Newtonian Physics

Keeping track of where objects are = KINEMATICS

- position = $\vec{x}(t)$
- velocity = $\vec{v}(t) = d\vec{x}/dt$
- acceleration $\vec{a}(t) = d\vec{v}/dt$
- angle = $\vec{\theta}(t)$
- angular vel = $\vec{\omega}(t) = d\vec{\theta}/dt$
- angular accel = $\vec{\alpha}(t) = d\vec{\omega}/dt$

Math tools & tricks

- Vectors & right trigonometry
- Time-derivatives
- Graph interpretation
- Conserved quantities

Problem Solving Techniques

- Figure out what special points $x_i(t_i)$, $v_i(t_i)$, $a_i(t_i)$ you know and which ones you need to know
- Projectile problems: special case where a = (0, -g) = (0, -9.8m/s)

Things that affect an object's motion = MECHANICS

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

A list of common forces

- Normal ($\vec{a}_\perp = 0$)
- Gravity ($F = -mg\hat{j}$)
- Friction
  - static $|F_{max}| = \mu_s|F_N|$
  - kinetic $|F| = \mu_k|F_N|$
- Tension
- Springs $F = -k_s x$

Work and energy

- $W = F \cdot \vec{d}$
- $(\Sigma F) \cdot \vec{x} = \Delta KE$
- Kinetic energy $KE = \frac{1}{2}mv^2$
- Potential energy = keep track of work done by each reversible force
  - gravitational $\Delta U = mg\Delta h$
  - spring $U = \frac{1}{2}k_s x^2$

Q1: A bicycle wheel (radius r) rolls a distance d in time t. What is its angular velocity in radians per second?

A) $\omega = d/(rt)$

B) $\omega = d/(2\pi rt)$

C) $\omega = 2\pi r/t$

D) $\omega = 1/2\ md^2$

E) $\omega = 1/2\ r\ t^2$

Q2: Here is a series of snapshots of a mass on a stick.

Which graph best represents its position vs. time?