

## Formulae for Exam II

Phys 171

You need to know the basics of what we learned for first exam!

Kinematics  $x(t) = x_0 + v_0 t + \frac{1}{2} a_x t^2$  likewise for  $y(t)$  etc.  
 $v_x(t) = v_0 + a_x t$   
if  $a_x(t) = \text{const.}$

$$\vec{v}(t) = \frac{d\vec{r}}{dt} ; \vec{a} = \frac{d\vec{v}}{dt}$$

## Newton's Laws

I)  $\vec{v}_i = \text{const}$  or  $\vec{F}_{\text{net}} \neq 0$     II)  $\vec{F} = m\vec{a}$     III)  $\vec{F}_{12} = -\vec{F}_{21}$

Circular motion:  $a_c = \frac{v^2}{r}$  ; centripetal acceleration

Friction:  $F_{\text{friction}} = \mu_k F_N$  ;  $\mu_k$  effective kinetic coefficient of friction

Gravity:  $\vec{F}_{21} = -G \frac{m_1 m_2}{r_{12}^2} \hat{r}_{12}$  ;  $\hat{r}_{12}$  is unit vector pointing from mass 1 to mass 2.

Work:  $W = \vec{F} \cdot \vec{d} = |\vec{F}| |\vec{d}| \cos \theta_{\vec{F}, \vec{d}}$  ; displacement  $d$   
generally:  $W = \int_a^b \vec{F} \cdot d\vec{l}$

## Potential Energy

Kinetic energy:  $K = \frac{1}{2} m v^2$

$U_{\text{grav}} = mgh$  (near surface);  $U_s = \frac{1}{2} k x^2$  (spring) ;  $U_g(r) = -\frac{G m_1 m_2}{r}$  (gravity)  
if  $U(\infty) = 0$

Scalar product:  $\vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z = |\vec{A}| |\vec{B}| \cos \theta_{AB}$

Energy balance:  $K_1 + U_1 + W_{nc} = K_2 + U_2$

where  $W_{nc}$  is the work done by non-conservative forces on the system as the system goes from 1  $\rightarrow$  2.