<u>Physics Second Marking Period Review Sheet</u>

Fall, Mr. Wicks

<u>Chapter 4: Forces and the Laws of Motion</u>

- I know that a force is a push or a pull. The unit of force is the Newton (N); 1 N = 1 kg-m/s^2
- I can identify ***contact forces***, which are action-reaction pairs of forces produced by physical contact of two objects.
- I can identify ***field forces*** like gravitational forces, electric forces, and magnetic forces, which do not require direct contact. They are studied in later chapters.
- I can draw forces for objects represented in free-body diagrams. The force vectors are drawn with the tails of the vectors originating at an object's center of mass.
- I can clearly explain Newton's laws of motion in Table 1 and apply them to everyday life. Common forces on a moving object include an applied force, a frictional force, a weight, and a normal force.

Table 1: Newton's Laws of Motion

Newton's First Law: ***(Law of Inertia)*** Recall that mass is a measure of inertia.	An object at rest will remain at rest. An object in motion will remain in motion at constant velocity unless acted upon by an external force.
Newton's Second Law:	$F_{net} = ma$
Newton's Third Law: Recall action-reaction pairs	For every action, there is an equal but opposite reaction.

- I can identify the force due to gravity (weight) in a free-body diagram and determine its value when needed. ***Weight***, $\overrightarrow{F_g}$, is the gravitational force exerted by Earth on an object whereas mass, m, is a measure of the quantity of matter in an object ($F_g = mg$). Although weight depends on gravity, mass does not.
- I can identify the normal force in a free-body diagram and determine its value when needed. The ***normal force***, $\overrightarrow{F_n}$, is perpendicular to the contact surface along which an object moves or is capable of moving.
  - For an object on a level surface, $\overrightarrow{F_n}$ and $\overrightarrow{F_g}$ are equal in size but opposite in direction. This means we can use $F_n = mg$ to help us solve problems for objects on level surfaces.
  - However, for an object on a ramp, the previous statement is not true because $\overrightarrow{F_n}$ is perpendicular to the surface of the ramp.
- I can distinguish between the maximum force due to static friction and the force due to kinetic friction and clearly explain the difference between the two forces.
  - I can solve problems involving the coefficient of ***static friction*** = $\mu_S = \dfrac{F_{S,\max}}{F_n}$ where $\overrightarrow{F}_{S,\max}$ is the maximum force due to static friction.

- I can solve problems involving the coefficient of ***kinetic friction*** = $\mu_K = \frac{F_K}{F_n}$ where $\vec{F}_K$ is the force due to kinetic friction.
- A common lab experiment involves finding the angle at which an object just begins to slide down a ramp. In this case, a simple expression can be derived to determine the coefficient of static friction: $\mu_S = \tan\theta$. Note that this expression is independent of the mass of the object.
    - I can draw a free-body diagram for an object on a ramp.
    - I can use $\mu_S = \tan\theta$ to determine the coefficient of static friction, μ_S.
    - I can answer the question, "If the mass is doubled, at what angle does the crate begin to slide?"

Chapter 5: Work and Energy

- I understand that a force exerted through a distance performs mechanical work.
- When force and distance are parallel, I can calculate work using $W = Fd$ with Joules (J) or Nm as the unit of work.
- When force and distance are at an angle, only the ***component*** of force in the direction of motion is used to compute the work, and I can calculate work using $W = Fd\cos\theta$
- I understand that work is negative if the force opposes the motion (θ>90°). Also, 1 J = 1 Nm = 1 kg-m^2/s^2.
- I can determine kinetic energy and potential energy using the equations given in Tables 2 and 3.
- I can tell whether kinetic energy and potential energy are increasing, decreasing, or constant for the following examples:
    - A ball thrown upward
    - An object like a car or skier going up or down a hill.
    - A pendulum swinging up or down
- For a ball thrown upwards, I can describe and explain the shape of the kinetic energy, potential energy, and total energy curves on a plot of energy versus time.
- I can solve problems involving the conservation of mechanical energy. In a conservative system, the total mechanical energy remains constant: $ME_i = ME_f$. Since $ME = PE + KE$, it follows that $PE_i + KE_i = PE_f + KE_f$. ***See Tables 2 and 3 for additional information.***

