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Workforce Development:

Module 10

1.1 Lessons Abbreviation Key Table

C = Calculator Lesson
P = Pre-algebra Lesson
A = Algebra Lesson
G = Geometry Lesson
T = Trigonometry Lesson
S = Special Topics

The number following the letter is the Lesson Number.

E = Exercises with Answers: Answers are in brackets **[ ]**.
EA = Exercises Answers: (only used when answers are not on the same page as the exercises.)
ES = Exercises Supplemental: Complete if you feel you need additional problems to work.

1.2 Exercises Introduction

Why do the Exercises?

Mathematics is like a "game." The more you practice and play the game the better you will understand and play it.

The Foundation's Exercises, which accompany each lesson, are designed to reinforce the ideas presented to you in that lesson's video.

It is unlikely you will learn math very well by simply reading about it or listening to Dr. Del, or anyone else, or watching someone else doing it.

You WILL learn math by "doing math."

It is like learning to play a musical instrument, or write a book, or play a sport, or play chess, or cooking.

You will learn by practice.

Repetition is the key to mastery.

You will make mistakes. You will sometimes struggle to master a concept or technique. You may feel frustration sometimes "**WE ALL DO.**"

But, as you learn and do math, you will begin to find pleasure and enjoyment in it as you would in any worthwhile endeavor. Treat it like a sport or game.

These exercises are the KEY to your SUCCESS!

ENJOY!

S5 LESSON: FLO SCI ENG Formats

Numbers can be expressed in three different formats:

FLO or Floating Point is the format you are familiar with.

64327.59 is an example.

Of course you know this is the same as:
$6x10^4+4x10^3+3x10^2+2x10^1+7x10^0+5x10^{-1}+9x10^{-2}$

And, $10^0 = 1$, $10^{-n} = 1/10^n$

Now we can also express this number is what is called **SCI or scientific format**

$64327.59 = 6.432759 \text{ x } 10^4$

Or in **ENG or engineering format**

$64327.59 = 64.32759 \text{ x } 10^3$

In the ENG format you will always have 10 to an exponent that is a multiple of 3. You'll see why this is when we study Prefixes in another lesson.

SCI and ENG notations are sometimes used in documentation and you can always convert from one to the other with our calculator or to FLO if the number is not too large.

However, for very large or very small numbers, SCI or ENG formats are necessary.

Frankly, if you are going to be working with very large or very small numbers you will probably be using a computer and much more powerful tools than a calculator.

It is easy to use scientific notation with a tool like Wolfram Alpha. However, you may occasionally see them with the calculator if you multiply or divide large numbers or use the y^x key with large exponents.

$12^{21} = 4.6 \times 10^{22}$

Now multiply by 9^{13}

$1.169 \times 10^{35} = 1.169388422 \times 10^{35}$

Also, the largest exponent of 10 the calculator will accept is 99.

109^85   error

But, WA handles it just fine.

S5E

FLO SCI ENG Formats

Using your calculator, convert the following numbers to both SCI and ENG.

1. 640873.26 =

2. 2347168.002 =

3. 0.0002547 =

Using your calculator, convert the following numbers to both SCI and ENG, fixing each to the number digits past the decimal point as indicated.

4. 54178962.3 (3 digits past the decimal point) =

5. 214697.0045 (2 digits past the decimal point) =

6. 145879125 (4 digits past the decimal point) =

Using your calculator, calculate the following numbers. If you receive an error message, use Wolfram Alpha.

7. $15^{26}x2^{23}$ =

8. $26^{56}x32^{54}$ =

9. $45^{-23}x16^{-13}$ =

10. $18.45^{-56}x46.78^{-24}$ =

S5EA

FLO SCI ENG Formats Answers: [ ]'s

1. 640873.26 = [**SCI = 6.4087326x10^{5}; ENG = 640.87326x10^{3}**]

2. 2347168.002 = [**SCI = 2.347168002x10^{6}; ENG = 2.347168002x10^{6}**]

3. 0.0002547 = [**SCI = 2.547x10^{-4}; ENG = 254.7x10^{-6}**]

4. 54178962.3 (3 digits past the decimal point) = [**SCI = 5.418x10^{7}; ENG = 54.179x10^{6}**]

5. 214697.0045 (2 digits past the decimal point) = [**SCI = 2.15x10^{5}; ENG = 214.70x10^{3}**]

6. 145879125 (4 digits past the decimal point) = [**SCI = 1.4588x10^{8}; ENG = 145.8791x10^{6}**]

7. 15^{26}x2^{23} = [**4.0331166x10^{34}**]

8. 26^{56}x32^{54} = [**Error**
WA **26^56x32^54**
3.28553665x10^{160}]

9. 45^{-23}x16^{-13} = [**2.101611366x10^{-54}**]

10. 18.45^{-56}x46.78^{-24} =
[**Interestingly, the calculator says "0" instead of "Error"**
WA **18.45^-56x46.78^-24**
1.053799609x10^{-111}]

S5A LESSON: FLO SCI ENG Formats Addendum

As we learned in S5, numbers can be expressed in three different formats.

FLO or Floating Point is the format you are familiar with.
64327.59 is an example.

SCI or scientific format
$64327.59 = 6.432759 \times 10^4$

ENG or engineering format
$64327.59 = 64.32759 \times 10^3$

What we haven't learned yet is how to enter a number in a SCI or ENG format into the calculator.

It is very easy. You just use the EE Key.

To enter 6.432759×10^4:

Just enter 6.432759 and Press the EE key,

Then enter 4, and you are done.

Now you can change it into any other format, and also you can save it in memory and the recall it in this format.

Similar for ENG format:

Just enter 64.32759 and Press EE, and then enter 3

You can also enter negative numbers.

Just press the + <-> - key before you press the EE Key.

6.432759 + <-> - EE 3

Enters the negative of this number

You can also enter a negative exponent by just pressing the + <-> - key before entering the exponent.

6.432 EE + <-> - 4

Enters $6.432x10^{-4}$ or .00006432

Of course, you could also enter

$-6.432x10^{-5}$ or -.00006432

6.432 + <-> - EE 5 + <-> -

S6 Lesson: Prefixes

In science and engineering Prefixes are used to change the size of units.

