Pre-Lab #2: Vectors on a Force Table

Name: _____ **Course:** _____

Date: _____

Answer the following questions.

1. Scalars are physical quantities that can be completely specified by their _____.

2. A vector quantity is one that has both _____ and _____.

3. Classify each of the following physical quantities as vectors or scalars:

(a) Volume _____

(b) Velocity _____

(c) Force _____

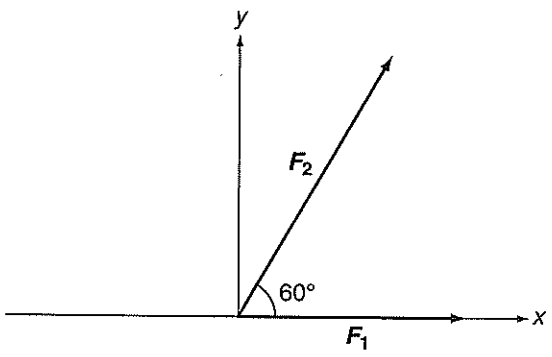
(d) Density _____

(e) Speed _____

(f) Acceleration _____

4. Where $\mathbf{F}_1$ stands for a force vector of magnitude 30.0 N and $\mathbf{F}_2$ stands for a force vector of magnitude 40.0 N each acting in the directions shown in the Figure below, what are the magnitude and direction of the resultant vector obtained by the addition of these two vectors?

Magnitude = _____ N Direction (relative to x axis) = _____ degrees

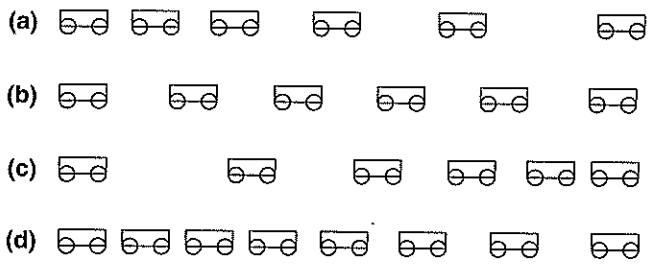


Pre-Lab #3: Free-Fall and Projectile Motion

Name: _____ **Course:** _____

Date: _____

The carts pictured below are all moving in a straight line to the right. The pictures were taken 1.00 s apart. Circle the correct choice (a), (b), (c), or (d) to the questions below.



1. These pictures show a cart that is moving at constant velocity. (a) (b) (c) (d)

2. These pictures show a cart that has positive acceleration. (a) (b) (c) (d)

3. These pictures show a cart that travels at a constant velocity and then has a positive acceleration. (a) (b) (c) (d)

4. These pictures show a cart that has negative acceleration. (a) (b) (c) (d)

5. A projectile is fired in Earth's gravitational field with a horizontal velocity of $v = 9.00$ m/s.

(a) How far does it go in the horizontal direction in 0.550 s? _____

(b) How far does the projectile fall in the vertical direction in 0.550 s? _____

6. A projectile is launched in the horizontal direction. It travels 2.050 m horizontally while it falls 0.450 m vertically, and then strikes the floor.

(a) How long is the projectile in the air? _____

(b) What was the original velocity of the projectile? _____

Pre-Lab #4: Static and Kinetic Friction

Name: _____ **Course:** _____

Date: _____

Answer the following questions. (Assume $g = 9.80$ m/s^2.)

1. Suppose a block of mass 25.0 kg rests on a horizontal plane, and the coefficient of static friction between the surfaces is 0.220. What is the maximum possible static frictional force that could act on the block? _____

2. What is the actual static frictional force that acts on the block if an external force of 25.0 N acts horizontally on the block? _____

3. A 5.00 kg block rests on a horizontal plane. A force of 10.0 N applied horizontally causes the block to move horizontally at constant velocity. What is the coefficient of kinetic friction between the block and the plane? _____

4. For either type of coefficient of friction, what is generally assumed about the dependence of the value of the coefficient on the area of contact between the two surfaces? _____

5. Suppose a block of mass M lies on a plane inclined at an angle θ. Let θ_s be the maximum angle at which the mass can remain static on the plane. Let θ_k be the angle at which the block slides down the incline at constant speed. Show that the coefficient of static friction is $\mu_s = \tan\theta_s$ and that the coefficient of kinetic friction is $\mu_k = \tan\theta_k$. (Provide a force diagram.)

