Physics: AP PHYSICS I Name ________________________
Introductory Math Problems

I. Physics, and AP Physics in particular, requires an exceptional proficiency in algebra, trigonometry, and geometry. In addition to the science concepts Physics often seems like a course in applied mathematics. The following assignment includes mathematical problems that are considered routine in senior Physics. This packet is a math review to brush up on valuable skills, and perhaps a means to assess whether you are correctly placed in senior Physics. This includes knowing several key metric system conversion factors and how to employ them.

II. The attached pages contain a brief review, hints, and example problems. It is hoped that combined with your previous math knowledge this assignment is merely a review and a means to brush up before we get into the physics.

III. What if I don't get all the problems or don't understand the instructions?

   A. Simply do the best you can, but don't be afraid to ask, always show some work / effort in order to receive credit.

   B. Come to class with your questions, in order to resolve the issues

1. The following are ordinary physics problems. Place the answer in scientific notation when appropriate and simplify the units (Scientific notation is used when it takes less time to write than the ordinary number does. As an example 200 is easier to write than $2.00\text{x}10^2$, but $2.00\text{x}10^8$ is easier to write than 200,000,000). Do your best to cancel units, and attempt to show the simplified units in the final answer.

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

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

e. $e = \dfrac{\left(1.7\times10^{3}\,J\right)-\left(3.3\times10^{2}\,J\right)}{\left(1.7\times10^{3}\,J\right)} =$ ________________

f. $(1.33)\sin 25.0^o = (1.50)\sin\theta$ $\theta =$ ________________

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. Often problems in physics are done with variables only. Solve for the variable indicated. Don't let the different letters confuse you. Manipulate them algebraically as though they were numbers.

a. $v^2 = v_o^{\,2} + 2a(s - s_o)$ $, a =$ ________________

b. $K = \dfrac{1}{2}kx^2$ $, x =$ ________________

c. $T_p = 2\pi\sqrt{\dfrac{\ell}{g}}$ $, g =$ ________________

d. $F_g = G\dfrac{m_1 m_2}{r^2}$ $, r =$ ________________

e. $mgh = \dfrac{1}{2}mv^2$ $, v =$ ________________

f. $x = x_o + v_o t + \dfrac{1}{2}at^2$ $, t =$ ________________

g. $B = \dfrac{\mu_o}{2\pi}\dfrac{I}{r}$ $, r =$ ________________

h. $x_m = \dfrac{m\lambda L}{d}$ $, d =$ ________________

i. $pV = nRT$ $, T =$ ________________

j. $\sin\theta_c = \dfrac{n_1}{n_2}$ $, \theta_c =$ ________________

k. $qV = \dfrac{1}{2}mv^2$ $, v =$ ________________

l. $\dfrac{1}{f} = \dfrac{1}{s_o} + \dfrac{1}{s_i}$ $, s_i =$ ________________

3. Science uses the ***MKS*** system (***SI***: System Internationale). ***MKS*** stands for meter, kilogram, second. These are the units of choice of physics. The equations in physics depend on unit agreement. So you must convert to ***MKS*** in most problems to arrive at the correct answer.

kilometers (*km*) to meters (*m*)	and meters to kilometers	gram (*g*) to kilogram (*kg*)
centimeters (*cm*) to meters (*m*)	and meters to centimeters	Celsius (^oC) to Kelvin (*K*)
millimeters (*mm*) to meters (*m*)	and meters to millimeters	atmospheres (*atm*) to Pascals (*Pa*)
nanometers (*nm*) to meters (*m*)	and metes to nanometers	liters (*L*) to cubic meters (m^3)
micrometers (μm) to meters (*m*)		

Other conversions will be taught as they become necessary.

What if you don't know the conversion factors? Universities want students who can find their own information (so do employers).

Enjoy.

a. 4008 *g* = ________________ *kg*

b. 1.2 *km* = ________________ *m*

c. 823 *nm* = ________________ *m*

d. 298 *K* = ________________ ^oC

e. 0.77 *m* = ________________ *cm*

f. $8.8\text{x}10^{-8}$ *m* = ________________ *mm*

g. 1.2 *atm* = ________________ *Pa*

h. 25.0 μm = ________________ *m*

i. 2.65 *mm* = ________________ *m*

j. 8.23 *m* = ________________ *km*

k. 5.4 *L* = ________________ m^3

l. 40.0 *cm* = ________________ *m*

m. $6.23\text{x}10^{-7}$ *m* = ________________ *nm*

n. $1.5\text{x}10^{11}$ *m* = ________________ *km*

6. Solve the following geometric problems.

a. What is angle θ ?

