Upper St. Clair High School Summer Assignment	
Course: AP PHYSICS 1	
Assignment Title:	SUMMER AP PHYSICS 1 ASSIGNMENT
Due Date:	8/19/2026
Purpose of the assignment:	☑ Review foundational material, concepts, or skills ☐ Build interest ☐ Provide a diagnostic measuring tool to help guide student differentiation & instruction ☐ Establish a supportive class culture & environment ☑ Expose students to required material, concepts, skills, and/or texts that will be referenced throughout the academic year
Resources needed to complete assignment:	☐ Textbook assigned by school ☐ Book(s) supplied by student ☑ Packet provided by teacher (please visit the Interactive Program of Studies) ☑ Other supplies: Previous knowledge of mathemetics & science concepts from previous courses.
Estimated time for Completion:	Students may average an estimated 2.0 hours to complete the assignment, but we encourage students to spend time on this assignment over several weeks.
Impact on Semester 1 Grade	Graded: ☐ Yes ☑ No Teacher Note:

Name: _____

This is the AP Physics 1 Summer Assignment.

- This assignment contains items related to a list of basic skills you have already learned in previous math and/or science classes.
- These skills will be applied and built upon for success in AP Physics 1.
- These skills are NOT all-inclusive but center around those most important to physics.
- This assignment is NOT worth points; this assignment will NOT be collected.
- This assignment will not be reviewed together as a group...but you may use the answer key to check your work.
- There may be some time in class for students to ask general questions on these items.
- It is the student's responsibility to work through this packet before the first day of class.

At some point, during the first week or so of classes in semester one, you will be tested on this material. Keep in mind these basic skills will be applied as we learn physics throughout the academic year.

Part A: Using a calculator properly

Complete the following computations using a calculator. (DO NOT USE "E" or "EE" in your ANSWER). You may write your answers in regular form OR scientific notation.

1) $(2 \times 10^6) \times (4 \times 10^2) =$

2) $\dfrac{6.00 \times 10^9}{9.50 \times 10^{-5}} =$

3) $(4.48 \times 10^6)(5.6 \times 10^5)(1.9 \times 10^{-3}) =$

4) $(4) \cdot (2) + \frac{1}{2}(3) \cdot (2)^2 =$

5) $(-10) + (-9.8)(5) =$

6) $\sqrt{\dfrac{(5)}{((2^3)(40+((-7)(2)))}} =$

Part B: Writing numbers in Scientific Notation

7)Write the following numbers in **scientific notation:** *(DO NOT USE "E" or "EE" in your ANSWER)*

A. 10,000 Hz

B. 450,000,000 Hz

C. 875 Hz

D. 6700 m

E. 0.0078 m

F. 0.0000000071 m

8) The following numbers are expressed in scientific notation. **Write these in regular form:**

A. 6.25×10^{-4} m

B. 9.92×10^{4} m/s

C. 3.00×10^{3} m/s

D. 40×10^{-5} m

E. 6.32×10^{12} Hz

F. 6.21×10^{-10} m

Part C: Using Prefixes

Use the chart of prefixes for the following items. You may use your calculator and feel free to express your answers in regular form or scientific notation.

PREFIXES		
Factor	Prefix	Symbol
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

9) The mass of the parasitic wasp *Caraphractus cintus* can be very small. Suppose such a wasp has a mass of **9.19×10^{-6} kg.** What is this mass in...

(a) grams (g)

(b) milligrams (mg)

(c) micrograms (μg)

10) The mass of a raindrop is 4 **milligrams.** What is the correct mass of the raindrop in grams?

11) Express the value of **44.5 mm** in meters.

Part D: Significant Figures

12) To the correct number of significant figures, add the following masses together: 3.6 kg, 113 kg, and 4.19 kg

13) To the correct number of significant figures, multiply the following values together: 50.0 yards and 25.50 yards

Part E: Conversions Using Factor Label Method

Perform the desired conversions for each of the following. Be sure to show your work using the factor label method. The example below shows how this method is used to convert 979.0 meters to feet...

Reasoning

When converting between units, we write down the units explicitly in the calculations and treat them like any algebraic quantity. In particular, we will take advantage of the following algebraic fact: Multiplying or dividing an equation by a factor of 1 does not alter an equation.

Solution

Since 3.281 feet = 1 meter, it follows that (3.281 feet)/(1 meter) = 1. Using this factor of 1 to multiply the equation "Length = 979.0 meters," we find that

$$\text{Length} = (979.0\ \text{m})\,(1) = (979.0\ \cancel{\text{meters}})\left(\frac{3.281\ \text{feet}}{1\ \cancel{\text{meter}}}\right) = \boxed{3212\ \text{feet}}$$

You do not need to memorize conversion factors. Therefore, if needed, you may look up conversion factors online.

14) A bicyclist in the Tour de France has a speed of 29.0 miles per hour (mi/h) on a flat section of the road. What is this speed in...

(a) kilometers per hour (km/h)?

(b) meters per second (m/s)?

15) Vesna Vulovic survived the longest fall on record without a parachute when her plane exploded and she fell 3 miles, 514 yards. What is this distance in meters?

16) Suppose a man's scalp hair grows at a rate of 0.41 mm per day. What is this growth rate in feet per century?

17) How many seconds are in 3.25 weeks?

18). A candy shop sells a pound of chocolate for $ 10.85. What is the price of 1.50 kg of chocolate at the shop?

19) The Boston Marathon is the oldest annual foot race, in which those that finish complete a distance of 26 miles, 385 yards. Express this distance in kilometers.

Part F: Algebra and Showing Work

20) $v = v_o + a \cdot t$ Solve for ***a***. *Show your work in at least 2 algebra steps.*

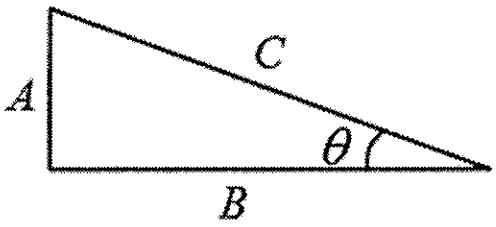
21) $x = v_o \cdot t + \frac{1}{2} a \cdot t^2$ Solve for ***a***. *Show your work in at least 2 algebra steps.*

22) $K = \frac{1}{2} \cdot m \cdot v^2$ Solve for ***v***. *Show your work in at least 2 algebra steps.*

23) $T = 2\pi \cdot \sqrt{\frac{m}{k}}$ Solve for ***k***. *Show your work in at least 2 algebra steps.*

Part G: Trigonometry

24) Referring to the triangle (assume this is a right triangle and angle C is 90 degrees) with sides labeled A, B, and C as shown...

