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

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

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

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

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

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

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

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.

kilometers (*km*) to meters (*m*) and meters to kilometers
centimeters (*cm*) to meters (*m*) and meters to centimeters
millimeters (*mm*) to meters (*m*) and meters to millimeters
nanometers (*nm*) to meters (*m*) and metes to nanometers
micrometers (μm) to meters (*m*)

gram (*g*) to kilogram (*kg*)
Celsius (^oC) to Kelvin (*K*)
atmospheres (*atm*) to Pascals (*Pa*)
liters (*L*) to cubic meters (m^3)

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).

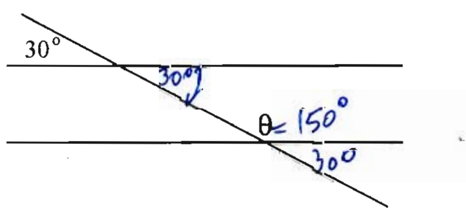
Enjoy.

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.

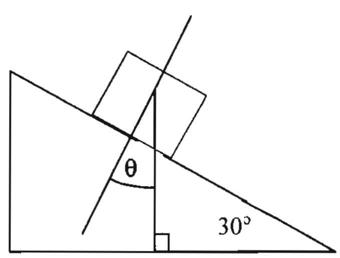
a. What is angle θ ?

150°



b. How large is *θ*?

θ = 30°



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

i. What is the circumference in meters?

2π(5.5)cm = 34.6 cm = 0.346 m.

C = 2πr
A = πr²

ii. What is its area in square meters?

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

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

64 units².