For example, Kilometer, km, means 1,000 Meters

So, 1 km = 1,000m = 10^3 m

1 centimeter = .01m = (1/100)m = 10^{-2}m = 1cm

1 decimeter = .1m = (1/10)m = 10^{-1}m = 1dm

1 millimeter = .001m = (1/1000)m = 10^{-3}m = 1mm

The most common Metric Prefixes are listed below along with their exponents of 10.

milli (m)	-3	Kilo (K)	+3	Thousand
micro(μ)	-6	Mega(M)	+6	Million
nano (n)	-9	Giga (G)	+9	Billion
pico (p)	-12	Tera (T)	+12	Trillion

Examples: 27 nS = $27\text{x}10^{-9}$ S = .000000027 S

27 μS = $27\text{x}10^{-6}$ S = .000027 S

45 GH = $45\text{x}10^{9}$ H = 45000000000 H

78KB = $78\text{x}10^{3}$B = 78000B

3.5KΩ = 3500Ω

Now the laws or rules of exponents are:

$10^n \times 10^m = 10^{n+m}$ for any exponents n and m

Also, $10^0 = 1$ and $10^{-n} = 1/10^n$

So suppose we have, for example:

$7mA \times 8M\Omega = 7\times10^{-3}A \times 8\times10^{6}\Omega = 56\times10^{3}V = 56KV$

Since, $1A \times 1\Omega = 1V$ [This is Ohm's Law]

Thus, we see mxM = K since $10^{-3} \times 10^{6} = 10^{3}$

So we multiply, x, **two prefixes to get one prefix by simply adding the exponents**.

mxG = M since -3 + 9 = 6
mxm = μ since -3+ -3 = -6
nxK = μ since -9 + 3 = -6

If you are going to become an electrician or electronics technician you should learn this prefix table, and practice multiplying prefixes.

Then, you will use this along with the Technician's Triangle we will discuss in another lesson.

This will greatly simplify calculations you will be making when you troubleshoot electrical or electronic systems or equipment.

In the **Metric system** we use powers of 10

In the **Digital system** we use powers of 2.

Note: $2^{10} = 1024 \approx 1000 = 10^3$

The most common Digital Prefixes are listed below along with their exponents of 2.

milli (m)	-10	Kilo (K)	+10
micro(μ)	-20	Mega(M)	+20
nano (n)	-30	Giga (G)	+30
pico (p)	-40	Tera (T)	+40

If you are going to become a computer or communications technician, you will want to master this system as well. It works just like the metric system.

For example, mSxMH = KC since 1Sx1H = 1C

Because -10 + 20 = +10

The purpose of this Lesson is to make you aware of these Prefixes. You will want to master them IF you decide to learn a technical field where they are used a lot.

Prefix Product Table

		0	**+3**	**+6**	**+9**	**+12**
X		1	K	M	G	T
0	1	1	K	M	G	T
-3	**m**	m	1	K	M	G
-6	**μ**	μ	m	1	K	M
-9	**n**	n	μ	m	1	K
-12	**p**	p	n	μ	m	1

We will make use of this when we discuss the Technician's Triangle

Of course, this Table can be expanded, but this is what one usually uses.

For example, mxn = p

But, μxn = f

where femto stands for 10^{-15}

Some Musings.

Most of us don't really appreciate the difference between a million and a billion.

How long is one million seconds, 1 MS ?

11.57 days 1,000,000/60/60/24

How long is one billion seconds, 1GS ?

32 years 11,570/365

How long is one trillion seconds, 1 TS ?

32,000 years.

Apply similar questions about our national debt and our money supply.

One million pennies is ten thousand dollars

One billion pennies is ten million dollars.

The DNA in one human cell is about 6 ft long if it unwound. Of course, it is very thin. Similar to extending your little finger from LA to Paris.

There are about one trillion cells in your body. So how long would your DNA be if it was all strung out end to end? How about a billion miles?

S6E

Prefixes

1. Using the generic unit of measure, S, and the **metric** prefixes, calculate the new prefix for the following problems.
   a. mS x nS
   b. mS x MS
   c. KS x MS
   d. μS x μS
   e. nS x GS
   f. TS x μS
   g. GS x KS
   h. mS x μS
   i. GS x pS
   j. TS x μS
2. Using the generic unit of measure, S, and the **metric** prefixes, convert the following to numbers.
   a. 15 nS
   b. 23 KS
   c. 47 TS
   d. 28 μS
   e. 84 GS
   f. 18 MS

g. 43 pS

h. 98 mS

i. 4.2 mS

j. 3.84 GS

3. Using the generic unit of measure, S, and the **digital** prefixes, calculate the new prefix for the following problems.

   a. mS x nS

   b. mS x MS

   c. KS x MS

   d. µS x µS

   e. nS x GS

   f. TS x µS

   g. GS x KS

   h. mS x µS

   i. GS x pS

   j. TS x µS

Q4. Using the generic unit of measure, S, and the **digital** prefixes, convert the following to numbers.

   a. 15 nS

   b. 23 KS

   c. 47 TS

   d. 28 µS

   e. 84 GS

   f. 18 MS

   g. 43 pS

   h. 98 mS

i. 4.2 mS

j. 3.84 GS

S6EA

Prefixes

1.

a. mS x nS = 10^{-3}S x 10^{-9}S = 10^{-12}S = pS
b. mS x MS = 10^{-3}S x 10^{6}S = 10^{3}S = KS
c. KS x MS = 10^{3}S x 10^{6}S = 10^{9}S = GS
d. µS x µS = 10^{-6}S x 10^{-6}S = 10^{-12}S = pS
e. nS x GS = 10^{-9}S x 10^{9}S = 10^{0}S = S
f. TS x µS = 10^{12}S x 10^{-6}S = 10^{6}S = MS
g. GS x KS = 10^{9}S x 10^{3}S = 10^{12}S = TS
h. mS x µS = 10^{-3}S x 10^{-6}S = 10^{-9}S = nS
i. GS x pS = 10^{9}S x 10^{-12}S = 10^{-3}S = mS
j. TS x µS = 10^{12}S x 10^{-6}S = 10^{6}S = MS

2.

a. 15 nS = 15×10^{-9} S = 0.000000015 S
b. 23 KS = 23×10^{3} S = 23,000 S
c. 47 TS = 47×10^{12} S = 47,000,000,000,000 S
d. 28 µS = 28×10^{-6} S = 0.000028 S
e. 84 GS = 84×10^{9} S = 84,000,000,000 S
f. 18 MS = 18×10^{6} S = 18,000,000 S
g. 43 pS = 43×10^{-12} S = 0.000000000043 S
h. 98 mS = 98×10^{-3} = 0.098 S
i. 4.2 mS = 4.2×10^{-3} = 0.0042 S
j. 3.84 GS = 3.84×10^{9} S = 3,840,000,000 S

