Final Exam Details:

The final exam will take place in room MPHY-204 on December 12th, 2023 from 3:30pm – 5:30pm. Please arrive at least 15 minutes early to get settled; we would like to begin exactly on time. If you have any questions during the exam, you may ask the proctor monitoring the exam.

The exam will consist of 30 multiple-choice questions. There will also be 5 bonus questions. You will mark your answers down on the scantron provided and turn in the scantron at the conclusion of the exam.

A formula sheet will be provided. In addition, you are also allowed to make 1 (one) handwritten set of personal notes for the exam. The notes should fit on one side of a standard 8"x11" sheet of paper. You may write anything you believe to be useful for the exam within this limit.

Chapters to be covered on exam: 1-16

Items to bring:

- Pencil and eraser
- Scientific Calculator (up to a Ti-84 is allowed)
- Yourself

Items *not* to bring:

- Scantron (one will be provided on exam)
- Computerized Calculator (example: Ti-nspire with touchpad keyboard)
- A laptop, tablet, or phone (all computer devices should be kept powered off and left in your bag for the duration of the exam)
- Any other prohibited item

Useful homework's:

Review through the numbered weekly assignments, and problems covered in recitation/lecture.

Review through the posted practice exam is highly recommended.

Review through the previous 4 exams is highly recommended.

Concepts to review:

- Units
  - Size prefix's (examples: kilo-, centi-, mili-, etc.)
  - Conversions (example: kilometers to meters)
  - Significant figures
- Vectors
  - Addition and subtraction
  - Components
  - Magnitude and direction
- Projectile Motion
  - Velocity (1D and 2D)

    - Acceleration (1D and 2D)
    - Falling objects (examples: ball dropped from a height, throwing a rock in the air)
    - Objects moving in a flat plane (examples: block sliding on ice, moving car)
- Newton's laws
    - Force (examples: gravitational force, tension, push & pull)
    - First Law
    - Second Law
    - Third Law
    - Free-body Diagrams
- Circular Motion
    - Centripetal force
    - Angular Velocity
    - Angular Acceleration
- Satellite Motion
    - Gravitational force
    - Period
- Work & Energy
    - Definition
    - Kinetic Energy
    - Potential Energy
    - Conservation of Energy
    - Non-conservative Forces
- Momentum
    - Definition
    - Impulse
    - Conservation of Momentum
- Rotational Mechanics
    - Moments
    - Torque
    - Angular momentum
    - Center of Mass
- Fluid Mechanics
    - Quantities
        - Pressure
        - Density
        - Velocity
    - Bernoulli's principle
- Periodic Motion
    - Simple Harmonic Motion
    - Waves
    - Interference
    - Sound
- Thermodynamics
    - Expansion & Heat

- Thermal Transfer
- Ideal Gas Law
- Laws of Thermodynamics
- Processes
- Entropy

Example of Formula sheet:

Chapters 1—5 (Exam 1)

Constant acceleration equations:

$v_x = v_{0x} + a_x t$ $\quad x = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$

$v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$ $\quad x - x_0 = \left(\frac{v_{0x} + v_x}{2}\right)t$

$g = 9.80\ \text{m/s}^2$ $\quad w = mg$

$\sum F_x = ma_x$ $\quad \sum F_y = ma_y$

$f_k = \mu_k n$ $\quad f_s \le \mu_s n$

$F_{spr} = -kx$

quadratic formula: The equation $ax^2 + bx + c = 0$ has solutions $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

PHYS 201 Formula Sheet **Chapters 9—11 (Exam 3)**

For constant α:

$\omega = \omega_0 + \alpha t$ $\quad \omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$

$\theta - \theta_0 = \omega_0 t + \frac{1}{2}\alpha t^2$ $\quad \theta - \theta_0 = \left(\frac{\omega + \omega_0}{2}\right)t$

$s = r\theta$ $\quad v = r\omega$ $\quad a_{tan} = r\alpha$ $\quad a_{rad} = v^2/r = r\omega^2$

$K = \frac{1}{2}I\omega^2$ $\quad I = m_A r_A^2 + m_B r_B^2 + \ldots.$ $\quad U = Mgy_{cm}$

$K_{total} = \frac{1}{2}Mv_{cm}^2 + \frac{1}{2}I_{cm}\omega^2$

$\tau = Fl$ $\quad \sum \tau = I\alpha$ $\quad \Delta W = \tau\Delta\theta$ $\quad P = \tau\omega$ $\quad L = I\omega$

$\sum \tau = \frac{\Delta L}{\Delta t}$ $\quad L = mvl$

first and second conditions for equilibrium:
$\sum F_x = 0$, $\sum F_y = 0$ and $\sum \tau = 0$ (any axis)

$Y = \frac{F_\perp / A}{\Delta l / l_0}$ $\quad B = -\frac{\Delta p}{\Delta V / V_0}$ $\quad S = \frac{F_\parallel / A}{x/h} = \frac{F/A}{\phi}$

$F_s = -kx$ $\quad a_x = -\frac{k}{m}x$ $\quad \omega = 2\pi f$ $\quad f = \frac{1}{T}$

