AP Physics 1
2.2-2.5 – Newton's Laws
Assessment

Name: _____ Period: _____

1) Two forces act on a moving object that has a mass of 27 kg. One force has a magnitude of 12 N and points due south, while the other force has a magnitude of 17 N and points due east. What is the acceleration of the object?

2) Two ice skaters, Paul and Tom, are each holding on to opposite ends of the same rope. Each pulls the other toward him. The magnitude of Paul's acceleration is 1.25 times greater than the magnitude of Tom's acceleration. What is the ratio of Paul's mass to Tom's mass?

3) A 1580 kg car is traveling with a speed of 15.0 m/s. What is the horizontal net force that is required to bring the car to a halt in a distance of 50.0 m?

4) Two forces, $\mathbf{F_A}$ and $\mathbf{F_B}$ are applied to an object whose mass is 8.0 kg. The larger force is $\mathbf{F_A}$. When both forces point due east, the object's acceleration has a magnitude of 0.50 m/s/s. However, when $\mathbf{F_A}$ points due east and $\mathbf{F_B}$ points due west, the acceleration is 0.40 m/s/s. Find the magnitude of the two force vectors.

5) An electron ($m = 9.11 \times 10^{-31}$ kg) is subject to electric forces. An electron moving in the +x direction accelerates from an initial velocity of $+5.40 \times 10^{5}$ m/s to a final velocity of $+2.10 \times 10^{6}$ m/s while traveling a distance of 0.038 m. This acceleration is due to two electric forces parallel to the x-axis: $\mathbf{F_1} = +7.5 \times 10^{-17}$ N, and $\mathbf{F_2}$, which points in the –x direction. Find
   a. the net force acting on the electron.
   b. the electric force $\mathbf{F_2}$.

6) Two ice skaters, a man and a woman, are standing on ice. Neglect any friction between the skate blades and the ice. The mass of the man is 82 kg, and the mass of the woman is 48 kg. The woman pushes on the man with a force of 45 N due east. Determine the acceleration (magnitude and direction) of (a) the man, and (b) the woman.

7) In a time when mining asteroids is becoming feasible, astronauts have connected a line between their 3500 kg space tug and a 6200 kg asteroid. Using the tug's engine, they pull on the asteroid with a force of 490 N. Initially the tug and the asteroid are at rest, 450 m apart. How much time does it take for the tug and the asteroid to meet?

8) A 325 kg boat is sailing 15 degrees north of east at a speed of 2.0 m/s. Thirty seconds later, it is sailing 35 degrees north of east at a speed of 4.0 m/s. During this time, three forces act on the boat: a 31.0 N force directed 15 degrees north of east (due to an auxiliary engine), a 23.0 N force directed 15 degrees south of west (water resistance), and $\mathbf{F_W}$ (due to the wind). Find the magnitude and direction of the force $\mathbf{F_W}$. Express the direction as an angle with respect to due east.

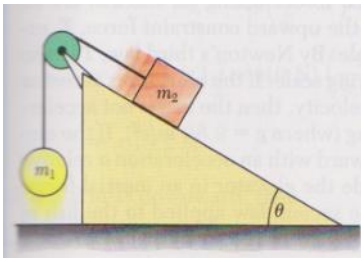
9) A 35 kg crate rests on a horizontal floor, and a 65 kg person is standing on the crate. Determine the magnitude of the normal force that (a) the floor exerts on the crate, and (b) the crate exerts on the person.

10) A student presses a book between his hands and holds it vertically. The forces that he exerts on the front and back covers of the book are perpendicular to the book and horizontal. The book weighs 31 N. The coefficient of static friction between his hands and the book is 0.40. To keep the book from falling, what is the magnitude of the minimum pressing force that each hand must exert?

11) A 95 kg person stands on a scale in an elevator. What is the apparent weight when the elevator is
   a. accelerating upward with an acceleration of 1.80 m/s^2?
   b. moving upward with a constant speed?
   c. accelerating downward with an acceleration of 1.30 m/s^2?

12) A 20 kg sled is being pulled across a horizontal surface at a constant velocity. The pulling force has a magnitude of 80 N, directed at an angle of 30 degrees above the horizontal. Determine the coefficient of kinetic friction.

13) Two unequal masses are attached by a light string that passes over a light, frictionless pulley. The block of mass m_2 lies on a smooth incline of angle θ. Show that



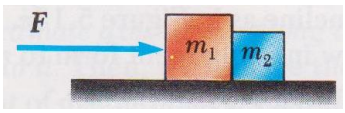
a. the acceleration of the two masses is given by:

$$\bar{a} = \frac{m_2 \bar{g} sin\theta - m_1 \bar{g}}{m_1 + m_2}$$

b. the tension in the string is given by:

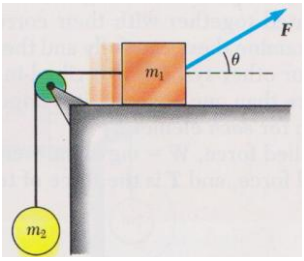
$$\bar{T} = \frac{m_1 m_2 \bar{g}(1 + sin\theta)}{m_1 + m_2}$$

14) Two blocks of masses m_1 and m_2 are placed in contact with each other on a smooth, horizontal surface. A constant horizontal force **F** is applied to m_1,as shown.

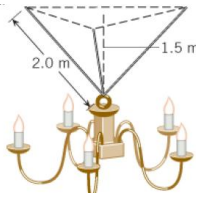


a. Find the acceleration of the system.
b. Determine the magnitude of the contact force between the two blocks.

15) A block of mass m_1 on a rough, horizontal surface is connected to a second mass m_2 by a light chord over a light, frictionless pulley. A force of magnitude F is applied to m_1 as shown. The coefficient of kinetic friction between m_1 and the surface is μ. Determine the acceleration of the masses and the tension in the chord.

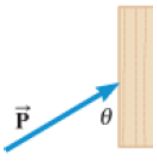


16) A 44 kg chandelier is suspended 1.5 m below a ceiling by three wires, each of which has the same tension and the same length of 2.0 m. Find the tension in each wire.



17) A block of weight 39 N is pressed against a vertical wall by a force **P**. This force can either push the block upward at a constant velocity or allow it to slide downward at a constant velocity. The magnitude of the force is different in the two cases, while the directional angle θ is the same at 30 degrees. Kinetic friction exists between the block and the wall, and the coefficient of kinetic friction is 0.250. Determine the magnitude of P when the block slides

a. up the wall.
b. down the wall.



18) A helicopter flies over the arctic ice pack at a constant altitude, towing an airborne 129 kg laser sensor that measures the thickness of the ice. The helicopter and the sensor move only in the horizontal direction and have a horizontal acceleration of magnitude 2.84 m/s^2. Ignoring air resistance, find the tension in the cable towing the sensor.