Fall AP Physics 1 Resources

The following are constants and equations taken directly from the AP Physics 1 website. If you decide to take the AP Physics 1 exam in the spring, you will be given these sheets. Learn how to use them!

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

$$v_x = v_{x0} + a_x t$$

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

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

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

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

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

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

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

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

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

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

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

$$\omega = \omega_0 + \alpha t$$

$$x = A\cos(2\pi f t)$$

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

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

$$L = I\omega$$

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

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

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

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

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

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

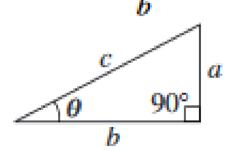
A = area
C = circumference
V = volume
S = surface area
b = base
h = height
ℓ = length
w = width
r = radius

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: First Semester Project (50 Points – 10% of your semester's grade)

Ever seen Wyle E. Coyote defy gravity for a moment after chasing the roadrunner off a cliff? As we all have experienced, gravity doesn't wait, but will pull us down as soon as we step off the ledge.

All students (maximum of three/group) will select one instance in popular entertainment (movies or television) in which "bad physics" is demonstrated. One detail: NO CARTOONS. Cartoons already force us to suspend disbelief; only clips from real-life (or CG) will be accepted.

The students will then report to the class the following:

1. Show the incident's footage from the sample. Please keep the clip to under a minute. If you need to verbally fill in the audience as to what happened leading up to the scene, that's OK. Whether this involves renting the DVD, using Youtube, or whatever, the incidents must be shown. I have a computer that will be able to show the clips. Please no VHS tapes – unless you bring your own tape player.
   To maximize effectiveness, you will need to submit your clip to me before the presentation deadline, whether it's the actual clip that I can store on my computer, or a URL that we can click and access a YouTube video, it must be fast.
2. Explain conceptually where the physics is in error.
3. Explain mathematically where the physics is in error, providing at least one equation that could have helped the directors of the movie to abide by the physical laws of the universe.
4. "Fix" the problem (if fixable), OR propose an alternate scenario to the film. This should take at least two minutes to give a complete rendition of your solution(s).
5. Once groups have given their presentations, other students will evaluate their findings, asking questions to clarify or dissect the presenting groups' work. Presenting groups must defend their physics solutions with supporting arguments as needed.
6. Extra credit will be given for individual students who dress up in formal attire.

Presentations should run between 5 and 8 minutes, and will be given at the end of the week before finals. I will pick randomly from the pool of presenters, but if any students volunteer to go first I will honor that.

Groups must register their movies, and the sections of the movie they've elected to do. There should be no redundancy in presentations this way.

The clip must not have nudity, swear words, or excessive violence. I will preview it to ensure that it meets high school standards of decency.

Fall Semester Project			
Student(s):			
Video Clip From:	View of Clip (1 Minute Max.)	Clip of Movie Present	/ 10
		Too Long (Over 1 minute)?	-1 -2
Total Time (<8 min.) Start Time: ______ End Time: ______ Total Time: __ Too Long? -2	Error Explanation	Conceptual Errors:	/ 8
		Mathematical Errors Explained: . Equation Provided	/ 4 . / 3
	Clip Fixed (At least two minutes):		/ 15
Cross Examination	Notes:		/ 10
Extra Credit for Dressing Up (Per Student)		___________________	+ 2
Registration Late Fee			-2 -4 -6
Total:			/ 50

Timeline:

Project Introduction: after Unit 4.

Video clip registration deadline: after Unit 5 (Late fees apply). **Date (T.B.A.)_________**

Presentations: after Unit 6 – immediately before finals week. **Date (T.B.A.)_________**

Unit 1 Resources – Introduction to Physics, Measurement

Table 1.1 – 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 $inches^3$

1.0 kg = 2.2 Pounds

Standard Physics Problem Solving Format

1. Draw a picture of the situation if possible. Include angles, forces, or other values from the problem that will increase conceptualization.

2. Write down any data provided. Include any that are not stated directly in the problem. For example: if a motion problem states that something is falling to earth, you can assume the acceleration due to gravity is 9.81 m/s^2.

3. Make unit conversions before starting the problem. For example, if you are given a temperature in degrees Fahrenheit, but the problem deals with gas laws, you convert to Kelvin.

