(3+4)} = 10^7$

A fancy rule: **to multiply** powers with the same base **add** their exponents.

Product Law of Exponents

general law: $b^m * b^n = b^{m+n}$

example: $10^2 * 10^6 = 10^8$

7. You try:

a. $10^3 * 10^6$ *one thousand times one million*	b. $10^2 * 10^5$ **one hundred times one hundred thousand**	c. $3*10^2 * 5*10^6$
d. $4.2 * 10^5 * 3* 10^2$ *42,000 * 300*	e. $3.06 * 10^2 * 5$	f. $(1.4*10^{11}) \div (3*10^8)$ **The distance to the sun divided by the speed of light!**

Notice that last example, it was a divide! You may have deduced (logic) the rule we used there to divide. Multiply is to add as divide is to …….. ?

8. **Rule**: To multiply powers of the same base we add exponents.

so to divide powers of the same base we _____ exponents

Quotient Law of Powers

general law: $b^m \div b^n = b^{m-n}$

example: $10^6 \div 10^4 = 10^2$

9. You Try: (you may start to notice that proper use of brackets is important, especially with dividing involved)

a. **$10^4 \div 10^3 =$** 10	b. **$(6 * 10^7) \div (3 * 10^3) =$** $2*10^4$ or 20,000
c. **$(4.86 * 10^5) \div 2 =$** $2.43*10^5$ or 243,000	d. **$(1.84 * 10^2) \div (12.4 * 10^4) =$** $1.48* 10^{-3}$ or 0.00148….

Word Problem using Really Big Numbers

10. There are about **15 billion** stars in our galaxy. Each star weighs about **$4.1 * 10^{30}$ kg**. Planets weigh hardly anything in comparison. What is the wait of the all the [visible] matter in our galaxy?

What is 15 Billion times 4,100,000,000,000,000,000,000,000,000,000 kg

ie: 15,000,000,000 * 4,100,000,000,000,000,000,000,000,000,000 kg

Easy:

$15 * 10^9 * 4.1 * 10^{30} = 15 * 4.1 * 10^9 * 10^{30} =$

$= 61.5 * 10^{39}$

so 61.5 and move the decimal point 39 places to the right;

so: **61,500,000,000,000,000,000,000,000,000,000,000,000,000 kg**

try doing that on paper or on a non-scientific calculator! I think **$61.5 * 10^{39}$** kg is easier.

Minor note. Technically speaking a proper scientific notation number should be between 1 and 10, so we should have called $61.5 * 10^{39} \rightarrow 6.15 * 10^{40}$.

11. Very Small fractions and negative Exponents will be discussed outside of these notes. They will be somewhat intuitive if you take the time to consider them or research them.

EXPONENTS AND SCIENTIFIC NOTATION ON A CALCULATOR

Calculators do exponents too you know. Each calculator is different. For some you use the **y^x** button, others use a ^ button. Figure it out. Try **2^5**, should get **32**.

Better yet, a scientific calculator does Scientific Notation too! Since each calculator is different you will have to ask your teacher what buttons apply. On some calculators it is an EE button, on some it is an EXP button. And there are many differing ways that calculators display the answer, so you really need to ask your teacher.

MULTI-STEP CONVERSIONS USING CONVERSION FACTORS

12. In the main notes we primarily used the method of proportions and unit ratios to convert measurements. (if one muffin gets 8 raisins then 10 muffins get 80 raisins). A much more useful method is the **unit factor method**. It allows you to mix together lots of different conversions all at the same time in one shot. This is what you will use exclusively in any science!

Example: how many minutes in 80 years? (a lifetime)

$$80\ yr * \frac{365\ days}{1\ yr} * \frac{24\ hr}{1\ day} * \frac{60\ min}{1\ hr}$$

arranging all the conversion factor ratios so that the units in the top cancel the units in the bottom until you get it to where you want!

= 80 * 365 * 24 * 60 min = **42, 048, 000** minutes.

13. So you live about forty-two million forty-eight thousand minutes. *How many seconds*?

ADDING FRACTIONS (REVIEW)

14. If you are a carpenter or welder or any tradesperson then you will need to know how to work fractions. ***There is no way around it***! Sorry.

15. If your boss want to know the perimeter around the outside of a rectangular box form to install a fan switch and you measure it to be **1½" + 2¼" + 1½" + 2¼"** then what is the sum? Did you say **7½"** **?** That would make your boss happy!