$U_{el} = \frac{1}{2}kx^2$ $\quad K = \frac{1}{2}mv^2$

$x = A\cos\omega t$ $\quad v_x = -\omega A \sin\omega t$ $\quad \omega = \sqrt{\frac{k}{m}}$ $\quad f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$ $\quad T = 2\pi\sqrt{\frac{m}{k}}$

$f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$ $\quad T = 2\pi\sqrt{\frac{L}{g}}$

Chapters 6—8 (Exam 2)

$a_{rad} = \frac{v^2}{R}$ $\quad v = \frac{2\pi R}{T}$

$F_g = G\frac{m_1 m_2}{r^2}$ $\quad G = 6.67\times10^{-11}\ \text{N}\cdot\text{m}^2/\text{kg}^2$ $\quad T = \frac{2\pi r^{3/2}}{\sqrt{Gm_E}}$

$W = F_\parallel s = (F\cos\phi)s$ $\quad W_{total} = K_f - K_i = \Delta K$

$U_{grav} = mgy$ $\quad K = \frac{1}{2}mv^2$ $\quad U_{el} = \frac{1}{2}kx^2$

$K_f + U_f = K_i + U_i + W_{other}$

$P_{av} = \frac{W}{t}$ $\quad P = Fv$

$\vec{p} = m\vec{v}$ $\quad \Delta\vec{p} = \vec{F}_{av}(t_f - t_i) = \vec{J}$

$x_{cm} = \frac{m_A x_A + m_B x_B + m_C x_C + \ldots}{m_A + m_B + m_C + \ldots}$ $\quad y_{cm} = \frac{m_A y_A + m_B y_B + m_C y_C + \ldots}{m_A + m_B + m_C + \ldots}$

PHYS 201 Formula Sheet **Chapters 12--16 (Exam 4)**

$v = f\lambda$ $\quad v = \sqrt{\frac{F_T}{\mu}}$ $\quad y(x,t) = A\sin\left[2\pi f\left(t - \frac{x}{v}\right)\right] = A\sin\left[2\pi\left(\frac{t}{T} - \frac{x}{\lambda}\right)\right]$

$f_n = n\left(\frac{v}{2L}\right)$, $n = 1,2,3,\ldots$ $\quad f_n = n\left(\frac{v}{4L}\right)$, $n = 1,3,5,\ldots$

$I = \frac{P}{4\pi r^2}$ $\quad \beta = (10\ \text{dB})\log\left(\frac{I}{I_0}\right)$ $\quad f_{beat} = f_1 - f_2$ $\quad f_L = \left(\frac{v + v_L}{v + v_S}\right)f_S$

$T_F = \frac{9}{5}T_C + 32°$ $\quad T_C = \frac{5}{9}(T_F - 32°)$ $\quad T_K = T_C + 273.15°$ $\quad 1\ C° = \frac{9}{5}\ F°$

$\Delta L = \alpha L_0 \Delta T$ $\quad \Delta V = V_0\beta\Delta T$ $\quad \frac{F}{A} = -Y\alpha\Delta T$

$Q = mc\Delta T$ $\quad Q = \pm mL$

$H = kA\frac{T_H - T_C}{L}$ $\quad H = Ae\sigma T^4$ $\quad \sigma = 5.67\times10^{-8}\ \text{W}/(\text{m}^2\cdot\text{K}^4)$

$N = 6.022\times10^{23}$ molecules/mol $\quad m_{total} = nM$

$pV = nRT$ $\quad \rho = \frac{pM}{RT}$ $\quad R = 8.314\ \text{J}/(\text{mol}\cdot\text{K})$

$K_{tr} = \frac{3}{2}nRT$ $\quad K_{av} = \frac{1}{2}m(v^2)_{av} = \frac{3}{2}kT$ $\quad pV = NkT$ $\quad k = 1.38\times10^{-23}\ \text{J/K}$

$v_{rms} = \sqrt{\frac{3kT}{m}} = \sqrt{\frac{3RT}{M}}$ $\quad Q = nC\Delta T$

$W = p\Delta V$ $\quad W = nRT\ln\left(\frac{V_2}{V_1}\right)$ $\quad \Delta U = Q - W$

$C_p = C_V + R$ $\quad p_1V_1^\gamma = p_2V_2^\gamma$ $\quad T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$ $\quad \gamma = C_p/C_V$

$W = Q = |Q_H| - |Q_C|$ $\quad e = \frac{W}{Q_H} = 1 - \left|\frac{Q_C}{Q_H}\right|$ $\quad K = \frac{Q_C}{|W|} = \frac{|Q_C|}{|Q_H| - |Q_C|}$

Carnot: $\frac{Q_C}{Q_H} = -\frac{T_C}{T_H}$ $\quad e_{Carnot} = 1 - \frac{T_C}{T_H}$

$\Delta S = \frac{Q}{T}$

$\rho = \frac{m}{V}$ $\quad p = \frac{F_\perp}{A}$ $\quad p = p_{atm} + \rho gh$