Spring AP Physics Resources

The following are constants and equations taken directly from the most recent AP Physics exam. You may use ALL of the Resource section on any test and quiz.

ADVANCED PLACEMENT PHYSICS 1 EQUATIONS, EFFECTIVE 2015

CONSTANTS AND CONVERSION FACTORS	
Proton mass, $m_p = 1.67 \times 10^{-27}$ kg	Electron charge magnitude, $e = 1.60 \times 10^{-19}$ C
Neutron mass, $m_n = 1.67 \times 10^{-27}$ kg	Coulomb's law constant, $k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ \text{N}\cdot\text{m}^2/\text{C}^2$
Electron mass, $m_e = 9.11 \times 10^{-31}$ kg	Universal gravitational constant, $G = 6.67 \times 10^{-11}\ \text{m}^3/\text{kg}\cdot\text{s}^2$
Speed of light, $c = 3.00 \times 10^8$ m/s	Acceleration due to gravity at Earth's surface, $g = 9.8\ \text{m/s}^2$

UNIT SYMBOLS								
	meter,	m	kelvin,	K	watt,	W	degree Celsius,	°C
	kilogram,	kg	hertz,	Hz	coulomb,	C		
	second,	s	newton,	N	volt,	V		
	ampere,	A	joule,	J	ohm,	Ω		

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

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.

I. The frame of reference of any problem is assumed to be inertial unless otherwise stated.
II. Assume air resistance is negligible unless otherwise stated.
III. In all situations, positive work is defined as work done <u>on</u> a system.
IV. The direction of current is conventional current: the direction in which positive charge would drift.
V. Assume all batteries and meters are ideal unless otherwise stated.

ADVANCED PLACEMENT PHYSICS 1 EQUATIONS, EFFECTIVE 2015

MECHANICS

$v_x = v_{x0} + a_x t$

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

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

$\vec{a} = \frac{\sum \vec{F}}{m} = \frac{\vec{F}_{net}}{m}$

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

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

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

$\Delta \vec{p} = \vec{F}\,\Delta t$

$K = \frac{1}{2}mv^2$

$\Delta E = W = F_{\parallel}d = Fd\cos\theta$

$P = \frac{\Delta E}{\Delta t}$

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

$\omega = \omega_0 + \alpha t$

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

$\vec{\alpha} = \frac{\sum \vec{\tau}}{I} = \frac{\vec{\tau}_{net}}{I}$

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

$L = I\omega$

$\Delta L = \tau\,\Delta t$

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

$|\vec{F}_s| = k|\vec{x}|$

$U_s = \frac{1}{2}kx^2$

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

a = acceleration
A = amplitude
d = distance
E = energy
f = frequency
F = force
I = rotational inertia
K = kinetic energy
k = spring constant
L = angular momentum
ℓ = length
m = mass
P = power
p = momentum
r = radius or separation
T = period
t = time
U = potential energy
V = volume
v = speed
W = work done on a system
x = position
y = height
α = angular acceleration
μ = coefficient of friction
θ = angle
ρ = density
τ = torque
ω = angular speed

$\Delta U_g = mg\,\Delta y$

$T = \frac{2\pi}{\omega} = \frac{1}{f}$

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

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

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

$\vec{g} = \frac{\vec{F}_g}{m}$

$U_G = -\frac{Gm_1 m_2}{r}$

ELECTRICITY

$|\vec{F}_E| = k\left|\frac{q_1 q_2}{r^2}\right|$

$I = \frac{\Delta q}{\Delta t}$

$R = \frac{\rho\ell}{A}$

$I = \frac{\Delta V}{R}$

$P = I\,\Delta V$

$R_s = \sum_i R_i$

$\frac{1}{R_p} = \sum_i \frac{1}{R_i}$

A = area
F = force
I = current
ℓ = length
P = power
q = charge
R = resistance
r = separation
t = time
V = electric potential
ρ = resistivity

WAVES

$\lambda = \frac{v}{f}$

f = frequency
v = speed
λ = wavelength

GEOMETRY AND TRIGONOMETRY

Rectangle
$A = bh$

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

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

Rectangular solid
$V = \ell wh$

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

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

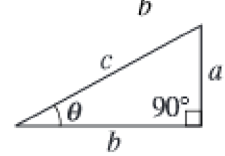
A = area
C = circumference
V = volume
S = surface area
b = base
h = height
ℓ = length
w = width
r = radius

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

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

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

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



Real World Physics: Second Semester Project (100 Points)

Working in small groups (2 or 3), students will be given one of the following research topics that presents a real world problem that needs solving.

