

Spring AP Physics 2 Resources

The following are constants and equations taken directly from the AP Physics 2 website. If you decide to take the AP Physics 2 exam in the spring, you will be given these sheets. Learn how to use them!

ADVANCED PLACEMENT PHYSICS 2 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	1 electron volt, $1 \text{ eV} = 1.60 \times 10^{-19}$ J
Electron mass, $m_e = 9.11 \times 10^{-31}$ kg	Speed of light, $c = 3.00 \times 10^8$ m/s
Avogadro's number, $N_0 = 6.02 \times 10^{23}$ mol ⁻¹	Universal gravitational constant, $G = 6.67 \times 10^{-11}$ m ³ /kg·s ²
Universal gas constant, $R = 8.31$ J/(mol·K)	Acceleration due to gravity at Earth's surface, $g = 9.8$ m/s ²
Boltzmann's constant, $k_B = 1.38 \times 10^{-23}$ J/K	
1 unified atomic mass unit, $1 \text{ u} = 1.66 \times 10^{-27}$ kg = 931 MeV/c ²	
Planck's constant, $h = 6.63 \times 10^{-34}$ J·s = 4.14×10^{-15} eV·s	
	$hc = 1.99 \times 10^{-25}$ J·m = 1.24×10^3 eV·nm
Vacuum permittivity, $\epsilon_0 = 8.85 \times 10^{-12}$ C ² /N·m ²	
Coulomb's law constant, $k = 1/4\pi\epsilon_0 = 9.0 \times 10^9$ N·m ² /C ²	
Vacuum permeability, $\mu_0 = 4\pi \times 10^{-7}$ (T·m)/A	
Magnetic constant, $k' = \mu_0/4\pi = 1 \times 10^{-7}$ (T·m)/A	
1 atmosphere pressure, $1 \text{ atm} = 1.0 \times 10^5$ N/m ² = 1.0×10^5 Pa	

UNIT SYMBOLS	meter, m	mole, mol	watt, W	farad, F
	kilogram, kg	hertz, Hz	coulomb, C	tesla, T
	second, s	newton, N	volt, V	degree Celsius, °C
	ampere, A	pascal, Pa	ohm, Ω	electron volt, eV
	kelvin, K	joule, J	henry, H	

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

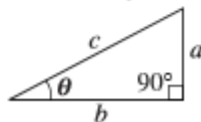
VALUES OF TRIGONOMETRIC FUNCTIONS FOR COMMON ANGLES							
θ	0°	30°	37°	45°	53°	60°	90°
$\sin \theta$	0	1/2	3/5	$\sqrt{2}/2$	4/5	$\sqrt{3}/2$	1
$\cos \theta$	1	$\sqrt{3}/2$	4/5	$\sqrt{2}/2$	3/5	1/2	0
$\tan \theta$	0	$\sqrt{3}/3$	3/4	1	4/3	$\sqrt{3}$	∞

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. In all situations, positive work is defined as work done on a system.
- III. The direction of current is conventional current: the direction in which positive charge would drift.
- IV. Assume all batteries and meters are ideal unless otherwise stated.
- V. Assume edge effects for the electric field of a parallel plate capacitor unless otherwise stated.
- VI. For any isolated electrically charged object, the electric potential is defined as zero at infinite distance from the charged object.

ADVANCED PLACEMENT PHYSICS 2 EQUATIONS, EFFECTIVE 2015[illegible]

