What you know about Mechanics?

(1) IMPULSE:

i) How is impulse related to the momentum of an object?

ii) What is the formula for impulse? Is it a vector or a scalar? What are the units of impulse?

Example:

a) What is the impulse given to a golf ball by a club if they are in contact for 0.0050 s during which the club exerts an average force of 500N on the ball?

b) You are playing in a baseball game and your friend throws a baseball at you and you are not wearing a glove. To lessen the pain on your hands, what can you do to decrease the force of the ball as it impacts your hands? Explain in terms of impulse and momentum.

(2) WORK:

i) In physics, how is the term “work” defined? Is it a vector or a scalar? What are its units?

ii) How do you know which forces do work on an object and which do not?

Examples:

a) You and your friends are trying to push a 4000kg car out of a snow ditch. The car, however, does not move. What is the work done?

b) A skydiver falls out of a plane. Does gravity do positive or negative work? Does air resistance do positive or negative work?

c) Tiny Tim pulls a sled across an icy pavement. What are all the forces acting on the sled? Which ones do work and which ones do not?
(3) **KINETIC ENERGY:** any MOVING object has kinetic energy!

i) Is kinetic energy a scalar or a vector? Units? How is kinetic energy related to the mass of the object (direct or inverse relation)? Can kinetic energy ever be negative?

ii) What is the relationship between WORK and KINETIC ENERGY? Write down a mathematical statement for the work-energy theorem.

iii) When the speed of an object doubles, by what factor does its kinetic energy increase or decrease? What about if the mass is halved?

iv) Fill in the blanks: In any collision ____________ is always conserved. Kinetic energy, however, is only conserved in __________ collisions.

(4) **GRAVITATIONAL POTENTIAL ENERGY:** any object at a HEIGHT relative to a chosen surface has gravitational potential energy.

i) What two variables does gravitational potential energy depend on?

Example:

A 10kg rock is on top of a house 5m high on the edge of a cliff 20 m high. What is the gravitational potential energy of the rock relative to:

a) the roof of the house
b) the floor of the house
c) the bottom of the cliff.

(5) **CONSERVATION OF ENERGY:** In the same way that momentum is always conserved in a system, energy is also always conserved. The Law of Conservation of Energy states that an any transfer of transformation of energy, the total amount of energy remains __________. Total mechanical energy is the sum of kinetic and potential energies.
Ok, so how do you apply this law to real-life problems?

Examples:

a) Roller Coasters:

As a coaster car loses height, it gains speed; PE is transformed into KE. As a coaster car gains height it loses speed; KE is transformed into PE. The sum of the KE and PE is a constant.

ENERGY IS NEVER DESTROYED NOR CREATED ONCE THE OBJECT IS IN MOTION.

Use the following diagram to answer the following questions. Neglect the effect of friction and air resistance.

As the object moves from point A to point D across the frictionless surface, the sum of its gravitational potential and kinetic energies
a. decreases, only.
b. decreases and then increases.
c. increases and then decreases.
d. remains the same.

The object will have a minimum gravitational potential energy at point
a. A. b. B. c. C. d. D. e. E.

The object's kinetic energy at point C is less than its kinetic energy at point
a. A only. b. A, D, and E. c. B only. d. D and E.
Question: A bulldozer drops a wrecking ball to the ground. Describe all the energy transformations that occur.

(6) **POWER:** Power is the rate at which _________ is done and is given by the formula \( P = \) _________. What are the units of power?

Question: How long would you have to leave a 40W light bulb on to use 1 kilowatt-hour of energy?

(7) **ANGULAR MOMENTUM:**

→ An object that is rotating has different type of momentum called angular momentum. Examples include a merry-go-round, a car wheel, and a skater doing a spin. For angular momentum, you must always choose an axis of rotation!

Linear momentum is defined as \( p = mv \).

Angular momentum is defined as \( L = mvr \), where \( r \) is the distance from the axis of rotation to the rotating object.

Is angular momentum conserved? Under what conditions?
A real life example of angular momentum:

Everyone is familiar with a spinning skater who, all of a sudden, begins to spin with a much greater angular velocity, with no apparent external force acting on her. She begins with her arms outstretched, creating a large moment of inertia for herself (What’s inertia again?). When she quickly pulls her arms in close to her axis of rotation, her moment of inertia decreases but her angular momentum is conserved. To make-up for the decrease in her moment of inertia, her velocity will increase to compensate. Now that is physics in action!