General College Physics II (PHY 104)

Final Exam

Spring 2019

Instructions: Do 4 of the 6 questions and 3 of the 4 problems. Clearly indicate which questions and problems you want graded, or I will grade the first 4 questions and the first 3 problems.

General College Physics II (PHY 104)

Equation Sheet

$$F = k\frac{|qQ|}{r^2} \qquad \text{PE} = k\frac{qQ}{r}$$

$$\mathbf{F} = q\mathbf{E} \qquad \text{PE} = qV$$

$$E = k\frac{|Q|}{r^2} \qquad V = k\frac{Q}{r}$$

$$E = \frac{|\sigma|}{2\epsilon_0} = 2\pi k\,|\sigma| \qquad V = -2\pi k\sigma\,|x|$$

$$\Delta V = Ed \qquad Q = C\Delta V$$

$$C = \epsilon_0\frac{A}{d} \qquad \text{PE} = \frac{1}{2}Q\Delta V = \frac{1}{2}C(\Delta V)^2 = \frac{1}{2}\frac{Q^2}{C}$$

$$V = IR \qquad P = IV = I^2R = \frac{V^2}{R}$$

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

$$I_{\text{rms}} = \frac{I_0}{\sqrt{2}} \qquad V_{\text{rms}} = \frac{V_0}{\sqrt{2}}$$

$$R_{\text{eq}} = R_1 + R_2 \qquad R_{\text{eq}} = \frac{R_1R_2}{R_1 + R_2}$$

$$F = \frac{\mu_0}{2\pi}\frac{I_1I_2}{d}l$$

$$B = \frac{\mu_0 I}{2\pi r} \qquad B = \mu_0 NI/l$$

$$F = |q|\,vB\sin\theta \qquad F = IlB\sin\theta$$

$$\Phi_B = BA\cos\theta \qquad \mathcal{E} = -N\frac{\Delta\Phi_B}{\Delta t}$$

$$\Phi_B = BA\cos\omega t \qquad \mathcal{E} = NB\omega A\sin\omega t$$

$$n = \frac{c}{v} \qquad f = \frac{r}{2}$$

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f} \qquad m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$$

$$n_1 \sin\theta_1 = n_2 \sin\theta_2 \qquad \sin\theta_C = \frac{n_2}{n_1}$$

Conventions:

- The focal length f is positive for concave mirrors and converging lenses, and negative for convex mirrors and diverging lenses.
- For a single-lens or single-mirror system, we choose $d_o > 0$.
- A real image has $d_i > 0$, while a virtual image has $d_i < 0$.
- An upright image has $h_i > 0$, while an inverted image has $h_i < 0$.

$$\lambda_n = \frac{\lambda}{n} \qquad \sin\theta = \frac{\lambda}{D}$$

$$\#\lambda\text{s} = \frac{d\sin\theta}{\lambda} \qquad \#\lambda\text{s} = \frac{2tn}{\lambda_0} + \left\{ \begin{array}{c} 1/2 \\ 0 \end{array} \right\} + \left\{ \begin{array}{c} 1/2 \\ 0 \end{array} \right\}$$

$$E = hf \qquad p = \frac{E}{c} = \frac{hf}{c} = \frac{h}{\lambda}$$

$$E_n = -(13.6\text{ eV})\frac{Z^2}{n^2}$$

$$N = N_0 e^{-\lambda t} \qquad T_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$$

Electron mass	9.11×10^{-31} kg
Proton mass	1.6726×10^{-27} kg
Neutron mass	1.6749×10^{-27} kg
Atomic mass unit (1 u)	1.6605×10^{-27} kg $= 931.5$ MeV/c^2
Avagadro's number	6.02214×10^{23} u/g
Proton charge	1.602×10^{-19} C
Electrical constant	$k = 8.988 \times 10^{9}$ N·m^2/C^2
Permittivity of free space	$\epsilon_0 = 8.85 \times 10^{-12}$ C^2/N·m^2
Permeability of free space	$\mu_0 = 4\pi \times 10^{-7}$ T·m/A
Gravitational constant	$G = 6.67 \times 10^{-11}$ N·m^2/kg^2
Planck's constant	$h = 6.63 \times 10^{-34}$ J·s
Speed of light in vacuun	$c = 3.00 \times 10^{8}$ m/s

$$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$$

Material	Resistivity, ρ
Silver	1.59×10^{-8} Ω·m
Copper	1.68×10^{-8} Ω·m
Gold	2.44×10^{-8} Ω·m
Tungsten	5.6×10^{-8} Ω·m

Medium	Index of refraction, n
Vacuum	1.0000
Air (at STP)	1.0003
Water	1.33
Lucite	1.51
Crown glass	1.52

Earth's magnetic field in Annville, Pennsylvania

B_x	20.2 μT	x is North
B_y	-4.1 μT	y is East
B_z	47.4 μT	z is Down
Horizontal Intensity	20.6 μT	
Total Field	51.7 μT	
Inclination (+ D , − U)	66.5°	
Declination (+ E , − W)	−11.4°	