Pre-Lab #5: Centripetal Force

Name: _____ **Course:** _____

Date: _____

Answer the following questions.

1. If a particle moves in a circle of radius R at constant speed v, its acceleration is

(a) directed toward the center of the circle

(b) equal in magnitude to v^2/R

(c) because the direction of the velocity vector changes continuously

(d) all of the above are true.

2. A particle of mass 0.350 kg moves in a circle of radius $R = 1.35$ m at a constant speed of $v = 6.70$ m/s. What is the magnitude and direction of the centripetal force acting on the particle?

Answer: _____

3. A 0.500-kg particle moves in a circle of radius $R = 0.150$ m at constant speed. The time for 20 complete revolutions is 31.7 s.

(a) What is the period T of the motion? Answer: _____

(b) What is the frequency f of the circular motion? Answer: _____

(c) What is the speed v of the particle? Answer: _____

(d) What is the magnitude of the centripetal acceleration? Answer: _____

Pre-Lab #6: Hooke's Law for a Spring

Name: _____ **Course:** _____

Date: _____

Answer the following questions. (Assume $g = 9.80$ m/s^2.)

1. A massless spring having a spring constant $k = 8.75$ N/m is hung vertically. If the spring is displaced 0.150 m from its equilibrium position, what is the force that the spring exerts? _____

2. A 400-g mass is suspended from this spring. What is the displacement of the end of the spring due to the weight of the mass? _____

3. Suppose this mass is allowed to oscillate on the spring. What is the period of the oscillation? _____

4. What is the frequency of the oscillation? _____

5. A 0.100-kg mass suspended vertically on a spring takes 10.94 s to undergo 20 oscillations. What is the spring constant of the spring? _____

Pre-Lab #7: Simple Harmonic Motion – The Simple Pendulum

Name: _____ **Course:** _____

Date: _____

(Use $g = 9.80\ \text{m/s}^2$.)

1. What is the requirement for a force to produce simple harmonic motion?

Answer: _____

2. A simple pendulum of length $L = 0.800$ m has a mass $M = 0.250$ kg. What is the period T of its motion?

Answer: _____

3. The motion of a simple pendulum is described by the equation

$$\theta = 20\cos(10t)$$

where θ is in degrees and t is in seconds.

(a) What is the amplitude of the motion?

Answer: _____

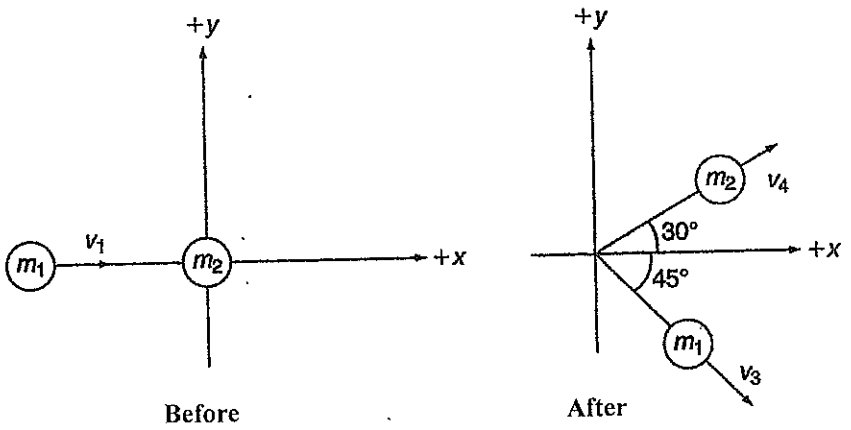
(b) What is the period of the motion?

Answer: _____

Pre-Lab #8: Conservation of Momentum

Name: _____ **Course:** _____

Date: _____



Referring to the figure above, answer the following questions:

1. A particle of mass $m_1 = 1.000$ kg moves at speed $v_1 = 0.500$ m/s. It collides with a particle of mass $m_2 = 2.000$ kg at rest.

(a) What is the total momentum of the system in the x direction before the collision?

Answer: _____

(b) What is the total momentum of the system in the y direction before the collision?