Problem 1: You are a bicycle manufacturer designing a more user-friendly bike. Your company's present design involves a wheel whose rim has a moment of inertia larger than necessary for the requirements of ordinary riders. Conduct a detailed analysis of different rim designs that will yield a more energy efficient product.

Problem 2: You are an auditorium designer, whose job it is to build a venue for a new type of music called "Squeak Pop". This type of music emphasizes particular frequencies played during songs, and the best listening areas for an audience are those that will resonate at the particular frequencies played. Your task is to design an auditorium that accounts for small changes in air temperature, using a given musical score that you'll have to interpret to determine optimal frequencies for your building.

Problem 3: You are a clock maker, trying to find a better pendulum design for a grandfather clock your company manufactures. The original pendulum has problems with friction and arc length, and the new one must meet different specifications that your boss has established. Your task is to determine what parameters you should change in order to optimize the pendulum's performance.

Problem 4: You are a logistics specialist for a company that ships goods around the county by road. Your company has a fleet of vehicles that has a specific power output, volume capacity, and weight limit. One work day your company gets a massive order from several different cities for a certain product, and it is your job to figure out the optimum delivery strategy to minimize costs and maximize efficiency, while working within the physical parameters of your fleet vehicles.

Note: More on this Later

A Few Metric to Imperial Conversions

1 cm = 0.393 inches 1 inch = 2.54 cm

1 m = 3.28 feet 1 foot = 0.3048 m

1 km = 0.621 statute miles = 0.540 nautical miles 1statute mile = 1.609 km = 0.869 nautical miles

1 mL = 1 cm^3 = 0.061 $inches^3$

Unit 7 Resources – Work, Energy, Power

Unit 7 Notes:

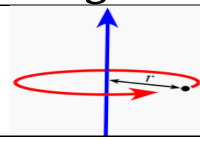
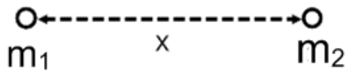
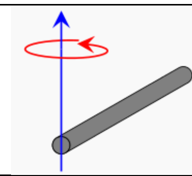
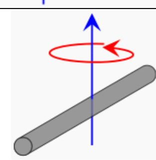
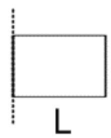
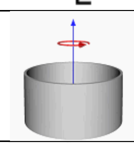
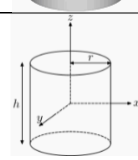
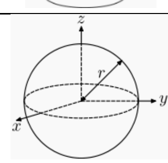
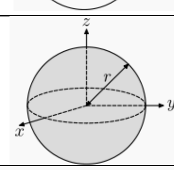
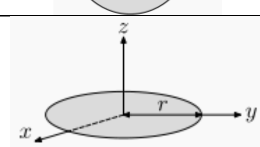
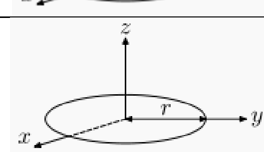
Unit 8 Resources – Momentum, Impulse, Collisions

Solar System Data			
Object	**Mass (kg)**	**Radius (km)**	**Distance Details (km)**
Earth	5.98 E 24	6.4 E 3	Earth-Moon: 3.8 E 5
			Earth-Sun: 1.5 E 8
Moon	7.40 E 22	3500	Moon-Earth: 3.8 E 5
Sun	2.00 E 30	1.40 E 6	Sun-Earth: 1.5 E 8

Unit 8 Notes:

Unit 9 Resources – Rotational Motion & Equilibrium

Unit 9 Notes:

Description	Figure	Moment(s) of Inertia
Point Mass		$I = mr^2$
Two Point Masses (axis NOT at center, x is distance b/w)		$I = \frac{m_1 m_2}{m_1 + m_2} x^2$
Rod – Axis at End		$I_{\text{end}} = \frac{mL^2}{3}$ L = Length
Rod – Axis in Center		$I_{\text{center}} = \frac{mL^2}{12}$ L = Length
Rectangular Solid – Axis on Edge (Like a Door)		$I_{\text{end}} = \frac{mL^2}{3}$ L = Length
Hollow Cylinder		$I = mr^2$
Solid Cylinder (Disc)		$I_z = \frac{mr^2}{2}$
Hollow Sphere		$I = \frac{2mr^2}{3}$
Solid Sphere		$I = \frac{2mr^2}{5}$
Solid Disc		$I_z = \frac{mr^2}{2}$
Circular Hoop		$I_z = mr^2$ $I_x = I_y = \frac{mr^2}{2}$

