University Physics I (Phys214) - Lesson Sheet 1

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Chapter 5 - Application of Newton's Laws of Motion

APPLICATION OF NEWTONS LAWS OF MOTION describes why the sifaka, a lemur (old-world monkey) from Madagascar, spreads out its arms and legs in front of itself while making spectacular leaps from tree to tree.

THE STUDENT LEARNING OUTCOME is **SLO2:** Use Newton's law of motion to analyze objects in dynamic equilibrium and undergoing acceleration.

WEEKLY LEARNING OBJECTIVES are to:

- Solve problems about objects in equilibrium;
- Use free-body diagrams, Newton's second law, and the problem-solving approach to solve dynamics problems;
- Work with and distinguish between mass and weight;

HOMEWORK IS DUE on the Friday following the next class period. Please upload homework assignments as a pdf to Google Scholar. You can either scan your assignment or take a picture of your assignment and convert it to a pdf. If you have an iPhone, tap on the 'Share' icon, then share to iBooks to automatically convert the jpg to a pdf.

WEEK ONE PROBLEMS Chapter 5 problems #: 3, 7, 9, 13, 17, 19, 25.

LOOKING FORWARD TO NEXT WEEK we will complete Chapter Five.

FORCES ARE INTERACTIONS, pushes and pulls, between **agents** and **objects**. An object at rest with no net forces on it will stay at rest. An object in motion with no net forces acting on it will continue moving in a straight line at constant speed. [1] Forces are in units called **newtons**. [2] [3]

[1] **Newton's First Law**

[2] 1 newton = 1 N = $1\frac{kg \times m}{s^2}$

[3] 1 pound (force) = 1 lb = 4.45 N

- Weight is caused by gravity and always points vertically downward. [4] Your sensation of weight [5] is the magnitude of the contact forces supporting an object.

[4] $\vec{w} = mg$

[5] the apparent weight

- Spring force is caused by the compression or tension of a spring.
- Tension force is caused by a string or rope pulling on an object. The direction of the tension force is in the direction of the string or rope.
- Normal forceis the force exerted on an object by the surface it is resting on. The normal force is perpendicular to the surface.
- Thrust is the force of air expelled from a jet turbine or rocket that propels an object forward. Thrust is in the direction opposite the direction of which the exhaust gas is expelled.
- Electic and magnetic forces are long-range forces acting on charged particles. [6]

[6] We will discuss these forces in detail in Physics II.

FORCES CAUSE OBJECTS TO ACCELERATE, to change their velocity. A larger force causes a larger acceleration. The connection between force and motion is described by [7] $\vec{a} = \vec{F_{net}}/m$

[7] **Newton's Second Law**

OBJECTS INTERACT WITH ONE ANOTHER as action/reaction pairs. Every force occurs as one member of an action/reaction pair of forces. [8] The two members of the pair always act on *different* objects. The two members of the action/reaction pair point in *opposite* directions and are *equal* in magnitude

[8] **Newton's Third Law**

FOR EQUILIBRIUM PROBLEMS the net forces equal zero because $\vec{a} = 0$. Objects at rest or moving at constant velocity are at equilibrium.

1. Use a picture
2. Identify what is known and what you are trying to find
3. Draw a free-body diagram
4. Evaluate [9] [10]
5. Assess if result is reasonable

[9] $\Sigma F_x = ma_x = 0$

[10] $\Sigma F_y = ma_y = 0$

FOR DYNAMICS PROBLEMS the net forces do not equal zero because the object is accelerating. $\vec{a} \neq 0$. Find the net forces:

1. Use a picture
2. Identify what is known and what you are trying to find, often the force causing the aceleration [11]
3. Draw a free-body diagram
4. Evaluate, [12] [13]
5. Assess if result is reasonable

FREE BODY DIAGRAMS should be drawn using a ruler to draw figures to scale, and a protractor to draw and measure angles. FBDs should be a minimum of 3-inches by 3-inches. [14] [15]

[11]
$$\vec{a} = \frac{\vec{F}}{m}$$

[12]
$$\Sigma F_x = m \cdot a_x$$

[13]
$$\Sigma F_y = m \cdot a_y$$

[14] to make your life easier…

[15] Tactics Box 4.2 discusses how to identify forces using free body diagrams.

In Class Problems

PROBLEM 1–SYLLABUS Please go to Google Classroom, enroll for the class and print out your syllabus. Go to `https://classroom.google.com/c/MTUyNTI3NDQ0MDBa`. The class code is **kk6aw2y**. [16]

[16] You will need to use your OLC email address to access Google Classroom.