

Instructions: You have a total of 55 minutes to complete this test.

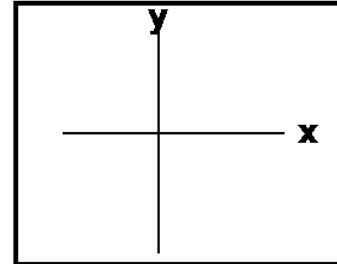
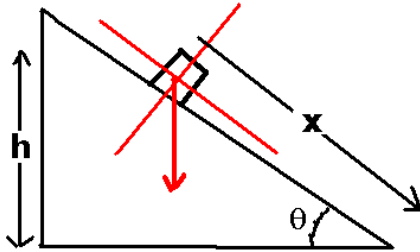
Answer each of the following questions completely.

Time Start _____ Time finish _____ Pledged _____

You must supply all details that led to your answer. You must provide correct SI units where required.

Do not discuss any aspect of this test with anyone until I return the test.

[1] A mass m is on an inclined plane (inclined at an angle θ) as shown. The mass is given a tiny push to start it moving down the plane. The coefficient of friction between the mass and the plane is μ . Note: x and h are related by $h = x \sin(\theta)$.



(a) Draw in the space provided (above) a correct free body diagram of the situation.

(b) If the mass falls through the height h , how fast is the mass moving at the bottom of the plane? Your answer will involve h , g , θ and μ . You must use energy considerations here and thus, you must write the correct work-energy equation for this situation as part of your solution.

(c) Suppose $h=1\text{m}$, $\theta=35^\circ$, and $\mu=.3$, provide a numerical answer for v together with correct SI units. $v=$ _____



(2) A mass m_1 is moving with a velocity v as shown. The mass strikes and sticks to a mass m_2 which is initially at rest. The system then collides with a spring of spring constant k and the spring is observed to compress through a distance x when the system comes to a stop. Answer the following questions.

(a) What is the velocity of the system immediately after the collision in terms of m_1 , m_2 and v ?

(b) After the collision, using energy considerations, what will be the compression of the spring? You must use energy considerations here and thus, you must write the correct work-energy equation for this situation as part of your solution.

(c) If $m_1=2\text{kg}$, $m_2=4\text{ kg}$, $v=3\text{ m/s}$ and $k=10\text{ N/m}$, provide numerical answers to (a) and (b) together with correct SI units.

(2:a): $V_{\text{after}}=$ _____

(2:b): $x=$ _____

(3) A wheel of radius R which is initially at rest experiences an angular acceleration given by $\alpha=c$ where c has SI units of $\frac{\text{rad}}{\text{s}^2}$. At a time t , answer the following (you may assume the wheel is initially at $\theta_0=0$).

(a) What is the angular velocity, ω , in terms of c and t ?

(b) What is the tangential velocity, v , in terms of c , t , and R ?

(c) What is the tangential acceleration, a in terms of c , t , and R ?

(d) What is the centripetal acceleration, a_c in terms of c , t , and R ?

(e) What is the magnitude of the acceleration in terms of c , t , and R ?

(f) What is the angle (θ) which the wheel turned through in terms of c , t , and R ?

(4) A mass m_1 (initially at rest) is subject to an impulse $\vec{J} = \vec{F}\Delta t$ where $\vec{F} = (c)\hat{x}$ where c has SI units of N. Answer the following questions.

(a) After a time t , how fast is the mass moving in terms of c , t and m_1 ?

(b) Now, assume that the mass is moving with the velocity obtained in (4a) (which you may refer to as v here) after this time t (and the impulse is removed). The mass is observed to undergo a completely elastic collision with a second mass m_2 which is initially at rest. If mass m_2 is the same as mass m_1 , what is the velocity of mass m_1 and m_2 after the collision?