Student Name: ______________________________

Honors Physics
Summer Work Packet

Welcome to Honors Physics! The study of physics takes us on a journey investigating matter, energy, and how they interact. We will be exploring concepts including motion, forces, energy, thermodynamics, waves, electricity, and magnetism. By the end of the course I hope you will have an appreciation for the physics that is happening around you every day.

All students taking Honors or AP science courses are required to complete a review packet prior to the start of the course. Each course's packet is designed to help the student review material that was learned in prerequisite science classes. The material is necessary for the student to successfully be in the honors/AP course that he/she has chosen. A pretest will be administered the first day of class to assess the students' knowledge of the science/math concepts covered in the packet. This pretest **will not** be reflected on the marking period grade. The work done in the summer packet, however, will be collected on the first day of class and graded.

The teacher will personally consult with the parent/student to discuss their future in the class if:

1. The student does not show adequate knowledge of the subject material covered on the pretest.
2. The student does not complete the summer work packet by the first day of class.
3. The student does not hand in the summer work packet on the first day of class.

If you have any questions, please call the high school office at 838-1331.

I have read and understand the information written above.

Student signature: ______________________________ Date: ____________

Parent signature: ______________________________ Date: ____________

I attest that all of the work contained in my packet is my own. *This does not mean that you can't work together on this, however this means that you did not just copy someone's work.*

Student signature: ______________________________ Date: ____________

The following packet is designed to help you review for the pretest and to make you aware of the prerequisite science and math skills that you are expected to have in order to succeed in Honors Physics. You may do the work and provide your answer right on the packet or on separate paper – whichever you prefer. **Make sure to show your work and put a box around your final answer.** The main topics to be covered include:

Significant figures	Scientific Notation	Units & Conversions
Graphing	Algebra Review	Trigonometry Review

Feel free to e-mail me with any questions over the summer at nicholas_swartz@pasd.us

Enjoy your summer! I look forward to having you in class in the fall or spring!

Neil Swartz

Part 1: Significant Figures

Rules:

1. Nonzero digits are always significant.
2. All final zeros after the decimal point are significant.
3. Zeros between two other significant digits are always significant.
4. Zeros used solely as placeholders are not significant.

1. Practice: state the number of significant digits in each measurement.

   a. 2804 m
   b. 2.84 km
   c. 0.0029 kg
   d. 0.003068 g
   e. 4.6×10^{5} s
   f. 4.60×10^{-5} s

Addition/Subtraction with significant figures: the final answer cannot me more accurate than the least accurate measurement => the answer has the least number of decimal places.

Multiplication/Division with significant figures: the answer has the least number of total significant figures.

Examples:

1. When adding/subtracting: round answer to the least number of decimal places
   Example: 24.25 m + 3.5 m = 27.75 m = 27.8 m

   Has 2 decimal places | Has 1 decimal place

2. When multiplying/dividing: round answer to the least number of total sig figs
   Example: 36.5 ÷ 3.414 = 10.69127... = 10.7

   Has 3 sig figs | Has 4 sig figs

2. Practice: perform the indicated operation and express your answer to the appropriate number of significant figures.

   a. 6.0 m + 10.73 m + 111.250 m = ____________
   b. 10.970 mL – 5.0 mL = ____________
   c. (797.6 m)(54 m) = ____________
   d. (1075 kg)/(15 kg) = ____________

Part 2: Scientific Notation

Scientific Notation

In science, very large and very small decimal numbers are conveniently expressed in terms of powers of ten. Numbers expressed with the aid of powers of ten are said to be in scientific notation.

Examples: Earth's radius = 6,380,000 m = 6.38×10^6 m
Bohr radius of H atom = 0.0000000000529 m = 5.29×10^{-11} m

All scientific notations are composed of an integer ($0 < m \leq 1$) and powers of ten.