3.

a. mS x nS = 2^{-10}S x 2^{-30}S = 2^{-40}S = pS
b. mS x MS = 2^{-10}S x 2^{20}S = 2^{10}S = KS
c. KS x MS = 2^{10}S x 2^{20}S = 2^{30}S = GS
d. µS x µS = 2^{-20}S x 2^{-20}S = 2^{-40}S = pS
e. nS x GS = 2^{-30}S x 2^{30}S = 2^{0}S = S
f. TS x µS = 2^{40}S x 2^{-20}S = 2^{20}S = MS
g. GS x KS = 2^{30}S x 2^{10}S = 2^{40}S = TS
h. mS x µS = 2^{-10}S x 2^{-20}S = 2^{-30}S = nS
i. GS x pS = 2^{30}S x 2^{-40}S = 2^{-10}S = mS
j. TS x µS = 2^{40}S x 2^{-20}S = 2^{20}S = MS

4.

a. 15 nS = 15x2^{-30} S = 0.000000014 S
b. 23 KS = 23x2^{10} S = 23,552 S
c. 47 TS = 47x2^{40} S = 5.167704651x10^{13} S
d. 28 µS = 28x2^{-20} S = 0.000026703 S
e. 84 GS = 84x2^{30} S = 8,589,934,592 S
f. 18 MS = 18x2^{20} S = 18,874,368 S
g. 43 pS = 43x2^{-40} S = 3.910827218x10^{-11} S
h. 98 mS = 98x2^{-10} = 0.095703125 S
i. 4.2 mS = 4.2x2^{-10} = 0.004101562 S
j. 3.84 GS = 3.84x2^{30} S = 34,123,168,604 S

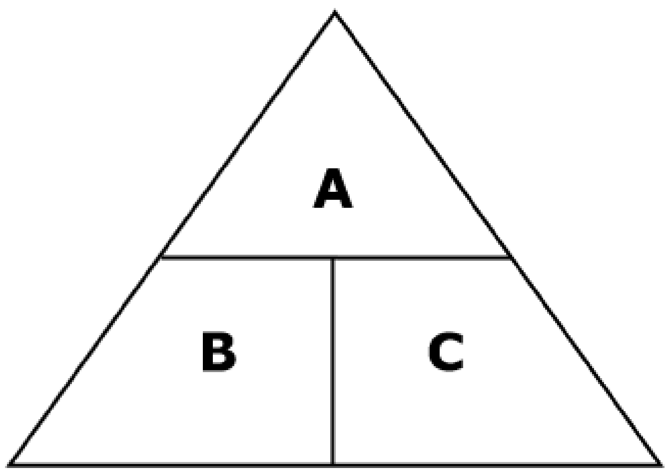
S7 Lesson: Technician's Triangle

Often one is faced with an equation A = BxC, where one must solve for one of these variables when the other two are known.

This yields three equations as you have learned.

A = BxC   B = A/C   C = A/B

Sometimes it is easiest to simply put this into what I call a Technician's Triangle. Then, one can "solve" the equation very easily.



Now to "solve" for any variable, just perform the calculation with the other two variables.

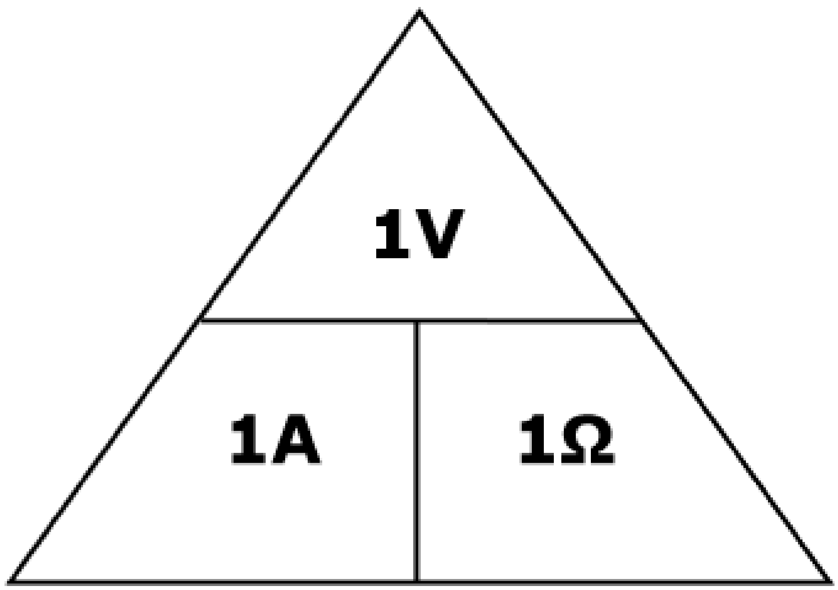
A = BxC   B = A/C   C = A/B

Things get interesting when the units involved have prefixes attached.

Let’s look at an example from electronics.

Ohm’s Law is $1V = 1A \times 1\Omega$

Where: V is Volts, A is Amps, Ω is Resistance



But, often one has to deal with prefixes attached to these units. For example, we might have:

$5\mu A \times 7K\Omega = .000005 \times 7000\ V = .035\ V = 35\ mV$

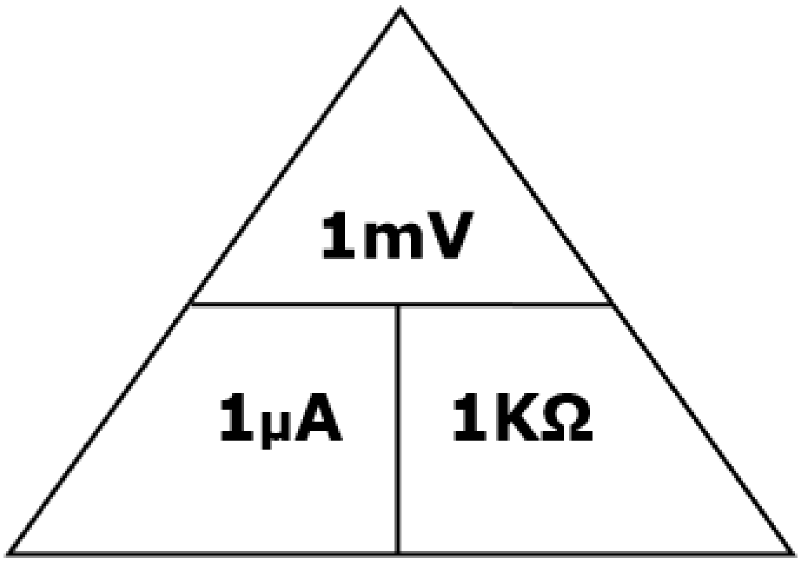
This is the way it has been dealt with classically.