Adding Mixed Numbers and Fractions → Same Denominator.

16. **Important** to know that **1½"** *means* **1 whole plus a** ½ fraction of a whole.

So **1½"** ***means*** **1" + ½"**. That is why we call it one and a half! It is an inch long plus an extra half!

Numbers that are a mixture of whole counting numbers and fractions of numbers are called **mixed numbers**.

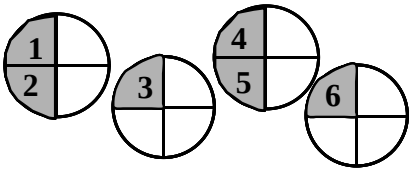
The ***whole*** parts of those measurement were easy **1" + 2" + 1" + 2" = 6"**

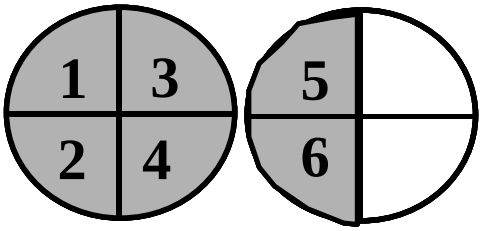
How about those fractions? **½" + ¼" + ½" + ¼"**

17. **Pizza Math**

½pizza + ¼pizza + ½pizza + ¼pizza

If you put all the fractions of pizzas together you would have 6 quarters of pizzas, or **1½** pizzas re-arranging the slices.





One and a half pizzas

18. That was the **quickest fraction lesson** you ever had!

19. But notice your **slices** have to be the **same size**! Half pizzas and quarter pizzas are not the same size so you turn all the fractions of pizzas into quarters of pizzas so you can count them up! And if some of them add up to a whole pizza or more then that is ok too!

20. You Try:

a. **2½ + 3¼** 5¾	b. **6½ + 10¾** 17¼
c. $5\frac{1}{8}+2\frac{1}{2}$ 7&5/8	d. $6\frac{3}{8}+3\frac{3}{4}$ 10&1/8

21. That is how easy it is in the Imperial System. Especially since there is no such thing as fifths and sevenths. Everything is just halves (½) and halves of halves (¼) and halves of halves of halves (*eighths*).

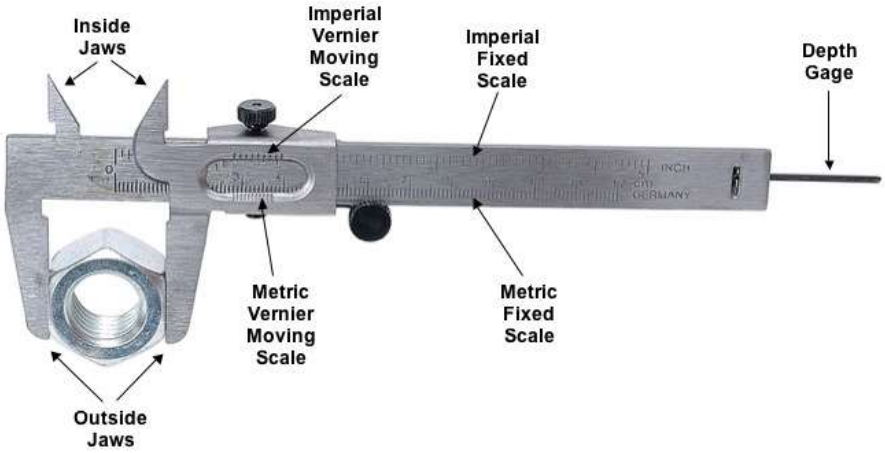
22. **Multiply Fractions**. Of course to multiply fractions you could just add a bunch of times, 2½ * 6 = 2½ + 2½ + 2½ + 2½ + 2½ + 2½ = 12 + 6/2 = 15 but we will save that for a geometry unit.

MEASURING DEVICES: CALIPERS AND MICROMETERS

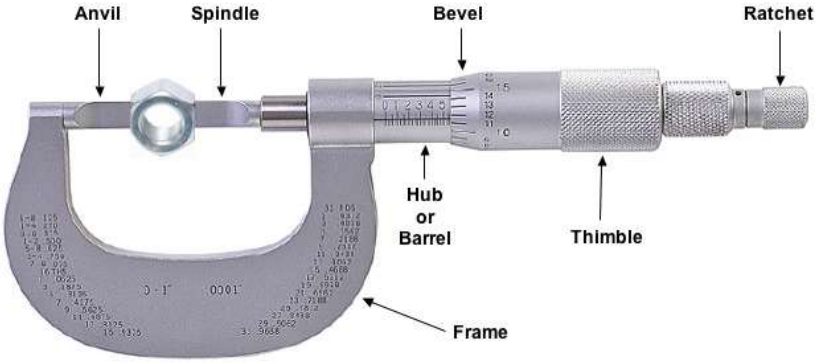
Learning to use calipers and micrometers for very accurate and precise measurements will be demonstrated in class.

