

Phys2020: Final Exam Version A for May 5, '16. 7:30-10 AM

Your Name (please print neatly!) _____

Student ID # _____

TA's name (**Circle one!!**)

Robert Ariniello

Nicholas Kellaris

Prasanth Prahladan

Thomas Gray

Andrew Spott

Shane Rightley

Day your lab meets (**Circle one!!**) Tue Wed Thu

Time your lab starts (**Circle one!!**) 8 10 12 2 4

Please follow these instructions before you start the exam!

- Fill in the lines above, and *circle* your TA + the day and time of your lab.
- Write in **and bubble** in your name *and* your ID # on the bubble sheet!
- Write **and bubble** the exam version (**A**) in the space (top left of the bubble sheet.)

Double check all the above! Then, please wait until a TA announces you may begin.

There are (**xx, around 35**) **multiple choice questions**

Please BUBBLE IN your answer on the bubble sheet. Answers circled on this exam will NOT be used for grading purposes!! Use a #2 pencil. Erase mistakes carefully. If you can't thoroughly erase, ask for a fresh bubble sheet.

At the end, *check* that you have bubbled in *one* answer only, for all questions.

All multiple choice questions are equally weighted.

PLEASE IGNORE EARTH'S GRAVITY AND THE EARTH'S MAGNETIC FIELD IN ALL QUESTIONS (unless explicitly stated otherwise)

PLEASE turn in your exam in the **proper TA pile** up front!

“On my honor, as a University of Colorado at Boulder student, I have neither given nor received unauthorized assistance on this work”

Signature _____

This exam is double sided, please look at the backs of pages!

Useful constants:

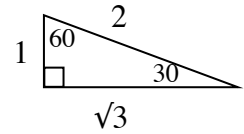
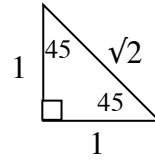
$k = 9 \times 10^9 \text{ N m}^2/\text{C}^2$, $\mu_0 = 4 \pi \times 10^{-7} \text{ T m/A}$
 $e = 1.6 \times 10^{-19} \text{ C}$, $c = 3 \times 10^8 \text{ m/s}$

Some Units: Units of [force] = [N] = [kg*m/s²],

Units of [energy or work] = [J] = [N*m] = [kg*m²/s²], [Power] = [J/s], Intensity = [J/(s*m²)]

Units are Current = C/s, Units of resistance is $\Omega = \text{Ohm} = [\text{J s/C}^2]$ Unit of resistivity is [$\Omega \cdot \text{m}$]

Units of Magnetic field = [T] = [N/(C*m/s)] = [kg/(C*s)]

**Useful Formulas:**

Newton's 2nd Law: $\vec{F}_{net} = m\vec{a}$, Work = $\vec{F} \cdot \vec{d} = |F||d| \cos\theta$, Power = $\vec{F} \cdot \vec{v} = |F||v| \cos\theta$

Coulomb's Law: $|F_{elec}| = \frac{k|q_1||q_2|}{r^2}$

Electric Fields:

$\vec{E} = \vec{F}/q$. Special cases of the above: $|E_{near a point charge}| = \frac{k|q|}{r^2}$

Electric Potential (or "Voltage")

$\Delta V = \frac{\Delta PE}{q}$. Special cases of the above: $V_{near a point charge q} = \frac{kq}{r}$

For uniform fields (or short distances), $|\vec{E}| = \left| \frac{\Delta V}{\Delta d} \right|$

Capacitors:

$Q = C\Delta V$, $C_{parallel plate} = \frac{A}{4\pi k d}$, $|E|_{parallel plate} = \frac{4\pi k Q}{A}$,

Stored energy in capacitor: $U = \frac{1}{2} C(\Delta V)^2 = \frac{1}{2} \frac{Q^2}{C} = \frac{1}{2} Q\Delta V$

Currents and circuits

Current is charge passing per second. Resistance is $R = \rho L/A$, where ρ = resistivity

$\Delta V = IR$ across a resistor, and power dissipated is $P = I\Delta V = I^2 R = \Delta V^2/R$

Resistors in series add up, resistors in parallel obey $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$

Magnetic fields

Force on a wire in a B-field: $F = I * length * B * \sin\theta$, direction given by a "right hand rule"

Force on a moving charge in a magnetic field is $F = q v B \sin\theta$ (again, "right hand rule")

Special case: $|B_{near wire}| = \frac{\mu_0 I}{2\pi r}$. In uniform B-field, charges move in circles, with $R = \frac{mv}{qB}$.

Faraday's law

$EMF = -N \frac{\Delta\Phi_{mag}}{\Delta t}$, where $\Phi_{mag} = BA \cos\theta$, and N is the number of turns (or coils)

(Lenz' law is the minus sign in the above equation!)

Electromagnetic Waves (radiation): Speed of light $c = 3E8 \text{ m/s}$. For any wave with speed c ,

$\lambda f = c$ (λ = wavelength, $f = 1/T$ = frequency)

In a medium with index of refraction n , speed is c/n , frequency is unchanged.

Geometric Optics: Snell's law: for light refracting from medium 1 into medium 2,

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

For thin lenses: $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$, and magnification $m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$

Physical Optics: Constructive interference happens when path length difference = $m\lambda$,
 or (for the case of 2 or more slits) $d \sin\theta = m\lambda$ (where $m=0, \pm 1, \pm 2$, etc.)

Destructive interference (from 2 slits) happens when path length difference = $(m+1/2)\lambda$,
 or $d \sin\theta = (m + \frac{1}{2})\lambda$ (where $m=0, \pm 1, \pm 2$, etc.)