Physics Midterm Study Guide

Multiple Choice (35 Points)

Kinematics (11 Questions)

- Understand the difference between scalar and vector and know examples of each.
- Be able to calculate distance and displacement given a scenario of a moving object.
- Be able to calculate speed and velocity given a scenario of a moving object.
- Be able to calculate the speed of an object given a position-time graph or the acceleration of an object given a velocity-time graph by using the slope.
- Be able to calculate the acceleration of an object using the constant acceleration equations and being given the initial velocity, final velocity, and time.
- Be able to identify the velocity-time graph of an object in free fall.
- Understand that the acceleration remains constant and speed changes for an object in free fall.
- Be able to calculate the maximum height or maximum speed of an object in free fall using the acceleration of gravity and the constant acceleration equations.
- Be able to calculate the time an object takes to hit the ground and horizontal distance it travels if horizontally off a height (parabolic motion cliff problem).
- Understand that the horizontal velocity remains constant while an object vertically accelerates during parabolic motion.
- Understand the optimum angle of 45° for an object launched at full parabolic motion to achieve the greatest horizontal displacement.

Dynamics (8 Questions)

- Understand that mass if not affected by gravitational affects.
- Understand Newton's First Law (Law of Inertia) and inertia's sole dependence on mass.
- Understand Newton's First Law in that an object in equilibrium will stay in motion or stay at rest until a net force (not in equilibrium) acts upon that object.
- Be able to identify an object in equilibrium.
- Be able to identify the forces that need to be applied in order to establish equilibrium in an object given the forces acting on the objects.
- Be able to use Newton's Second Law ($a = F_{net} / m$) in order to calculate the acceleration of an object with a net force applied to it.
- Be able to use Newton's Second Law ($a = F_{net} / m$) in order to calculate the acceleration of an object with a multiple forces acting upon it.
- Understand Newton's Third Law and action-reaction forces being equal and opposite.

Uniform Circular Motion and Gravity (4 Questions)

- Understand that the net force as well as the acceleration on an object is moving in circular motion is directed towards the center.
- Understand that the velocity of an object moving in circular motion is directed tangent to the curve.
- Be able to calculate the velocity of an object moving in circular motion given the mass, radius, and net force on the object.
- Understand that the gravitational force between any two objects with mass is equal and opposite to each other.

Work, Energy, and Power (6 Questions)

- Be able to calculate the kinetic energy of a moving object.
- Be able to calculate the gravitational potential energy of an object.
- Be able to identify the point on a roller coaster that has the greatest gravitational potential energy, greatest kinetic energy, and greatest velocity.
- Understand how energy transfers through systems by identifying kinetic energy, gravitational potential energy, elastic potential energy, internal energy, etc.
- Understand that the total energy of a system is conserved or stays constant.
- Be able to calculate the maximum speed or initial height of an object using the full potential to full kinetic energy equation.
- Be able to calculate the power required to lift an object.

Momentum (4 Questions)

- Be able to apply the Impulse-Momentum Theorem to calculate the average force or time to change the velocity of an object.
- Be able to calculate the momentum of an object.
- Be able to apply the Law of Conservation of Momentum to calculate the recoil velocity during an explosion.
- Be able to apply the Law of Conservation of Momentum and use a momentum table to calculate the velocity of an object after a collision.

General Questions (2 Questions)

- Know the units of measurement and be able to derive the SI Units for each measurement.
- Be able to identify the graph of the relationship of two units of measurement by its equation.

Free Response (15 Points)

Some free response problems will need to show the equation, substitution, and solve with units in order to receive full credit. All problems will need to show units.

- **Kinematics** – 3 points
- **Dynamics** – 4 points
- **Work, Energy, and Power** – 6 points
- **Momentum** – 2 points