Unit 10 Resources – Electrostatics

Unit 10 Notes:

Table 10.1 Subatomic Particles and Charges		
Particle	**Electric Charge**	**Mass**
Electron	-1.602 E -19 C	m_e = 9.109 E -31 kg
Proton	+1.602 E -19 C	m_p = 1.673 E-27 kg
Neutron	0	m_n = 1.675 E -27 kg

Unit 11 Resources – Basic Electric Circuits

Unit 11 Notes:

Unit 11 Guide to Multimeters

Multimeters are electronic tools that measure a variety of parameters. The meters we will use in here will measure both alternating current (AC) and direct current (DC) voltage, resistance (measured in ohms (symbol = Ω)), and current (measured in Amperes (A = Coulombs/second)).

Caution: Do not measure current unless expressly told to do so. It is easy to set the meter to the wrong setting and fry it with a current measurement!

<u>Power – Resistance - Current – Voltage Quick Guide</u>

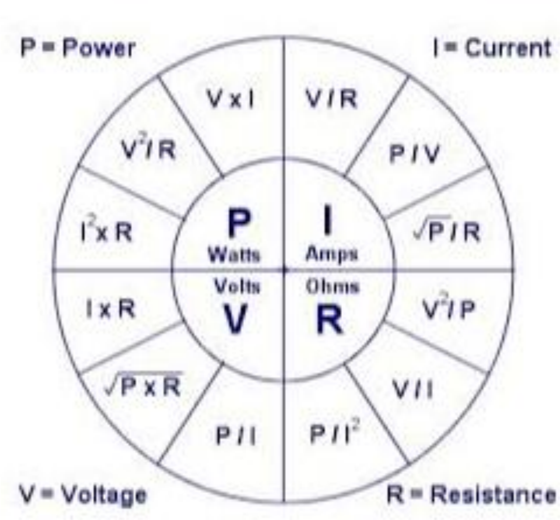
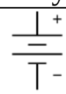
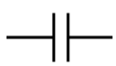
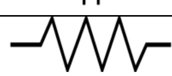
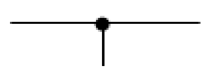
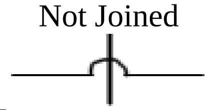
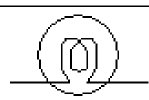
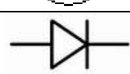
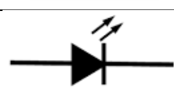
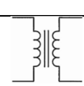
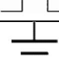


Table 11.1 - Resistivities (at 20 °C) and Temperature Coefficients for Materials					
Conductors			**Semiconductors**		
Material	**ρ (Ω•m)**	**α (1/°C)**	**Material**	**ρ (Ω•m)**	**α (1/°C)**
Aluminum	2.82 E -8	4.29 E -3	Carbon	3.6 E -5	-5.0 E -4
Copper	1.70 E -8	6.80 E -3	Germanium	0.46	-5.0 E -2
Iron	10.0 E -8	6.51 E -3	Silicon	250	-7.0 E -2
Mercury	98.4 E -8	0.89 E -3			
Nichrome	100. E -8	0.40 E -3	**Nonconductors**		
Nickel	7.80 E -8	6.0 E -3	Glass	10 E 12	
Platinum	10.0 E -8	3.93 E -3	Rubber	10 E 15	
Silver	1.59 E -8	4.1 E -3	Wood	10 E 10	
Tungsten	5.60 E -8	4.5 E -3			

Table 11.2 - Typical Power and Current Requirements of Appliances (120V)					
Appliance	**Power (W)**	**Current (A)**	**Appliance**	**Power (W)**	**Current (A)**
Room Air Conditioner	1500	12.5	Portable Heater	1500	12.5
Central Air Conditioner	5000	41.7	Microwave Oven	900	5.2
Blender	800	6.7	Radio – CD Player	14	0.12
Clothes Dryer	6000	50	Refrigerator	500	4.2
Clothes Washer	840	7.0	Range	6000	50.0
Coffeemaker	1625	13.5	Oven	4500	37.5
Dishwasher	1200	10.0	Television	100	0.83
Electric Blanket	180	1.5	Toaster	950	7.9
Hair Dryer	1200	10.0	Water Heater	4500	37.5