ADVANCED PLACEMENT PHYSICS 2 EQUATIONS, EFFECTIVE 2015

<p>FLUID MECHANICS AND THERMAL PHYSICS</p> $\rho = \frac{m}{V}$ $P = \frac{F}{A}$ $P = P_0 + \rho gh$ $F_b = \rho Vg$ $A_1 v_1 = A_2 v_2$ $P_1 + \rho gy_1 + \frac{1}{2} \rho v_1^2 = P_2 + \rho gy_2 + \frac{1}{2} \rho v_2^2$ $\frac{Q}{\Delta t} = \frac{kA \Delta T}{L}$ $PV = nRT = Nk_B T$ $K = \frac{3}{2} k_B T$ $W = -P \Delta V$ $\Delta U = Q + W$	<p>WAVES AND OPTICS</p> $\lambda = \frac{v}{f}$ $n = \frac{c}{v}$ $n_1 \sin \theta_1 = n_2 \sin \theta_2$ $\frac{1}{s_i} + \frac{1}{s_o} = \frac{1}{f}$ $ M = \left \frac{h_i}{h_o} \right = \left \frac{s_i}{s_o} \right $ $\Delta L = m\lambda$ $d \sin \theta = m\lambda$
<p>MODERN PHYSICS</p> $E = hf$ $K_{\max} = hf - \phi$ $\lambda = \frac{h}{p}$ $E = mc^2$	<p>GEOMETRY AND TRIGONOMETRY</p> <p>Rectangle $A = bh$</p> <p>Triangle $A = \frac{1}{2}bh$</p> <p>Circle $A = \pi r^2$ $C = 2\pi r$</p> <p>Rectangular solid $V = \ell wh$</p> <p>Cylinder $V = \pi r^2 \ell$ $S = 2\pi r \ell + 2\pi r^2$</p> <p>Sphere $V = \frac{4}{3} \pi r^3$ $S = 4\pi r^2$</p> <p>Right triangle $c^2 = a^2 + b^2$ $\sin \theta = \frac{a}{c}$ $\cos \theta = \frac{b}{c}$ $\tan \theta = \frac{a}{b}$</p> 

Real World Physics – Second Semester Project

Working in small groups, students will be given a research topic which will be presented in random order to the class for 8 – 12 minutes. Note: even if you meet the minimal temporal constraint, if your topic seems inadequately demonstrated, you will lose points.

Each member of the group must talk for at least one minute.

After completing a presentation (Power Point, Prezi, poster, etc.) as a team, groups will present their projects to the class. The audience members will then ask questions. Presenting groups, as experts on their topics, should answer questions adequately, or at least provide guidance as to where to research the answers to difficult questions.

All groups must submit an electronic copy of your presentation, or leave your poster behind for me.

A minimum of three sources must be cited within your presentation, and included at the end of your presentation. Be sure to cite pictures that you use.

Extra Credit can be gained by dressing up for your presentations (per student). Additionally, building a device or a model, or bringing in objects that enhance your topic will earn extra credit.

This project weighs in at 10% of your semester grade, and all group members will get the same grade, regardless of input. It's up to you to determine work load within a group.

Spring Project Scoring Guide		
Research Presentation	Duration: 8 – 12 Minutes	/ 5
	At Least 4 Visual Aids: Pictures, Graphs, Equations, Etc.	/ 8
	Overview of Topic	/ 7
	History of Topic	/ 15
	Specific Applications	/ 10
	Questions Answered	/ 5
General	Sources Cited Within Presentation	/ 5
	Minimum of 3 Sources	/ 9
	All Members Present at Least 1 Minute	/ 6
	Copy of Project Submitted	/ 5
	Built Model E. C.	+2 +4 +6
	Dressed Up E. C.	+1 +2
Late Fee:		-10
Total:		/ 75

Topic 1: Electric Circuits

Research Component: Prepare a presentation that describes a brief history of modern electronics, including a description of how semiconducting elements are used in components (such as transistors).

Topic 2: Magnetism

Research Component: Prepare a presentation that describes a brief history of the discovery of magnetism (permanent magnets AND electromagnets), as well as some of its applications in modern life.

Topic 3: Geometric Optics

Research Component: Prepare a presentation that describes a brief history of lens usage and manufacture, and present day applications of lenses.

Topic 4: Reflection and Refraction

Research Component: Prepare a presentation that describes a brief history of mirrors as they have been used by humanity over the millennia, as well as modern day applications.

Topic 5: Nuclear Physics

Research Component: Prepare a presentation that describes a brief history of nuclear power development, and modern day nuclear reactors. Include in your presentation a brief overview of thorium reactors.