Table 2: Potential Energy

Potential Energy Type	***Equation***	***Comments***
Gravitational Potential Energy:	$PE_g = mgh$	Good approximation for an object near sea level on the Earth's surface.
Elastic Potential Energy	$PE_{Elastic} = \frac{1}{2}kx^2$ where k is the force (spring) constant and x is the distance the spring is stretched or compressed from equilibrium.	Useful for springs, rubber bands, bungee cords, and other stretchable materials.

Table 3: Kinetic Energy		
Kinetic Energy Type	***Equation***	***Comments***
Kinetic Energy as a Function of Motion:	$KE = \frac{1}{2}mv^2$	Used to represent kinetic energy in most conservation of mechanical energy problems.

<u>Chapter 6: Momentum and Collisions</u>

- I can determine linear momentum, which is given by $\vec{p} = m\vec{v}$ with kg-m/s as the unit of momentum.
- I can determine the force, time, and impulse using the impulse-momentum theorem, which states $\vec{F}\Delta t = \Delta\vec{p}$ where the quantity $\vec{F}\Delta t$ is called the impulse. For problem-solving purposes, a more useful form of the impulse-momentum equation is $F\Delta t = m(v_f - v_i)$.
- I can analyze situations and explain how the impulse-momentum theorem is applied in everyday life. For example, a practical application of the impulse-momentum theorem, $\vec{F}\Delta t = \Delta\vec{p}$, involves auto air bags. In an automobile collision, the change in momentum, Δp, remains constant. Thus, an increase in collision time, Δt, will result in a decreased force of impact, $\vec{F}$, reducing personal injury.
- I can calculate masses and velocities for objects before and after collisions using the conservation of momentum concept. The total momentum of all objects interacting with one another remains constant regardless of the nature of the forces between the objects. In other words, $p_i = p_f$.
- I can compare and contrast elastic collisions with perfectly inelastic collisions as shown in Table 4. For an elastic collision, $m_1v_{1,i} + m_2v_{2,i} = m_1v_{1,f} + m_2v_{2,f}$ and for a perfectly inelastic collision, $m_1v_{1,i} + m_2v_{2,i} = (m_1 + m_2)v_f$.

Table 4: Collision Types			
Collision Type and Example	***Do the Objects Stick Together?***	***Is Momentum Conserved?***	***Is Kinetic Energy Conserved?***
Elastic: • Objects “bounce off” each other. • <u>Ex.</u>: billiard balls collide.	No	Yes	Yes
Perfectly Inelastic: • Objects lock together and move as a single unit. • <u>Ex.</u>: train cars collide and lock together.	Yes	Yes	No

Equations Available on Physics Second Marking Period Test

$F_{net} = ma$	$\mu_S = \frac{F_{S,\max}}{F_n}$	$KE = \frac{1}{2}mv^2$
$F_g = mg$	$\mu_K = \frac{F_K}{F_n}$	$PE_g = mgh$
$\vec{F}_x = -kx$	$\mu_S = \tan\theta$	$PE_{Elastic} = \frac{1}{2}kx^2$
$W = Fd\cos\theta$	$\vec{p} = m\vec{v}$	$\vec{F}\Delta t = \Delta\vec{p}$

- This list of equations will be provided on the test.
- You are not allowed to use note cards, review sheets, textbooks, or any other aids during the test.
- You may use a calculator. However, you are not allowed to use any other electronic devices (*i*-Pods, *i*-Phones, smart phones, netbooks, laptop computers etc.) until the last person is finished with the test.
- Calculator sharing is not allowed.
- It is to your advantage to check your work.
- All test materials including scratch paper must be returned at the end of the test.