An essential skills for trades like machinist.

Calipers



Micrometer



APPENDIX B TO
UNIT C – MEASUREMENT GLOSSARY

Accuracy. How close a measurement is to the true value. Accuracy can be affected by inaccurate rulers (devices) or user error (how well the user reads the device). Additionally, there is some statistical error frequently as well.

British Imperial System. The former system we used in Canada until mid-70s. Based on weird values and measures, some of which were not accurately defined for hundreds of years. It uses fractions a lot, weird fractions too, like twelfths and 16ths, etc.

Commutative laws of arithmetic. The common sense law that says that 3 beans plus 4 beans is the same number of beans as 4 beans plus 3 beans; **3 + 4 = 4 + 3** or more generally **a + b = b + a**; some number of beans added to another number of beans is the same as the other number of beans added to the first number of beans

It works for multiplication too! **a * b = b * a**. ie: 3 bunches of 6 is the same as 6 bunches of 3.

Decimal. A decimal number is really a fraction. When we say 4.52 we mean 4 and 52/100^{ths}. But with decimals the fractional part is always based on tenths and hundredths and thousandths.

Exponent. The number of times we multiply the same factor together. So **2 * 2 * 2 * 2** is more easily written as the $\mathbf{2^4}$ since it is four factors of 2 multiplied together. Exponents are used extensively in Scientific Notation.

Factor. Numbers that are multiplied together are called factors.

Fraction. A part of something. If one thing is broken into 4 parts we call that ¼. If we share 5 perogies with 8 people obviously each person only gets a part of a whole perogie! They only get 5/8^{ths} of a perogie.

Proportion Method. A [Unit] Conversion ratio is used to find an equivalent ratio or proportion. 6 is to 1 as 60 is to 10. Most easily solved by cross multiplying across the equals sign

$$\frac{6}{1} \quad \frac{x}{10}$$

Mixed Numbers. Whole numbers (counting numbers) mixed with fractions. So 2½ means two whole things plus half of that thing. 2½ is identical to 2 + ½. (people often forget that)

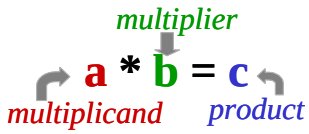
Metric System. a two hundred year old system developed by the French. It is based on well defined measures and larger and smaller measures are all multiples of 10! It uses decimals instead of fractions.

Precision. Precision is different from **accuracy**. A precise ruler would have very tiny marks on it, maybe every 1/16th of an inch of every millimetre. But of course, the ruler could still be inaccurate because it was left sitting in the sun and stretched!

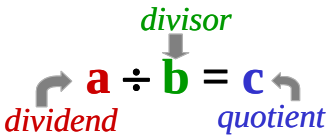
> You can tell someone you will meet them for coffee at 11:34, a pretty **precise** time; but if your watch is off by seven minutes you will not be very **accurate** in telling time.

Proportion. The equivalent comparison of two ratios. 4 girls for every 5 boys are the same as 8 girls for every 10 boys. $\frac{4}{5} = \frac{8}{10}$

Product. A product is the result of a multiplication. A multiplicand is multiplied by a multiplier to get a product. Technically speaking it doesn't matter much what you call the first two since a * b = b * a (commutative)



Quotient. The result of dividing. A dividend is divided by a divisor to get a quotient. **a ÷ b = c** is most often actually written: $\frac{a}{b} = c$. Division is not commutative.



Ratio. The comparison of two numbers, generally of the same unit.
6 raisins for every 1 muffin: 6:1, or 6/1

Scientific Notation. The use of exponents and powers of 10 to express very large numbers and very small numbers. Especially useful for science. Eg: 3,400,000,000 is better expressed with scientific notation as **$3.4 * 10^9$**.

