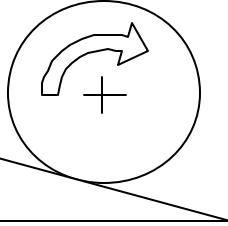


Chapter 13-6

Kinetics:
Plane Motion



Miami University

1

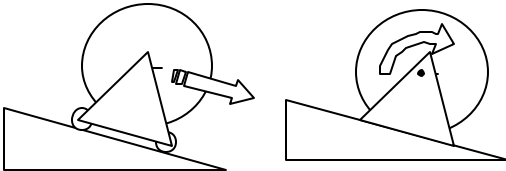
Plane Motion

- A rolling wheel
 - It travels down an incline
 - It also rotates about its axis
 - Two types of inertia are found

2

Plane Motion

- Translation & Centroidal Rotation



3

Combining Motion

- Use both angular & linear motion
- Linear ($F = ma$) Angular ($t = I_C \alpha$)
- Linear forces and accelerations
 - X and Y directions
- Angular torques and accelerations
 - CW and CCW directions

4

Dynamic Equilibrium

- Inertial force and inertial torque are opposite acceleration
- Torque and force are used for calculating equilibrium
- Use $m \cdot a$, (in X and Y directions), and use $I \cdot \alpha$

5

Summation of Moments

- Establish directions of accel.
- Note torque and inertia
- Note forces and inertia
- Sum forces in X and Y direction
- Sum moments about center or center of rotation
- Sum of Forces and Moments = zero

Examples

- 13-11, 13-12, 13-13 & 13-14

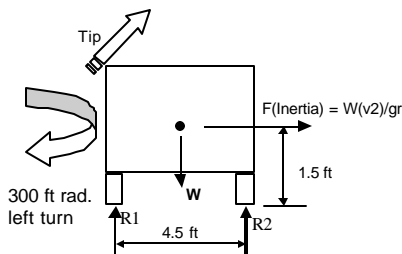
7

Other Practical Problems

- A vehicle rounds a level curve with a radius of 300 ft. The center to center distance of the wheels of the car is 4.5 ft. The center of gravity of the car is 18 inches above the ground. Assuming the tires create enough friction to prevent sliding, at what speed will the car tip over?

8

Free Body Diagram



9

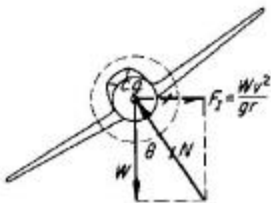
Sum Moments about R2

- $\Sigma M_2 = 0$
- $-W(2.25 \text{ ft}) + [Wv^2/g(300\text{ft})] * 1.5 = 0$
- W cancels out
- $v = 120 \text{ ft/s}$ or 82 mph

10

Banking Aircraft

1 CURVILINEAR MOTION



11

Maintain Normal Force

- $\theta = \text{Angle of Bank}$
- Planes bank so Resultant stays normal to floor of plane
- $\tan \theta = \frac{Wv^2/gr}{W}$ or $\frac{v^2}{gr}$

12

Bank Turn Example

What angle must a pilot bank in order to make a 2000 ft radius turn at 300 mph?

$$\tan \theta = (440)^2 / (32.2)(2000)$$

$$\theta = 71 \text{ degrees (hold on!)}$$

13

G-force during turn

$$N = \text{SqRt}(W^2 + F(I)^2)$$

If $W = 200 \text{ lbs}$

$$F(I) = (200)(440)^2 / (32.2)(2000)$$

$$N = \text{SqRt}(200^2 + 600^2) = 630 \text{ lbs}$$

Pilot experiences a 3.2 g turn

14

Week 10 Homework

- Chapter 13
 - Problems: 50, 58, 61 and 62
- Read Section 14-1 through 14-4

15