Table 11.3 - Resistor Color Code				
Color	First Band	Second Band	Third Band	Tolerance Band
Black	0	0	X 1	
Brown	1	1	X 10	Gold ± 5%
Red	2	2	X 100	Silver ± 10%
Orange	3	3	X 1,000	None ± 20%
Yellow	4	4	X 10,000	
Green	5	5	X 100,000	
Blue	6	6	X 1,000,000	
Violet	7	7	Silver ÷ 100	
Gray	8	8	Gold ÷ 10	
White	9	9		

Table 11.4 - Circuit Symbols				
Parameter/Device	Circuit Symbol	Units	SI Symbol	Equation Symbol
Battery – Direct Current Power Source		DC Volts	V	V
Outlet – Alternating Current Power Source		AC Volts	V	V
Capacitor		Farads	F	C
Resistor		Ohms	Ω	R
Switch				
Wire		Connected 	Not Joined 	
Light Bulb				
Diode				
Light Emitting Diode				
Inductor		Henry	H	L
Transformer				
Ground				

Unit 12 Resources – Mechanical Waves and Sound

Unit 12 Notes:

Table 12.1 - Speed of Sound in Various Media

Solids		**Liquids**		**Gases**	
Aluminum	5100 m/s	Ethyl Alcohol	1125 m/s	Air (0 °C)	331 m/s
Copper	3500 m/s	Mercury	1400 m/s	Air (100 °C)	387 m/s
Iron	4500 m/s	Water	1500 m/s	Helium (0 °C)	965 m/s
Glass	5200 m/s			Hydrogen (0 °C)	1284 m/s
Polystyrene	1850 m/s			Oxygen (0 °C)	316 m/s
Zinc	3200 m/s				

Table 12.2 - Musical Notes Vs. Frequency (Room Temperature = 23.3 °C (v_s = 345 m/s)

Note	Frequency (Hz)	Note	Frequency (Hz)	Note	Frequency (Hz)
G_2	98.0	G_3	196.0	G_4	392.0
$G^{\#}_2/A^b_2$	103.8	$G^{\#}_3/A^b_3$	207.7	$G^{\#}_4/A^b_4$	415.3
A_2	110.0	A_3	220.0	A_4	440.0
$A^{\#}_2/B^b_2$	116.5	$A^{\#}_3/B^b_3$	233.1	$A^{\#}_4/B^b_4$	466.2
B_2	123.5	B_3	246.9	B_4	493.9
C_3	130.8	**C_4 – Middle C**	261.6	C_5	523.3
$C^{\#}_3/D^b_3$	138.6	$C^{\#}_4/D^b_4$	277.2	$C^{\#}_5/D^b_5$	554.4
D_3	146.8	D_4	293.7	D_5	587.3
$D^{\#}_3/E^b_3$	155.6	$D^{\#}_4/E^b_4$	311.1	$D^{\#}_5/E^b_5$	622.3
E_3	164.8	E_4	329.6	E_5	659.3
F_3	174.6	F_4	349.2	F_5	698.5
$F^{\#}_3/G^b_3$	185.0	$F^{\#}_4/G^b_4$	370	$F^{\#}_5/G^b_5$	740.0

Excel Tutorial Resource

This resource will allow you to use the spreadsheet program Microsoft Excel at a rudimentary level, and produce graphs. My hope is that you can eventually use this to make world-class lab reports.

Basic Functions in Excel:

Excel, as a spreadsheet program, has great capacity to manipulate numbers. Here are some common ones.

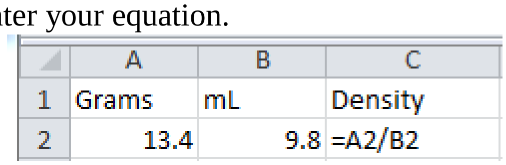
Basic Math Functions	
Addition	+
Subtraction	-
Division	/
Multiplication	*
Square Root	^.5
Square	^2

Making Equations in Excel:

To program equations in excel, start by inputting an equal sign (=) in your cell. Then, fill in your equation, using the functions listed in the table above.

Often, you will want to manipulate values of different cells against each other. Since each cell has a designation (letter/number (Ex: C5)), you can program equations with different cells by selecting the cells as you enter your equation.