On the calculator: you can punch in scientific notation on a scientific calculator using the following buttons, depending on your calculator:

[EE] or [Exp]

Example: 6.38×10^6 m : 6.38 [EE] 6 = 6.38E6 (the scientific notation on the calculator)

NOTE: Do not punch 6.38 [X] 10 [EE] 6, or your notation will be incorrect.

Practice:

1. Express the following in scientific notation:

a. 5,200 s = ___________

b. 0.0000365 m =___________

2. Express the following in their expanded form:

a. 6.2×10^{-4} g = ___________

b. 3.178×10^2 A = ___________

Part 3: Units & Conversions

Units are essential to communicating information in science – without them we would not know what a number by itself is supposed to represent! The scientific world uses SI units. Since many quantities can be measured in different units it is important to know how to convert from one unit to another.

Table 1 shows the seven fundamental SI units of measurement. Table 2 shows commonly used prefixes. **Please memorize these!**

Table 1: The Seven Fundamental Units of Measurement (SI)

Quantity Measured	Unit	Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

Table 2: Metric prefixes

Prefix	symbol	Factor
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	µ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}

Unit Conversions

- Use a conversion factor – which is equal to 1.
- Multiplying by 1 does not change the value, it just changes the units that it is expressed in.

1 km = 1000 m	1 L = 1000 mL
1 m = 10 dm	1 kg = 1000 g
1 m = 100 cm	1 g = 1000 mg
1 m = 1000 mm	1 mile = 5,280 ft.
1 m = 1 x 10^6 μm	1 inch = 2.54 cm
1 m = 1 x 10^9 nm	1 cal = 4.184 J

Example #1: Convert 37 km to m:

$$37\ km \times \frac{10^3\ m}{1\ km} = 3.7 \times 10^4\ m$$

Example #2: Convert 1.6 ns to s:

$$1.6\ ns \times \frac{10^{-9}\ s}{1\ ns} = 1.6 \times 10^{-9}\ s$$

Example #3: Convert 420 μg to kg:

$$420\ \mu g \times \frac{10^{-6}\ g}{1\ \mu g} \times \frac{1\ kg}{10^3 g} = 4.2 \times 10^{-7} kg$$

Example #4: Convert 21.2 km/hr to m/s:

$$\frac{21.2\ km}{hr} \times \frac{10^3\ m}{km} \times \frac{1\ hr}{60\ min} \times \frac{1\ min}{60\ s} = 5.89\ m/s$$

Example #5: Convert 203 km² to m²:

$$203\ km^2 \times \frac{10^3\ m}{1\ km} \times \frac{10^3\ m}{1\ km} = 203{,}000{,}000\ m^2 = 2.03\ \times 10^8\ m^2$$

Practice: make the following conversions. Show your work!

a. 506 millimeters to meters

b. 5.38 km to m

c. 12,565 g to kg

d. 4.59 kg to g

e. Magician David Blaine spent 7 days underwater. How many seconds was his body exposed to water?

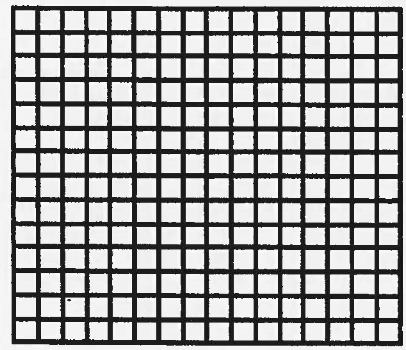
f. If you are going 50 miles per hour, how many meters per second are you traveling?

Part 4: Graphing Review

A car was designed so that each time one liter of gasoline was used, a light would flash on and the driver would then read the number of kilometers traveled. The data is given below. Make a graph and answer the questions about the graph.

A complete graph should include the following: a labeled x and y axis with appropriate units, a title, an appropriate scale, plotted points, and a line of best fit.

