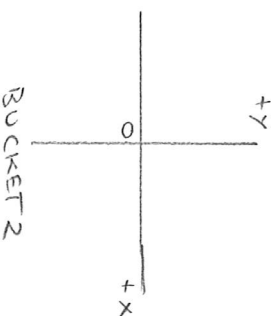
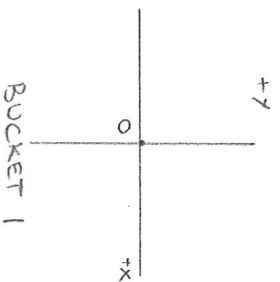
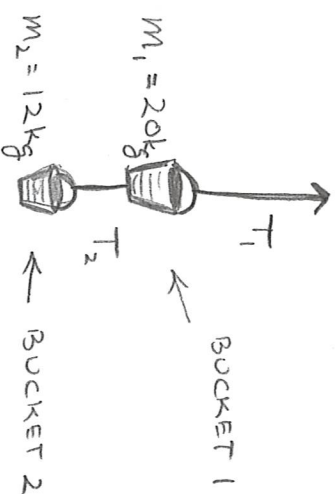


Problem 1 (2nd Law) On a construction site buckets are used to transport nails to the top floors. Two buckets are connected together by a rope and pulled up to the top floors with another rope as shown.

a) Draw the Free-Body-Diagram (FBD) for each of the buckets:



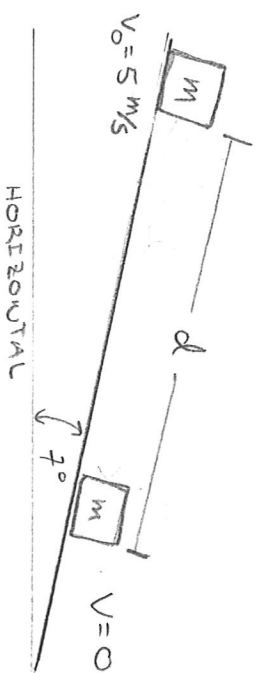
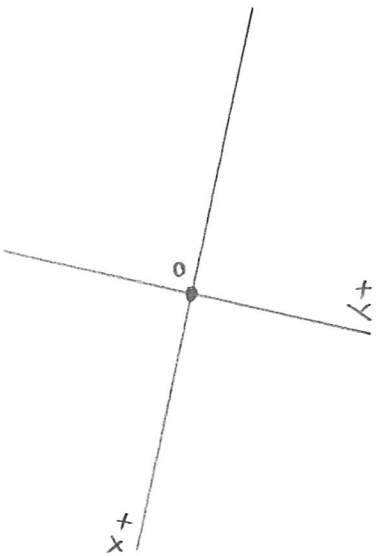
b) The buckets have an initial acceleration of 4 m/s^2 upward. Find the tension in each of the ropes during this acceleration.



c) After the initial acceleration the buckets move upward with constant velocity. Find the tension in each of the ropes in this case.

Problem 2 (2nd Law with friction force) A crate with a mass of $m = 25\text{kg}$ is sliding down a 7° slope with an initial velocity of 5m/s . The coefficient of friction is $\mu = 0.38$.

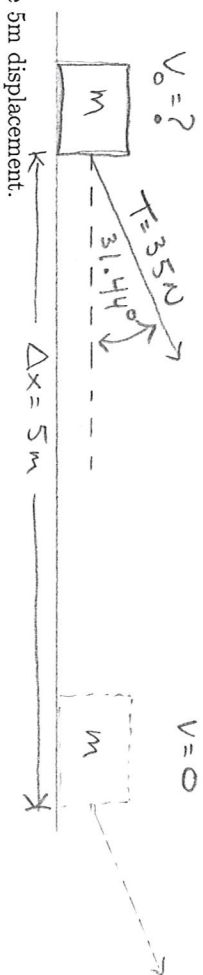
a) Draw the FBD for the crate.



b) Use the 2nd law to determine the magnitude of the friction force acting on the crate.

c) Determine the acceleration of the crate and find the distance, d , it slides down the slope before coming to rest.

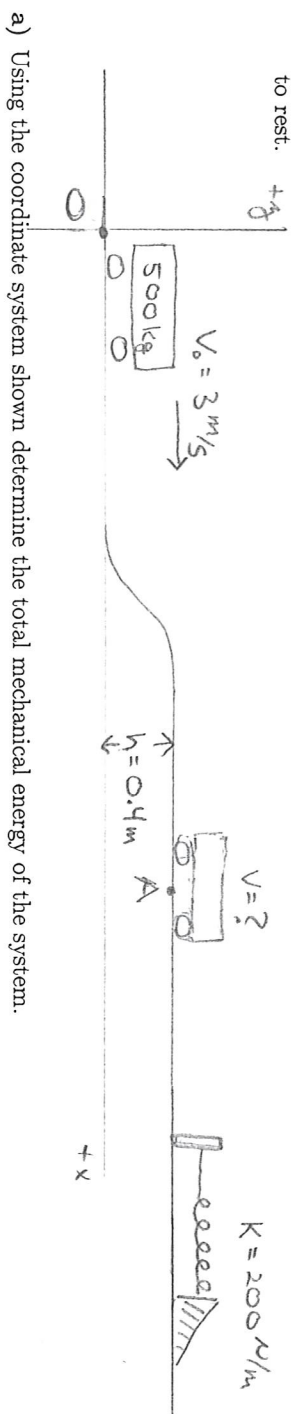
Problem 3 (Work and Work-Kinetic Energy Theorem) A box of mass $m = 25\text{kg}$ is dragged across a horizontal surface with a rope that makes an angle of $\theta = 31.44^\circ$ with the horizontal. The tension in the rope is $T = 35\text{N}$. The crate is also subject to a friction force of $f = 92.41\text{N}$. The box comes to rest after being dragged a distance of $\Delta x = 5\text{m}$.



- Calculate the work done by T (the tension in the rope) over the 5m displacement.
- Calculate the work done by friction over the 5m displacement.

- Apply the Work-Kinetic Energy Theorem to find the initial speed of the box.
 V_o

Problem 4 (conservation of total mechanical energy) A train car with a mass of $m = 500\text{kg}$ is rolling on a frictionless track with an initial speed of $v_0 = 3\text{m/s}$. It rolls up a hill with a height of $h = 0.4\text{m}$. After rolling up the hill the train car runs into a spring with a spring constant of $k = 200\text{N/m}$ and is brought to rest.



a) Using the coordinate system shown determine the total mechanical energy of the system.

b) Determine the speed of the train car at the top of the hill (point A).

c) Determine how far the spring gets compressed in stopping the train car.