Example:



	A	B	C
1	Grams	mL	Density
2	13.4	9.8	=A2/B2

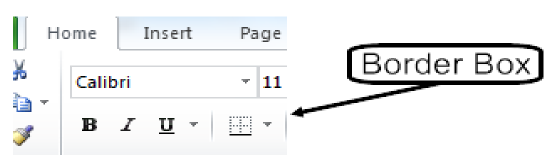
The output for C2 will be 1.3673469 as soon as I press Enter.

Miscellaneous Useful Functions:

Some time-saving, or tidying functions in Excel, besides cutting (Ctrl-x), copying (Ctrl-c), and pasting (Ctrl-v) are:

Copying a formula: Select the parent cell you want to copy, then click and drag the little black square at the bottom right of the cell. When you release, your formula will have been copied to all the destination cells.

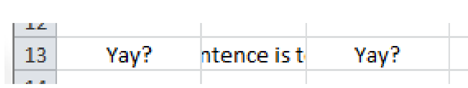
Borders: It puts a nice finish on your data set when it's bounded by a thoughtful border. There are lots of choices, select the data you want to border, and click on the one that works for you.



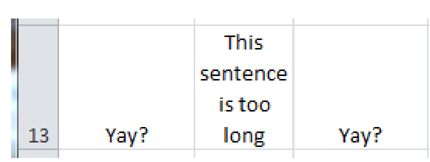
Widening/Shrinking Columns/Rows: Hover over the junction between letters or numbers at the top or side of your spreadsheet, and a line with a double headed arrow will appear. Click and hold while moving the cursor where you want it. You will see the number of pixels that the column or row is.

Wrapping Text: Sometimes it will make sense to make your text go on two or more lines. Select the cell(s) you want to do this to, then right click. Choose the "format cells" option. Click the 'Alignment' tab, then click the little box that says 'Wrap Text'.

Before:



After:



Merging Cells: You may need to engineer a spreadsheet so that two or more cells are combined into one. This could happen if you have a long title for a data table and want it to always be visible. Select the cells you want to do this to, then right click. Choose the "format cells" option. Click the 'Alignment' tab, then click the little box that says 'Merge Cells'.

Subscript/Superscripting: Select the bit of text you want to do this to, then right click. Choose the "format cells" option. Click the little box that says 'Superscript' or 'Subscript'.

Holding a value in a copied formula: Once in a while, you'll copy a formula with a fixed value you want to keep the same from cell to cell. Putting dollar signs in front of the cell's letter/number values will achieve this.

Example:

	A	B	C
1	Acceleration	Time (s)	Velocity
2	9.81	0.00	=A2*B2
3	This is the	0.50	
4	fixed value,	1.00	
5	as I copy the	1.50	
6	formula it	2.00	
7	must not	2.50	
8	change.	3.00	

After copying:

	A	B	C
1	Acceleration	Time (s)	Velocity
2	9.81	0.00	0
3		0.50	4.905
4		1.00	9.81
5		1.50	14.715
6		2.00	19.62
7		2.50	24.525
8		3.00	29.43

Graphing in Excel

In this class, you will most likely want to make x-y scatter plots to pit one value against another. This is a simple procedure to make a basic, no-frills graph:

1. Select the exact data that you want to graph. If the two columns are separated, first select one of the columns, then hold down the Control key while selecting the second column.
2. Press the Insert tab at the top of the Excel worksheet, and select 'scatter.' Several types are available: I recommend the one with points and smooth curves.
3. Unless you have more than one series, delete the 'Series 1' at the right of your graph.
4. **Titles**. When your chart is selected, a 'Chart Tools' tab opens up with three sub-tabs: Design, Layout, and Format. Select the 'Layout' tab, then click on 'Chart Title'. Give your chart a title that describes what you're graphing.
5. Click 'Axis Titles' and give your graph both horizontal, and vertical titles (with units!) The options for the vertical axis are several – choose the one that is the most useful.
6. To print your graph, select the graph and press Control-P. If you want to include your graph along with your spreadsheet data, select the spreadsheet and press Control-P.

There are always more ways to improve your graph, take some time to add details to it if you choose. I may have some ideas as to how to do specific things, just ask.

Wizard Challenges by Unit

FLAG WHICH SECTIONS CHALLENGES PERTAIN TO

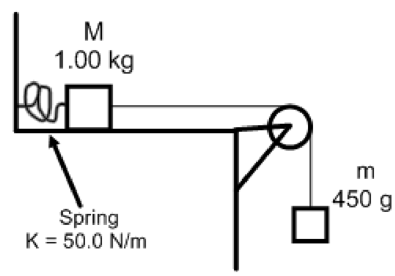
These problems are more advanced than those in the regular homework section, and completing them will earn you two points per problem, applied to the Assessments category of your grade.