Answer: _____

2. After the collision, m_1 moves with speed v_3 at an angle $\theta_3 = 315.0°$ with respect to the x axis, and m_2 moves with speed v_4 at an angle $\theta_4 = 30.0°$ with respect to the x axis. Write an expression for the total momentum of the system in the x direction and another expression for the total momentum in the y direction after the collision in terms of the symbols m_1, m_2, v_3, v_4, and angles θ_3 and θ_4.

x momentum: _____

y momentum: _____

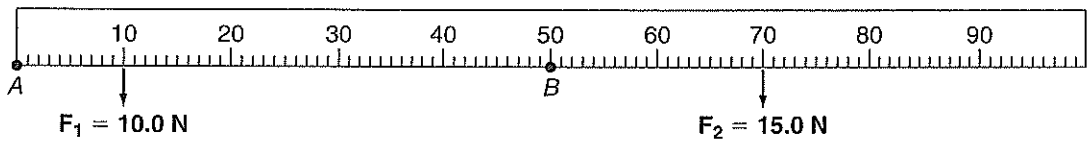
3. Equate the expression for the x component in Question 2 to the value of the x component in Question 1. Equate the expression for the y component in Question 2 to the value of the y component in Question 1. In the resulting two equations v_3 and v_4 are the only two unknowns. Solve the two equations for v_3 and v_4. Show work below.

$v_3 =$ _____ $v_4 =$ _____

Pre-Lab #9: Torque, Equilibrium, and Center of Gravity

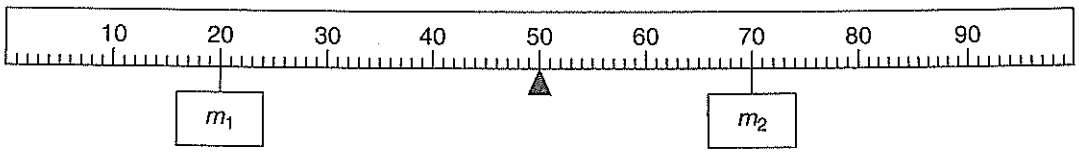
Name: _____ **Course:** _____

Date: _____



1. For the meter stick shown above, the force F_1 = 10.0 N acts at 10.0 cm. What is the magnitude of the torque due to F1 about an axis through point A perpendicular to the page? Is the torque clockwise, or is it counterclockwise? _____

2. In the figure the force F_2 = 15.0 N acts at the point 70.0 cm. What is the magnitude of the torque due to F_2 about an axis through point B and perpendicular to the page? Is the torque clockwise, or is it counterclockwise? _____



3. In the figure above, if the mass m_1 = 0.100 kg acts at 20.0 cm, what is the value of mass m_2 that must be placed at the position 70.0 cm shown to put the system in equilibrium? Assume the meter stick is uniform and symmetric. Show your work. _____

Pre-Lab #10: Rotational Inertia

Name: _____ **Course:** _____

Date: _____

(Show your work in the space provided. Even if you substitute an incorrect answer from an earlier part, if your approach is correct, then credit will be given.)

1. A mass hung on a string that is wrapped around an axle on a wheel produces a tension in the string of 6.00 N. The axle has a radius of 0.050 m. The wheel has a mass of 4.00 kg, a radius of 0.100 m, and a thickness of 0.050 m. What is the torque produced by the tension on the axle?

Answer: _____

2. Regarding the shape of the wheel as that of a uniform, solid cylinder, what is the moment of inertia of the wheel?

Answer: _____

3. What is the angular acceleration α of the system?

Answer: _____

4. With what linear acceleration a does the mass on the end of the string fall?

Answer: _____

Pre-Lab #11: Standing Waves on a String

Name: _____ **Course:** _____

Date: _____

(Use $g = 9.80\ m/s^2$.)

A 2.0-m length of string with a mass density of 2.95×10^{-4} kg/m is fixed at both ends and driven at 120 Hz. The tension is varied to obtain standing waves (resonances) on the string.

1. What is the longest wavelength λ for a standing wave possible on the string?

Answer: _____

2. The tension on the string is varies to obtain the 4^{th} harmonic.

(a) What is the wavelength of this standing wave?

Answer: _____

(b) What is the wave speed?

Answer: _____

3. What should the tension be to obtain the 3^{rd} harmonic?

Answer: _____