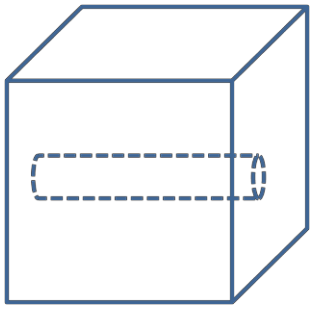
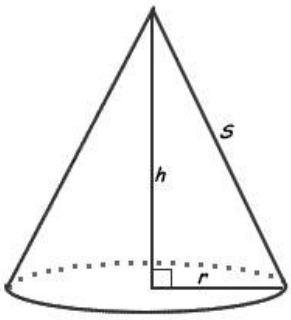
Experiment 1

1. A cube made of wood has sides $18.20\ cm$ in length with an uncertainty of $0.0500\ cm$. A cylindrical hole is drilled perpendicular to the cube from one side to the other. The diameter of the hole is $3.75\ cm$ with $0.0200\ cm$ of uncertainty. What is the volume of the wood and its uncertainty?



2. Suppose a cone has a radius, r, of $17.63\ mm$ measured by the metric micrometer. The distance *s* (see figure) is equal to 2.5 times *r*.

a) Calculate the surface area and volume of the cone. **b)** Calculate the uncertainty in the surface area and volume. c) Calculate percent uncertainty in volume and surface area. Recall that $V_{cone} = (1/3)\pi r^2 h$, $A_{cone} = \pi rs + \pi r^2$. Note that the uncertainty of the micrometer is $0.01\ mm$. Please show detailed calculations. Report your answers first using symbolic algebra and then calculate real values.



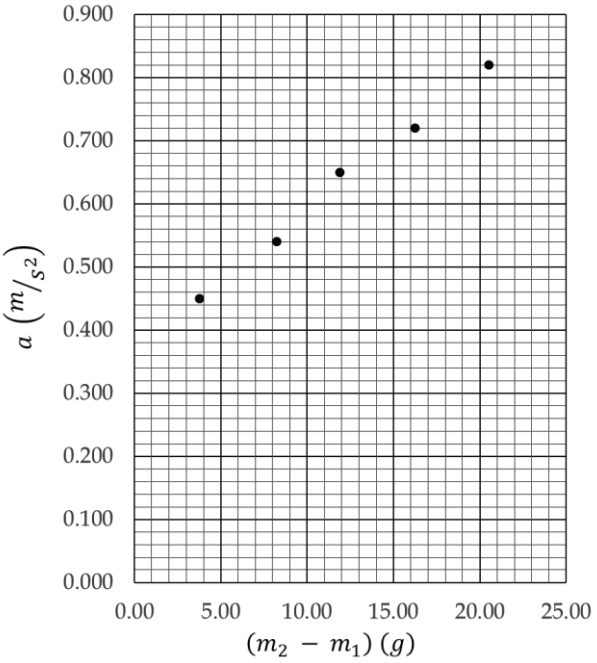
Experiment 2

1. Force **1** ($\boldsymbol{F_1}$) is produced by a mass of $165.0\ g$ applied at an angle of 235.0 degrees.

For force **2** ($\boldsymbol{F_2}$), instead of giving you the value of a mass applied at a certain angle, your instructor told you to use a force whose $x-$ and $y-components$ were given by $F_{2x} = 0.825\ N$ and $F_{2y} = -0.765\ N$. (a) Find the mass and its angle of application to produce $\boldsymbol{F_2}$. Specify the angle measured counter – clockwise from the zero angle on the force table. (b) A third mass is to be hung on the force table to produce equilibrium. Find the mass and its angle of application. Recall that the magnitude of a force $\boldsymbol{F}$ caused by a mass m is $F = mg$, where $g = 9.80\ m/s^2$.