4. List which unknown(s) you are seeking at the end of the data section.

5. List any equations that you think you will use to solve the problem. Rearrange the equations to isolate your target variable BEFORE inserting any numbers.

6. Solve the problem by plugging in numbers and computing the value, in a manner such that other scientists can follow your work. If you have different areas of computations that tie into the problem, connect them with arrows to show where they go.

7. Draw a box around your answer, and include UNITS! Make sure to abide by significant figure and rounding rules, then ask yourself if your answer makes sense.

Metric Conversions Resource

Some Metric Prefixes		
Prefix	**Symbol**	**Comparable Size:**
Giga	G	1 Gigaunit = 1 billion (1 E 9) units
Mega	M	1 Megaunit = 1 million (1 E 6) unit
Kilo	k	1 kilounit = 1,000 (1 E 3) units
Base Dimension = grams, seconds, meters, liters, moles, etc.		1 base unit = 1 base unit
centi	c	100 centiunits = 1 base unit
milli	m	1,000 (1 E 3) milliunits = 1 base unit
micro	μ	1 million (1 E 6) microunits = 1 base unit
nano	n	1 billion (1 E 9) nanounits = 1 base unit

Conversion Factor Details

Remember that in a fraction, there is a numerator and a denominator:

$$\frac{\text{Numerator (Top)}}{\text{Denominator (Bottom)}}$$

Note:

When converting from a large prefixed unit to a small one, the exponent increases.

When converting from a small prefixed unit to a large one, the exponent decreases.

Process

1. Write down the value you want to convert with its unit(s)
2. Multiply it by a conversion factor such that the unit you want to end up with is in the numerator, and the one you are converting from is in the denominator.
3. For multiple step conversions, add more conversion factors, so that the undesired units cancel out.
4. Cancel out units, and perform the mathematical steps (multiply numerators, divide by denominators)

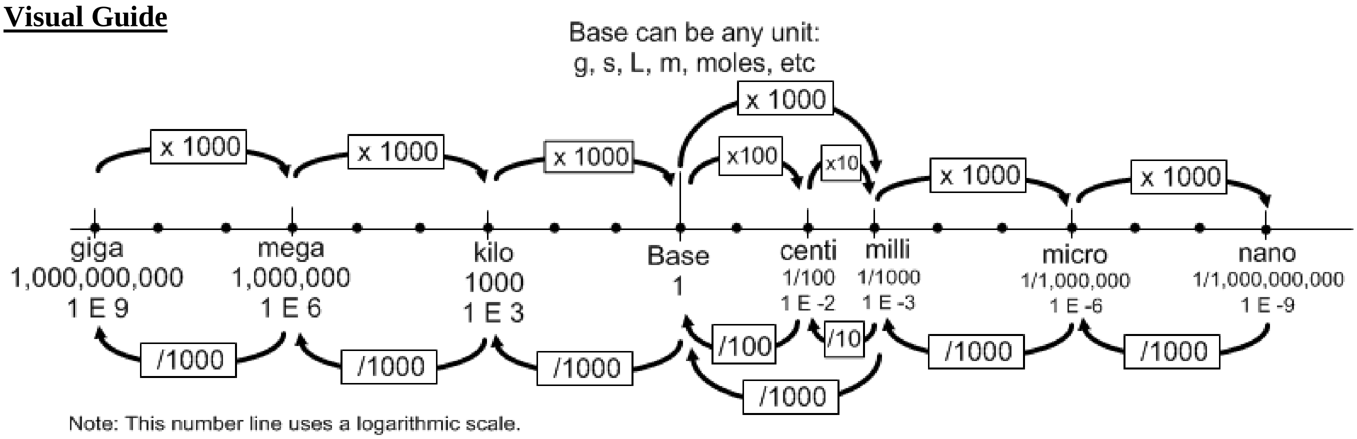
Example 1: 145 ng → g

$$145\ \cancel{\text{ng}} \times \frac{1\ \text{g}}{1\ \text{E}\ 9\ \cancel{\text{ng}}} = 1.45\ \text{E} - 7\ \text{g}$$

