Phys2020: Final Exam Version A for May 5, '15. 7:30-10 AM

Your Name (please print neatly!) _____

Student ID # _____

**TA's name** and your corresponding seating location (**Circle one!!**)

Oscar Henriksson (Coors Sec 23) Adam Higuera (Coors Sec 20/21 upper)

Ian Leahy (Coors section 20/lower) Nick Pellatz (Coors sec 21/lower)

Devin Rourke (Coors Sec 22) Keith Tauscher (Coors Sec 19)

**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.

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There are **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!

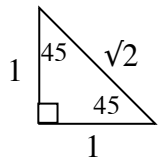
**"On my honor, as a University of Colorado at Boulder student, I have neither given nor received unauthorized assistance on this work"**

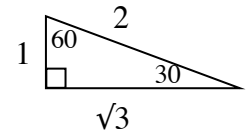
**Signature** _____

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

**Useful constants**:

k=9x10$^9$ N m$^2$/C$^2$, $\mu_0$=4 $\pi$ x10$^{-7}$ T m/A, e=1.6x10$^{-19}$ C




**Some Units:**
Units of [force] = [N] = [kg*m/s$^2$], Units of [energy, or work] = [J] = [N*m] = [kg*m$^2$/s$^2$]
Units of current = [A] = [C/s], Units of resistance is Ω=Ohm=[J s/C$^2$], Unit of resistivity is [Ω*m]

**Useful 2010 Formulas:**
Newton's 2nd Law: $\vec{F}_{net} = m\vec{a}$, Work = $\vec{\mathbf{F}} \cdot \vec{\mathbf{d}}$, Kin. energy = $\frac{1}{2}mv^2$, centripetal acceleration = $v^2/R$

**Electric Fields:** $\vec{E} = \frac{\vec{F}}{q}$ , special cases of the above: $\left|E_{near\ a\ point\ charge}\right| = \frac{k|q|}{r^2}$
For uniform fields (or short distances), $\left|\vec{E}\right| = \left|\frac{\Delta V}{\Delta d}\right|$

**Electric Potential (or "Voltage"):** $\Delta V = \Delta PE/q$ , special cases: $V_{near\ pt\ charge\ q} = \frac{kq}{r}$,
$\Delta V_{in\ uniform\ field} = -Ed$ (where d is the distance parallel to the electric field)

**Capacitors:** $Q = C\Delta V,\ C_{parallel\ plate} = \frac{A}{4\pi k\ d}$ , stored energy: $U = \frac{1}{2}C(\Delta V)^2 = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}Q\Delta V$

**Currents and circuits:** Current is charge passing per second.
Resistance is $R = \rho L/A$, where ρ = resistivity, $\Delta V = IR$ across a resistor,
power dissipated $P = I\Delta V = I^2R = \Delta V^2/R$
Resistors in series add up, resistors in parallel obey $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$

**Magnetic fields**
Force on wire in a B-field is $F = I * length * B * \sin\theta$ (direction given by a "right hand rule)
Force on a moving charge in a magnetic field is $F = q\ v\ B \sin\theta$ (again, a "right hand rule")
Special case: $\left|B_{near\ a\ long\ wire}\right| = \frac{\mu_0}{2\pi}\frac{I}{r}$
Special case of a charged particle in a uniform B field: the radius of the circular orbit is R = mv/qB

**Faraday's law:** $EMF = -\frac{\Delta\Phi_{mag}}{\Delta t}$, where $\Phi_{mag} = BAcos\theta$.

**Transformers:** $\frac{V_p}{V_S} = \frac{N_p}{N_s}$ , and energy (power) conservation also tells us $I_pV_p = I_sV_s$

**Electromagnetic Waves (radiation):** Speed of light c = 3E8 m/s. For any wave with speed c, λf = c (λ = wavelength, f = 1/T = frequency) **In a medium with index of refraction n, speed is c/n.**

**Geometric Optics:**
Snell's law: for light refracting from medium 1 into medium 2, $n_1 sin\theta_1 = n_2 sin\theta_2$

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

**Physical Optics:** Constructive interference happens when path length difference = mλ, or (for the case of 2 or more slits) $dsin\theta = m\lambda$ (where m=0, ±1,±2, etc.)
Destructive interference (from 2 slits) happens when path length difference = (m+1/2) λ, or $dsin\theta = (m + \frac{1}{2})\lambda$ (where m=0, ±1,±2, etc.)