Please do each of these on a separate sheet of paper, and show all work for full credit.

Unit 7

1. A 3250-kg aircraft takes 12.5 minutes to achieve its cruising altitude of 10.0 km and cruising speed of 850 km/h. If the plane's engines deliver, on average, 1500 hp during this time, what is the efficiency of the engines?

2. A 1.00-kg block (M) is on a flat frictionless surface. This block is attached to a spring initially at its relaxed length (spring constant of 50.0 N/m). A light string is attached to the block and runs over a frictionless pulley to a 450-g dangling mass (m). If the dangling mass is released from rest, how far does it fall before stopping?



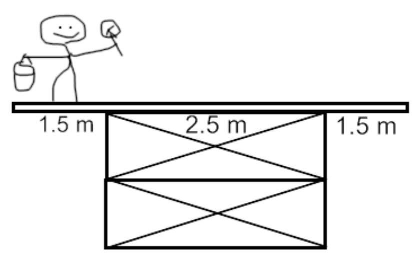
Unit 8

1. (Section 8.4) A proton of mass m moving with a speed of 3.0 E 6 m/s undergoes a head-on elastic collision with an alpha particle of mass 4m, which is initially at rest. What are the velocities of the two particles after the collision?

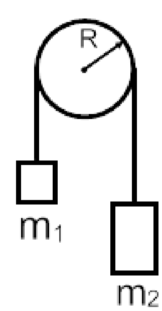
2. (Section 8.4) A dropped rubber ball hits the floor with a speed of 8.0 m/s and rebounds to a height of 0.25 m. What percentage of the initial kinetic energy was lost in the collision? (Hint: Refer to Unit 7.3 notes).

Unit 9

1. While standing on a long, uniform board resting on a scaffold, a 70.0-kg painter paints the side of a house, as shown in the diagram. If the mass of the board is 15.0 kg, how close to the **end** can the painter stand without tipping the board over?



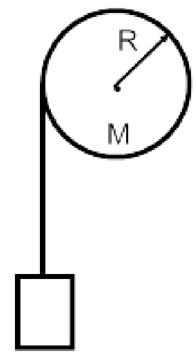
2. Two masses are suspended from a solid disc pulley as shown. The pulley itself has a mass of 0.20 kg, a radius of 0.15 m, and a constant torque of 0.35 m•N due to the friction between the rotating pulley and its axle. What is the magnitude of the acceleration of the pulley if m_1 = 0.40 kg and m_2 = 0.80 kg?



3. You wish to accelerate a small merry-go-round from rest to a rotational speed of one-third of a revolution per second by pushing tangentially on it. Assume the merry-go-round is a hoop with a mass of 250.0 kg and a radius of 1.50 m. Ignoring friction, how hard do you have to push tangentially to accomplish this in 5.00 s?

4. An ice skater has a moment of inertia of 100. kg • m^2 when his arms are outstretched and a moment of inertia of 75.0 kg • m^2 when they are close to his chest. If he starts to spin at an angular speed of 2.0 rev/s with his arms outstretched, what will his angular speed be when they are tucked in?

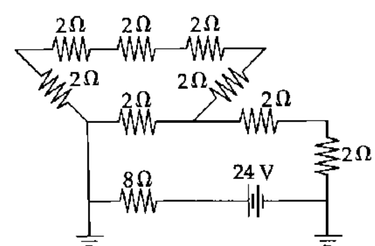
5. A 1.0-kg mass descends 2.0 m vertically from rest as seen in the picture. What is the linear speed of the mass after this distance it if M = 0.30 kg, and R = 0.15 m?



Unit 11.

1. A wire made of brass and a wire made of silver have the same length, but the diameter of the brass wire is 4 times that of the silver wire. The resistivity of brass is 5 times greater than the resistivity of silver. If R_B denotes the resistance of the brass wire and R_S denotes the resistance of the silver wire, which of the following is true?
   a) $R_B = 5/16\ R_S$ b) $R_B = 4/5\ R_S$ c) $R_B = 5/4\ R_S$ d) $R_B = 5/2\ R_S$

2. What is the current through the 8 Ω resistor in the circuit shown?
   a) 0.5 A b) 1.0 A c) 1.5 A d) 3.0 A e) 4.8 A



Unit 12

1. The vertical displacement, y, of a transverse traveling wave is given by the equation $y = 6 \sin(10 t - 1/2\ \pi x)$, with x and y in centimeters and t in seconds. What is the wavelength?
   a) 0.25 cm b) 0.5 cm c) 2 cm d) 4 cm

2. A person holds a rifle horizontally and fires at a target. The bullet has a muzzle speed of 200. m/s, and the person hears the bullet strike the target 1.00 s after firing it. The air temperature is 22.2 °C. What is the distance to the target?