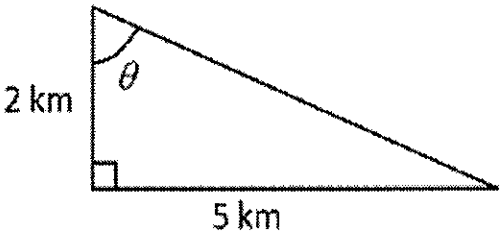


a) What ratio is equal to the sine of the angle θ?

b) What ratio is equal to the cosine of the angle θ?

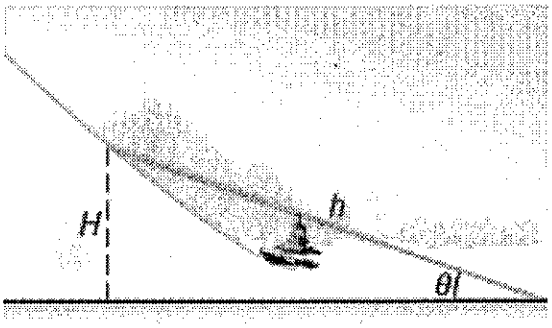
c) What ratio is equal to the tangent of the angle θ?

25) Write an expression that may be used to correctly find the angle θ in the drawing. Then solve for the angle in degrees.



26) An observer, whose eyes are 1.54 m above the ground, is standing 29.0 m away from a tree. The ground is level, and the tree is growing perpendicular to it. The observer's line of sight with the treetop makes an angle of 1.46 ° above the horizontal. How tall is the tree?

27) The gondola ski lift at a ski resort is 2340 m long. On average, the ski lift rises 11.5 ° above the horizontal. How high is the top of the ski lift relative to the base?



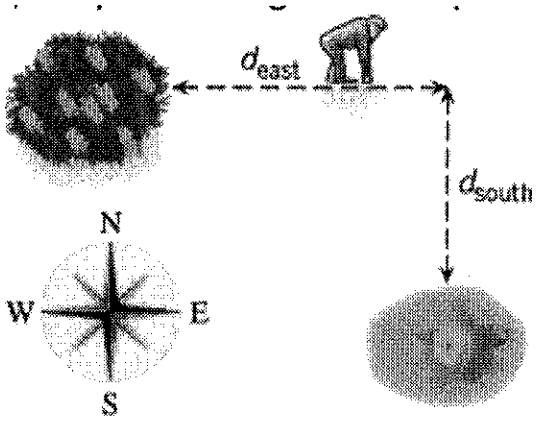
28) What is the value of each of the angles of a triangle whose sides are 146, 187, and 92 cm in length? *Hint: Consider using the law of cosines*

a) The angle opposite the side of length 92 is ____?

b) The angle opposite the side of length 146 is ____?

c) The angle opposite the side of length 187 is ____?

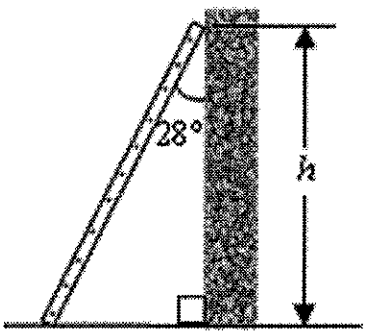
29) A chimpanzee sitting against his favorite tree gets up and walks 60.2 m due east and 75.3 m due south to reach a termite mound, where he eats lunch.

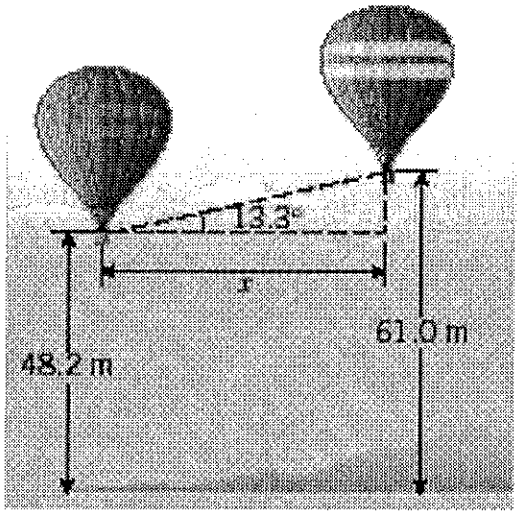


(a) What is the shortest distance between the tree and the termite mound?

(b) What direction does the shortest distance make, as a positive angle with respect to due east?

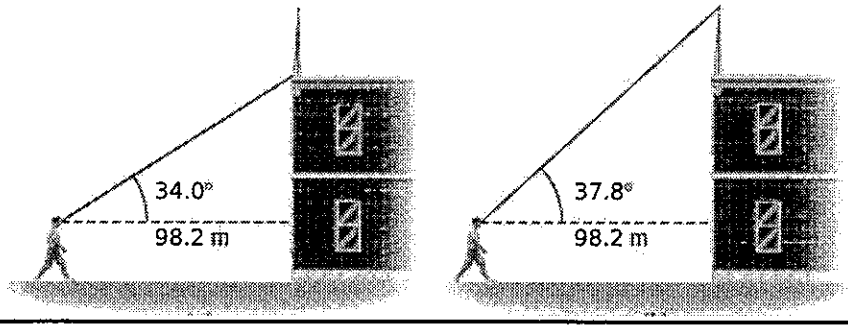
30) A 3.0-m ladder leans against a wall and makes an angle with the wall of 28° as shown in the drawing. What is the height *h* above the ground where the ladder makes contact with the wall?





31) Two hot-air balloons in the drawing are 48.2 m and 61.0 m above the ground. A person in the left balloon observes that the right balloon is 13.3° above the horizontal. What is the horizontal distance *x* between the two balloons?