There must be an easier way!

Well, there is.

We learned in the Prefixes lesson that:

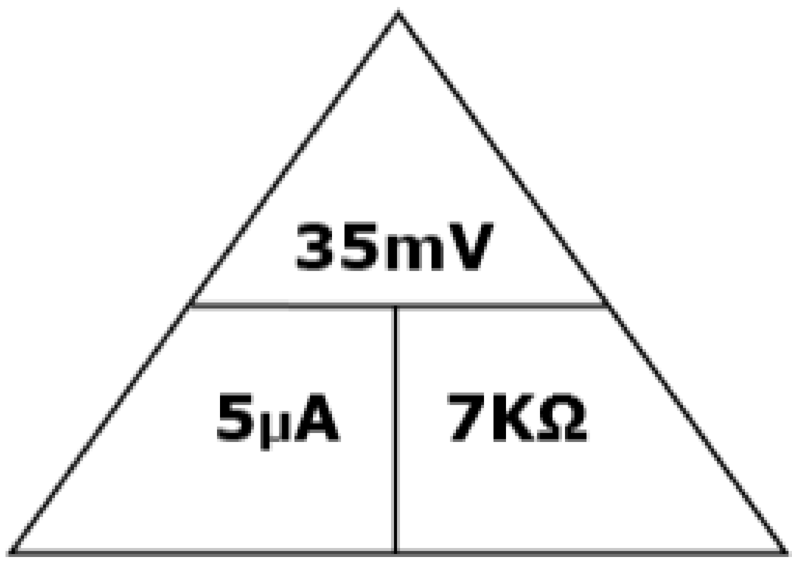
μ x K = m



This then leads us to the following Tech Triangle.

Remember we know μ x K = m

So, this then leads us to the following Tech Triangle



So, all we have to do to solve for any one of these given the other two is simply do the simple arithmetic.
This is much easier than the old-fashioned way.

5μAx7KΩ = .000005x7000V = .035V= 35mV

Or 35mV/7KΩ = .035/7000 A = .000005 A = 5μA

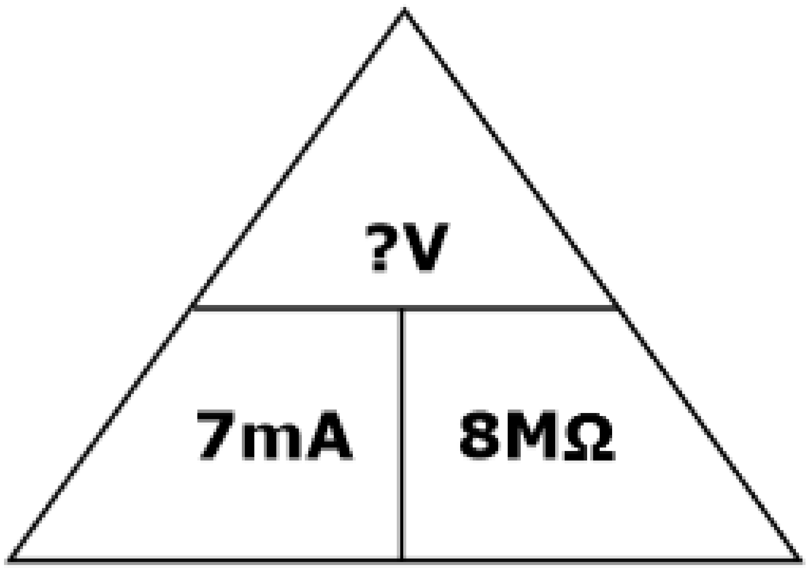
Or 35mV/5μA = .035/.000005 Ω = 7000Ω = 7 KΩ

It was amazing how many times engineers and technicians got the decimal place wrong and were off by an order of magnitude, i.e., 10x.

So, quick now, what is 7 mA times 8 MΩ ?

Remember we know m x M = K

So, this then leads us to the following Tech Triangle



Answer: 56 KV

This is much easier than the old-fashioned way.

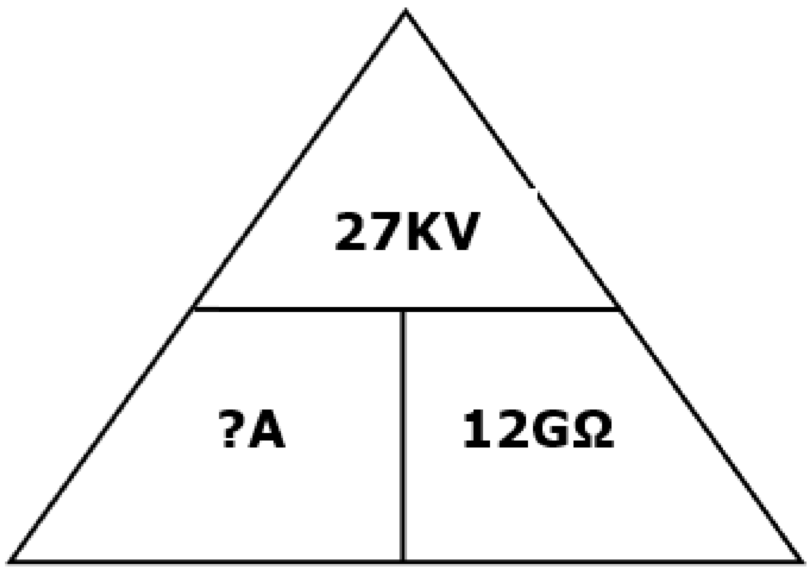
So, quick now, what is 7 mA times 8 MΩ ?

Try it the old-fashioned way if you want to experience what some of our ancestors went through. Even with slide rules and log tables it was more difficult than with a calculator. But, it is even easy to make a mistake with a calculator doing it the old-fashioned way.

Try: 2.4mA x 6.7 MΩ Use the TT, mxM = K

Answer: 2.4x6.7 KV = 16 KV

OK one more, quick. 27KV across a 12GΩ resistor yields how many amps, A? So, this then leads us to the following Tech Triangle



Well look in the Prefix Table.