Points:	/ 25
E. C.:	
Late Fee: - 5	

Physics Spring Semester Review Questions

This is an opportunity to see how much you know or remember about what we've covered so far in Physics, and prepare you for the final. You are required to do 25 problems – any problems beyond that will earn you extra credit at the rate of 1 Point per 3 extra problems. Your score will be based on completion.

Unit 7 Review: Work, Energy, and Power

1. A father pulls his young daughter on a sled with a constant velocity on a level surface a distance of 10.0 m. If the total mass of the sled and the girl is 35 kg, and the coefficient of kinetic friction between the sled runners and the snow is 0.20, how much work does the father do? How much work is done by friction?

2. If it takes 400. J of work to stretch a spring 8.00 cm, what is the spring constant?

3. What work is necessary to slow a 13.8 m/s, 1.5 kg object to 2.4 m/s?

4. What's the potential energy of a 16.5 kg object that's at a height 100.0 m above the ground?

5. Disregarding all forms of friction, how much energy is required to propel a 240 gram toy rocket to a speed of 45 m/s at an elevation of 48.5 m?

6. A crane rated at 15.0 horsepower lifts 100.0 kg crates up from a platform, and puts them on an elevated deck 25.0 m above the starting position. How long will this crane take to raise one crate to the platform?

7. If it takes a 50.0 W motor15 seconds to raise a 30.0 kg box 2.0 m, what it the motor's efficiency?

Unit 8 Review: Momentum, Impulse, Collisions

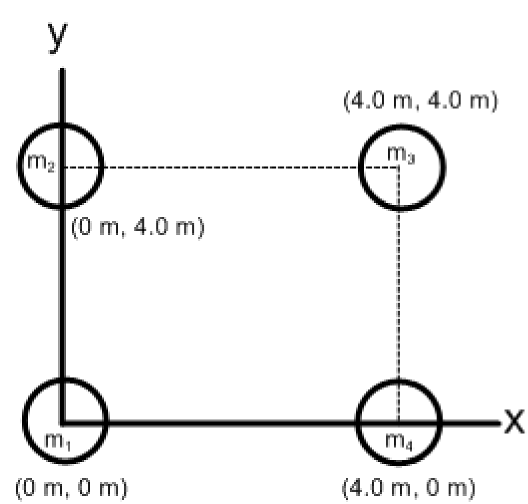
1. A 0.150-kg baseball travelling with a horizontal speed of 18.50 m/s is hit by a bat and then moves with a speed of 28.7 m/s in the opposite direction. What is the change in the ball's momentum?

2. A semi with a total mass of 3500 kg traveling at 1.50 km/h hits a loading dock and comes to a stop in 0.24 s. What is the magnitude of the average force exerted on the truck by the dock?

3. To get off a frozen, frictionless lake, a 55.0-kg person takes off her 0.250-kg shoe and throws it horizontally, directly away from the shore with a speed of 13.0 m/s. If she is 10.00 m from the shore, how long does she take to reach it?

4. A dropped rubber ball hits the floor with a speed of 8.0 m/s and rebounds to a height of 1.25 m. What percentage of the initial kinetic energy was lost in the collision? (Hint: Refer to Unit 7.3 notes).

5. Locate the center of mass of the system shown in the figure if m_1 =31.0 kg, m_2 = 25.0 kg, m_3 = 3.0 kg, and m_4 = 14.0 kg.



Unit 9 Review: Rotational Motion and Equilibrium

1. A rope goes over a circular pulley with a radius of 6.5 cm. If the pulley makes 4.0 revolutions without the rope slipping, what length of rope passes over the pulley?

2. A bowling ball with a radius of 15.3 cm travels down the lane so that its center of mass is moving at 3.6 m/s. The robotic bowler estimates that it makes 3.5 complete revolutions in 1.2 seconds. Is it rolling without slipping? Prove your answer (to 2 sig figs).