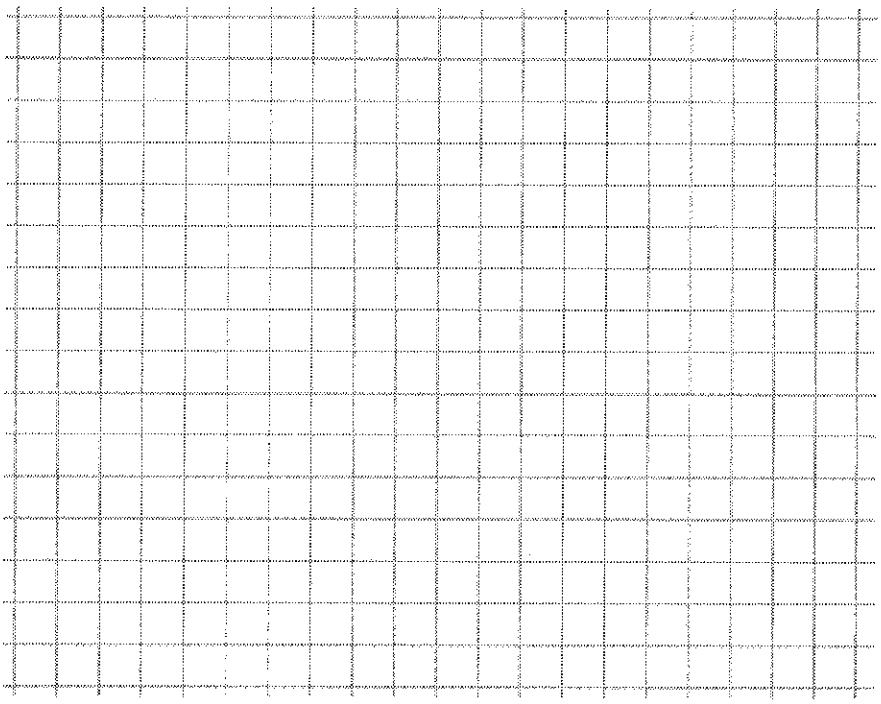
32) The drawing shows a person looking at a building on top of which an antenna is mounted. The horizontal distance between the person's eyes and the building is 98.2 m. In part *a* the person is looking at the base of the antenna, and his line of sight makes an angle of 34.0° with the horizontal. In part *b* the person is looking at the top of the antenna, and his line of sight makes an angle of 37.8° with the horizontal. How tall is the antenna?



Part H: Graphing using a Table of Data

33) Use the data table below…

Normal Force (N)	Kinetic Friction Force (N)
2.1	0.83
4.1	1.50
8.0	2.23
12.0	4.02
17.0	5.78



a) **Create a graph** of **Kinetic Friction Force vs. Normal Force** on the grid below. (Note- the title informs that Kinetic Friction Force is on the y-axis and Normal Force is on the x-axis.) Remember to use all the rules for creating a proper graph, including…*Starting each axis at zero, including placing name and units on each axis, spacing out increments on each axis properly, including all data points, placing a proper title on the graph.*

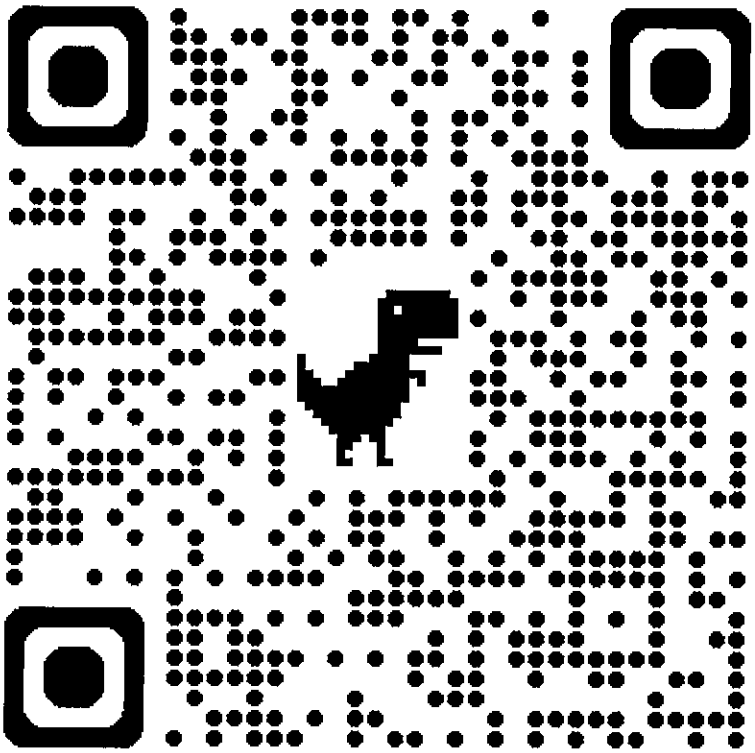
b) Then draw a "line of best fit" on your graph as a straight line.
c) Calculate the slope of your line of best fit, using any 2 points on your line. Include units to your slope if applicable

d) Identify the y-intercept using your line.

e) Write the equation for this linear model in the form $y = mx + b$, using your numerical values from c and d. Then substitute in the appropriate variables for $\mathbf{F_N}$ as *Normal Force* and $\mathbf{f_k}$ as *Kinetic Friction Force.*

CHECK YOUR AP PHYSICS 1 SUMMER ASSIGNMENT ANSWERS NOW

Scan the QR code below to access the answer key.



