<u>Chapter 8: Momentum, Impulse, & Collisions</u>

linear momentum:

Newton's second law in terms of momentum:

impulse:

Under what SPECIFIC condition is linear momentum conserved? (The answer does not involve collisions.)

List the types of collisions and what defines them in the table below.

collisions	**properties**

What is the only collision *during* which you can analyze the energy and why?

What is always true about the relative velocities between objects before and after a collision?

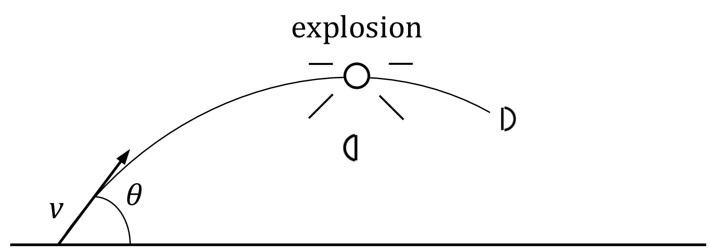
center of mass:

Why is the center of mass of a collection of particles or an extended, rigid body significant?

Examples: 8

* I also recommend you do at least one problem from each section at the end of the chapter in your University Physics book.

Ex: 8.1 A cannonball is fired with an initial velocity v at an angle θ with the horizontal. At the top of the trajectory, the shell explodes into two fragments of equal mass. One fragment, whose speed immediately after the explosion is zero, falls vertically. How far from the cannon does the other fragment land? Ignore air resistance.



(If v = 20 m/s, θ = 60°, then x = 53 m.)

Ex: 8.2 A body of mass m is moving through space in one dimension with a speed of $2v$ when, due to an internal explosion, it breaks into three parts. One part, with a mass of $\frac{1}{2}m$ moves away from the point of explosion with a speed of v perpendicular to the original direction of velocity. A second part with a mass of $\frac{1}{5}m$ moves in the negative direction of the original velocity with a speed of $5v$.

a. What is the velocity of the third part?

b. How much energy is released in the explosion? Ignore effects due to gravity.

(If m = 20.0 kg, v = 100 m/s in the positive x-direction, then a. $v_{3x} = 1.00 \times 10^3$ m/s, v_{3y} = -167 m/s, or $v_3 = 1.01 \times 10^3$ m/s, $\theta = 9.48°$ below the x-axis; b. $\Delta K = 3.23 \times 10^6$ J.)

Ex: 8.3 After a completely inelastic collision, two objects of the same mass and same initial speed move away together at half their initial speed. Find the angle between the initial velocities of the objects. Ignore external forces such as gravity.
($\theta = 120°$)

<u>Chapter 9: Rotation of Rigid Bodies</u>

rigid body:

angular velocity:

How do you determine the direction of angular velocity?

angular acceleration:

How do you determine the direction of angular acceleration? (We did not cover this in class.)

List the constant angular acceleration equations.

Give the equation of linear speed in terms of angular speed.

Give the equation of linear acceleration in terms of angular acceleration.

Give the equation of centripetal acceleration in terms of angular velocity.

moment of inertia:

rotational kinetic energy:

What is special about the gravitational potential energy for an extended body that is different than the gravitational potential energy for a point particle?

parallel axis theorem:

Examples: 9
* I also recommend you do at least one problem from each section at the end of the chapter in your University Physics book.

Ex: 9.1 A wheel has a constant angular acceleration of 3.0 rad/s^2. During a certain 4.0 s interval, it turns through an angle of 120 rad. Assuming that the wheel started from rest, how long has it been in motion at the start of this 4.0-s interval?
(t = -8s; The wheel started from rest 8 seconds before the start of the 4.0-s interval.)

