Physics – Unit 1 Goals – Tools of Physics

- Compare and contrast the different areas of physics and explain the methods used to study all areas of science.
- Utilize standard scientific conventions in the study of physics.

Physics – Chapter 1 Study Guide – Tools of Physics

1. Which branch of physics has been studied during the 1st semester?
2. Outline and discuss the steps of the scientific method.
3. Identify the SI base units used this semester in physics and demonstrate how these units can be combined into derived units used describe velocity, acceleration, force, energy, momentum, torque, and angular momentum.
4. Differentiate between accuracy and precision. What is responsible for each?
5. Sketch the shapes of the following functions:
   a. $y = x^2 + 1$
   b. $y = 1/x$
   c. $y = x$
6. Use the following data to create a graph. Describe the shape of the graph with both words and equations.

time (s)	distance (m)
0.05	2
0.15	9
0.20	20
0.30	35
0.35	55
0.40	80

7. Identify the similarities and differences between scalar and vector quantities.
8. Explain the component method of vector addition. Why is the component method better than the graphical method of vector addition?
9. A hiker walks 13.5 km from her base camp at 35o south of east. On the second day she walks 51.0 km in a direction 65o north of east, at which point she discovers a forest ranger's tower. Determine the magnitude and direction of her resultant displacement between the base camp and the ranger's tower.

Physics – Unit 2 Goals – Kinematics

- Compare and contrast scalar terms with their vector equivalents.
- Analyze motion in terms of displacement, velocity, acceleration, and time.
- Apply kinematic equations to predict different variables of motion.
- Construct, interpret, and analyze motion graphs.
- Distinguish between different frames of reference for the same type of motion.
- Apply kinematics equations to projectiles.

Physics – Unit 2 Study Guide – Kinematics

1. Describe a situation in which displacement could equal zero while distance traveled is not zero. How is this possible?
2. Use the following data to create and label a graph. During which time interval is velocity the greatest? smallest? During which time interval is the object at rest? What does the slope of each line segment represent?

time (s)	displacement (m)
0	3
5	3
10	3
15	5
20	12
25	19
30	20

3. Describe a situation in which acceleration can be negative while velocity is positive.
4. Use the following data to create and label a graph. During which time interval is acceleration the greatest? smallest? During which time interval is the object at rest? traveling at a constant velocity? What does the slope of each line segment represent? What does the area under the curve represent?

time (s)	velocity (m/s)
0	0
5	0
10	3
15	6
20	9
25	9
30	5

5. What does it mean to say that an object is in free-fall?
6. A snowmobile has an initial velocity of 3.0 m/s. If it accelerates at 0.50 m/s^2 for 7.0 s, what is the final velocity? What is the displacement of the snowmobile during this acceleration? What deceleration is required if the snowmobile stops in 5.0 s?

7. A worker drops a wrench from the top of a tower 80.0 m tall. With what velocity does the wrench strike the ground? How long does it take for the wrench to strike the ground?
8. A physics student throws a softball straight up into the air. The ball was in the air for a total of 3.56 s before it was caught at its original position. What was the original velocity of the ball? How high did it rise? What was the final velocity of the ball?
9. Given the launch angle of any projectile identify the following: horizontal acceleration, vertical acceleration, and the vertical velocity at the projectile's peak.
10. In a perfect world, what mathematical term is used to describe the shape of a projectile's path?
11. A person standing at the edge of a cliff kicks a stone over the edge with a speed of 18 m/s. The cliff is 52 m above the water's surface. How long does it take for the stone to fall to the water? With what horizontal speed does the stone strike the water? With what vertical speed does the stone strike the water?
12. A daredevil is shot out of a cannon at 45.0^o to the horizontal with an initial speed of 25.0 m/s. A net is positioned a horizontal distance of 50.0 m from the cannon. At what height above the cannon should the net be placed in order to catch the daredevil?

Physics – Unit 3 Goals – Newton’s Laws and Applications

- Apply Newton’s 1st Law to physical situations and relate the 1st Law to inertia.
- Construct free body diagrams to explain how forces affect the motion on an object.
- Apply free body diagrams to solve Newton’s 2nd Law problems.
- Determine the net external force using everyday forces by applying Newton’s 2nd Law.
- Describe Newton’s 3rd Law in terms of action-reaction pairs.

Physics – Unit 3 Study Guide – Newton’s Laws and Applications

1. Define and give examples of both contact and field forces.
2. Explain the advantages of using a free-body diagram over a force diagram.
3. State Newton’s 1st Law of Motion. How does this relate to inertia and equilibrium?
4. State Newton’s 3rd Law of Motion. How does this relate to Newton’s 2nd Law of Motion and solving force problems?
5. Define and identify the most likely direction of the following forces: weight, normal, friction, applied.
6. What is the coefficient of friction and how is it used to determine the frictional force between an object and a surface?
7. A worker moves a box of cans through an aisle by pulling on a rope attached to the box. The worker pulls with a force of 185.0 N parallel to the ground. The box has a mass of 35.0 kg and the coefficient of kinetic friction between the box and the floor is 0.450. Find the acceleration of the box.
8. What if the worker is pulling up on the rope at an angle of 25.0^o to the horizontal? Find the acceleration.
9. A box sits on a 30.0^o ramp in equilibrium. Determine the coefficient of kinetic friction between the box and the ramp.