ADVANCED PLACEMENT PHYSICS 1 TABLE OF INFORMATION

CONSTANTS AND CONVERSION FACTORS	
Universal gravitational constant, $G = 6.67 \times 10^{-11}\ \text{m}^3/(\text{kg}\cdot\text{s}^2) = 6.67 \times 10^{-11}\ \text{N}\cdot\text{m}^2/\text{kg}^2$	Acceleration due to gravity at Earth's surface, $g = 9.8\ \text{m/s}^2$
1 atmosphere of pressure, $1\ \text{atm} = 1.0 \times 10^5\ \text{N/m}^2 = 1.0 \times 10^5\ \text{Pa}$	Magnitude of the gravitational field strength at the Earth's surface, $g = 9.8\ \text{N/kg}$

PREFIXES		
Factor	Prefix	Symbol
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

UNIT SYMBOLS				
	hertz,	Hz	newton,	N
	joule,	J	pascal,	Pa
	kilogram,	kg	second,	s
	meter,	m	watt,	W

VALUES OF TRIGONOMETRIC FUNCTIONS FOR COMMON ANGLES							
θ	0°	30°	37°	45°	53°	60°	90°
$\sin\theta$	0	1/2	3/5	$\sqrt{2}/2$	4/5	$\sqrt{3}/2$	1
$\cos\theta$	1	$\sqrt{3}/2$	4/5	$\sqrt{2}/2$	3/5	1/2	0
$\tan\theta$	0	$\sqrt{3}/3$	3/4	1	4/3	$\sqrt{3}$	∞

The following conventions are used in this exam:

- The frame of reference of any problem is assumed to be inertial unless otherwise stated.
- Air resistance is assumed to be negligible unless otherwise stated.
- Springs and strings are assumed to be ideal unless otherwise stated.
- Fluids are assumed to be ideal, and pipes are assumed to be completely filled by fluid, unless otherwise stated.

GEOMETRY AND TRIGONOMETRY

Rectangle
$A = bh$

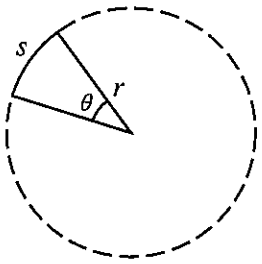
Triangle
$A = \frac{1}{2}bh$

Circle
$A = \pi r^2$
$C = 2\pi r$
$s = r\theta$

Rectangular Solid
$V = \ell wh$

Cylinder
$V = \pi r^2 \ell$
$S = 2\pi r\ell + 2\pi r^2$

Sphere
$V = \frac{4}{3}\pi r^3$
$S = 4\pi r^2$



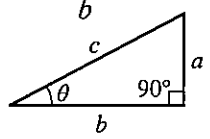
A = area
b = base
C = circumference
h = height
ℓ = length
r = radius
s = arc length
S = surface area
V = volume
w = width
θ = angle

Right Triangle
$a^2 + b^2 = c^2$

$\sin\theta = \frac{a}{c}$

$\cos\theta = \frac{b}{c}$

$\tan\theta = \frac{a}{b}$



MECHANICS AND FLUIDS

$v_x = v_{x0} + a_x t$

$x = x_0 + v_{x0} t + \frac{1}{2} a_x t^2$

$v_x^2 = v_{x0}^2 + 2a_x \left(x - x_0\right)$

$\vec{x}_{\text{cm}} = \frac{\sum m_i \vec{x}_i}{\sum m_i}$

$\vec{a}_{\text{sys}} = \frac{\sum \vec{F}}{m_{\text{sys}}} = \frac{\vec{F}_{\text{net}}}{m_{\text{sys}}}$

$\left|\vec{F}_g\right| = G\frac{m_1 m_2}{r^2}$

$\left|\vec{F}_f\right| \le \left|\mu \vec{F}_n\right|$

$\vec{F}_s = -k\Delta\vec{x}$

$a_c = \frac{v^2}{r}$

$K = \frac{1}{2} m v^2$

$W = F_{\parallel} d = F d \cos\theta$

$\Delta K = \sum W_i = \sum F_{\parallel,i} d_i$

$\Delta U_s = \frac{1}{2} k (\Delta x)^2$

$U_G = -\frac{G m_1 m_2}{r}$

$\Delta U_g = mg\Delta y$

$P_{\text{avg}} = \frac{W}{\Delta t} = \frac{\Delta E}{\Delta t}$

$P_{\text{inst}} = F_{\parallel} v = F v \cos\theta$

$\vec{p} = m\vec{v}$

$\vec{F}_{\text{net}} = \frac{\Delta \vec{p}}{\Delta t} = m\frac{\Delta \vec{v}}{\Delta t} = m\vec{a}$

$\vec{J} = \vec{F}_{\text{avg}} \Delta t = \Delta \vec{p}$

$\vec{v}_{\text{cm}} = \frac{\sum \vec{p}_i}{\sum m_i} = \frac{\sum (m_i \vec{v}_i)}{\sum m_i}$

a = acceleration
d = distance
E = energy
F = force
J = impulse
k = spring constant
K = kinetic energy
m = mass
p = momentum
P = power
r = radius, distance, or position
t = time
U = potential energy
v = velocity or speed
W = work
x = position
y = height
θ = angle
μ = coefficient of friction

$\omega = \omega_0 + \alpha t$

$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$

$\omega^2 = \omega_0^2 + 2\alpha\left(\theta - \theta_0\right)$

$v = r\omega$

$a_T = r\alpha$

$\tau = r_{\perp} F = rF\sin\theta$

$I = \sum m_i r_i^2$

$I' = I_{\text{cm}} + Md^2$

$\alpha_{\text{sys}} = \frac{\Sigma\tau}{I_{\text{sys}}} = \frac{\tau_{\text{net}}}{I_{\text{sys}}}$

$K = \frac{1}{2} I\omega^2$

$W = \tau\Delta\theta$

$L = I\omega$

$L = rmv\sin\theta$

$\Delta L = \tau\Delta t$

$\Delta x_{\text{cm}} = r\Delta\theta$

$T = \frac{1}{f}$

$T_s = 2\pi\sqrt{\frac{m}{k}}$

$T_p = 2\pi\sqrt{\frac{\ell}{g}}$

$x = A\cos(2\pi ft)$

$x = A\sin(2\pi ft)$

$\rho = \frac{m}{V}$

$P = \frac{F_{\perp}}{A}$

$P = P_0 + \rho gh$

$P_{\text{gauge}} = \rho gh$

$F_b = \rho V g$

$A_1 v_1 = A_2 v_2$

$P_1 + \rho g y_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho v_2^2$

a = acceleration
A = amplitude or area
d = distance
f = frequency
F = force
h = height
I = rotational inertia
k = spring constant
K = kinetic energy
ℓ = length
L = angular momentum
m = mass
M = mass
P = pressure
r = radius, distance, or position
t = time
T = period
v = velocity or speed
V = volume
W = work
x = position
y = vertical position
α = angular acceleration
θ = angle
ρ = density
τ = torque
ω = angular speed

Name: KEY

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1) $(2 \times 10^6) \times (4 \times 10^2) =$ 8×10^8