Percent Error Calculation: Used in many Labs

$$\% \text{ Error} = \frac{|\text{Accepted Value} - \text{Experimental Value}|}{\text{Accepted Value}} \times 100\%$$



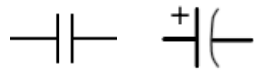
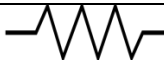
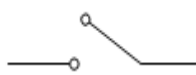







Unit 3.C Student Notes and Resources - Current, Resistance, RC Circuits:

3.C.1 Resistor Color Code Resource				
Color	First Band	Second Band	Third Band	Tolerance Band
Black	0	0	X 1	
Brown	1	1	X 10	Gold \pm 5%
Red	2	2	X 100	Silver \pm 10%
Orange	3	3	X 1,000	None \pm 20%
Yellow	4	4	X 10,000	
Green	5	5	X 100,000	
Blue	6	6	X 1,000,000	
Violet	7	7	Silver \div 100	
Gray	8	8	Gold \div 10	
White	9	9		

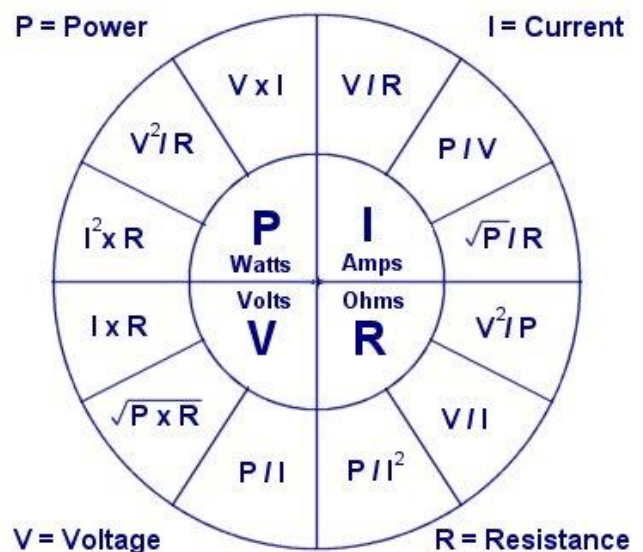
3.C.2 Resistivities (at 20 °C) and Temperature Coefficients for Materials Resource					
Conductors			Semiconductors		
Material	ρ ($\Omega\cdot\text{m}$)	α (1/°C)	Material	ρ ($\Omega\cdot\text{m}$)	α (1/°C)
Aluminum	2.82 E -8	4.29 E -3	Carbon	3.6 E -5	-5.0 E -4
Copper	1.70 E -8	6.80 E -3	Germanium	0.46	-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			

3.C.3 Typical Power and Current Requirements of Appliances (120V) Resource					
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