Physics – Unit 4 Goals– Energy and Momentum (Conservation Laws)

- Recognize that Newton's 3rd Law predicts the Impulse-Momentum Theorem.
- Classify energy types as kinetic or potential.
- Formulate the laws of conservation of energy and momentum.
- Contrast different types of collisions.
- State the Work-Kinetic Energy Theorem using a scientific definition of work.

Physics – Unit 4 Study Guide – Energy and Momentum (Conservation Laws)

1. Describe momentum using the idea of inertia.
2. How is the momentum of an object changed?
3. Which of Newton's Laws of Motion is the Impulse-Momentum Theory derived?
4. State the Law of Conservation of Momentum. From which of Newton's Laws of Motion is momentum conservation derived?
5. Explain elastic collisions in terms of energy and momentum conservation. Why are these types of collisions rare in nature?
6. Explain inelastic collisions in terms of energy and momentum conservation. Why are these types of collisions more commonplace in nature?
7. A 0.025 kg golf ball moving at 18 m/s crashes through a window of a house is 0.0005 s. After the crash, the ball continues in the same direction with a speed of 10 m/s. Assuming the force exerted on the ball by the window was constant, what was the magnitude of this force?
8. Two carts with masses of 4.0 kg and 3.0 kg, respectively, move on a frictionless track with velocities of 5.0 m/s and 4.0 m/s. The carts stick together after colliding head-on. Identify the type of collision, find the final speed, and calculate the loss of kinetic energy.
9. A billiard ball traveling at 4.0 m/s has an elastic head-on collision with a billiard ball that is initially at rest. The first ball is at rest after the collision. What is the speed of the second ball after the collision?
10. Explain the significance of doing work on an object. How does this affect the mechanical energy of an object?
11. What does the angle (θ) indicate when calculating work?
12. Identify, explain, and determine the most important factor in the two types of energy discussed in class.
13. State the Law of Conservation of Energy. Is this ever defied?
14. What is the Work-Kinetic Energy Theorem? What force does it account for?
15. A child and sled with a combined mass of 50.0 kg slide down a frictionless hill. If the sled starts from rest and has a speed of 12.0 m/s at the bottom, what is the height of the hill?
16. Same child, same sled: If the child starts at the top of the hill moving at 1.5 m/s and has a speed of 12.0 m/s at the bottom, what is the height of the hill?
17. An 80.0 N box of clothes is pulled 20.0 m across the floor by a force of 115 N that points along the floor. If the coefficient of kinetic friction between the box and floor is 0.22, calculate the change in the box's kinetic energy. What is the boxes final speed after 20.0 m?

Physics – Unit 5 Goals – Complex Motion

- Describe angular motion in terms of radians.
- Convert translational kinematics equations into rotational kinematics equations.
- Calculate values for tangential and angular motion.
- Identify and predict the centripetal force present in circular motion.
- Apply equilibrium conditions to rotational dynamics.
- Explain how the shape of an object influences rotational dynamics.
- Solve problems using angular momentum and rotational kinetic energy.

Physics – Unit 5 Study Guide – Complex Motion

1. Identify and explain the symbols and units used to describe angular motion.
2. Explain how increasing the radius affects the angular speed of a rotating object. Explain how increasing the radius affects the tangential speed of a rotating object.
3. When an object is in circular motion, why is the object always accelerating?
4. What force is responsible for circular motion? What type of acceleration does this force generate?
5. Find the angular acceleration of a spinning amusement park ride that initially travels at 0.50 rad/s then accelerates to 0.60 rad/s during a 0.50 s time interval. What is the angular displacement during this time interval?
6. What is the instantaneous angular speed of a spinning amusement park ride that accelerates from 0.50 rad/s at a constant angular acceleration of 0.20 rad/s^2 for 1.0 s? What is the angular displacement during this angular acceleration?
7. Find the tangential speed of a ball swung at a constant angular speed of 5.0 rad/s on a rope that is 5.0 m long. What is the tangential speed at a radius of 2.0 m? What is the centripetal acceleration at 5.0 m? at 2.0 m?
8. A 40.0 kg child takes a ride on a Ferris wheel that rotates with an angular speed of 0.50 rad/s. Find the magnitude of the force that maintains the circular motion of the child if the distance from the center of the Ferris wheel to the child is 18.0 m.
9. Identify three ways to maximize torque.
10. A hoop, a solid ball, a disk, and a spherical shell of equal mass and radius race down an inclined plane. Identify the order of finish. Explain.
11. What are the two conditions for rotational equilibrium? What two conditions are considered for rotational dynamics?
12. A uniform 40.0 N board supports two children, one weighing 510 N and the other weighing 350 N. The support is under the center of mass of the board, and the 510 N child is 1.5 m from the center. Where should the 350 N child sit to balance the system? How much force does the support exert on the board?
13. A 2.0 kg bicycle wheel with a radius of 0.30 m turns at a constant angular speed of 25 rad/s when a 0.30 kg reflector is at a distance of 0.15 m from the axle. What is the angular speed of the wheel when the reflector slides to a distance of 0.25 m from the axle?
14. A solid 240 N ball with a radius of 0.20 m rolls 6.0 m down a ramp that is inclined 37^{o} with the horizontal. What is the angular speed of the ball at the bottom of the ramp if it starts from rest?