Partial list of topics covered for PHYS 163 Exams

Anything in the book or lectures/labs is also considered fair game.

Test 1 info on page 1.
Test 2 info on page 2.
Test 3 info on page 3.
Final exam info on page 4.

Standard expectations for results on exams:

- Put final answers in the boxes (if one is provided).
- *Numerical* results typically include units (e.g., $t = 2.22$ s or $\Delta x = 1.234$ m).
- Algbraic results typically do NOT include units.
- If the rest of the problem is an algebraic result, leave constants (e.g., g) in algebraic form.
- Compress numerical factors to a three sig fig decimal number *in the numerator* (e.g., $\frac{2\pi kx}{3r} = 2.09\frac{kx}{r}$).
- Simplify answers or risk losing points.
- Avoid intermediate rounding!
- Round final answers to three sig figs *unless otherwise noted*.
- Optional: use 4 sig figs if the 1st digit of a result is 1.

Point Charges

- Electric forces, fields, potential, potential energy
- Often arranged in a line (e.g. dipole), triangle, rectangle, circle, or even 3D
- Use symmetry to simplify
- Occasionally rotating coordinates helps
- Could also have FBDs, moving through plates, or using $K_i + U_i = K_f + U_f$ stuff

Continuous distributions of charge

- Electric field or electric potential
- Mainly rods, arcs, rings, disks, and washers
- Uniform or non-uniform density possible

Gauss's Law

- Slabs, spheres (or spherical shells), & cylinders (or cylindrical shells
- Could have conductors, insulators, or both
- Insulators could be uniform or non-uniform
- Use integration to relate total charge to constants in a given non-uniform density formula
- Sketch plots and determine units of constants

Relate potential to field and vice versa

- Use partial derivative to go from V to E
- Use line integral to go from E to V
- Interpret V vs x plots, use for computations

Capacitance (Ch 25)

- Deriving capacitance for shells, plates, etc.
- Capacitor Networks (should be able to solve with series and parallel rules)
- Connecting two previously charged caps, how will charges rearrange (or bring dielectric in/out)

Resistance & Resistivity (Ch 26)

- Current and current density (relate to the geometry of a resistor)
- Determine resistance for a particular shape (may have non-uniform cross-sectional area or resistivity)
- Resistance and/or resistivity versus temperature
- Relate resistance or resistivity to IV plots
- Relate resistivity to plots of R vs L

Resistor Circuits & RC transient Circuits (Ch 27)

- Resistor networks with series/parallel rules
- How does a resistor network change when a switch is opened/closed (or bulb burns out)
- Resistor networks with KVL & KCL
- *Simple* RC transients: determine initial and/or steady state conditions
- *Simple* RC transients: plot $I/Q/V/\mathcal{P}/U$ as functions of time
- *Simple* RC transients: interpret plots of $I/Q/V/\mathcal{P}/U$ to determine R, C, V_{max}, τ, etc.
- *Complex* RC transients: determine initial and/or steady state conditions

Magnetic Force & Torque (Ch 28)

- Mag force on moving charge
- Mag force on wire
- Mag torque on loop of wire
- Use right hand rules
- Determine or use magnetic moment

Biot-Savart Law

- Wires with straight and/or circular sections
- Net field from several long straight wires
- Use right hand rules for directions

Ampere's law

- Wires, cylindrical shells, cylinders, slab
- Uniform or non-uniform
- If non-uniform, relate current density constants to total current and find units
- Sketch plots of magnitude of B vs r
- Use right hand rules for directions

Mag flux and Induced EMF

- Rod translating or swinging in external B-field
- Rod on rails stuff
- External B-field as function of time near loop
- Loop spinning in presence of external field
- Loop changing size in external field

DC Circuits that might show up

- RL transients
- LC oscillators
- Damped Oscillator (RLC with no source or *battery*)
- Note: any *damped* oscillator question would probably be conceptual. The math is time-consuming and typically gets covered in-depth in a full circuits course.

AC circuits that might show up

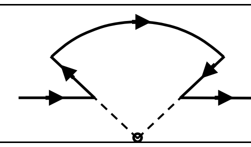
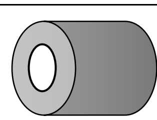
- RLC Series Circuit with a *function generator* (damped, *driven* oscillator)
- Filter circuits (plot Z vs ω or i_{max} vs ω)
- Filter circuits (interpret plots of Z vs ω or i_{max} vs ω)

Final exam is <u>cumulative</u>. No practice tests are provided. Be well prepared or you *will* run out of time. Redoing old exams should help.