What times G yields K? Answer: μ

[G is +9 and K is +3, so we need a -6 since 9+(-6)= +3
So, we need a μ and Gxμ = K]

So, the answer is 27/12 μA = 2.25 μA

This is much easier than the old-fashioned way.

Try it the old-fashioned way if you want to experience what some of our ancestors went through. They didn't even have

calculators. But, our calculator won't even take this many 0's in FLO so
you would have to use SCI format.

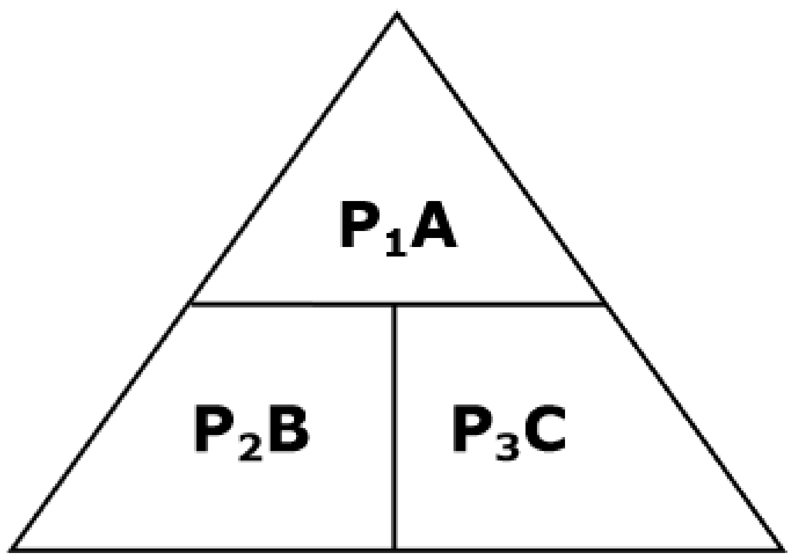
27000/12000000000 = .00000225

There are many fields where you have an equation like

1A = 1Bx1C where A,B,C are some units.

Then, a Technician's Triangle will apply.

You will need to learn the Prefixes and remember to multiply two prefixes you just add their exponents of their power of 10, or of their power of 2 in the digital case.



Where $P_1 = P_2 x P_3$, from the Table of Prefixes

This is much easier than the old-fashioned way.

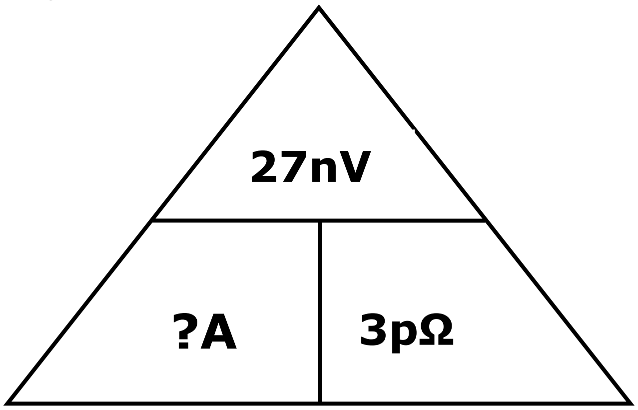
Simply practice in whatever technical field you are in with the relevant equations.

S7E

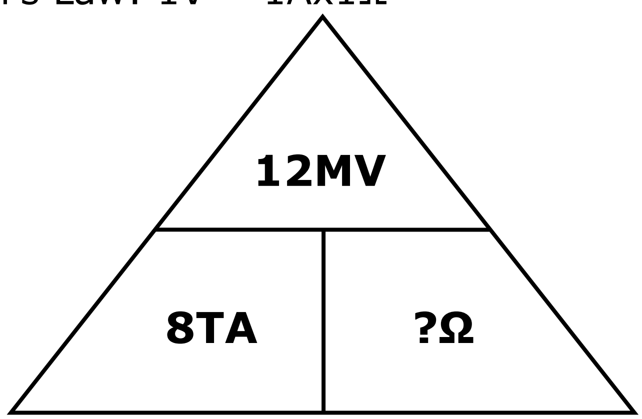
Technician's Triangle

Solve for the unknown using metric prefixes.