Example 2: 9.40 cm/min → m/s

$$\frac{9.40\ \cancel{\text{cm}}}{1\ \cancel{\text{min}}} \times \frac{1\ \text{m}}{100\ \cancel{\text{cm}}} \times \frac{1\ \cancel{\text{min}}}{60\ \text{s}} = 1.57\ \text{E - 3 m/s}$$

Visual Guide



Unit 4 Resources – Coefficients of Friction

Material Pair	μ_s (static)	μ_k (kinetic)
Aluminum/Aluminum	1.90	1.40
Glass/Glass	0.94	0.35
Rubber/Dry Concrete	1.20	0.85
Rubber/Wet Concrete	0.80	0.60
Steel/Aluminum	0.61	0.47
Steel/Dry Steel	0.75	0.48
Teflon/Steel	0.12	0.07
Teflon/Teflon	0.04	0.04
Wood/Wood	0.58	0.40

Unit 5 Resources – Solar System Data

	Radius (m)	Mass (kg)	Distances (m)
Earth	6.4 E 6	6.0 E 24	Earth-Moon: 3.8 E 8
Moon	1.75 E 6	7.4 E 22	
Sun	7.0 E 8	2.0 E 30	Earth-Sun 1.5 E 11

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

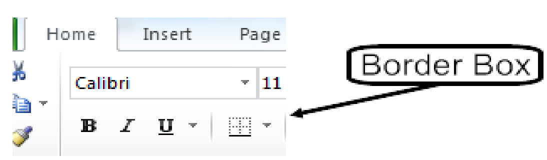
The output for C2 will be 1.3673469 as soon as I press Enter.

Miscellaneous Useful Functions:

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

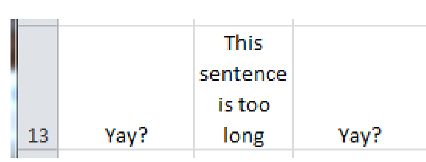
Copying a formula: Select the parent cell you want to copy, then click and drag the little black square at the bottom right of the cell. When you release, your formula will have been copied to all the destination cells.

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:

13	Yay?	ntence is t	Yay?

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

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

Unit 2

1. (Section 2.3) Derive the sandbag equation from the velocity and position equations on a separate sheet of paper. Show each substitution and step in your derivation, then submit the paper to me for scoring.

2. (section 2.3) A rifle bullet with a muzzle speed of 332 m/s is fired directly into a dense material that stops the bullet in 25.0 cm. Assuming the bullet's deceleration to be constant, what is its magnitude?

Unit 3

1. (Section 3.3) An artillery crew wants to shell a position on level ground 35 km away. If the gun has a muzzle velocity of 770 m/s, to what angle of elevation should the gun be raised?

2. (Section 3.4) Derive the equation that governs the time required for a projectile to reach the top of its arch. Describe the logical steps needed to reach your conclusion.
   The equation is:
$$t_u = \frac{v_{y_0}}{g}$$

3. (Section 3.4) Derive the Range equation that governs how far a projectile travels along the ground during its journey. Describe the logical steps needed to reach your conclusion. One hint you need is that a double angle substitution will be necessary at the end to tie trigonometric relations together.
   The equation is:
$$Range = \frac{v_0^2 \sin 2\theta}{g}$$

4. (Section 3.4) Derive the equation that governs the maximum height a projectile attains at the top of its arch.
   The equation is:
$$y_{\max} = v_{y_0} t_u - \frac{1}{2} g t_u^2$$

Unit 4

1. (Section 4.4) A 10.0 kg object slides on a frictionless vertical wall with a force of 60.0 N acting at an angle 60.0° above the horizontal. Determine the normal force exerted on the object by the wall, and determine the object's acceleration.

Unit 5

1. (Section 5.3) A 60 cm rope is tied to the handle of a 3-kg bucket which is then whirled in a vertical circle. At the lowest point in its path, the tension in the rope is 50 N. What is the bucket's speed?
   What is the critical speed below which the rope would become slack when the bucket reaches the highest point in the circle?

2. (Section 5.5) In the spin cycle of a washing machine, a wet towel (mass = 1.50 kg) is stuck to the inside surface of the cylinder. To have decent removal of water, clothes in this machine experience 10.0g. If the cylinder has a radius of 35.0 cm, determine the constant angular acceleration of the towel required if the machine takes 2.50 s to achieve its final angular speed.