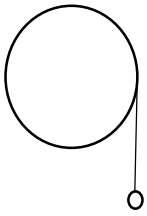
Experiment 3

1. For the situation described in Question 3, student decided to take couple of measurements of acceleration of the system while transferring mass from the m_1 to the m_2. She then decided to plot her date and obtained graph bellow. Please use proper graphical methods to calculate friction force and value for gravitational acceleration. Use $m_1 = m_2 = 225.0\ g$, $R = 3.500\ cm$, $m' = 5.425\ g$ and $r = 1.5875\ mm$.



Experiment 4

1. A string wound around a cylinder of $17.8\ cm$ radius has a $195\ gram$ mass attached. When released, the mass accelerates at $438\ cm/s^2$. (a) What is the angular acceleration of the system? (b) What is the moment of inertia of the cylinder?



Experiment 5

1. A simple pendulum has a $150.0\ g$ mass tied to it and 28.00 seconds are required to complete 10 oscillations. (a) If $g = 9.80\ m/s^2$, what is the length of the pendulum? (b) When the mass is released from a certain hight, its speed as it passes through its lowest point is measured to be $1.850\ m/s$. Calculate the tension in the string at the pendulum's lowest point. (c) The $150.0\ g$

mass is removed from the string forming the pendulum, and it is attached to a spring. If 27.00 seconds is required to complete 25 oscillations on the spring, calculate the spring constant. (d) If you are to move pendulum to another planet where $g = 6.78\ m/s^2$, how will period change? (e) If you are to move spring mass system to another planet where $g = 6.78\ m/s^2$, how will period change?

Experiment 6

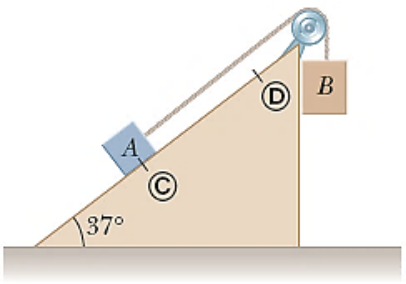
1. A car with a mass of 975 kg and a speed of 18.0 m/s approaches an intersection from west. A 1260 kg minivan traveling at 25.8 m/s due north is heading for the same intersection. The car and minivan collide and stick together. (a) State two equations that will satisfy the conversation of linear momentum. (b) Find the speed and direction of the wrecked vehicles just after the collision, assuming external forces can be ignored.

2. Two astronauts on opposite ends of a spaceship are comparing lunches. One has an apple, the other has an orange. They decide to trade. Astronaut 1 tosses the 0.132 kg apple toward astronaut 2 with a speed of 1.25 m/s. The 0.143 kg orange is tossed from astronaut 2 to astronaut 1 with a speed of 1.14 m/s. Unfortunately, fruits collide, sending the orange off with a speed 1.03 m/s and an angle of 43.0° with respect to its original direction of motion. Using conservation of linear momentum, find the final speed and direction of the apple. Assume an elastic collision occurs. Give the apple's direction relative to its original direction of motion.

Experiment 7

1. A boy exerts a force of 11.8 N at 28.0° above the horizontal on a 6.15 kg sled. Find the work done by the boy and the final speed of the sled after it moves 2.75 m, assuming the sled starts with an initial speed of 0.370 m/s and slides horizontally without friction.

2. Two blocks, A and B (with mass 65.0 kg and 130.0 kg, respectively), are connected by a string, as shown in the figure. The pulley is frictionless and of negligible mass. The coefficient of kinetic friction between block A and the incline is $\mu_k = 0.248$. Determine the change in the kinetic energy of block A as it moves from circle **c** to circle **d**, a distance of 18.7 m up the incline if the system starts from rest. Please show detailed calculation



Experiment 8

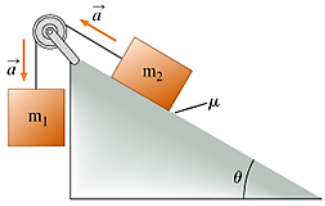
1. A bullet of mass 0.02070 kg collides inelastically with a wooden block of mass 28.00 kg,

initially at rest. After the collision the, system has speed of $1.180\ m/s$. (a) What was initial speed of the bullet? (b) What fraction of energy was transformed to other forms of energy?