3.C.4 Circuit Symbols Resource

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				

3.C.5 – Ohm's Law Equations Quick Guide



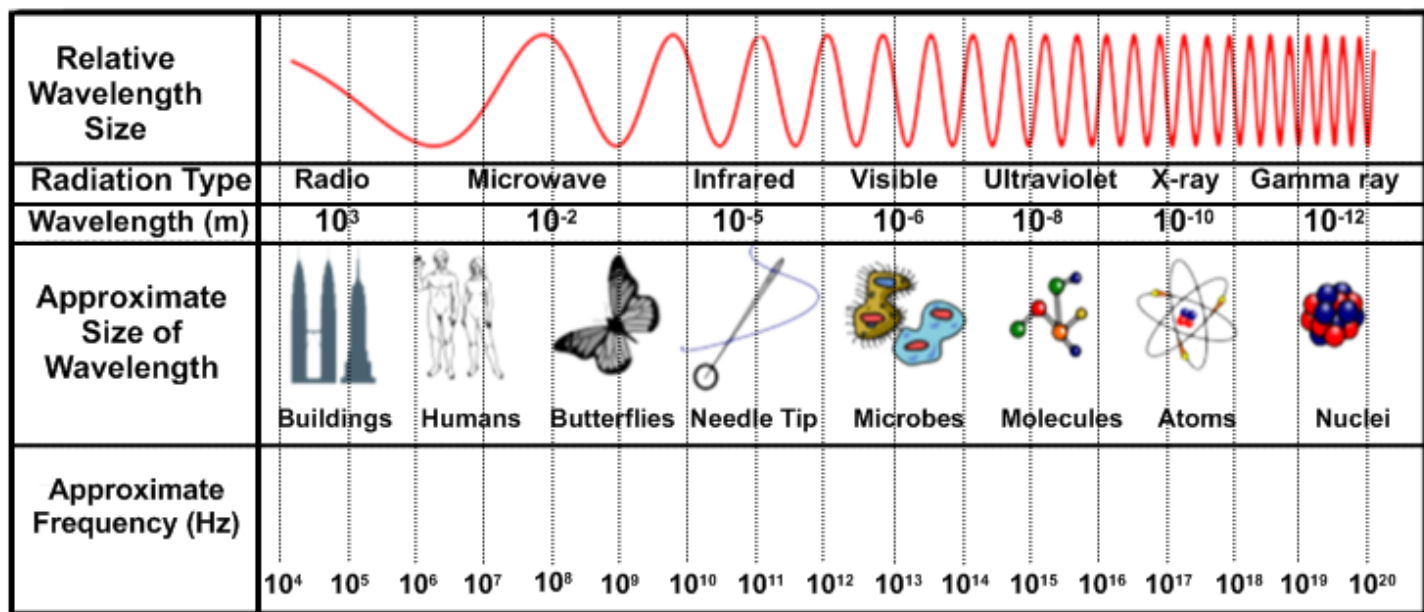
Unit 4 Student Notes and Resources – Magnetism

Unit 5.A Student Notes and Resources – Light, Reflection, Refraction

Unit 5.A.1 Electromagnetic Spectrum Resource:

This graph shows in rough detail the different types of EM radiation the approximate size of their wavelengths, and ranges of frequencies.

Note: the visible region of the spectrum spans a range of 390 nm to 700 nm.



5.A.2 Indices of Refraction (n) (at $\lambda = 590 \text{ nm}$) Resource

Substance	n	Substance	n	Substance	n
Air	1.00029	Fused Quartz	1.46	Crown Glass	1.52
Water	1.33	Human Eye	1.336 – 1.406	Flint Glass	1.66
Ice	1.31	Polystyrene	1.49	Zircon	1.92
Ethyl Alcohol	1.36	Oil	1.50	Diamond	2.42

5.B.1 Spherical Mirror and Lens Sign Conventions Resource

Focal Length	Concave Mirror	$f = \text{positive}$
	Convex Mirror	$f = \text{negative}$
	Converging Lens	$f = \text{positive}$
	Diverging Lens	$f = \text{negative}$
Radius of Curvature (r) (Lens Maker's Equation)	Planar Surface	$r = \infty$
	Convex Surface	$r = \text{positive}$
	Concave Surface	$r = \text{negative}$
Object Distance	Object in front of mirror	$s_o = \text{positive}$
	Object behind mirror (virtual image)	$s_o = \text{negative}$
Image Distance (and Type)	Image in front (real image)	$s_i = \text{positive}$
	Image behind (virtual image)	$s_i = \text{negative}$
Image Orientation (M)	Upright W.R.T object	$M = \text{positive}$
	Inverted W.R.T object	$M = \text{negative}$

Unit 5.B Student Notes and Resources – Geometric Optics

Unit 5.C Student Notes and Resources – Physical Optics

Unit 6 Student Notes and Resources – Modern Physics

Table of gamma vs. % c (expressed as decimal)			
v	γ	v	γ
0.0	1.00	0.600c	1.25
0.100c	1.01	0.700c	1.40
0.200c	1.02	0.800c	1.67
0.300c	1.05	0.900c	2.29
0.400c	1.09	0.995c	10.0
0.500c	1.15	0.999c	22.4

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	$^{\wedge}.5$
Square	$^{\wedge}2$

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

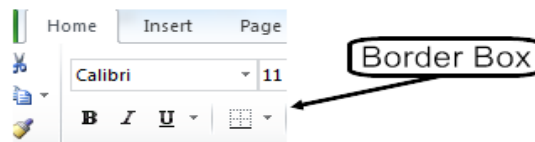
The output for C2 will be 1.3673469 as soon as I press Enter.