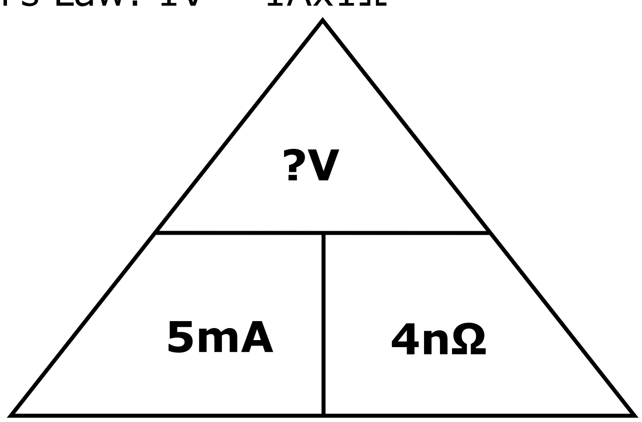
1. Ohm's Law: 1V = 1Ax1Ω



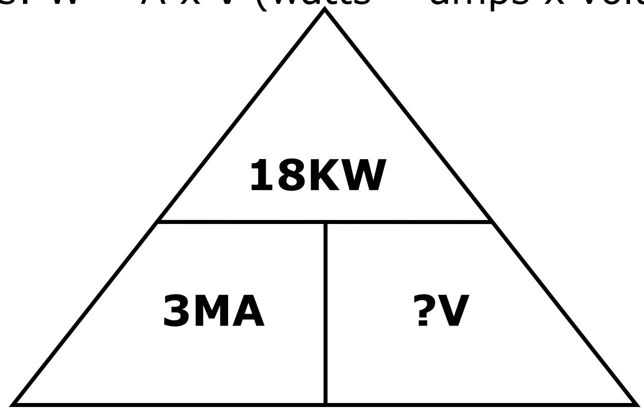
2. Ohm's Law: 1V = 1Ax1Ω



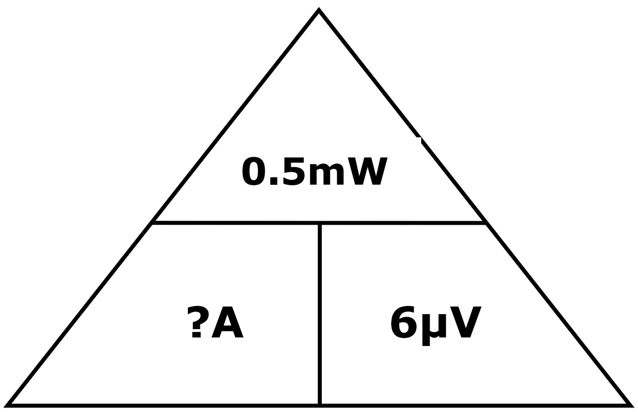
3. Ohm's Law: 1V = 1Ax1Ω



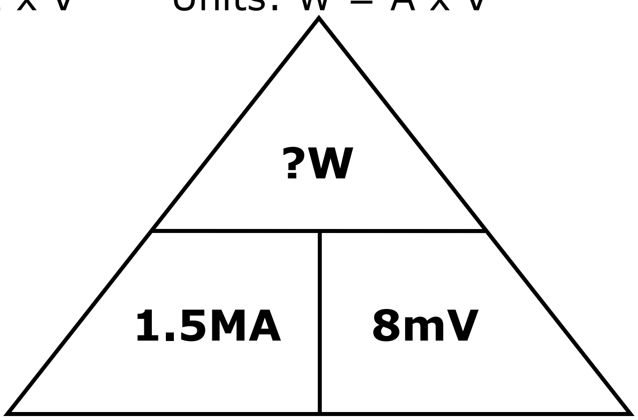
4. P = I x V (power = current x volts)
   Units: W = A x V (watts = amps x volts)