3. (Section 5.6) A man has a mass of 75 kg on the Earth's surface. How far above the surface of the Earth would he have to go to 'lose' 10.0% of his body weight?

4. (Section 5.6) An instrument package is projected vertically upward to collect data near the top of the Earth's atmosphere (at an altitude of 900. km). What initial speed is required at the Earth's surface for the package to reach this height?
   What percentage of escape speed is this initial speed?

5. (Section 5.6) Two large bodies, Body A or mass m and Body B of mass 4m, are separated by a distance R. At what distance from Body A, along the line joining the bodies, would the gravitational force on an object be equal to zero?

6. (Section 5.6) The dwarf planet Pluto has 1/500 the mass and 1/15 the radius of Earth. What is the value of *g* (in m/s^2) on the surface of Pluto?

Unit 6

1. (Section 6.3) As a workaround, a student puts a AA battery (mass = 55 grams) in a compartment designed to hold a C battery. The battery is oriented so that it could fall out if it's not snug enough. In order to be held in place by friction (coefficient of static friction between battery and contact points = 0.45), how much would the spring (K = 150 N/m) have to be compressed (spring constant = 150. N/m)?

2. (Section 6.3) A linear spring of force constant k is used in a physics lab experiment. A block of mass m is attached to the spring and the resulting frequency, f, of the simple harmonic oscillations is measured. Blocks of various masses are used in different trials, and in each case, the corresponding frequency is measured and recorded. If f^2 is plotted versus 1/m, the graph will be a straight line with slope

3. (Section 6.4) A 14.8 m pendulum in an amusement park on the planet Quark is used to tell time. If one complete cycle of the pendulum represents one second on this planet, how many Earth-seconds in one Quark-minute? Quark has a mass of 1.7 E 27 kg and radius of 60,000 km.

Fall Review Points:	/ 20
Late/Inc. Fee:	-1 -2 - 3 -4

AP Physics 1 Fall Semester Review

This is an opportunity to see how much you know or remember about what we've covered so far in Physics. Select at least 20 of the following math-based questions and answer them for credit. I will check for your effort and **then** provide a solution set. You may use this on the final.

Unit 1: Measurement

1. What is the density of an object with a mass of 24.5 kg and a volume of 19.5 L – in g/ml?

2. How many significant figures are in the following three numbers:
   10,800 kg   0.053 N   1.03 E 5 m

3. Make the following conversions:
   2.5 kg to mg   5.1 m to mm   3.8 km/h to m/s

4. Perform the following operations, and round to the correct number of significant figures:
   12.2 m • 4.8 cm   13.8 kg / 4 mL

Unit 2: One Dimensional Kinematics

1. What is the acceleration of a car that stops in 36 meters and has an initial velocity of 24.5 m/s?

2. A firework manufacturing company makes mortar shells that are fired straight up in the air. If they are designed to detonate exactly at the apex of their flight, 5.00 seconds after launching, what is the velocity of launch? Neglect air resistance.

3. A bus accelerates from rest at a constant rate of 1.5 m/s^2 for 5.0 s. What is the velocity of the bus after that time?

4. How far did the bus from the previous problem travel in 10.0 seconds?

5. What is the velocity of a dropped object that falls for 5.8 seconds before hitting the ground?

6. For the previous problem, how far did the object fall before hitting the ground?

Unit 3: Motion and Two Dimensional Kinematics

1. A student walks 120.0 m north, then 20.0 m east, then 30.0 m south, then 10.0 m west. What is his resultant displacement (distance AND direction)?

2. A person drags a sled along the ground, and the tow rope has an angle of 30.0° . If the tension on the rope is 87 N, what are the horizontal and vertical components of the force he exerts?

3. A motorboat's speed in still water is 5.0 m/s. The driver wants to go directly across a river with a current of 2.5 m/s. At what angle upstream should the boat be steered?

4. How far will a cannonball travel if it is launched on level ground at an angle of 65.0° with an initial velocity of 150. m/s? Assume that there is no air resistance.

5. For the previous problem, what are the initial vertical and horizontal components of velocity?

<u>Unit 4: Dynamics (Forces)</u>

2. A 25.0 N net force is applied to a 2.3 kg mass. What is the object's acceleration?

A force acts on a 4.5 kg mass, giving it an acceleration of 3.0 m/s^2.

