Partial list of topics covered for PHYS 162 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, etc.

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.

Ch18 - Temperature, Heat, & Intro to Thermo

- Temperature conversions
- Thermal Expansion (1D, 2D, or 3D)
- $Q = mc\Delta T$ and $Q = \pm mL$ (including plots)
- Conduction (could include non-uniform k or non-uniform A)
- Radiation (conceptual or numerical)
- Convection (basic conceptual idea of how it works)

Ch19 - Kinetic Theory of Gases & the 1st Law of Thermo

- Relationships between mass, number of moles, molar mass, number of molecules, & N_A
- Ideal gas law using standard physics units
- Use FBDs applied to pistons to get parameters for $PV = nRT$ problems
- Degrees of freedom at various temperatures for diatomic molecules
- Distinction between constant volume & constant pressure processes
- Molar specific heat and adiabatic constant
- Maxwell-Boltzmann speed distribution (assume you'll have integral tables)
- Understand the terms on page 86 of the workbook well
- First Law (pay close attention to problem wording for work ON versus work BY)
- Work done by (or on) gas for isochoric, isobaric, isothermal, adiabatic & straight lines on a PV diagram. **Be ever vigilant watching for sign errors.**

Ch20 - Heat Engines, Entropy, & the 2nd Law of Thermo

- Master of all the tricks you can when sketching or interpreting PV diagrams
- Draw an engine diagram from a PV diagram cycle
- Know both heat pumps and engines (how to get efficiency or COP)
- Conceptual understanding of entropy
- Basic computation of entropy changes

Ch15 - Oscillations

- Horizontal mass springs
- Vertical mass springs
- Physical Pendulums (with or without spring attached)
- Know how to use the parallel axis theorem on table of I's
- Problems involving torque, force, energy, and/or kinematics
- Writing a differential equation using forces or torques
- Determining resonant frequency or period from differential equation
- Verify an equation is a solution to a differential equation by plugging it in
- Interpreting or using *functions* for $U,\ K,\ x,\ v,$ or a versus t
- Interpreting or sketching *plots* of $U,\ K,\ x,\ v,$ or a versus t
- Knowing how to determine or use phase angles in problems
- Knowing how & when to use the small angle approximations for trig functions
- Conceptual understanding of damped oscillators
- Conceptual understanding of damped, driven oscillators
- Conceptual understanding of resonance

Ch16 - Waves

- Requirements of mechanical wave
- Identify wave equations by looking for $x \pm vt$ or $kx \pm \omega t$
- Manipulate $y(x,t)$ and $v_y(x,t)$ for continuous sinusoidal waves
- Determine phase angles
- Use FBDs to determine parameters useful in string wave problems
- Wave speed problems (including non-uniform tension or non-uniform μ)
- Superposition Principle
- Reflections from fixed & free boundary conditions
- Standing Waves with various boundary conditions
- Conceptual understanding of Fourier synthesis

Ch17 - Sound

- Dependence of sound speed in air on temperature
- Compressions & rarefactions
- Pressure versus overpressure
- Position versus displacement
- Intensity emitted versus absorbed (in particular, what area should be used)
- Sound Intensity Level versus Intensity
- Two source interference
- Standing waves
- Beats
- Doppler shifts (double for echoes!)
- Shock Waves & Mach Number

Ch33 - EM Waves

- EM spectrum, $k = \frac{2\pi}{\lambda},\ \omega = 2\pi f, c = f\lambda,\ \&\ e = hf = \frac{hc}{\lambda}$
- Polarization (including plots of transmission versus angle)
- Reflection: angle of incidence = angle of reflection)
- Refraction: Snell's Law, angles to normal, $c = nv$, $\lambda_n = \frac{\lambda}{n}$, & $f_n = f$
- TIR
- Conceptual understanding of dispersion (short lambda, more refraction)
- Brewster angle
- Geometry...tons of it
- Conceptual understanding of index of refraction gradient

Ch34 - Image Formation

- Flat, concave, or convex mirror (ray diagrams & equations)
- Convex or concave lenses (ray diagrams & equations)
- Two lens systems or lens with mirror system
- Single refracting surface
- Magnification, image distance, object distance, focal length, radius
- Well-practiced applying the sign conventions for any of the above

Ch35 - Interference

- Huygens's Principle
- Wavelength changes in medium & possible phase shifts from reflections
- Thin film interference (including thin film of variable thickness)
- Double slit (or two source) interference (including when to use approximations)
- Basic color addition for multi-λ problems (R+B=M, B+G=C, G+R=Y, R+G+B=W)

Ch36 - Diffraction

- Single slit diffraction pattern (including when to use approximations)
- Babinet's Principle
- Diffraction gratings & conceptual understanding of multiple slit interference pattern
- Resolution & circular apertures

Ch37 - Special Relativity

- Definitions, postulates, and consequences
- Correctly identify frames for proper times & proper length
- Quickly go back and forth between Lorentz factor (γ) and speed (β)
- Time dilation & length contraction problems
- Resolutions of twin paradox & pole in the barn paradox (including space-time graphs)
- Relativistic velocity addition
- Relativistic momentum
- Relativistic energy
- Relativistic Doppler shift

Ch38 - Intro to Quantum: Matter Wave & Photons

- Conceptual understanding of UV catastrophe & blackbody radiation intensity plots
- Photoelectric effect (conceptual and/or quantitative...including plots)
- Compton scattering
- Bohr model (know this one inside and out)
- Matter waves (de Broglie wavelength)
- Uncertainty principle
- Historical importance of any of these modern physics topics

Ch39 - Quantum Mechanics

- Wave functions (boundary conditions, when does $\psi = \psi^*$, etc.)
- Probability density functions (expectation values, most probable x, probability, etc)
- Conceptual understanding of graphs of ψ and $\psi^*\psi$ (including sketching)
- Use the TISE with given ψ to derive stationary state energy values
- Well-practiced using integral tables & integration tricks
- Particle-in-a-box (infinite square well)
- Quantum harmonic oscillator
- Mixed states and how to quickly do math on ψ's from orthonormal basis
- Conceptual understanding of finite square well (electron can be found beyond walls)
- Simple tunneling problems using approximation

Ch40 - Atomic Structure

- Quantum numbers of hydrogen atom
- Convert ψ to a radial probability density function (remember that $4\pi r^2$)
- Expectation values or probability for radial probability distribution
- Derive energy eigenvalue using TISE in radial form
- Angles for various types of angular momentum
- Distinction between angular momentum quantum number & angular momentum
- Distinction between angular momentum & z-component of angular momentum