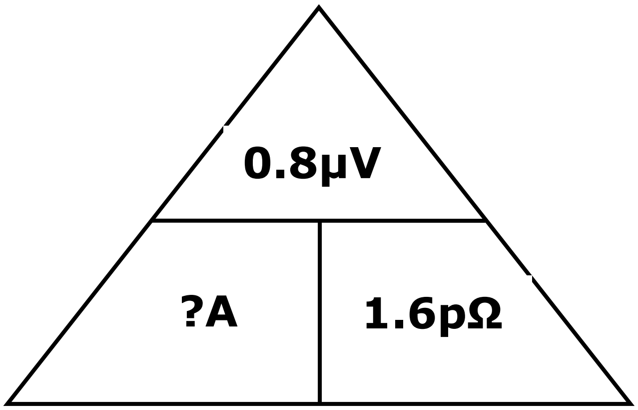
5. P = I x V   Units: W = A x V



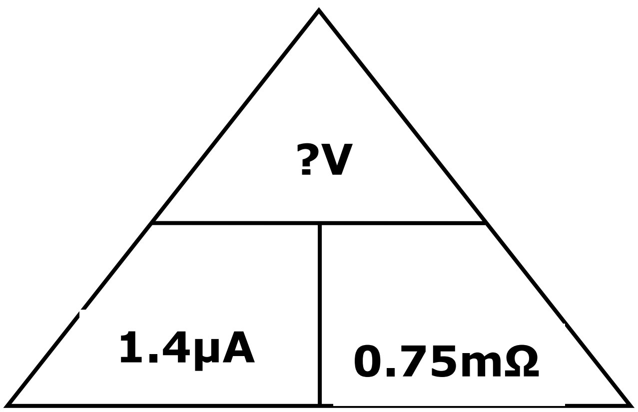
6. P = I x V   Units: W = A x V



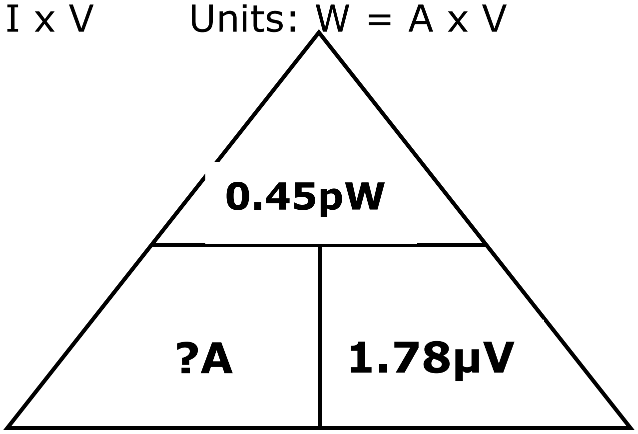
7. Ohm's Law: 1V = 1Ax1Ω



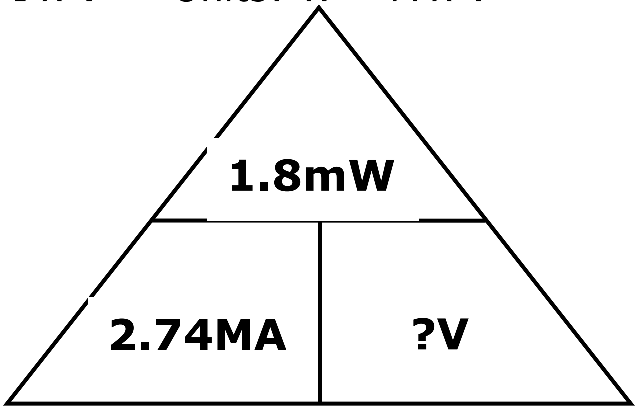
8. Ohm's Law: 1V = 1Ax1Ω



9. P = I x V Units: W = A x V



10. P = I x V Units: W = A x V



S7EA

Technician’s Triangle

1. 27nV = ?A x 3pΩ

    n = ? + p --> -9 = ? + -12 --> ? = +3 --> K

    27nV = ?KA x 3pΩ

    27 = ? x 3 -> ? = 9

    Unknown: 9KA

    27nV = 9KA x 3pΩ

2. 12MV = 8TA x ?Ω

    M = T + ? --> +6 = +12 + ? --> ? = -6 --> μ

    12MV = 8TA x ?μΩ

    12 = 8 x ? -> ? = 1.5

    Unknown: 1.5μΩ

    12MV = 8TA x 1.5μΩ

3. ?V = 5mA x 4nΩ

    ? = m + n --> ? = (-3) + (-9) --> ? = -12 --> p

    ?pV = 5mA x 4nΩ

    ? = 5 x 4 -> ? = 20

    Unknown: 20pV

    20pV = 5mA x 4nΩ

4. 18KW = 3MA x ?V

K = M + ? --> +3 = +6 + ? --> ? = -3 --> m

18KW = 3MA x ?mV

18 = 3 x ? -> ? = 6

Unknown: 6mV

18KW = 3MA x 6mV

5. 0.5mW = ?A x 6μV

m = ? + μ --> -3 = ? + (-6) --> = +3 --> K

0.5mW = ?KA x 6μV

0.5 = ? x 6 -> ? = 1/12 or 0.083

Unknown: 0.083KA

0.5mW = 0.083KA x 6μV

6. ?W = 1.5MA x 8mV

? = M + m --> ? = +6 + (-3) --> = +3 --> K

?KW = 1.5MA x 8mV

? = 1.5 x 8 -> ? = 12

Unknown: 12KW

12KW = 1.5MA x 8mV

7. 0.8μV = ?A x 1.6pΩ

μ = ? + p --> -6 = ? + (-9) --> ? = +3 --> K

0.8μV = ?KA x 1.6pΩ

0.8 = ? x 1.6 -> ? = 0.5

Unknown: 0.5KA

0.8μV = 0.5KA x 1.6pΩ

8. ?V = 1.4µA x 0.75mΩ

?= µ + m --> ? = (-6) + (-3) --> ? = -9 --> n

?nV = 1.4µA x 0.75mΩ

? = 1.4 x 0.75 -> ? = 1.05

Unknown: 1.05nV

1.05nV = 1.4µA x 0.75mΩ

9. 0.45pW = ?A x 1.78µV

p = ? + µ --> -12 = -6 + ? --> = -6 --> µ

0.45pW = ?µA x 1.78µV

0.45 = ? x 1.78 -> ? = 0.253

Unknown: 0.253µA

0.45pW = 0.253µA x 1.78µV

10. 1.8mW = 2.74MA x ?V

m = M + ? --> -3 = +6 + ? --> = -9 --> n

1.8mW = 2.74MA x ?nV

1.8 = 2.74 x ? -> ? = 0.657

Unknown: 0.657nV

1.8mW = 2.74MA x 0.657nV

S8 Lesson: Polar Rectangular Coordinates

In the plane, there are two ways to specify a point.

Rectangular Coordinates (**x**,**y**)

Polar Coordinates (**r**, **θ**) where

r = $(x^2 + y^2)^{1/2}$,

θ = **tan** $^{-1}$(**y**/**x**) in Quadrants 1 and 4

and θ = **tan**-1(**y**/**x**) + 180º in Quads 2 and 3

Example 1: (4,3) = (5, 36.87º) since **tan**$^{-1}$(3/4) = 36.87º
and 5 = $(4^2 + 3^2)^{1/2}$

Example 2: (-4,3) = (5, 143.13º) since **tan**$^{-1}$(-3/4) =
-36.87º + 180º = 143.13º

Fortunately, the **TI30Xa** will do this automatically with the R → P and P → R Keys.

2nd . 2 This fixes the display to two digits past.

FUNCTION	KEY	ENTER	DISPLAY
	4	4	
x <--> y	2nd π		0.00
	3	3	
R< - ->P	2nd -		5.00
x <--> y	2nd π		36.87

FUNCTION	KEY	ENTER	DISPLAY
	4	4	
+< -->-		-4	
x <--> y	2^{nd} π		0.00
	3	3	
R< - ->P	2^{nd} -		5.00
x <--> y	2^{nd} π		143.13

You can go from **P** to **R** also.

FUNCTION	KEY	ENTER	DISPLAY
	5	5	
x <--> y	2^{nd} π		0.00
		143.13	143.13
P< - ->R	2^{nd} x		-3.9999
x <--> y	2^{nd} π		3.00

Note: All of this works if you use **RAD** or **GRAD** for the degrees, for those of you who are more advanced in trigonometry.

Now just do some Exercises

(4, 9) = (9.85, 66.03º) **R** to **P**

(7, 197º) = (-6.69, -2.05) **P** to **R**

S8E

Polar Rectangular Coordinates Exercises

For the following exercises, graph the rectangular coordinates to determine quadrant, then solve for the polar coordinates.

1. (5, 12)
2. (8, 15)
3. (-8, -15)
4. (-4.5, 6.3)
5. (3.7, -8.2)
6. (-8.9, -12.5)

For the following exercises, solve for the rectangular coordinates.

7. (9, 45º)
8. (6, 32 º)
9. (12, 127º)
10. (4.7, 118.6º)
11. (5.6, 210º)
12. (7.8, 301.9º)

Using the R → P button on your calculator, convert these rectangular coordinates to polar coordinates.

13. (5, 7)
14. (8, 13)
15. (-7, 16)
16. (6.3, -8.2)

Using the P → R button on your calculator, convert these polar coordinates to rectangular coordinates.

17. (9, 27º)
18. (10, 75º)
19. (4.7, 190.5º)
20. (13.45, 347º)

