

## Physics 111 Final Exam Equation Sheet for 12:30 and 1:30 Classes

Acceleration of gravity:  $g = 9.80 \text{ m/s}^2$   
 Gravitational constant:  $G = 6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2$   
 Mass of Earth:  $M_E = 5.98 \times 10^{24} \text{ kg}$ ; Radius of Earth:  $R_E = 6.38 \times 10^6 \text{ m}$

**Quadratic Equation:** The solutions of  $ax^2 + bx + c = 0$  are  $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ .

### Equations of kinematics

$$x = v_{x0}t + \frac{1}{2}at^2$$

$$v = v_0 + at$$

$$v^2 = v_0^2 + 2ax$$

$$x = \frac{1}{2}(v + v_0)t$$

### Newton's 2<sup>nd</sup> Law

$$\Sigma \vec{F} = m\vec{a}$$

### Force of Friction

Static :  $F_s \leq \mu_s F_N$

Kinetic :  $F_k = \mu_k F_N$

### Circular motion

$$v = \frac{2\pi r}{T}$$

$$a_c = \frac{v^2}{r}$$

$$F_c = \frac{mv^2}{r}$$

### Gravitation

$$F_G = \frac{Gm_1m_2}{r^2}$$

Power:  $P = W/t$

### Unit conversion:

1 foot = 0.3048 m

1 mile = 1609 m

1 rad = 57.3°

### Work and Energy

$$W = (F \cos \theta)s$$

$$W_{Net} = KE_f - KE_i = \Delta KE$$

$$KE = \frac{1}{2}mv^2 \quad PE = mgh$$

$$E = KE + PE$$

$$W_{NC} = E_f - E_i$$

### Momentum and impulse

$$\vec{p} = m\vec{v}, \quad \vec{J} = \vec{F}\Delta t = \Delta\vec{p}$$

### Rotational Motion

$$\theta = \frac{\text{arc.length}}{r} \quad \theta = \frac{1}{2}(\omega_0 + \omega)t$$

$$\omega = \frac{\theta - \theta_0}{\Delta t}, \quad \alpha = \frac{\omega - \omega_0}{\Delta t}$$

$$v_T = r\omega, \quad \omega = \frac{2\pi}{T}, \quad \theta = \omega_0 t + \frac{1}{2}\alpha t^2$$

$$a_c = \frac{v^2}{r} = r\omega^2, \quad \omega = \omega_0 + \alpha t$$

$$a_T = r\alpha, \quad \omega^2 = \omega_0^2 + 2\alpha\theta$$

### Torque and Moment of Inertia

$$\tau = Fl = I\alpha \quad I = \Sigma mr^2$$

### Moment of inertia

solid cylinder:  $(\frac{1}{2})mr^2$

hollow cylinder:  $mr^2$

solid sphere:  $(\frac{2}{5})mr^2$