3. What is the magnitude of the force?

4. If the same force acts upon a 1.5 kg mass, what acceleration results?

5. A 72 kg male skater pushes a 45 kg female skater, causing her to accelerate at a rate of 2.0 m/s^2.

At what rate will the male skater accelerate?

6. A 40.0 kg crate is at rest on a level surface. If the coefficient of static friction between the crate and the surface is 0.69, what horizontal force is required to get the crate moving?

7. For the previous problem, if the same force is used to keep pushing the crate, what will its acceleration be if the coefficient of kinetic friction between the crate and the ground is 0.48?

Unit 5: Circular Motion and Gravitation

1. In winding a rope up, a pulley with a radius of 15 cm turns 5 complete rotations. How much rope was wound up?

2. How much of an angle does a rotating wheel (radius 0.88 m) move in 13.8 rotations?

3. The driver of a car sets the cruise control and ties the steering wheel so that the car travels at a uniform speed of 11 m/s in a circle of diameter 80 m. What angular distance does the car move in 2.00 minutes?

4. For the previous problem, what arc length does the car travel during the 2.00 minutes?

5. A 600.0-kg car with a constant speed of 20.5 m/s enters a circular flat curve with a radius of curvature of 0.30 km. What force of friction do the tires have to supply so the car doesn't slip?

6. Two objects are attracted to each other with a certain gravitational force. If the original force between the objects is 1.0 N and the distance is doubled, what is the new gravitational force between the objects?

7. Two objects with masses of 2.9 E 14 kg and 7.8 E 16 are 5.3 E 8 km apart. What is their gravitational attractive force?

8. How long is the period of an asteroid around our sun at a distance of 3.12 E 8 km?

9. A brass sphere (mass 1.2 kg) on the end of a rope swings in a circle with a radius of 1.8 m. If the tension on the rope can't excel 25 N, what is the maximum speed at which the sphere can rotate?

Unit 6: Simple Harmonic Motion

1. The time it takes a particle in SHM to travel from the equilibrium position to the first maxima is 0.33 seconds. What is the period of a complete oscillation?

2. How far would a spring be compressed (k = 14.3 N/m) if a 2.5 kg mass were placed on it?

3. An object of mass 0.45 kg is attached to a spring with spring constant 12.0 N/m. If the object is pulled down 0.25 m from the equilibrium position and released, what is its maximum speed?

4. If the frequency of a mass-spring system is 3.50 Hz and the mass on the spring is 3.00 kg, what is the spring constant?

5. How much energy is possessed by a mass-spring system with a mass of 12 kg, and a spring constant of 3.5 N/m, if it is drawn back 11 cm?

6. A kid rides on a swing that's 2.3 meters long. What is the period of the swing?

Fall AP Physics 1 Resources to use on ALL Semester 1 Tests

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, $k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9$ N.m^2/C^2
Electron mass, $m_e = 9.11 \times 10^{-31}$ kg	Universal gravitational constant, $G = 6.67 \times 10^{-11}$ m^3/kg.s^2
Speed of light, $c = 3.00 \times 10^8$ m/s	Acceleration due to gravity at Earth's surface, $g = 9.8$ 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

$v_x = v_{x0} + a_x t$

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

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

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

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

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

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

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

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

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

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

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

$\omega = \omega_0 + \alpha t$

$x = A\cos(2\pi f t)$

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

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

$L = I\omega$

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

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

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

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

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

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

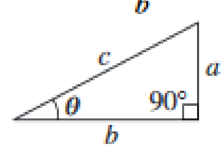
A	=	area
C	=	circumference
V	=	volume
S	=	surface area
b	=	base
h	=	height
ℓ	=	length
w	=	width
r	=	radius

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

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

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

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



AP Physics 1 Student Notes: Allowed on ALL Semester 1 Tests

Unit 1: Measurement Notes

Unit 2: One Dimensional Kinematics Notes

Unit 3: Motion and Two Dimensional Kinematics Notes

Unit 4: Dynamics (Forces) Notes

Unit 5: Circular Motion and Gravitation Notes

Unit 6: Simple Harmonic Motion Notes