Final Exam Information
Physics 111-01, Spring 2016

The final exam will take place in our regular classroom on Wednesday, May 18 from 10:45AM-1:15PM. It will be closed-notes and closed-book, and you will have the entire exam period to complete the test. There will be a mix of multiple-choice questions (probably 20-25) and some worked problems (probably 4-5). 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 the entire semester, but will be more heavily focused on recent material: sound waves, fluids, density and pressure, heat and temperature, and thermodynamics. For earlier material, please see the review sheets for the midterm exams. Be prepared to answer conceptual questions and to solve numerical problems.

PHYS 111 – Equations for Final Exam
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)

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

$v_f = v_i + at$

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

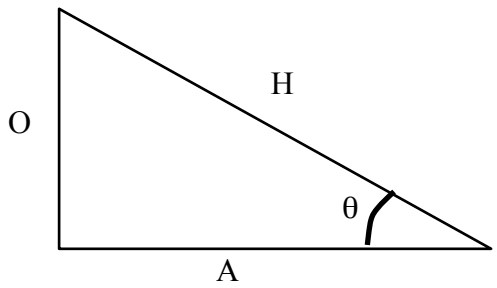
Triangles:

$\sin\theta = O/H$

$\cos\theta = A/H$

$\tan\theta = O/A$

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



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 = ΔKE

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

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

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

$PE_g = U_g = mgh$

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:

$\boldsymbol{\omega} = \Delta\theta/\Delta t$

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

$\theta_f = \theta_i + \omega_i\Delta t + \frac{1}{2}\alpha\Delta t^2$

$f = 1/T$

$v_{tan} = r\omega$

$\tau = rF_\perp$ or $r_\perp F$

$I = \Sigma\, m_i r_i^2$

$x_{cm} = (1/m_{tot})\,\Sigma m_i x_i$

$y_{cm} = (1/m_{tot})\,\Sigma m_i y_i$

$KE_{rot} = \frac{1}{2}I\omega^2$

$\omega_f = \omega_i + \alpha\Delta t$ $\quad\quad$ $\Sigma \tau = I\alpha$

$\omega_f^2 = \omega_i^2 + 2\alpha\Delta\theta$

SHM, Waves, and Sound:

$f = 1/T$ $\quad$ $f\lambda = v_{wave}$ $\quad$ $T_{spring} = 2\pi\sqrt{m/k}$ $\quad$ $T_{pendulum} = 2\pi\sqrt{L/g}$

$x(t) = A\cos(2\pi ft)$ $\quad$ $v_{wave,\ string} = \sqrt{F/\mu}$ $\quad$ $v_{max} = A(2\pi f)$ $\quad$ $a_{max} = A(2\pi f)^2$

$I = P/A = P/(4\pi r^2)$ $\quad$ $\beta = 10 \log (I/I_0)$ $\quad$ $f' = f[(1 +/- u_o/v)/(1 -/+ u_s/v)]$

string: $f_m = mv/2L$ $\quad$ $m = 1, 2, 3, 4, \ldots$ $\quad$ Constructive: $\Delta d = n\lambda$

open-open or

closed-closed: $f_m = mv/2L$ $\quad$ $m = 1, 2, 3, 4, \ldots$ $\quad$ Destructive: $\Delta d = (n + ½)\lambda$

open-closed: $f_m = mv/4L$ $\quad$ $m = 1, 3, 5, 7, \ldots$ $\quad$ $f_{beat} = |f_1 - f_2|$

Gases, Fluids, and Buoyancy

$PV = Nk_BT$ $\quad$ $P = F/A$ $\quad$ $\rho = m/V$

$P_1V_1/T_1 = P_2V_2/T_2$ $\quad$ $P_{liquid} = \rho gd + P_0$ $\quad$ $F_B = m_{liquid}g = W_{air} - W_{liquid}$

Thermodynamics & Heat Transfer

$e = E_{out} / E_{in}$ $\quad$ Heat Engines: $e = W_{out} / Q_H$ $\quad$ Refrigerators: $COP = Q_C / W_{in}$

$E_{therm} = (3/2)\, Nk_BT$ $\quad$ $e_{max} = 1 - (T_C/T_H)$ $\quad$ $COP_{max} = T_C / (T_H - T_C)$

$\Delta E_{therm} = \Delta Q + W$ $\quad$ $\Delta Q_{cond}/t = (kA/L)\,\Delta T$ $\quad$ $\Delta Q_{rad}/t = e\sigma AT^4$

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	μ	--
Spring constant	k	N/m
Area	A	m^2
Length	L	m
Angle	θ	rad
Angular velocity	ω	rad/s
Angular acceleration	α	rad/s^2
Torque	τ	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

Conversions:
1 km = 10^3m
1 m = 10^2 cm
1 cm = 10^1mm
1 rev = 360º
1 rev = 2π 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
$\sigma = 5.67 \times 10^{-8}\ W/(m^2\ K^4)$
$k_B = 1.38 \times 10^{-23}$ J/K

Frequency	f	1/s, Hz
Wavelength	λ	m
Period	T	s
Intensity	I	W/m^2
Decibel Level	β	dB
Thermal Energy	E_{th}	J
Heat	Q	J
Temperature	T	K
Efficiency	*e*	--
Coefficient of Performance	COP	--
Pressure	P	Pa, N/m^2
Volume	V	m^3
Number of particles	N	--
Density	ρ	kg/m^3
Emissivity	e	--
Thermal Conductivity	k	W/m K