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:

13	Yay?	This sentence is too long	Yay?
----	------	---------------------------	------

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

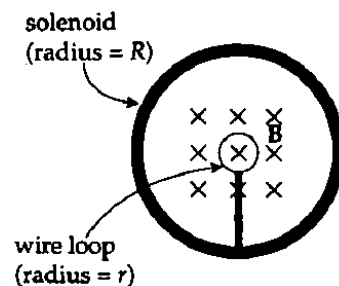
These problems are more advanced than those in the regular homework section, and successfully completing them will earn you two points per problem, applied to the Assessments category of your grade.

Unit 3.C

1. (Section 3.C.2) 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, what is the ratio of resistance between brass and silver (in the form $R_B : R_S$).

Unit 4

1. (Section 4.4) In a physics lab, a student discovers that the magnitude of the magnetic field at a certain distance from a long wire is $4.0 \mu\text{T}$. If the wire carries a current of 5.0 A , what is the distance of the magnetic field from the wire?
2. (Section 4.4) Two long, straight wires are hanging parallel to each other and are 1 cm apart. The current in Wire 1 is 5 A , and the current in Wire 2 is 10 A , in the same direction. What is the magnetic force between the wires? Is it attractive or repulsive?
3. (Section 4.5) A loop ($r = 20.0 \text{ cm}$) is in a uniform magnetic field of 0.15 T . What angle(s) between the normal to the plane of the loop and the field would result in a flux with a magnitude of $0.014 \text{ T} \cdot \text{m}^2$?
4. (Section 4.5) In the figure, a small, circular loop of wire (radius r) is placed on an insulating stand inside a hollow solenoid of radius R . The solenoid has n turns per unit length and carries a counter-clockwise current I . If the current in the solenoid is decreased at a steady rate of a amps/s, determine the induced emf, \mathcal{E} (symbolically – no numbers needed), and the direction of the induced current in the loop (clockwise or counterclockwise).



Unit 6

1. (Section 6.7) An electron is accelerated from rest through a potential difference of 2.50 MV . Find the electron's a) speed, b) kinetic energy, and c) momentum.
1. (Section 6.7) If a reactor produces an average power of 1000 MW for a year, how much ^{235}U is used up assuming 200 MeV are released per fission?

Early E. C.:	/ 1
Spring Review Points:	/ 15
Late/Inc. Fee:	-1 -2 -3
15+ E. C.:	/ 10

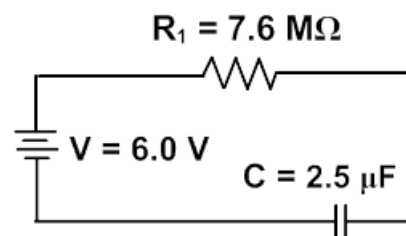
Spring Semester Review Questions

Select at least 15 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.

Early submissions will get +1 E.C. applied to the assessments category. More than the 15 required problems will earn one point per three problems, applied to the homework category of your grade.

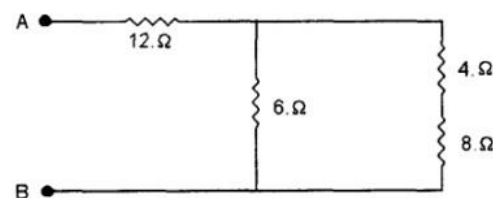
Unit 3.C: Current, Resistance, RC Circuits

1. A charge of 12. C passes through an electroplating apparatus in 2.0 min. What is the average current?
2. A heavy bus bar is 20. cm long and of rectangular cross-section, $1.0 \text{ cm} \times 2.0 \text{ cm}$. What is the voltage drop along its length when it carries 4000. A? (The resistivity of copper is $1.69 \text{ E } -8 \text{ } \Omega\text{-m}$.)
3. An RC circuit with $2.5 \text{ } \mu\text{F}$ and $7.6 \text{ M}\Omega$ includes a 6.0 volt source.
 - A. What is the time constant for charging the capacitor?