2) $\dfrac{6.00 \times 10^9}{9.50 \times 10^{-5}} =$ 6.32×10^{13}

3) $(4.48 \times 10^6)(5.6 \times 10^5)(1.9 \times 10^{-3}) =$ 4.8×10^9

4) $(4) \cdot (2) + \frac{1}{2}(3) \cdot (2)^2 =$ 14

5) $(-10) + (-9.8)(5) =$ -59

* 6) $\sqrt{\dfrac{(5)}{((2^3)(4)+((-7)(2)))}} =$ $\sqrt{0.024} = 0.15$

KEY

Part B: Writing numbers in Scientific Notation

7)Write the following numbers in **scientific notation:** *(DO NOT USE "E" or "EE" in your ANSWER)*

A. 10,000 Hz = 1.1×10^{4} Hz

B. 450,000,000 Hz = 4.5×10^{8} Hz

C. 875 Hz = 8.75×10^{2} Hz

D. 6700 m = 6.7×10^{3} m

E. 0.0078 m = 7.8×10^{-3} m

F. 0.0000000071 m = 7.1×10^{-9} m

8) The following numbers are expressed in scientific notation. **Write these in regular form:**

A. 6.25×10^{-4} m

= .000625 m

B. 9.92×10^{4} m/s

= 99200 m/s

C. 3.00×10^{3} m/s

= 3000 m/s

D. $.0040 \times 10^{-1}$ m

= .0004 m

E. 6.32×10^{12} Hz

= 6320000000000 Hz

F. 6.21×10^{-10} m

= .000000000621 m

KEY

Part C: Using Prefixes

Use the chart of prefixes for the following items. You may use your calculator and feel free to express your answers in regular form or scientific notation.

PREFIXES		
Factor	Prefix	Symbol
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10^{6}	mega	M
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10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

9) The mass of the parasitic wasp *Caraphractus cintus* can be very small. Suppose such a wasp has a mass of **9.19 x 10^{-6} kg**. What is this mass in...

(a) grams (g) $9.19\times10^{-6}\,\text{kg}\left(\frac{1\times10^{3}\,\text{g}}{1\,\text{kg}}\right) = .00919\,\text{g}$

(b) milligrams (mg) $9.19\times10^{-6}\,\text{kg}\left(\frac{1\times10^{3}\,\text{g}}{1\,\text{kg}}\right)\left(\frac{1\,\text{mg}}{1\times10^{-3}\,\text{g}}\right) = 9.19\,\text{mg}$

(c) micrograms (μg) $9.19\times10^{-6}\,\text{kg}\left(\frac{1\times10^{3}\,\text{g}}{1\,\text{kg}}\right)\left(\frac{1\,\mu\text{g}}{1\times10^{-6}\,\text{g}}\right) = 9190\,\mu\text{g}$

10) The mass of a raindrop is 4 **milligrams.** What is the correct mass of the raindrop in grams?

$4\,\text{mg}\left(\frac{1\times10^{-3}\,\text{g}}{1\,\text{mg}}\right) = 4\times10^{-3}\,\text{g}$

11) Express the value of 44.5 **mm** in meters.

$44.5\,\text{mm}\left(\frac{1\times10^{-3}\,\text{m}}{1\,\text{mm}}\right) = .0445\,\text{m}$

Part D: Significant Figures

12) To the correct number of significant figures, add the following masses together: 3.6 kg, 113 kg, and 4.19 kg

Round to one's place

120.79 kg → 121 kg

13) To the correct number of significant figures, multiply the following values together: 50.0 yards and 25.50 yards

3 sig figs 4 sig figs

$1275\,\text{yd}^2$ → $1280\,\text{yd}^2$ 3 sig figs

key

Part E: Conversions Using Factor Label Method

Perform the desired conversions for each of the following. Be sure to show your work using the factor label method. The example below shows how this method is used to convert 979.0 meters to feet...

Reasoning

When converting between units, we write down the units explicitly in the calculations and treat them like any algebraic quantity. In particular, we will take advantage of the following algebraic fact: Multiplying or dividing an equation by a factor of 1 does not alter an equation.

Solution

Since 3.281 feet = 1 meter, it follows that (3.281 feet)/(1 meter) = 1. Using this factor of 1 to multiply the equation "Length = 979.0 meters," we find that

$$\text{Length} = (979.0\ \text{m})(1) = (979.0\ \cancel{\text{meters}})\left(\frac{3.281\ \text{feet}}{1\ \cancel{\text{meter}}}\right) = \boxed{3212\ \text{feet}}$$

You do not need to memorize conversion factors. Therefore, if needed, you may look up conversion factors online.

14) A bicyclist in the Tour de France has a speed of 29.0 miles per hour (mi/h) on a flat section of the road. What is this speed in...

1 mile = 1609 m 1000 m = 1 km

(a) kilometers per hour (km/h)?

$$\frac{29\ \text{mi}}{\text{h}}\left(\frac{1609\ \text{m}}{1\ \text{mi}}\right)\left(\frac{1\ \text{km}}{1000\ \text{m}}\right) = \boxed{46.7\ \text{km/hr}}$$

(b) meters per second (m/s)?

$$\frac{29\ \text{mi}}{\text{hr}}\left(\frac{1609\ \text{m}}{1\ \text{mi}}\right)\left(\frac{1\ \text{hr}}{3600\ \text{sec}}\right) = \boxed{12.96\ \text{m/s}}$$

15) Vesna Vulovic survived the longest fall on record without a parachute when her plane exploded and she fell 3 miles, 514 yards. What is this distance in meters?

1 yd = 0.9144 m

$$3\ \text{mi}\left(\frac{1609\ \text{m}}{1\ \text{mi}}\right) = 4827\ \text{m}$$

$$514\ \text{yd}\left(\frac{.9144\ \text{m}}{1\ \text{yd}}\right) = 470\ \text{m}$$

$$+ \quad = \boxed{5297\ \text{m}}$$

16) Suppose a man's scalp hair grows at a rate of 0.41 mm per day. What is this growth rate in feet per century?

$$\frac{0.41\ \text{mm}}{1\ \text{day}}\left(\frac{365\ \text{days}}{1\ \text{yr}}\right)\left(\frac{100\ \text{yrs}}{1\ \text{century}}\right)\left(\frac{1\times10^{-3}\ \text{m}}{1\ \text{mm}}\right)\left(\frac{3.281\ \text{ft}}{1\ \text{m}}\right) = \boxed{49.10\ \text{ft/century}}$$

17) How many seconds are in 3.25 weeks?

$$3.25\ \text{week}\left(\frac{7\ \text{days}}{1\ \text{week}}\right)\left(\frac{24\ \text{hr}}{1\ \text{day}}\right)\left(\frac{3600\ \text{sec}}{1\ \text{hr}}\right) = \boxed{1,965,600\ \text{sec}}$$

18). A candy shop sells a pound of chocolate for $ 10.85. What is the price of 1.50 kg of chocolate at the shop?