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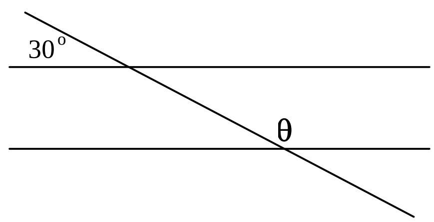

b. How large is *θ*?

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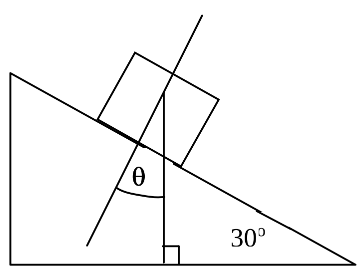

c. The radius of a circle is 5.5 *cm*,

i. What is the circumference in <u>meters</u>?

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ii. What is its area in <u>square meters</u>?

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d. What is the area under the curve at the right?

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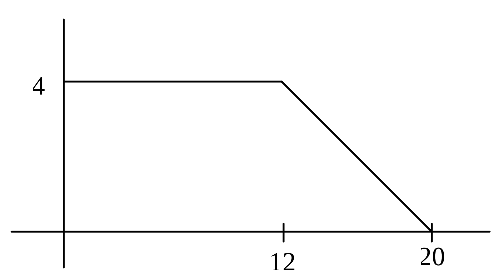

Teacher's Solutions

1. The following are ordinary physics problems. Place the answer in scientific notation when appropriate and simplify the units (Scientific notation is used when it takes less time to write than the ordinary number does. As an example 200 is easier to write than 2.00×10^2, but 2.00×10^8 is easier to write than 200,000,000). Do your best to cancel units, and attempt to show the simplified units in the final answer.

a. $T_s = 2\pi\sqrt{\dfrac{4.5\times10^{-2}\,kg}{2.0\times10^3\,kg/s^2}} =$ $0.0298\ s = 2.98\times10^{-2}\,s.$

b. $K = \frac{1}{2}(6.6\times10^2\,kg)(2.11\times10^4\,m/s)^2 =$ ie $KE = \frac{1}{2}mv^2$ $1.46\times10^{11}\,\frac{kg\,m^2}{s^2} = 1.46\times10^{11}\,J$

c. $F = \left(9.0\times10^9\,\dfrac{N\cdot m^2}{C^2}\right)\dfrac{(3.2\times10^{-9}C)(9.6\times10^{-9}C)}{(0.32m)^2} =$ $2.7\times10^{-6}\,N$

d. $\dfrac{1}{R_p} = \dfrac{1}{4.5\times10^2\Omega} + \dfrac{1}{9.4\times10^2\Omega}$ $R_p =$ $304.3\ \Omega$

e. $e = \dfrac{(1.7\times10^3 J)-(3.3\times10^2 J)}{(1.7\times10^3 J)} =$ 8.06×10^{-1} or 0.806

f. $(1.33)\sin 25.0^\circ = (1.50)\sin\theta$ $\theta =$ $\sin^{-1}\left(\dfrac{1.33\cdot\sin 25}{1.5}\right) = 22.0^\circ$

g. $K_{max} = (6.63\times10^{-34}\,J\cdot s)(7.09\times10^{14}\,s) - 2.17\times10^{-19}\,J =$ $2.53\times10^{-19}\,J$

h. $\gamma = 1\Big/\sqrt{1-\dfrac{2.25\times10^8\,m/s}{3.00\times10^8\,m/s}} =$ 2

2. Often problems in physics are done with variables only. Solve for the variable indicated. Don't let the different letters confuse you. Manipulate them algebraically as though they were numbers.