Liters	Kilometers
1	6
2	12
3	18
4	24
5	30



Questions:

1. What is the independent variable?

2. What is the dependent variable?

3. Calculate the slope of the line and include units. What does the slope represent?

4. What distance would be expected for 1.5 liters?

5. What distance would you expect for 6 liters?

Part 5: Algebra Review

1. Practice with equations & scientific notation. Solve the following and place your answer in scientific notation when appropriate. Do your best to cancel units and attempt to show the simplified units in the final answer. **When angles are involved make sure your calculator is in degree mode!**

a. $T_s = 2\pi\sqrt{\dfrac{4.5\times10^{-2}\,kg}{2.0\times10^{3}\,kg/s^2}} =$ ______________

b. $K = \dfrac{1}{2}\left(6.6\times10^{2}\,kg\right)\left(2.11\times10^{4}\,m/s\right)^2 =$ ______________

c. $F = \left(9.0\times10^{9}\,\dfrac{N\cdot m^2}{C^2}\right)\dfrac{\left(3.2\times10^{-9}C\right)\left(9.6\times10^{-9}C\right)}{\left(0.32m\right)^2} =$ ______________

d. $\dfrac{1}{R_p} = \dfrac{1}{4.5\times10^{2}\,\Omega} + \dfrac{1}{9.4\times10^{2}\,\Omega}$ $R_p =$ ______________

e. $e = \dfrac{1.7\times10^{3}\,J - 3.3\times10^{2}\,J}{1.7\times10^{3}\,J} =$ ______________

f. $1.33\sin 25.0° = 1.50\sin\theta$ $\theta =$ ______________

g. $K_{max} = \left(6.63\times10^{-34}J\cdot s\right)\left(7.09\times10^{14}s\right) - 2.17\times10^{-19}J =$ ______________

h. $\gamma = 1\Big/\sqrt{1-\dfrac{2.25\times10^{8}\,m/s}{3.00\times10^{8}\,m/s}} =$ ______________

2. Solve the following equations: (Show your work)

a) $-72 + t = -40$ ________

b) $\dfrac{3}{4} + x = \dfrac{7}{8}$ ________

c) $\dfrac{3}{2}r = -\dfrac{4}{5}$ ________

d) $\dfrac{1}{2}x + \dfrac{1}{3}x = \dfrac{1}{6}x - 5$ ________

3. Quadratic formula:

Example: Solve $3x^2 - 5x + 1 = 0$ using the quadratic formula.

Quadratic formula: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$$3x^2 - 5x + 1 = 0$$

$$a = 3 \quad b = -5 \quad c = 1$$

$$x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(3)(1)}}{2(3)}$$

$$= \frac{5 \pm \sqrt{25 - 12}}{6} = \frac{5 \pm \sqrt{13}}{6}$$

Practice – solve the following:

a. $x^2 - 3x - 4 = 0$

b. $y^2 - 6y = -8$

c. $x^2 - 36 = 0$

d. $2y^2 - 7y - 15 = 0$

4. Given the following equation: PE = mgh
   a) If m = 4, g = 10, h = 2, what is the value of PE?

   b) If PE = 60, g=10, h=2, what is the value of m?

5. Given the equation KE $= \frac{1}{2}mv^2$

   If KE = 100 and m = 5, solve for v.

6. In physics we will work with a lot of different equations that allow us to solve for various quantities. Often it is helpful to be able to rearrange these equations in terms of variables before plugging any numbers in. Refresh your algebra skills with these examples:

Example #1:

Suppose we want to know the height, h, in the following formula: $U_g = mgh$

Step 1: Divide by sides of the equation by mg:

$$\frac{U_g}{mg} = \frac{mgh}{mg}$$

Step 2: Reduce the fraction:

$$\frac{U_g}{mg} = \frac{\cancel{mg}h}{\cancel{mg}}$$

Result: $h = \frac{U_g}{mg}$

Example #2:

Suppose we want to know the radius, r, in the following equation: $F_c = \frac{mv^2}{r}$

