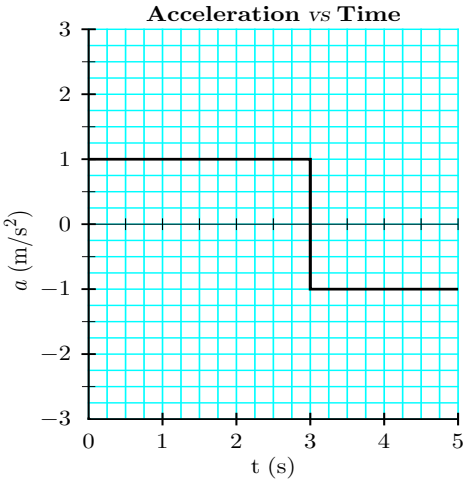
Exam A

Exam will consist of three questions either easy, medium, hard, or perhaps medium, medium, medium. The current practice exam is too long for an hour.

(easy) To test human response to a sustained acceleration lasting of order a second, you design a high speed rocket sled. Estimate how fast you would make the sled go to reasonably test human response to acceleration. Estimate the length of the runway required.

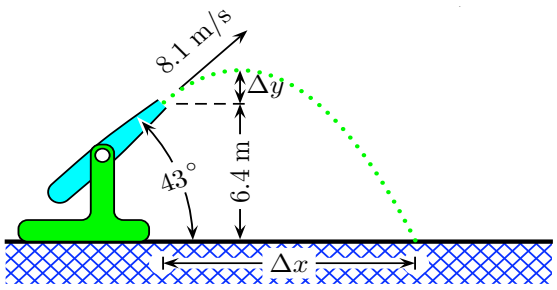
(medium) A particle has an acceleration (in $\mathrm{m/s^2}$) which has the time dependence shown on the graph below. The particle starts at the origin and is initially moving to the left with a speed of $1.5\,\mathrm{m}/s$

1. Find the velocity at t=5 s.
2. Find the position at t=5 s.
3. Make a graph of velocity vs. time.
4. Make a graph of position vs. time.
5. Describe the graphs in item 3. and 4. in words indicating in each period of time wether the particle is speed up or slowing and wether it is moving to the right or left.



(medium/long but easy) A projectile of mass 0.633 kg is shot from a cannon. The end of the cannon's barrel is at height 6.4 m as shown in the figure. The initial velocity of the projectile is 8.1 m/s.

The projectile rises to a maximum height of Δy above the end of the cannon's barrel and strikes the ground a horizontal distance Δx past the end of the cannon's barrel. The acceleration of gravity is 9.8m/s^2.



1. Determine the maximum height Δy the projectile achieves after leaving the end of the cannon's barrel. Answer in units of m.

2. Determine the time it takes for the projectile to reach its maximum height.

3. How long does it take the projectile to hit the ground?

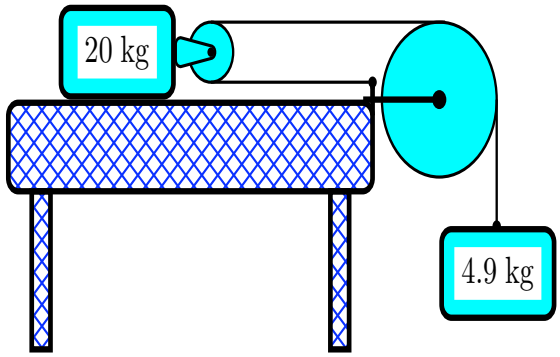
4. Find the speed of the projectile when it hits the ground.

5. Find the angle (with respect to horizontal) the projectile makes when hitting the ground

6. Find the range "$\Delta x''$ of the projectile.

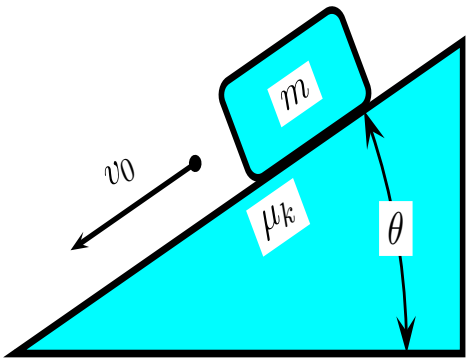
7. Compare the final speed computed above to the typical speed of a person running, a car driving, and a commercial airline.

(harder) A 20 kg block with a pulley attached slides along a frictionless surface. It is connected by a massless string to 4.9 kg block via the arrangement shown.



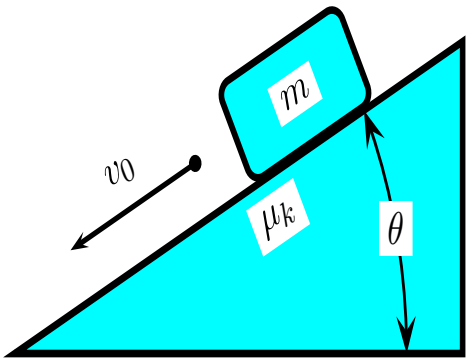
1. Find the acceleration of the 20 kg block.
2. Find the tension in the connecting string. Answer in units of N.
3. Determine the force on the pin which maintains large wheel in place.

(medium version) A block of mass m slides with an initial velocity v_o down a plane, inclined at angle θ with respect to the horizontal. The coefficient of kinetic friction is μ. Since the fricition is sufficiently large the block eventually comes to a stop.



1. Determine the distance the block travels in terms of these variables and the gravitational acceleration g.

(easy version) A block of mass m slides with an initial velocity v_o down a plane, inclined at angle θ with respect to the horizontal. The coefficient of kinetic friction is μ. Since the fricition is sufficiently large the block eventually comes to a stop.



1. Draw a free body diagram for the block.
2. Determine the acceleration.
3. Determine the distance the block travels in terms of these variables and the gravitational acceleration g.

(easy) An amusement park ride consists of a rotating circular platform of radius 8.0m from which a child in a seart are suspended at the end of 2.5m massles chains. The chains make an angle $\theta = 28.0^o$ with the vertical. The mass of the child + seat is 50kg.

1. Draw a free body diagram for the child+seat combo.

2. Find the speed of the child+seat combo.