2. On a touchdown attempt, $95.00\ kg$ running back runs toward the end zone at $3.750\ m/s$. A $113.0\ kg$ line-backer moving at $5.380\ m/s$ meets the runner in a head-on collision. If the two players stick together, a) what is their velocity immediately after collision? b) What is the kinetic energy of the system just before the collision and a moment after the collision?

Experiment 9

1. Block 1, of mass m_1, is connected over an ideal (massless and frictionless) pulley to block 2, of mass m_2, as shown. Assume that the blocks accelerate as shown with an acceleration of magnitude a and that the coefficient of kinetic friction between block 2 and the plane is μ. Find the ratio of the masses m_2 / m_1.



2. A $12.0\ kg$ block rests on an inclined plane. The plane makes an angle of 31.0° with the horizontal, and the coefficient of friction between the block and the plane is 0.158. The $12.0\ kg$ block is tied to a second block ($mass = 38.0\ kg$) which hangs over the end of the inclined plane after the rope passes over an ideal pulley. (a) What is the acceleration of each of the two blocks, and (b) what is the tension in the rope?

Experiment 10

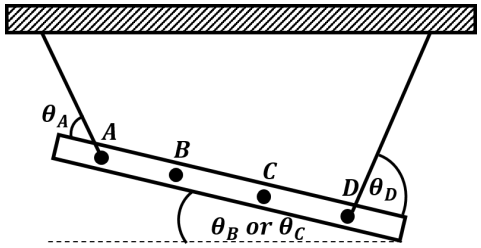
1. For a car traveling at a certain speed, it is possible to bank a curve at just the right angle so that no friction is needed to maintain the car's turning radius. At what angle θ should the curve be bunked so that a car moving at a speed of $57.0\ mi/h$ can safely make the turn even with no friction? The radius of the curve is $R = 215.0\ m$. Please draw a free – body diagram for the car.

2. The sports car is rounding a flat, unbanked curve with radius R. If the coefficient of static friction

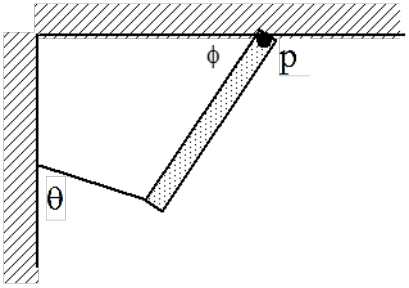
between tires and road is μ_s, what is the maximum speed v_{max} at which the driver can take the curve without sliding. Please draw a free – body diagram for the car. (10 pts)

Experiment 11

1. Find the position of the center of mass if torque bar on the figure bellow has mass 0.785 kg. The length of the torque bar is 53.0 cm, point ***A*** is at 8.00 cm and point ***D*** at 45.0 cm from the left end. The tensions in left cord is 5.30 N and values for θ_A, θ_D and θ_c are respectively 63.0°, 74.9° and 5.0°.



2. The figure shows a bar suspended from a pivot ***p*** with a calibrated spring attaching the bar to the wall. The length of the bar is 0.970 m, its mass is 0.775 kg, and the tension measured by the calibrated spring is 3.25 N. Use the standard coordinate system with $+x$ to the right and $+y$ up the page. (a) Write the symbolic equation that represents equilibrium for the forces in the $x-direction$. (b) Write the symbolic equation that represents equilibrium for the forces in the $y-direction$. (c) Write the symbolic equation that represents equilibrium for the torques around point ***p.*** Please use $\phi = 45.0$ degrees, $\theta = 63.0$ degrees, $g = 9.80\ m/s^2$, and calculate the horizontal and vertical components of the force the pivot exerts on the bar and the location of the center of mass of the bar, measured from the pivoted end.



Experiment 12

1. List two ways in which the velocity of the wave along the string can be quadrupled. In each case, explain to detail why such a change would quadruple the velocity.

2. The drawing shows a $1.125\ meter$ long string vibrating at $120.0\ Hz$ (vibrations per second). (a) Calculate the wavelength and speed of the wave. (b) If the linear mass density of the string is $0.001250\ kg/m$, find the tension in the string.