Step 1: Multiply both sides of the equation by r:

$$F_c r = \frac{mv^2}{r} * r$$

Step 2: Reduce the fraction:

$$F_c r = \frac{mv^2}{\cancel{r}} * \cancel{r}$$

$$F_c r = mv^2$$

Step 3: Divide both sides of the equation by F_c to isolate r:

$$\frac{F_c r}{F_c} = \frac{mv^2}{F_c}$$

Step 4: Reduce the fraction:

$$\frac{\cancel{F_c}r}{\cancel{F_c}} = \frac{mv^2}{F_c}$$

Result:

$$r = \frac{mv^2}{F_c}$$

Example #3:

Given the equation $v_f^2 = v_i^2 + 2ax$, solve for the initial velocity, v_i

Step 1: Subtract $2ax$ from both sides of the equation:

$$v_f^2 - 2ax = v_i^2 + 2ax - 2ax$$

$$v_f^2 - 2ax = v_i^2$$

Step 2: Take the square root of both sides of the equation:

$$\sqrt{v_f^2 - 2ax} = \sqrt{v_i^2}$$

Result: $v_i^2 = \sqrt{v_f^2 - 2ax}$

Practice:

Solve for the variable indicated. Do not be confused by the different letters – manipulate them algebraically as though they were numbers!

1. $v = \frac{d}{t}$ for d: ______________________

2. $v = \frac{d}{t}$ for t: ______________________

3. V = lwh for h: ____________________

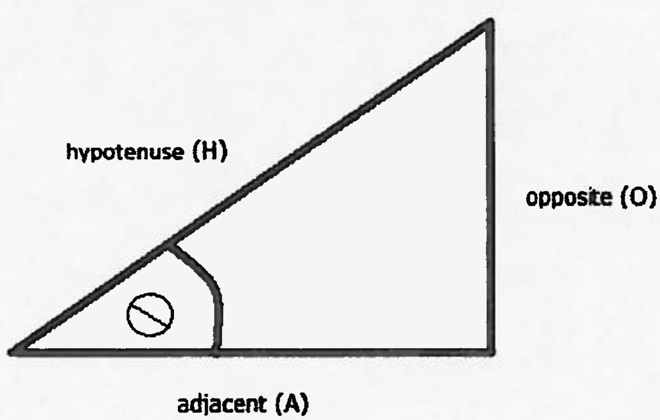
4. A = p + prt for r: __________________

5. KE = $\frac{1}{2}mv^2$for v: __________________

Part 6: Trigonometry Review

Basics:

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



Think: SOH CAH TOA

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

$$\cos\theta = \frac{A}{H}$$

$$\tan\theta = \frac{O}{A}$$

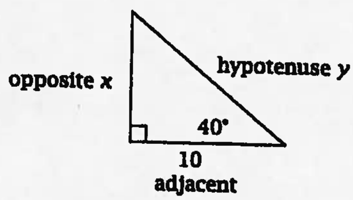
The following worksheets provide practice with calculating missing sides and angles using trigonometric ratios. **MAKE SURE YOUR CALCULATOR IS IN DEGREE MODE** ☺ Answers should be in **decimal** form.

Name____________________ Period____

Applying Trigonometric Ratios

Using the trigonometric ratios, solve for the missing sides x and y of each right triangle. Round your answers to the nearest tenth.

Example:



Ratios: $\sin 40 = \left(\frac{x}{y}\right)$ ← **Note:** having two variables in one ratio means it can not be solved.

$\cos 40 = \left(\frac{10}{y}\right)$

$\tan 40 = \left(\frac{x}{10}\right)$

Use the tan and the cos to solve for x and y.

$\cos 40^\circ = \frac{10}{y}$ $\tan 40^\circ = \frac{x}{10}$

$y \cos 40^\circ = 10$ $x = 10 \tan 40^\circ = 8.39099$

$y = \frac{10}{\cos 40^\circ} = 13.05407$ $x = 8.4$

$y = 13.1$

Note: Since these are right triangles, you can check your answer using the Pythagorean theorem. The answers will not be exact due to rounding.