<u>Ex: 9.2</u> A flywheel with a diameter of 1.20 m is rotating at an angular speed of 200 rev/min.

a. What is the angular speed of the flywheel in radians per second? *(ω = 20.9 rad/s)*

b. What is the linear speed of a point on the rim of the flywheel? *(v = 12.5 m/s)*

c. What constant angular acceleration (in revolutions per minute-squared) will increase the wheel's angular speed to 1000 rev/min in 60.0 s? *(α = 800 rev/min^2)*

d. How many revolutions does the wheel make during that 60.0 s? *(θ = 600 rev)*

<u>Ex: 9.3</u> Calculate the rotational inertia of a wheel that has a kinetic energy of 24,400 J when rotating at 602 rev/min. *(I = 12.3 kg·m^2)*

Ex: 9.4 Calculate the rotational inertia of a meter stick with mass 0.56 kg about an axis perpendicular to the stick and located at the 20 cm mark. (Treat the stick as a thin rod.)

($I = 9.7 \times 10^{-2}\ kg \cdot m^2$)

Chapter 10: Dynamics of Rotational Motion

What is the difference between translational and rotational motion?

torque:

How do you determine the direction of torque?

Give the equation for the rotational analog of Newton's second law for a rigid body.

Give the equation for the kinetic energy due to rolling without friction.

Give the equation for the condition for rolling without slipping.

List the equations for the summation of forces (in equilibrium, with linear acceleration, and with centripetal acceleration) and the summation of torques (in equilibrium and with angular acceleration).

Give the equation for work done by a constant torque.

Give the equation for the rotational analog of the work-energy theorem.

Give the equation for power due to a torque.

angular momentum:

How do you determine the direction of angular momentum?

Under what SPECIFIC condition is angular momentum conserved?

Give the equation for the angular momentum of a rigid body rotating around a symmetry axis.

precession:

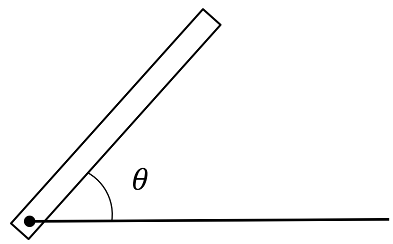
precession angular speed:

Examples: 10

* I also recommend you do at least one problem from each section at the end of the chapter in your University Physics book.

Ex: 10.1 A thin uniform rod has length 2.0 m and can pivot about a horizontal, frictionless pin through one end. It is released from rest at angle θ = 40° above the horizontal. Use the principle of conservation of energy to determine the angular speed of the rod as it passes through the horizontal position.

(ω = 3.1 rad/s)



Ex: 10.2 A 140-kg hoop rolls along a horizontal floor so that the hoop's center of mass has a speed of 0.150 m/s. How much work must be done on the hoop to stop it? *(W = -3.15 J)*

Ex: 10.3 At one instant, force $\vec{F} = 4.0\hat{\jmath}\,N$ acts on a 0.025-kg object that has position vector $\vec{r} = (2.0\hat{\imath} - 2.0\hat{k})$ m and velocity vector $\vec{v} = (-5.0\hat{\imath} + 5.0\hat{k})$ m/s. About the origin and in unit vector notation, what are

a. the object's angular momentum and

b. the torque acting on the object?

(a. $\vec{L} = 0$; b. $\vec{\tau} = (8.0\ N\cdot m)\hat{\imath} + (8.0\ N\cdot m)\hat{k}$)

<u>Ex: 10.4</u> A 3.0-kg particle with velocity $\vec{\boldsymbol{v}}$ = (5.0 m/s)$\hat{\boldsymbol{\imath}}$ – (6.0 m/s)$\hat{\boldsymbol{\jmath}}$ is at $x = 3.0\ m$, $y = 8.0\ m$. It is pulled by a 7.0 N force in the negative x-direction. About the origin, what are

a. the particle's angular momentum,

b. the torque acting on the particle, and

c. the rate at which the angular momentum is changing?

(a. $\vec{\boldsymbol{L}}$ = (-1.7 x 10^2 kg·m^2/s)$\widehat{\boldsymbol{k}}$; b. $\vec{\boldsymbol{\tau}}$ = (56 N·m)$\widehat{\boldsymbol{k}}$; c. $\frac{d\vec{L}}{dt}$ = (56 N·m)$\widehat{\boldsymbol{k}}$)