Significant digits. A consideration that is especially important in science measurements. When you combine two values that have different precision you can only be as precise as the least precise value. Eg: It is *about* 200 km to Brandon and you are driving at 113.4 km/h. How long will it take to get there?

> Technically speaking you cannot say 1.764 hours since combining a rough distance with an accurate speed should not give you an accurate time.

In daily math instruction we tend to neglect this concept, just be aware it is very important in science.

Unit conversion factor. A factor that we use to convert one unit to another by multiplying. Generally, it is best expressed as a ratio like $\frac{2.54\,cm}{1\,in}$ where one of the values is a 1.

$$3\,\cancel{in} * \frac{2.54\,cm}{1\,\cancel{in}} = 7.62cm$$

Whole Numbers. The numbers {0, 1, 2, 3, 4, 5, 6 …….} up to infinity.

APPENDIX C
TO GRADE 10 UNIT C MEASUREMENT

SELECTED CONVERSIONS

Système Internationale [SI] Metric System Unit Ratio Conversions

Conversions SI Metric – Length and Distance		
1 kilometre [km]	=	1,000 metres [m]
1 meter [m]	=	100 centimetres [cm]
1 centimetre [cm]	=	10 millimetres [mm]

Conversions SI Metric – Mass		
1 tonne [t]	=	1,000 kg
1 kilogram [kg]	=	1,000 grams [g]
1 gram g	=	1,000 milligrams [mg]

Conversions SI Metric – Volume		
1 litre [L]	=	1,000 millilitres [mL]
1 litre [L]	=	100 centilitres [cL]
1 litre [L]	=	1,000 cc (or 1,000 cm^3)
1 millilitre [mL]	=	1 cc (or 1 cm^3)

'**cc**' stands for cubic centimetre which is really just cm^3.

Notice also that a cube of dimensions 10cm by 10 cm by 10 cm [1,000 cm^3] is **one litre and** it weighs **one kg** when filled with pure water.

Conversions SI Metric – Area		
1 square metre	=	10,000 cm^2
1 hectare	=	10,000 m^2 (100m * 100m)
1 cm^2	=	100 mm^2

So, a square 100 m by 100 m is a hectare.
Used for measuring land area.

BRITISH IMPERIAL (and American) Conversions

Conversions Non-SI (Imperial) – Length		
1 mile [mi]	=	1,760 yards [yd]
1 yard [yd]	=	3 feet [ft]
1 foot [ft]	=	12 inches [in]

Conversions Non-SI Imperial – Mass		
1 ton [t]	=	2,000 pounds lb
1 pound [lb]	=	16 ounces oz

Conversions Non-SI Imperial – Volume (English)		
1 gallon [gal]	=	0.125 bushels
1 gallon [gal]	=	160 ounces oz
1 pint	=	0.125 gallons
or 8 pints	=	1 gallon
1 quart [qt]	=	0.25 gallons
or 4 qt	=	1 gal
1 pint	=	0.5 quarts

Conversions Non-SI Imperial – Volume (USA)		
1 gallon (US)	=	0.832 gallons (English)
1 gallon (US)	=	128 ounces oz (US)
Really gets confusing with two different volumes depending on your country!		

Caution Ounces of weight are different from ounces of volume.

Conversions Non-SI Imperial – Area		
1 acre	=	43,560 ft^2
1 acre	=	4,840 yd^2
1 square foot [ft^2]	=	144 square inches [in^2]
1 square mile	=	640 acres

So, a square having sides of 208 feet would be an acre. An acre originally was supposed to be the amount of land a man could work in one day, so it depended on how strong the man was!

Converting between the different systems

Conversions SI to Non-SI Length		
1 metre [m]	=	3.2808 feet ft
1 metre [m]	=	39.370 in
1 kilometre [km]	=	0.6214 mi
2.54 cm	=	1 inch

Conversions Non-SI Imperial – Mass		
1 kilogram kg	=	2.205 pounds lb
1 tonne	=	1.1 ton

Conversions SI to Non-SI Volume		
1 gallon (English)	=	4.546 litres
1 gallon (US)	=	3.785 litres
1 gallon (English)	=	4,546 cc^3
1 gallon (US)	=	3,785 cc^3

Conversions SI to Non-SI Area		
1 sq mile	=	259 hectares
1 sq mile	=	2,589,988 m^2
1 square metre	=	10.76 ft^2 *ie*: 3.2808^2 ft^2
1 square metre	=	1,550 in^2 *ie*: 39.37^2 in^2