1 pound = $10.85

$$1.50\ \text{kg}\left(\frac{2.20\ \text{pound}}{1\ \text{kg}}\right)\left(\frac{\$10.85}{1\ \text{pound}}\right) = \boxed{\$35.81}$$

19) The Boston Marathon is the oldest annual foot race, in which those that finish complete a distance of 26 miles, 385 yards. Express this distance in kilometers.

$$26\ \text{miles}\left(\frac{1.609\ \text{km}}{1\ \text{mile}}\right) = 41.834\ \text{km}$$

$$385\ \text{yd}\left(\frac{3\ \text{ft}}{1\ \text{yd}}\right)\left(\frac{1\ \text{m}}{3.281\ \text{ft}}\right)\left(\frac{1\ \text{km}}{1000\ \text{m}}\right) = 0.352\ \text{km}$$

$$+ \quad = \boxed{42.19\ \text{km}}$$

Part F: Algebra and Showing Work

20) $v = v_0 + a \cdot t$

Solve for **a**. *Show your work in at least 2 algebra steps.*

$-v_0 \quad -v_0$

$\frac{v - v_0}{t} = \frac{at}{t}$

$$\boxed{a = \frac{(v - v_0)}{t}}$$

21) $x = v_0 \cdot t + \frac{1}{2} a \cdot t^2$

Solve for **a.** *Show your work in at least 2 algebra steps.*

$-v_0 t \quad -v_0 t$

$2(x - v_0 \cdot t) = (\frac{1}{2} a t^2)2$

$\frac{2(x - v_0 \cdot t)}{t^2} = \frac{at^2}{t^2}$

$$\boxed{a = \frac{2(x - v_0 \cdot t)}{t^2}}$$

22) $K = \frac{1}{2} \cdot m \cdot v^2$

Solve for **v.** *Show your work in at least 2 algebra steps.*

$\frac{2K}{m} = \frac{mv^2}{m}$

$\sqrt{\frac{2K}{m}} = \sqrt{v^2}$

$$\boxed{v = \sqrt{\frac{2 \cdot K}{m}}}$$

23) $T = 2\pi \cdot \sqrt{\frac{m}{k}}$

Solve for **k.** *Show your work in at least 2 algebra steps.*

$\frac{T}{2\pi} = \frac{2\pi}{2\pi} \cdot \sqrt{\frac{m}{k}}$

$\left(\frac{T}{2\pi}\right)^2 = \left(\sqrt{\frac{m}{k}}\right)^2$

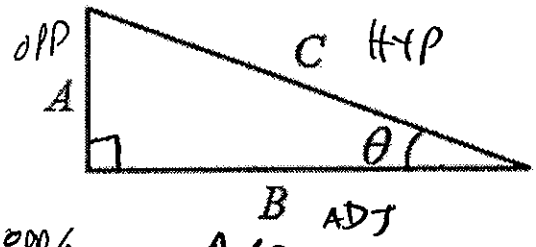
$\frac{T^2}{4\pi^2} = \frac{m}{k}$

$k \cdot T^2 = m \cdot 4\pi^2$

$$\boxed{k = \frac{m \cdot 4\pi^2}{T^2}}$$

Part G: Trigonometry

24) Referring to the triangle (assume this is a right triangle and angle C is 90 degrees) with sides labeled A, B, and C as shown...

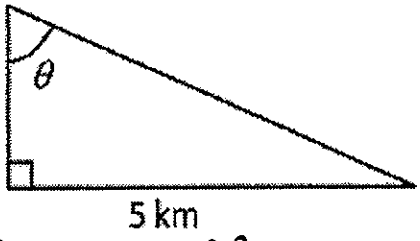


a) What ratio is equal to the sine of the angle θ? $opp/hyp = A/C$

b) What ratio is equal to the cosine of the angle θ? $adj/hyp = B/C$

c) What ratio is equal to the tangent of the angle θ? $opp/adj = A/B$

25) Write an expression that may be used to correctly find the angle θ in the drawing. Then solve for the angle in degrees.

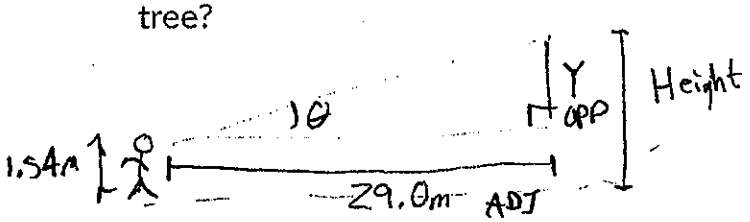


$\tan\theta = \frac{OPP}{ADJ}$ $\theta = \tan^{-1}\left(\frac{OPP}{ADJ}\right)$

$\theta = \tan^{-1}\left(\frac{5km}{2km}\right)$ $\theta \approx 68.20°$

OPP
*degree mode

26) An observer, whose eyes are 1.54 m above the ground, is standing 29.0 m away from a tree. The ground is level, and the tree is growing perpendicular to it. The observer's line of sight with the treetop makes an angle of 1.46 ° above the horizontal. How tall is the tree?



