**Midterm #3 Information**
**Physics 111-01, Spring 2016**

The third midterm exam will happen during class on Friday, April 29th. It will be closed-note and closed-book, and you will have the entire class period to complete the test. There will be a mix of multiple-choice questions and some worked problems. You will need to bring a pencil, a good eraser, a calculator, and an 882-E Scantron form. It is a good idea to bring extras just in case!

The exam will cover material from Chapters 10, 11, 13, and 14 of the Walker textbook (recall that we skipped Chapter 12 entirely). You should be familiar with rotational motion and rotational kinematics problems, torque and moment of inertia, and be able to solve equilibrium/statics problems using concepts from Chapters 6 and 11. The test will also cover simple harmonic motion displayed by springs and pendulums, and the basics of waves and sound. The following equations list will be provided at the exam. Be prepared to answer conceptual questions and to solve numerical problems.

PHYS 111 – Equations for Midterm #3

Vector quantities are shown in **bold**.

Motion and Kinematics:

$\mathbf{v}_{avg} = \Delta\mathbf{x}/\Delta t$ (constant velocity)

$\mathbf{a}_{avg} = \Delta\mathbf{v}/\Delta t$ (constant acceleration)

$x_f - x_i = v_i t + \frac{1}{2}at^2$

$v_f = v_i + at$

$v_f^2 = v_i^2 + 2a(x_f - x_i)$

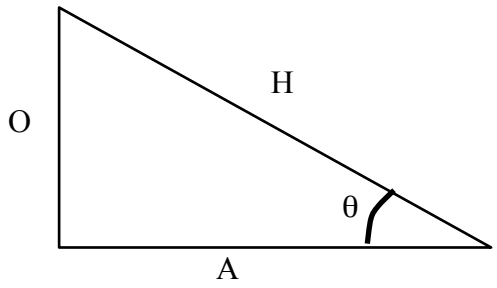
Triangles:

$\sin\theta = O/H$

$\cos\theta = A/H$

$\tan\theta = O/A$

$H^2 = O^2 + A^2$




Forces:

$\mathbf{\Sigma F} = \mathbf{F}_{net} = m\mathbf{a}$

$\mathbf{F}_{21} = -\mathbf{F}_{12}$

$\mathbf{F_g} = m\mathbf{g}$

$F_{\mathbf{fric,s}} \leq \mu_s F_N$

$F_{\mathbf{fric,k}} = \mu_k F_N$

$\mathbf{F}_{spring} = -k\mathbf{x}$

Uniform Circular Motion:

$a_{cent} = v^2/r$

Momentum and Energy

Work: $W = \mathbf{F} \bullet \mathbf{d}$

$KE = \frac{1}{2}\, mv^2$

$Work = \Delta KE$

$E_{i,tot} = E_{f,tot}$

$\mathbf{p} = m\mathbf{v}$

$p_{i,\,tot} = p_{f,\,tot}$

$PE_g = U_g = mgh$

$Power = W/\Delta t$

$\mathbf{p}_{tot} = m_1\mathbf{v}_1 + m_2\mathbf{v}_2 + m_3\mathbf{v}_3 + \ldots$

Impulse: $\mathbf{I} = \mathbf{F}\Delta t = \Delta\mathbf{p}$

$PE_{sp} = U_{sp} = \frac{1}{2}\, kx^2$

Rotational Motion:

| | | | |
|---|---|---|---|
| $\boldsymbol{\omega} = \Delta\theta/\Delta t$ | $f = 1/T$ | $I = \Sigma\, m_i r_i^2$ | $KE_{rot} = \frac{1}{2} I\omega^2$ |
| $a_{cent} = v^2/r = \omega^2 r$ | $v_{tan} = r\omega$ | $x_{cm} = (1/m_{tot})\, \Sigma m_i x_i$ | |
| $\theta_f = \theta_i + \omega_i \Delta t + \frac{1}{2}\alpha \Delta t^2$ | $\tau = rF_{\perp}$ or $r_{\perp}F$ | $y_{cm} = (1/m_{tot})\, \Sigma m_i y_i$ | |
| $\omega_f = \omega_i + \alpha \Delta t$ | $\Sigma\, \tau = I\alpha$ | | |
| $\omega_f^2 = \omega_i^2 + 2\alpha\Delta\theta$ | | | |

SHM, Waves, and Sound:

| | | | |
|---|---|---|---|
| $f = 1/T$ | $f\lambda = v_{wave}$ | $T_{spring} = 2\pi\sqrt{m/k}$ | $T_{pendulum} = 2\pi\sqrt{L/g}$ |
| $x(t) = A \cos(2\pi f t)$ | $v_{wave,\ string} = \sqrt{F/\mu}$ | $I = P/A = P/(4\pi r^2)$ | $\beta = 10 \log (I/I_0)$ |
| $f' = f[(1 +/- u_o/v)/(1 -/+ u_s/v)]$ | | | |

| | | | |
|---|---|---|---|
| string: | $f_m = mv/2L$ | m = 1, 2, 3, 4, … | Constructive: $\Delta d = n\lambda$ |
| open-open or | | | Destructive: $\Delta d = (n + \frac{1}{2})\lambda$ |
| closed-closed: | $f_m = mv/2L$ | m = 1, 2, 3, 4, … | $f_{beat} = \lvert f_1 - f_2 \rvert$ |
| open-closed: | $f_m = mv/4L$ | m = 1, 3, 5, 7, … | |

| QUANTITY | SYMBOL | UNIT OR VALUE |
|---|---|---|
| Mass | m | kg |
| Position | x | m |
| Displacement | **x** | m |
| Time | t | s |
| Velocity | **v** | m/s |
| Acceleration | **a** | $m/s^2$ |
| Weight | w | N |
| Force | **F** | N |
| Coefficient of friction | $\mu$ | -- |
| Spring constant | k | N/m |
| Area | A | $m^2$ |
| Length | L | m |
| Angle | $\theta$ | rad |
| Angular velocity | $\omega$ | rad/s |
| Angular acceleration | $\alpha$ | $rad/s^2$ |
| Torque | $\tau$ | Nm |
| Moment of inertia | I | $kg\ m^2$ |
| Momentum | p | kg m/s |
| Work | W | J (Nm) |
| Energy | E | J |
| Power | P | J/s, W |
| Kinetic Energy | KE | J |
| Potential Energy | U | J |
| Frequency | f | 1/s, Hz |
| Wavelength | $\lambda$ | m |
| Period | T | s |
| Intensity | I | $W/m^2$ |
| Decibel Level | $\beta$ | dB |

Conversions:
- 1 km = $10^3$ m
- 1 m = $10^2$ cm
- 1 cm = $10^1$ mm
- 1 rev = 360º
- 1 rev = $2\pi$ radians
- T(K) = T(ºC) + 273

Constants:
- $g = 9.8\ m/s^2$
- $I_0 = 1.0 \times 10^{-12}\ W/m^2$
- $v_{sound} = 343$ m/s
- $v_{light} = 3.0 \times 10^8$ m/s