Partial list of topics covered for PHYS 161 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.

Chapter 1-4:

Sig figs & math with sig figs

Prefixes & Notations

- Scientific versus engineering
- Be able to go from power of 10 to prefix
- Be able to go from prefix to power of 10
- WATCH OUT! Use *either* prefix *or* power of 10 BUT NOT BOTH!!!

Vectors

- Ordinal directions (N of W versus W of N)
- Dealing with angles to the vertical versus angles to the horizontal
- Addition (graphical or with SOH CAH TOA)
- Cross & dot products
- Creating unit vectors
- Angle between two vectors
- Angle between vector and an axis

1D motion graphs

- Use problem statement to create a graph
- Interpret graphs
- Distinctions between an xt-plot versus a vt-plot versus an at-plot

1D, 2D & 3D motion

- Standard projectiles ($a_x = 0$)
- Projectiles with non-zero a_x
- Tricky word problems requiring derivatives or integrals.
  Remember: sometimes plugging in zero for a limit gives non-zero result!
- Separation of variables
- Relative motion

Chapters 5-8

Excel or other computation

Newton's Laws

- Frictionless force problems (often multi-block)
- Friction force problems (often multi-block)
- Circular motion force problems
- Tricky concept questions

Work-energy theorem (Ch 7 methods)

Work done by non-constant force using integral

Determine force from potential energy

Determine potential energy from force

- Remember: sometimes plugging in zero for a limit gives non-zero result!

Energy problems (Ch 8 methods)

Know these tricks:

- Determining height of circular arc
- Determine height on incline
- For two blocks use two GPE reference levels
- Use FBD to determine n & f so you can get $W_{friction}$
- Often useful to do circular motion FBD for energy problems with circular tracks or loops
- If spring length *changes* in problem, we typically use energy (F_{spring} & a are NOT constant). Do NOT use constant acceleration kinematics if spring length is changing in problem!
- If spring length *is fixed* in problem, we can use $F_{spring} = kx$ in an FBD
- Be able to solve circular motion force equations for period, speed, &/or omega

Kinematics relates to force using $F = ma$

Instantaneous power is $\vec{F} \cdot \vec{v}$

Average power is change in energy over change in time

Chapters 9-12

Momentum and Impulse

- 1D elastic
- 1D or 2D inelastic
- Explosions

Center of Mass & Moment of Inertia

- If calc required, expect a 1D problem
- If calc NOT req'd, could be any dimensionality, could have holes, could require parallel axis
- Perpendicular axis might be extra credit

Rotational Kinematics

- Constant angular accel
- Non-constant angular accel
- Plots
- Know a, a_c, a_{tan} & a_{total}

Relating Rotational & Translational Motion

Torque & Energy Methods for:

- Rolling Motion (without slipping)
- Blocks with Massive Pulleys
- Swinging Motion*
- *WATCH OUT! In most swinging motion problems you CANNOT use constant acceleration kinematics (while most rolling or blocks w/ pulley you CAN).

Angular Momentum

- Rotating object changes shape (e.g. neutron star, figure skater brings arms in).
- Rotating object impacts rotating object (e.g. drop spinning disk on spinning turntable)
- Collision in space without pivot: Usually both angular and linear momentum conserve. After collision rotates about center of mass. Often need parallel axis theorem to get moment of inertia.
- Collision with pivot: Usually only angular momentum is conserved. After collision rotates about pivot.
- For points masses *flying freely in a straight line* use $L = mvr_{\perp}$
- For points masses *attached to something* spinning use $L = I_{point\ mass}\omega = mx^2\omega$
- Don't forget: angular momentum could be + or -!!!

Which conservation laws apply?

Static Equilibrium

Stress & strain (1D Young's modulus)

Final exam is cumulative. No practice tests are provided. Be well prepared or you *will* run out of time.
Redoing old exams and doing workbook problems from Chapter 13 & 14 (discussed below) should help.
Expect *more* questions than usual. Fortunately, most final exam calculations are shorter than mid-terms.
Questions on the final from chapters 13 & 14 are very similar to homework questions from the problem list.
I might put 2-3 *concept questions* and/or up to 2 *problems* from Chapter 13 & 14.
The remaining questions are a mix of concept questions & computational questions from the rest of the semester.
I shoot for *approximately* 25% of the test being relatively short conceptual questions but that is not always true.

Ch 13—Universal gravitation

- Circular orbit do FBD &/or KE & GPE
- Conservation of energy (Escape velocity, release four point masses from rest, etc)
- Place point masses on grid. Get net force on one of the masses.
  Remember you must add force VECTORS not force MAGNITUDES.
- Place point masses on a grid. Get gravitational potential energy.

Ch 14—Fluids & Pressure

- Buoyant force
- Static pressure versus depth (U-tubes or force on a dam)
- Ideal fluid flow problems using continuity equation &/or Bernoulli equation (e.g. siphon or hole in a can)
- Sometimes throw in a 1 pointer from all the weird demos...not worth stressing over.

It is impossible to make a perfect final for this course; there is too much to cover. That said, I made the following table of every topic I would put on an *idealized* final if time was no issue. I included the approximate number of points for each topic. That said, I can only fit *about half* of this stuff on the *real* final. Some topics will be left out. For some topics I'll include a concept questions or a simple 4 point calculation instead of a large 6-12 point calculation. Chapters 13 & 14 are the only topics guaranteed to be on the test.

Chapter	Topic	Points
1	Unit conversions, notation, simple geometry. I might ask for correct sig figs, prefix, or notation.	6
2	Analyze plots of motion	6
2	Multi-stage word problem or single stage requiring calculus.	6
3	Vector addition, dot product, or cross-product.	6
4	Problems involving drones or standard projectiles. Remind me in class not to use constraints…	8
5	Force problems with multiple blocks *without* friction. Newton's 3rd law.	8
6	Force problems with multiple blocks *with* friction. Which frictional case applies.	8
6	Force problems involving circular motion. Could involve period, omega, or speed.	8
7	Know work = *change* in energy. Determine if work by a force should be positive, negative, or zero.	4
8	Energy problem like any that were fair game for test 2	8
8	Plots of U versus x (get force, acceletation, or do $K_i + U_i = K_f + U_f$)	6
9	Center of mass (1D non-uniform rod or 2D shape with hole)	6
9	Collision or explosion *without* rotation. Concept questions on collisions.	6
10	Rotational Kinematics: word problem or plot, remember all those different types of acceleration!	6
10	Torque and/or energy: rolling object, pulley with two radii, or pendulum requiring $I_{total} = I_1 + I_2$ and possibly use of parallel axis theorem.	12
11	Collision with rotation. One of these: clay hits rod with or without pivot, rotation with shape change, spinning disc lands on spinning ring, etc.	12
12	Statics with rod	8
13	See notes above table. Guaranteed to have something from Ch 13 on test.	10
14	See notes above table. Guaranteed to have something from Ch 14 on test.	10