a. $v^2 = v_o^2 + 2a(s-s_o)$, $a =$ $\dfrac{v^2-v_o^2}{2(s-s_o)}$

b. $K = \frac{1}{2}kx^2$, $x =$ $\pm\left(\dfrac{2K}{k}\right)^{1/2}$

c. $T_p = 2\pi\sqrt{\dfrac{\ell}{g}}$ $\dfrac{T_p}{2\pi} = \sqrt{\dfrac{\ell}{g}}$, $g =$ $\sqrt{\dfrac{g}{\ell}} = \dfrac{2\pi}{T_p}$ $\therefore g = \dfrac{\ell\,4\pi^2}{T_p^2}$

d. $F_g = G\dfrac{m_1 m_2}{r^2}$, $r =$ $r = \sqrt{\dfrac{Gm_1m_2}{F_g}}$

e. $mgh = \frac{1}{2}mv^2$, $v =$ $v = \sqrt{2gh}$

f. $x = x_o + v_o t + \frac{1}{2}at^2$, $t =$ $\dfrac{-v_o \pm\sqrt{v_o^2-(4)(x_o-x)\frac{a}{2}}}{a}$

$0 = (x_o - x) + v_o t + \frac{1}{2}at^2$

g. $B = \dfrac{\mu_o I}{2\pi r}$, $r =$ $\dfrac{\mu_o I}{2\pi B}$

h. $x_m = \dfrac{m\lambda L}{d}$, $d =$ $\dfrac{m\lambda L}{x_m}$

i. $pV = nRT$, $T =$ $\dfrac{pV}{nR}$

j. $\sin\theta_c = \dfrac{n_1}{n_2}$, $\theta_c =$ $\sin^{-1}\left(\dfrac{n_1}{n_2}\right)$

k. $qV = \frac{1}{2}mv^2$, $v =$ $\sqrt{\dfrac{2qV}{m}}$

l. $\dfrac{1}{f} = \dfrac{1}{s_o} + \dfrac{1}{s_i}$, $s_i =$ $\left(\dfrac{1}{f} - \dfrac{1}{s_o}\right)^{-1}$

3. Science uses the ***MKS*** system (***SI***: System Internationale). ***MKS*** stands for meter, kilogram, second. These are the units of choice of physics. The equations in physics depend on unit agreement. So you must convert to ***MKS*** in most problems to arrive at the correct answer.

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Other conversions will be taught as they become necessary.

What if you don't know the conversion factors? Universities want students who can find their own information (so do employers).

Enjoy.

a. 4008 *g* = 4.008 kg

b. 1.2 *km* = 1200 m

c. 823 *nm* = 8.23×10^{-7} m

d. 298 *K* = 298 − 273 = 25 °C

e. 0.77 *m* = 77 cm

f. 8.8×10^{-8} *m* = $8.8\times10^{-8}\times10^{3}$ mm = 8.8×10^{-5} mm

g. 1.2 *atm* $\times \frac{101.3\times10^{3}\,Pa}{1\,atm} = 1.22\times10^{5}$ Pa

h. 25.0 μm = 25×10^{-6} m

i. 2.65 *mm* = 2.65×10^{-3} m

j. 8.23 *m* = 8.23×10^{-3} km

k. 5.4 *L* = 5.4×10^{-3} m^3

l. 40.0 *cm* = 40.0×10^{-2} m or 0.400 m

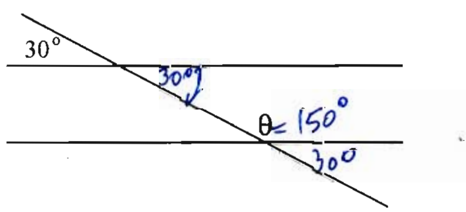
m. 6.23×10^{7} *m* = 6.23×10^{2} nm

n. 1.5×10^{11} *m* = 1.5×10^{8} km

6. Solve the following geometric problems.

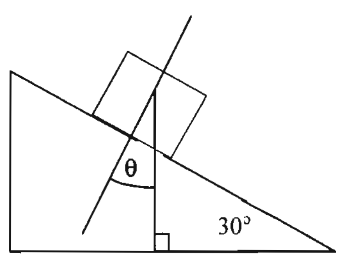
a. What is angle θ ?

150°



b. How large is *θ*?

θ = 30°



c. The radius of a circle is 5.5 *cm*,

i. What is the circumference in <u>meters</u>?

$2\pi(5.5)cm = 34.6\,cm = 0.346\,m.$

$C = 2\pi r$
$A = \pi r^2$

ii. What is its area in <u>square meters</u>?

$\pi(5.5)^2 cm^2 = 95.03\,cm^2 = 95.03(10^{-2}m)^2 = 95.03\times10^{-4}m^2 = 9.503\times10^{-3}m^2$

d. What is the area under the curve at the right?

64 units²