PHYS 0174 Learning Objectives

1. Make a graph of the instantaneous displacement, velocity, and/or acceleration of a system based on a description of the motion or using another graph.
2. Apply the equations of 1-D kinematics to one or more objects with constant acceleration. Examples include free-fall, two objects that meet one another, and an object that has different constant acceleration at different times.
3. Add or subtract two or more vectors. (Relative velocity problems are an application of this category.)
4. Find the dot product or cross product of two vectors.
5. Describe the behavior of an object undergoing projectile motion based on the equations of 2-D kinematics.
6. Apply a conceptual understanding of Newton's first and third law.
7. Draw a free-body diagram and solve for an unknown force or acceleration of a system under the influence of two or more forces.
8. Calculate the force of static/kinetic friction or the coefficient of friction.
9. Calculate the drag force or terminal speed of an object.
10. Identify the centripetal force that acts on a system undergoing circular motion.
11. Find the work done by a force in cases were integration is not required (perhaps by inspecting a graph of force versus displacement). Alternately, find the force given work and displacement.
12. Calculate the average power provided by a force.
13. Apply conservation of mechanical energy to describe the motion of a system.
14. Use the work-energy theorem to identify the amount of mechanical energy that has been lost.
15. Calculate the average force or impulse during a collision or series of collisions.
16. Apply conservation of momentum to an explosion or collision. Be able to identify whether a collision is elastic, inelastic, or completely inelastic.
17. Answer a conceptual question about momentum, rockets, and/or the motion of the center of mass.
18. Apply kinematics to a rotating system. Be able to convert between the tangential values of s, v, a and θ , ω,

    using the radius r.
19. Distinguish between angular, tangential, and centripetal acceleration.
20. Determine the net torque acting on a body about a given axis and/or the angular acceleration of that body. Doing so may require the use of one or more moments of inertia.
21. Use the definition of static equilibrium to solve for one or more unknown forces or torques acting on a system.
22. Calculate the motion of a rolling object using torques and/or energy conservation. "Rolling" could be caused by a cord wrapped around the object, like in a yo-yo.
23. Find the rotational kinetic energy of an object.
24. Identify whether angular momentum is or is not conserved, and if appropriate, apply conservation of angular momentum to a rotating system.
25. Calculate the gravitation acceleration for an object inside or outside of a planet, given some combination of mass, radius, and density.

26. Apply energy conservation to a system with gravity to describe the motion of an object in a case where $U = mg$ is *not* an appropriate assumption.

27. Use Kepler's laws of planetary motion to describe the motion of a planet, moon, or satellite about its parent body.

28. Apply the concepts of stress, strain, and ultimate strength to a deformed object.

29. Calculate a spring constant given the elastic properties of a material.

30. Identify when a system (spring, simple pendulum, or physical pendulum) is undergoing simple harmonic motion, and find the amplitude, period, frequency, angular frequency, phase angle, displacement, velocity, and/or acceleration.

31. Apply conservation of mechanical energy to a simple harmonic oscillator (spring, simple pendulum, or physical pendulum). Damping may be involved.

32. Determine the amplitude, period, frequency, angular frequency, wave number, wave length, and/or propagation speed of a transverse traveling wave. If the wave is on a string, be able to calculate the propagation speed using the tension and linear density.

33. Predict the result of interference between two waves with identical amplitude and frequency. Specifically, be able to identify constructive, destructive, and intermediate interference—determining the amplitude and/or phase difference in the later case.

34. Identify the resonant frequencies and/or harmonics of a string or open/closed pipe.

35. Apply the equation for the Doppler effect to determine the shift in frequency caused by motion.