$\theta = 1.46°$

$\tan\theta = \frac{opp}{adj}$

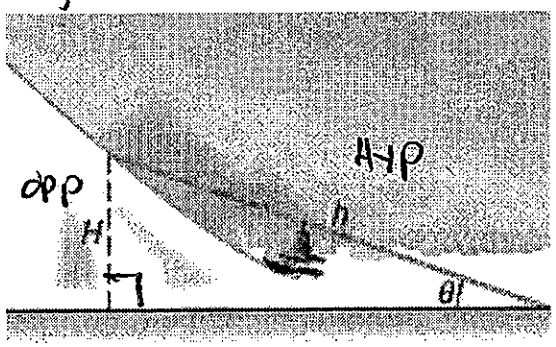
$opp = adj \cdot \tan\theta = (29m)\tan 1.46° = .739m$

Height = 1.54m + Y

Height = 1.54m + .739m

Height = 2.28m

27) The gondola ski lift at a ski resort is 2340 m long. On average, the ski lift rises 11.5 ° above the horizontal. How high is the top of the ski lift relative to the base?



$\theta = 11.5°$

$h = 2340m$

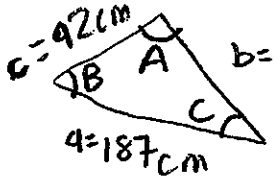
$H = ?$

$\sin\theta = \frac{OPP}{HYP}$

$\sin\theta = \frac{H}{h}$

$H = h \cdot \sin\theta = (2340m)\sin 11.5° = 466.52m$

28) What is the value of each of the angles of a triangle whose sides are 146, 187, and 92 cm in length? *Hint: Consider using the law of cosines* Don't assume Right △



1st Law of Cosines for C.. $c^2 = a^2 + b^2 - 2ab\cos C$

$\cos C = \frac{c^2 - a^2 - b^2}{-2ab}$ $C = \cos^{-1}\left(\frac{c^2 - a^2 - b^2}{-2ab}\right)$

$C = \cos^{-1}\left(\frac{92^2 - 187^2 - 146^2}{-2(187)(146)}\right)$

$C = \cos^{-1}\left(\frac{-47821}{-54604}\right)$

$C \approx 28.9^\circ$

a) The angle opposite the side of length 92 is 28.9°? C=?

b) The angle opposite the side of length 146 is 50.1°? B=?

c) The angle opposite the side of length 187 is 101°? A=?

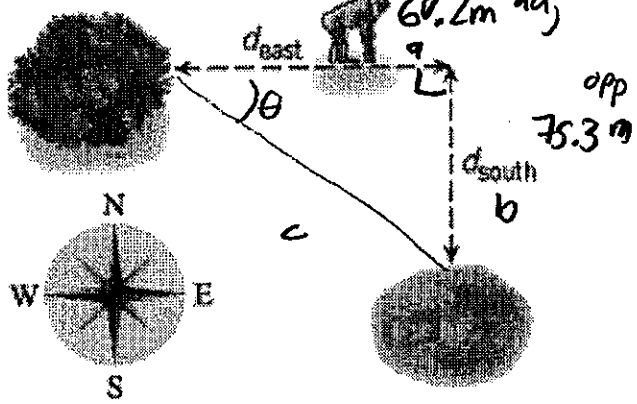
Law of Sines $\frac{\sin B}{b} = \frac{\sin C}{c}$ $\sin B = \left(\frac{b \cdot \sin C}{c}\right)$

$B = \sin^{-1}\left(\frac{b \sin C}{c}\right) = \sin^{-1}\left(\frac{(146)\sin 28.9^\circ}{92}\right)$

$B \approx 50.1^\circ$

$A = 180^\circ - 28.9^\circ - 50.1^\circ = 101^\circ$

29) A chimpanzee sitting against his favorite tree gets up and walks 60.2 m due east and 75.3 m due south to reach a termite mound, where he eats lunch.



(a) What is the shortest distance between the tree and the termite mound?

$c^2 = a^2 + b^2$

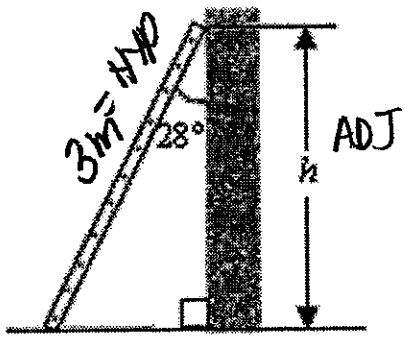
$c = \sqrt{a^2 + b^2} = \sqrt{(60.2)^2 + (75.3)^2} = \sqrt{9294.13}$

$c \approx 96.41\text{m}$

(b) What direction does the shortest distance make, as a positive angle with respect to due east?

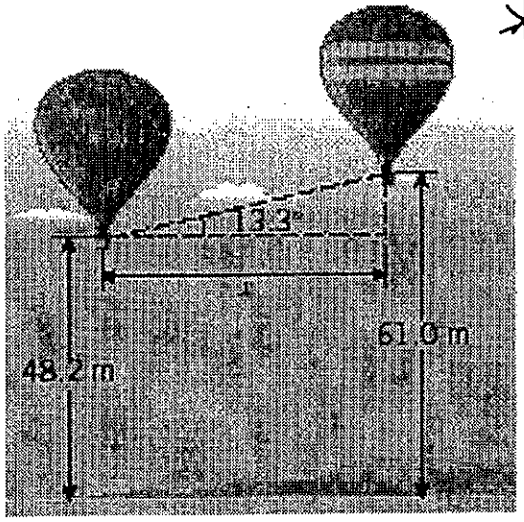
$\tan\theta = \frac{opp}{adj}$ $\theta = \tan^{-1}\left(\frac{opp}{adj}\right) = \tan^{-1}\left(\frac{75.3}{60.2}\right) \approx 51.4^\circ$

30) A 3.0-m ladder leans against a wall and makes an angle with the wall of 28° as shown in the drawing. What is the height *h* above the ground where the ladder makes contact with the wall?

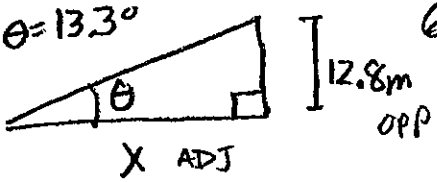


$\cos\theta = \frac{ADJ}{HYP}$ $ADJ = HYP \cdot \cos\theta$

$ADJ = (3\text{m}) \cdot \cos 28^\circ \approx 2.65\text{m}$



✳ 31) Two hot-air balloons in the drawing are 48.2 m and 61.0 m above the ground. A person in the left balloon observes that the right balloon is 13.3° above the horizontal. What is the horizontal distance x between the two balloons?