From Giancoli 7th, Appendix B

Atomic Number Z	Element	Symbol	Mass Number A	Atomic Mass†	Half-life (if radioactive)
0	(Neutron)	n	1	1.008665	10.183 min
1	Hydrogen	H	1	1.007825	
	proton	p	1	1.007276	
	Deuterium	${}^{2}_{1}\mathrm{H}$	2	2.014102	
	Tritium	${}^{3}_{1}\mathrm{H}$	3	3.016049	12.32 yr
2	Helium	He	3	3.016029	
			4	4.002603	
6	Carbon	C	11	11.011434	20.334 min
			12	12.000000	
			13	13.003355	
			14	14.003242	5730 yr
11	Sodium	Na	22	21.994437	2.6027 yr
			23	22.989769	
			24	23.990963	14.997 hr
82	Lead	Pb	206	205.974466	
			207	206.975897	
			208	207.976652	
			210	209.984189	22.20 yr
			211	210.988737	36.1 min
			212	211.991898	10.64 h
			214	213.999806	26.8 min
84	Polonium	Po	210	209.982874	138.376 days
			214	213.995202	164.3 μs
85	Astatine	At	218	218.008695	1.5 s

†Masses given are those for the neutral atom, including the Z electrons (except for the proton).

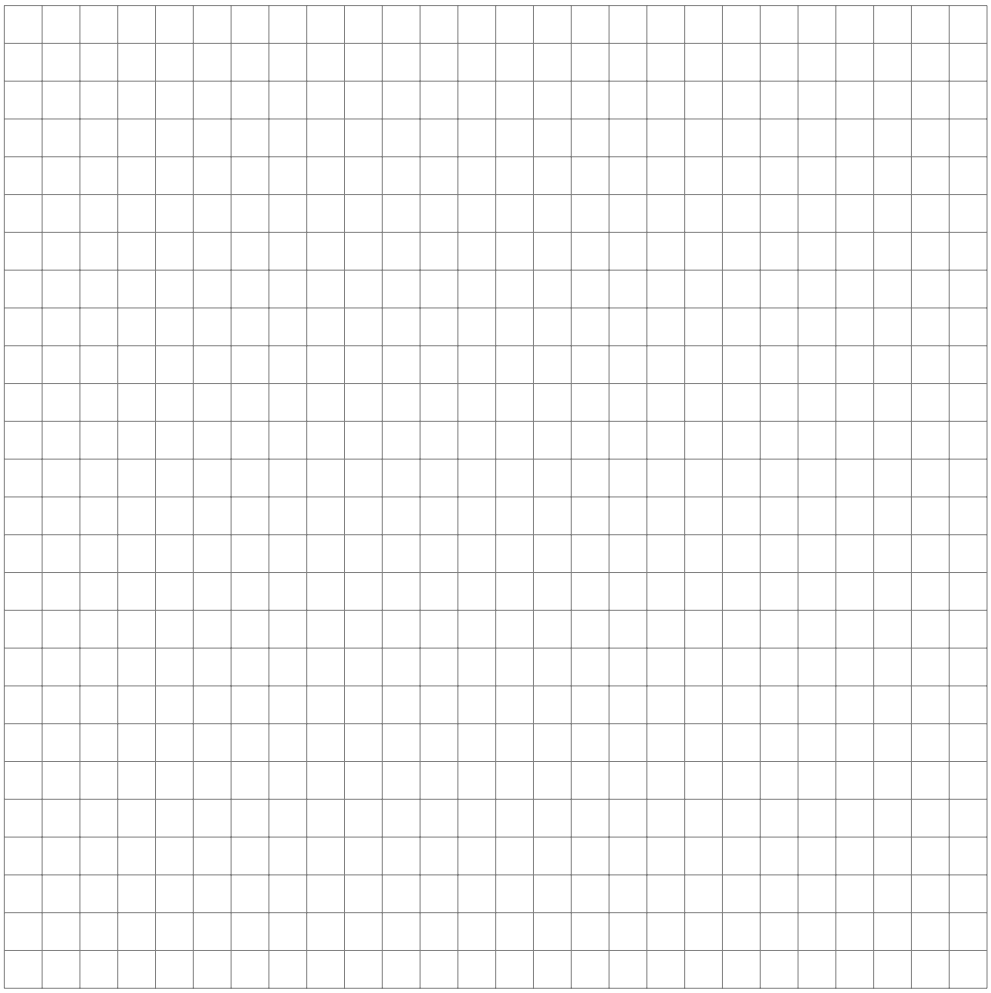
Question 1 (4 points) Chapter 17 Question 5

Question 2 (4 points) Electric Circuits 4

Question 3 (4 points) Magnetism 7

Question 4 (4 points) Ch 23 MisConceptual Question 6

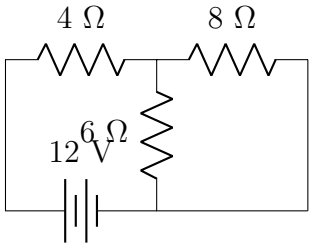
Question 5 (4 points) Consider a convex mirror with radius 20 cm. An object is placed 5 cm in front of the mirror. Make a ray diagram that shows where an image would be formed. Is the image real or virtual? Is it inverted or upright?



Question 6 (4 points) In Rutherford's planetary model of the atom, what keeps the electrons from flying off into space?

Problem 1 (8 points) Chapter 16 Problem 11

Problem 2 (8 points) Analyze the circuit below. Give the voltage across and the current through each circuit element listed in the box provided.



	Voltage across	with high potential on which side? (left, right, top, bottom)	Current through	with current flowing toward what direction? (left, right, up,down)
4 Ω				
6 Ω				

Problem 3 (8 points) Ch 24 Problem 52

Problem 4 (8 points) Chapter 30 Problem 45