3. A. The drain plug on a car's engine has been tightened to a torque of 18.6 m•N. If a 0.35 m long wrench is used to change the oil, what is the minimum force needed to loosen the plug?

4. A uniform meterstick pivoted at its center has a 159.-g mass suspended at the 31.0-cm position. At what point should a 63.2-g mass be suspended to put the system in equilibrium?

5. What net torque is required to give a uniform 20.0-kg solid cube with a side length of 13.2 cm of 0.35 m an angular acceleration of 10.0 rad/s around its center of mass?

6. A fixed, 0.15 kg solid disk pulley with a radius of 0.75 m is acted upon by a net torque of 6.4 m•N. What is the angular acceleration of the pulley?

7. A wheel spinning at 144 rpm comes to rest after 850 rotations. What was the magnitude of deceleration during that time?

8. A constant retarding torque of 12 N•m stops a rolling wheel of diameter 0.80 m in a distance of 15 m. How much work is done by the torque?

9. A. An ice skater spinning with outstretched arms has an angular speed of 4.0 rad/s. She tucks her arms in, decreasing her moment of inertia by 15.5 %. What is the resulting angular speed?

Unit 10 Review: Electrostatics

1. What is the net charge of an object that has 1.8 billion excess electrons?

2. A rubber rod rubbed with fur acquires a charge of -4.8 E -9 C. What is the charge on the fur, and how much mass is transferred to or from the rod?

3. What is the force between the following charges, spaced 0.63 m apart: -1.85 E -6 C and +13.2 E -4 C?

4. An electron is acted on by two electric forces, one of 2.5 E -11 N acting upward and a second of 1.8 E -9 N acting to the right. What is the magnitude and direction of the electric field at the electron's location? Hint: This is a vector addition problem.

5. Two charges, -3.0 μC and -3.0 μC, are located at (-0.50 m, 0) and (0.50 m, 0), respectively. Find the location of the point where the electric field is zero.

6. What is the force between two -1.5 E 8 C and +1.2 E 13 C charges spaced 186.63 m apart?

Unit 11 Review: Basic Electric Circuits

1. Four 6-V batteries and one 12-V battery are connected in series. What is the voltage across the whole arrangement?

2. For the previous problem, what rearrangement of these five batteries would give a total voltage of 24-V?

3. A net charge of 2.4 C passes through the cross sectional area of a wire in 38.0 minutes. What is the current in the wire?

4. A battery labeled supplies 0.90 A to a 6.00-Ω resistor. What is the voltage of the battery?

5. The wire in a heating element of an electric stove burner has a 0.55-m effective length and a 2.0 E -6 m^2 cross sectional area. If the wire is made of iron and operates at 480 ^oC, what is its resistance?

6. The current in a refrigerator with a resistance of 10.0 Ω is 9.0 A. What is the power delivered to the refrigerator?

7. Two identical resistors (R) are connected in parallel and then wired in series to a 30-Ω resistor. If the total equivalent resistance is 50 Ω, what is the value of R?

Unit 12 Review: Mechanical Waves and Sound

1. A aquatic wave has a speed of 1500 m/s. What is its wavelength of a 1000 Hz tone?

2. A surfer trying to catch a wave estimates the distance between wave crests is about 7.2 m, and that the arrival time between waves is 9.4 s. What is the approximate speed of the waves?

3. If the frequency of the third harmonic of a vibrating string is 750 Hz, what is the frequency of the first harmonic? How about the fifth harmonic?

4. What is the speed of sound in air at 55.0 °C?

5. What is the linear mass density of a 2.5 m length of string under a tension of 19.00 N, if it makes a 1240 Hz note (its fundamental frequency) when plucked?

6. Particles approximately 3.2 E -4 cm in diameter are to be scrubbed loose from machine parts in an aqueous ultrasonic cleaning bath. Above what frequency should the bath be operated to produce wavelengths of this size and smaller?

7. Calculate the intensity generated by a 1.48-W point sound at a location 2.5 m and 8.0 m from it.

8. Find the intensity level in decibels for sounds with an intensity of (a) 5.6 E -2 W/m^2.

9. What is the frequency heard by a person driving 45 km/h directly toward a factory whistle (f = 650 Hz) if the air temperature is 13.5°C?

10. A closed organ pipe has a fundamental frequency of 418 Hz at 25°C. What is the fundamental frequency of the pipe at 0 °C?

This AP Physics 1 Booklet Belongs To:

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