- B. What voltage is across the capacitor 25.0 s after charging begins?

4. A. Find the equivalent resistance of the network shown between points A and B:



- B. If a 12.0 volt battery were connected between A and B, What would the total power of the circuit be?
- B. With the same battery, what current would flow through the $12 \text{ } \Omega$, and $4 \text{ } \Omega$ resistors?

Unit 4: Magnetism

1. A proton moving at 5.0×10^4 m/s horizontally enters a region where a magnetic field of 0.12 T is present, directed vertically downward. What magnitude force acts on the proton?

2. A long straight wire carrying 15. A is perpendicular to a 0.10 T field. Find the force per meter on the wire.

3. What is the magnetic field at the center of a circular loop of wire of radius 4.0 cm when a current of 2.0 A flows in the wire?

4. A metal airplane flies horizontally at 200. m/s where the Earth's magnetic field is vertical and is 45.0 μ T. If the wingspan is 25.0 meters:
 - A. what emf is induced across the wings?

 - B. what wingspan would produce 1.0 volt emf?

 - C. The plane reverses direction. Does the polarity of the wingtip emf change, i.e., if the left wing was positive, does it now become negative? Explain.

5. An ideal transformer steps down 120. volts to 12. volts and the 2630. turn secondary supplies 12. Amperes.
 - A. Determine the ratio of turns.

 - B. Determine the current in the primary.

 - C. What is the ratio of output power to input power?

Unit 5.A: Light, Reflection, Refraction

1. If a transparent material has an index of refraction of 1.67, what is the speed of light in the material?

2. A light beam having a wavelength of 470. nm in air is directed into glycerin ($n = 1.47$).
 - A. What is the frequency of the light in the glycerin?

 - B. What is its wavelength in the glycerin?

 - C. If the incident angle is 75.0° , what is the refracted angle?

3. A light ray strikes a glass plate of thickness 0.80 cm at an angle of incidence of 60° . The index of refraction of the glass is 1.55. By how much is the beam displaced from its original line of travel after it has passed through the glass?

4. The index of refraction for a certain material is 1.399 for red light and 1.432 for blue light. Find the angle separating the two refracted colors if the:
 - A. angle of incidence is 30° .

 - B. angle of incidence is 60° .

5. A light beam enters a liquid at an angle of incidence of 35° . What is the index of refraction, if the refracted ray has an angle of 27° ?

Unit 5.B: Geometric Optics

1. A friend who is 180. cm tall stands 2.0 m from a plane wall mirror. You stand slightly behind him, 3.0 m from the wall mirror. How tall must the mirror be to see all of your friend in the mirror?

2. David stands 2.5 meters in front of a plane mirror.
 - A. How far from David is David's image in the mirror?

 - B. If David moves away from the mirror at 1.5 m/s, how fast are David and his image moving apart from each other?

 - C. If David is 180. cm tall, how tall is his image in the mirror?

3. An object 2.0 cm tall is placed 24. cm in front of a convex mirror whose focal length is 30. cm.
 - A. Where is the image formed?

 - B. How tall is it?

4. A converging lens with the same curvature on both sides and focal length 25. cm is to be made from crown glass ($n = 1.52$). What radius of curvature is required for each face?

Unit 5.C: Physical Optics

1. In the two-slit experiment, monochromatic light of wavelength 600 nm passes through a pair of slits separated by 2.20×10^{-5} m.
 - A. What is the angle corresponding to the first bright fringe?

 - B. What is the angle corresponding to the second dark fringe?

2. A soap bubble has an index of refraction of 1.33. What minimum thickness of this bubble will ensure maximum reflectance of normally incident 530. nm wavelength light?