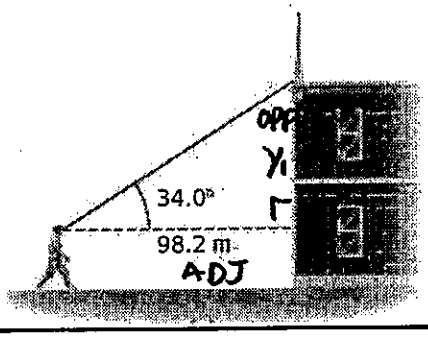


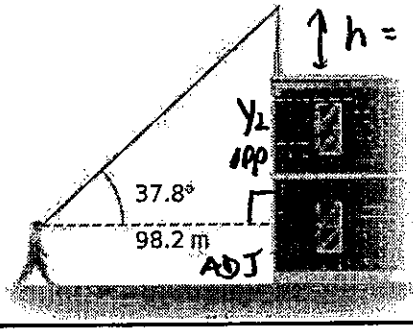
$61m - 48.2m = 12.8m$

$\tan\theta = \frac{x}{opp}$ $\quad x = opp \cdot \tan\theta$

$x = (12.8m)\tan 13.3° = \boxed{3.03m}$

32) The drawing shows a person looking at a building on top of which an antenna is mounted. The horizontal distance between the person's eyes and the building is 98.2 m. In part *a* the person is looking at the base of the antenna, and his line of sight makes an angle of 34.0° with the horizontal. In part *b* the person is looking at the top of the antenna, and his line of sight makes an angle of 37.8° with the horizontal. How tall is the antenna?





$h = Y_2 - Y_1 = 76.2m - 66.2m$

$\boxed{h = 10m}$

$\tan\theta = \frac{OPP}{ADJ}$

$\tan\theta = \frac{Y_1}{ADJ}$

$Y_1 = ADJ \cdot \tan\theta$

$Y_1 = (98.2m)\tan 34°$

$Y_1 = 66.2m$

$Y_2 = ADJ \cdot \tan\theta$

$Y_2 = (98.2m)\tan 37.8°$

$Y_2 = 76.2m$

Key

Part H: Graphing using a Table of Data

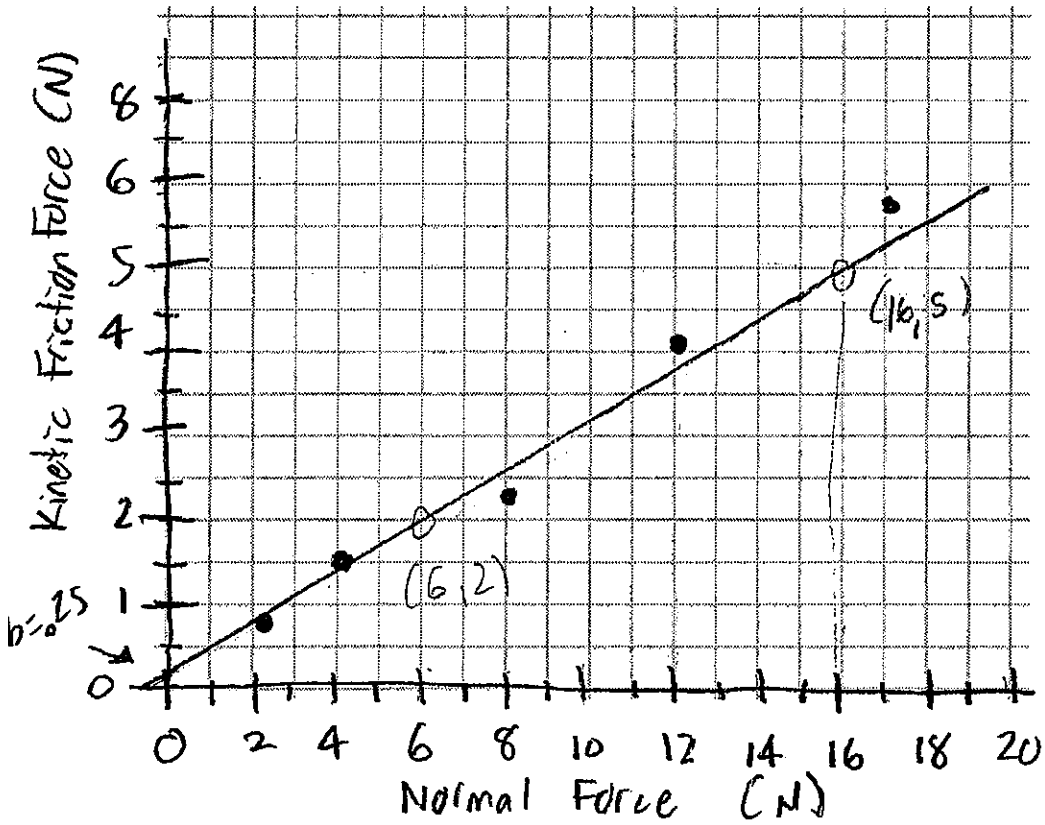
33) Use the data table below…

X

Normal Force (N)	Kinetic Friction Force (N)
2.1	0.83
4.1	1.50
8.0	2.23
12.0	4.02
17.0	5.78

Y

Kinetic Friction Force vs. Normal Force



a) **Create a graph** of **Kinetic Friction Force vs. Normal Force** on the grid below. (Note- the title informs that Kinetic Friction Force is on the y-axis and Normal Force is on the x-axis.) Remember to use all the rules for creating a proper graph, including…*Starting each axis at zero, including placing name and units on each axis, spacing out increments on each axis properly, including all data points, placing a proper title on the graph.*

b) Then draw a "line of best fit" on your graph as a straight line.

c) Calculate the slope of your line of best fit, using any 2 points on your line. Include units to your slope if applicable

$$m = \frac{\Delta y}{\Delta x} = \frac{(5-2)\,N}{(16-6)\,N} = \frac{3N}{10N} = .3$$ NO UNITS

d) Identify the y-intercept using your line.

$b = .25$

e) Write the equation for this linear model in the form y = mx + b, using your numerical values from c and d. Then substitute in the appropriate variables for F_N as *Normal Force* and f_k as *Kinetic Friction Force.*

$y = mx + b$

$y = .3x + .25$

$f_K = .3(F_N) + .25$