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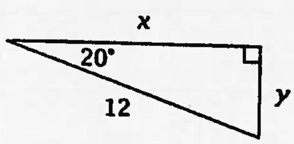

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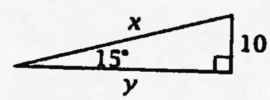

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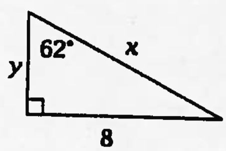

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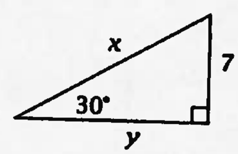

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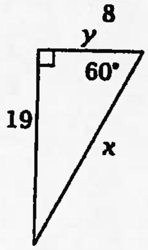

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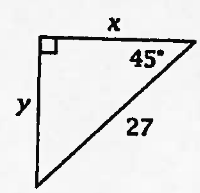

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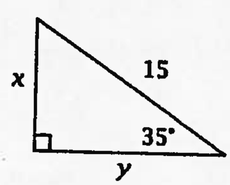

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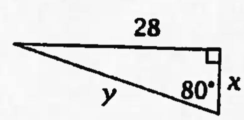
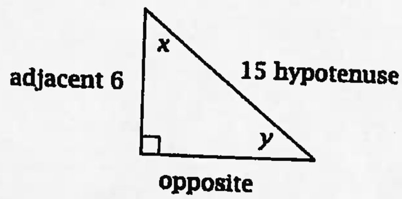


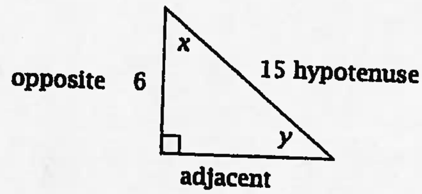
Name____________________ Period____

Using Trigonometric Ratios to Find Angles

Using the trigonometric ratios, solve for the missing angles x and y of each right triangle. Round your answers to the nearest degree.

Example:





Solving for angle x:

$\cos x = \left(\frac{6}{15}\right)$

$x = \cos^{-1}\left(\frac{6}{15}\right)$

$x = 66.421 = 66^\circ$

Solving for angle y:

$\sin y = \left(\frac{6}{15}\right)$

$y = \sin^{-1}\left(\frac{6}{15}\right)$

$y = 23.578 = 24^\circ$

Check: $66^\circ + 24^\circ = 90^\circ$

Check: The three angles of a triangle always add up to 180 degrees. Since these are right triangles, one angle must equal 90 degrees. Therefore the other two must add up to 90 degrees. Remember, rounding may cause the answers to be slightly off.

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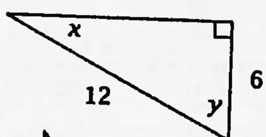

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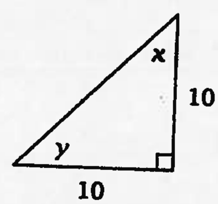

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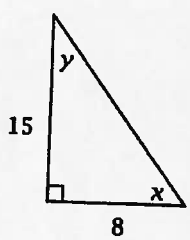

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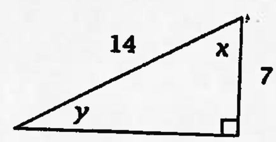

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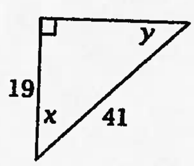

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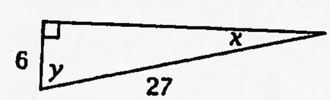

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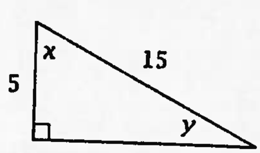

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