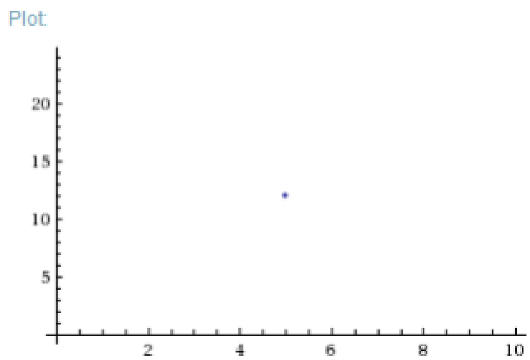
S8EA

Polar Rectangular Coordinates Exercise Answers

1. $\mathbf{r} = (x^2 + y^2)^{1/2}$

   $\mathbf{r} = (5^2 + 12^2)^{1/2}$

   $\mathbf{r} = 13$



Quadrant 1

$\Theta = \mathbf{tan}^{-1}(\mathbf{y/x})$

$\Theta = \mathbf{tan}^{-1}(12/5)$

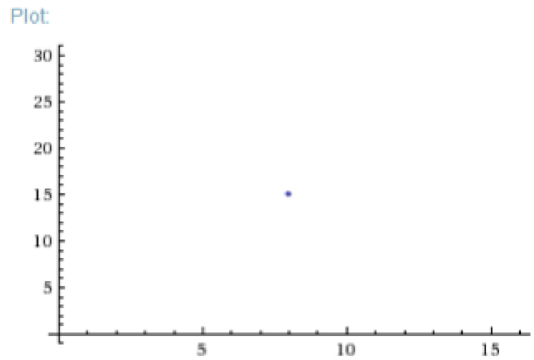
$\Theta = 67.38^o$

$(13, 67.38^o)$

2. $\mathbf{r} = (x^2 + y^2)^{1/2}$

   $\mathbf{r} = (8^2 + 15^2)^{1/2}$

   $\mathbf{r} = 17$



Quadrant 1

$\Theta = \tan^{-1}(y/x)$

$\Theta = \tan^{-1}(15/8)$

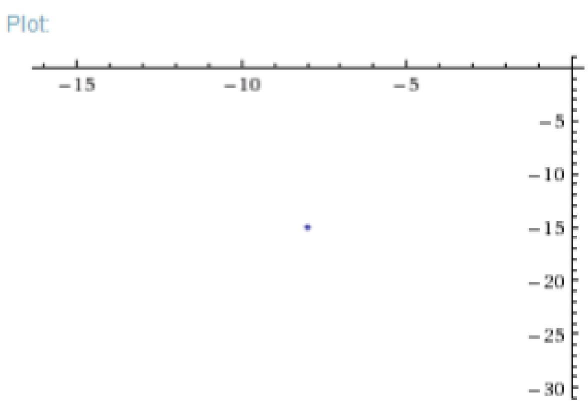
$\Theta = 61.93^{o}$

$(17, 61.93^{o})$

3. $r = (x^2 + y^2)^{1/2}$

$r = ((-8)^2 + (-15)^2)^{1/2}$

$r = 17$



Quadrant 3

$\Theta = \tan^{-1}(y/x) + 180^{o}$

$\Theta = \tan^{-1}(-15/-8) + 180^o$

$\Theta = 241.93^o$

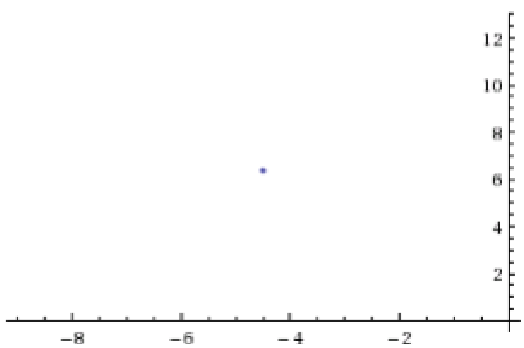
$(17, 241.93^o)$

4. $r = (x^2 + y^2)^{1/2}$

$r = ((-4.5)^2 + 6.3^2)^{½}$

$r = 7.74$

Plot:



Quadrant 2

$\Theta = \tan^{-1}(y/x) + 180^o$

$\Theta = \tan^{-1}(-4.5/6.3) + 180^o$

$\Theta = 144.46^o$

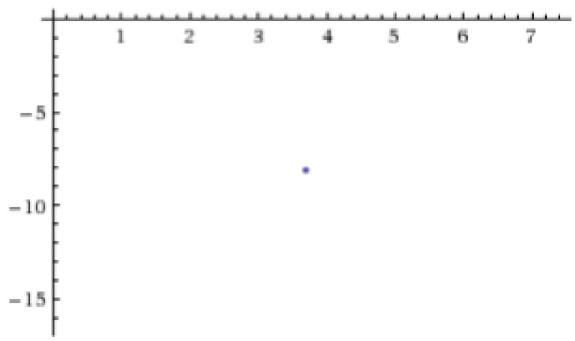
$(7.74, 144.46^o)$

5. $r = (x^2 + y^2)^{1/2}$

$r = (3.7^2 + (-8.2)^2)^{1/2}$

$r = 9.00$

Plot:



Quadrant 4

Θ = **tan**$^{-1}$(y/x)

Θ = **tan**$^{-1}$(3.7/-8.2)

Θ = -24.29º = -24.29º + 360º = 335.71º

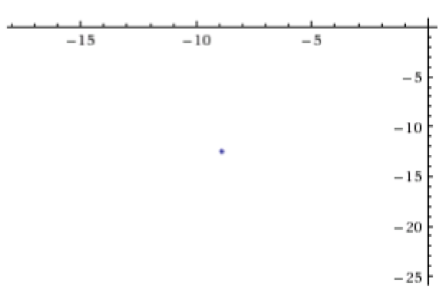
(9.00, -24.29º) or (9.00, 335.71º)

6. **r** = $(x^2 + y^2)^{1/2}$

r = $((-8.9)^2 + (-12.5)^2)^{1/2}$

r = 15.35

Plot:



Quadrant 3

Θ = **tan**$^{-1}$(y/x) + 180º

Θ = **tan**$^{-1}$(-8.9/-12.5) + 180º

Θ = 215.45º

(15.35, 215.45º)

7. $x = r\cos(\Theta)$

$x = 9\cos(45^\circ)$

$x = 6.36$

$y = r\sin(\Theta)$

$y = 9\sin(45^\circ)$

$y = 6.36$

$(6.36, 6.36)$

8. $x = r\cos(\Theta)$

$x = 6\cos(32^\circ)$

$x = 5.09$

$y = r\sin(\Theta)$

$y = 6\sin(32^\circ)$

$y = 3.18$

$(5.09, 3.18)$

9. $x = r\cos(\Theta)$

$x = 12\cos(127^\circ)$

$x = -7.22$

$y = r\sin(\Theta)$

$y = 12\sin(127^\circ)$

$y = 9.58$

$(-7.22, 9.58)$

10. $x = r\cos(\Theta)$

$x = 4.7\cos(118.6^\circ)$

$x = -2.25$

$y = r\sin(\Theta)$

$y = 4.7\sin(118.6°)$

$y = 4.13$

(-2.25, 4.13)

11. $x = r\cos(\Theta)$

    $x = 5.6\cos(210°)$

    $x = -4.8$

    $y = r\sin(\Theta)$

    $y = 5.6\sin(210°)$

    $y = -2.8$

    (-4.8, -2.8)

12. $x = r\cos(\Theta)$

    $x = 7.8\cos(301.9°)$

    $x = 4.12$

    $y = r\sin(\Theta)$

    $y = 7.8\sin(301.9°)$

    $y = -6.62$

    (4.12, -6.62)

13. (8.60, 54.46°)

14. (15.26, 58.39°)

15. (17.46, 113.63°)

16. (10.34, -52.47°) or (10.34, 307.53°) 52.47° + 360° = 307.53°

17. (8.02, 4.09)

18. (2.59, 9.66)

19. (-4.62, -0.86)

20. (13.11, -3.03)

Note: (13.45, -13º) will get you the same answer because 347º-360º=-13º