Expect *more* questions than usual. Fortunately, most final exam calculations are *shorter* than mid-terms.
There are too many problems to include and still have the test be doable in 2 hours.
I write the test, time it, and then start chopping stuff out to make it doable in 2 hours.
Expect many short questions with maybe five more involved calculations.
Ideally I would pick one question from each row from either column A or B (on some occasions both).

To be clear, any topics covered in the course are fair game.

For example, you might notice KVL & KCL are not emphasized in the list below. I may not make you go through all the gory details on a KVL problem, but instead have you write loop & junction equations without solving them.
I hope this gives you some idea of how I plan to get all these topics on the test while still keeping the time limit under 2 hours.
Again, some topics will have to be cut for time.

<table>
<tr><th>Column A</th><th>Column B</th></tr>
<tr><td colspan="2">Guaranteed some kind of question about E & M waves. Expect this problem to be blatantly copied from the Ch 33 workbook questions. This will be there for sure. As an example, one year I took a problem with numbers and simply made it algebraic. Other times I might change a number/prefix or the sign/direction of a quantity.</td></tr>
<tr><td colspan="2">Guaranteed conceptual/definition questions on diamagnetism, paramagnetism, ferromagnetism or Maxwell's laws similar to hmwk. This will be there for sure. Expect this problem to be blatantly copied from Ch 32 workbook questions.</td></tr>
<tr><td>Point charges relating to $\vec{F}, \vec{E}, U$ or V
Probably triangle, square, or circle geometry</td><td>Use Biot-Savart law with ∞ long wires located on corners of square, triangle, etc to relate to $\vec{B}_{NET}$ or force on a wire</td></tr>
<tr><td>Continuous distribution of charge (arc, rod, or washer) could be non-uniform…derive $\vec{E}$ or V</td><td>Biot-Savart law using straight & circular segments </td></tr>
<tr><td>Gauss's Law in spherical or cylindrical geometry, no slabs (insulator/conductor/or both, possibly non-uniform)</td><td>Ampere's law, cylindrical geometry (possibly non-uniform)</td></tr>
<tr><td>Cap circuit (think 2 in para plus 1 in series or 2 in series plus 1 in para). Might have dielectric in/out.</td><td>Concept Q on caps in series versus para
(charge, voltage, energy)</td></tr>
<tr><td>Resistor circuit (think 2 in para plus 1 in series or 2 in series plus 1 in para). Might have switch. Maybe KVL.</td><td>Concept Q on resistors in series versus para
(current, voltage, power)</td></tr>
<tr><td>Problem on Φ_B & $i_{induced}$ (i.e. rod on rails with $\vec{B}_{ext}$, changing area with $\vec{B}_{ext}$, $\vec{B}_{ext}$ is function of time changing flux through loop, generator/spinning loop → ωNBA)</td><td>Conceptual Q's on mag flux & induced currents (think magnet falls through tube or $\vec{B}_{ext}$ changes through loop)</td></tr>
<tr><td>LC oscillator</td><td>LRC series
This includes sketching or interpreting plots of Z vs ω and/or i_{max} vs ω (possibly including filter circuits).</td></tr>
<tr><td>RC transient</td><td>RL transient</td></tr>
<tr><td>Force/energy on charge in electric field (think charge on a string between parallel plates, charge travels between parallel plates, two charged balls on strings)</td><td>Force on moving charge in $\vec{B}_{ext}$, torque on loop of wire in $\vec{B}_{ext}$, forces on charge in $\vec{B}_{ext}$ moving in circular motion, or forces on wires carrying current in $\vec{B}_{ext}$</td></tr>
<tr><td>Derive resistance of a shape using calculus and/or geometry. May involve temperature variation. </td><td>Conceptual questions on resistivity, resistance, and temperature involving different shapes similar to hmwk</td></tr>
<tr><td>Determine electric field using $E_x = -\frac{dV}{dx}$ OR determine potential difference using $\Delta V = -\int \vec{E} \cdot d\vec{s}$</td><td>Electric potential versus position with graphing</td></tr>
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