3. When red light illuminates a grating with 7000. lines per centimeter, its second maximum is at 62.4° . What is the wavelength of the light?

4. In a diffraction experiment, light of 600. nm wavelength produces a first-order maximum 0.350 mm from the central maximum on a distant screen. A second monochromatic source produces a third-order maximum 0.870 mm from the central maximum when it passes through the same diffraction grating. What is the wavelength of the light from the second source?

5. A beam of light passes through a polarizer and then an analyzer. In this process, the intensity of the light transmitted is reduced to 10% of the intensity incident on the analyzer. What is the angle between the axes of the polarizer and the analyzer?

Unit 6: Modern Physics

1. A metallic surface is illuminated with light of wavelength 400. nm. If the work function for this metal is 2.4 eV, calculate the kinetic energy of the ejected electrons, in electron-volts.

2. The human eye can just detect green light of wavelength 500. nm, which arrives at the retina at the rate of 2×10^{-18} W. How many photons arrive each second?

3. What would be the deBroglie wavelength for a 1 gram object moving at "escape speed" 11,000 m/s?

4. If in Compton scattering of X-rays from a metal, the wavelength increases by 5% at an angle of 60° , what was the original wavelength before scattering?

5. A proton, moving freely, has a wavelength of 0.600 pm.
 - A. What is its momentum?

 - B. What is its speed?

 - C. Through what potential difference might it have been accelerated through, from rest, to reach this speed?

6. Starting with ^{235}U , assume the following sequence of decays occur: alpha decay, beta minus decay, alpha decay. Determine the correct isotopic product after each process has occurred sequentially.

The Periodic Table of the Elements

1																	2	
H Hydrogen 1.00794																	He Helium 4.003	
3	4															9	10	
Li Lithium 6.941	Be Beryllium 9.012182															F Fluorine 18.9984032	Ne Neon 20.1797	
11	12															17	18	
Na Sodium 22.989770	Mg Magnesium 24.3050															Cl Chlorine 35.4527	Ar Argon 39.948	
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
K Potassium 39.0983	Ca Calcium 40.078	Sc Scandium 44.955910	Ti Titanium 47.867	V Vanadium 50.9415	Cr Chromium 51.9961	Mn Manganese 54.938049	Fe Iron 55.845	Co Cobalt 58.933200	Ni Nickel 58.6934	Cu Copper 63.546	Zn Zinc 65.39	Ga Gallium 69.723	Ge Germanium 72.61	As Arsenic 74.92160	Se Selenium 78.96	Br Bromine 79.904	Kr Krypton 83.80	
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	
Rb Rubidium 85.4678	Sr Strontium 87.62	Y Yttrium 88.90585	Zr Zirconium 91.224	Nb Niobium 92.90638	Mo Molybdenum 95.94	Tc Technetium (98)	Ru Ruthenium 101.07	Rh Rhodium 102.90550	Pd Palladium 106.42	Ag Silver 107.8682	Cd Cadmium 112.411	In Indium 114.818	Sn Tin 118.710	Sb Antimony 121.760	Te Tellurium 127.60	I Iodine 126.90447	Xe Xenon 131.29	
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	
Cs Cesium 132.90545	Ba Barium 137.327	La Lanthanum 138.9055	Hf Hafnium 178.49	Ta Tantalum 180.9479	W Tungsten 183.84	Re Rhenium 186.207	Os Osmium 190.23	Ir Iridium 192.217	Pt Platinum 195.078	Au Gold 196.96655	Hg Mercury 200.59	Tl Thallium 204.3833	Pb Lead 207.2	Bi Bismuth 208.98038	Po Polonium (209)	At Astatine (210)	Rn Radon (222)	
87	88	89	104	105	106	107	108	109	110	111	112	113	114					
Fr Francium (223)	Ra Radium (226)	Ac Actinium (227)	Rf Rutherfordium (261)	Db Dubnium (262)	Sg Seaborgium (263)	Bh Bohrium (262)	Hs Hassium (265)	Mt Meitnerium (266)	(269)		(272)	(277)						

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