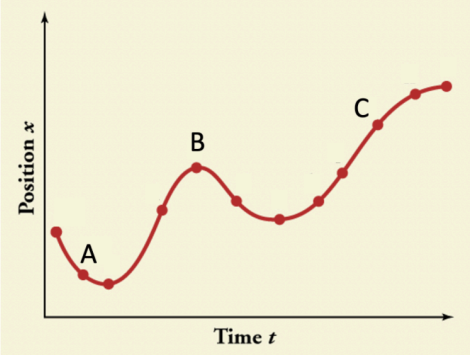
Question 2

3 pts

The figure below shows the position vs time graph for an object moving in 1-D



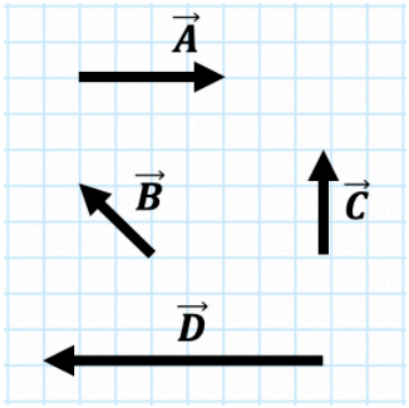
Rank the **speed** of the objects from slowest to fastest .

- ○ $v_B < v_A < v_C$
- ○ $v_C < v_A < v_B$
- ○ $v_A < v_C < v_B$
- ○ $v_A = v_B = v_C$
- ○ $v_A < v_B < v_C$

Question 3

3 pts

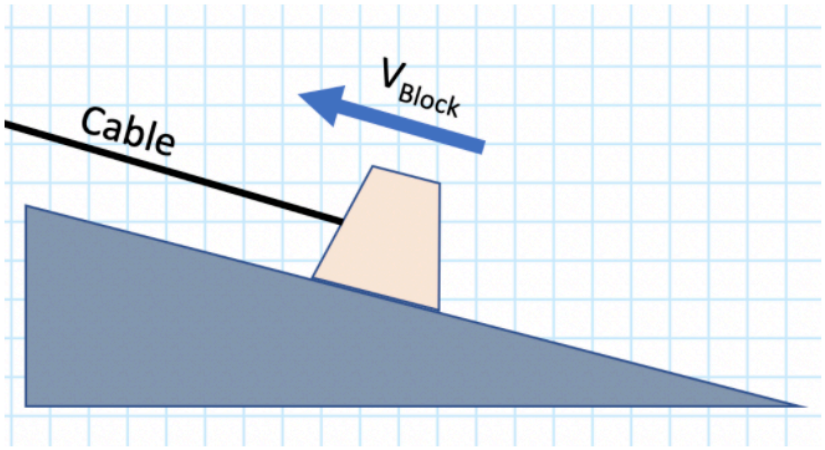
In the figure below, 4 vectors are given. For which combination of the four vector is the magnitude of the resulting vector the greatest?



- ○ $\vec{A}+\vec{C}$
- ○ $\vec{A}-\vec{D}$
- ○ $\vec{D}+\vec{A}$
- ○ $\vec{A}+\vec{B}$
- ○ $\vec{B}+\vec{C}$

Question 4 — 3 pts

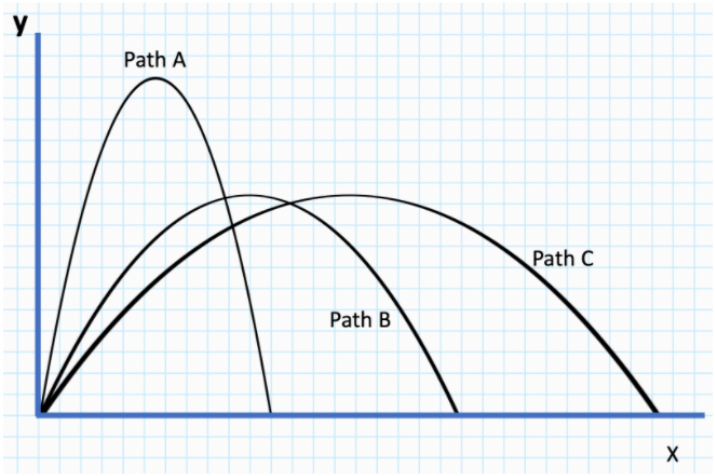
A block is being dragged up a hill by a cable with constant velocity as shown in the figure. Which statement about the normal force acting on the block is true.



- ○ The magnitude of the normal force is less than the magnitude of the gravitational force (Weight)
- ○ The magnitude of the normal force is equal to the magnitude of the gravitational force (Weight)
- ○ The magnitude of the normal force is zero
- ○ The magnitude of the normal force is equal to the magnitude of the kinetic frictional force
- ○ The magnitude of the normal force is greater than the magnitude of the gravitational force (Weight)

Question 5 — 3 pts

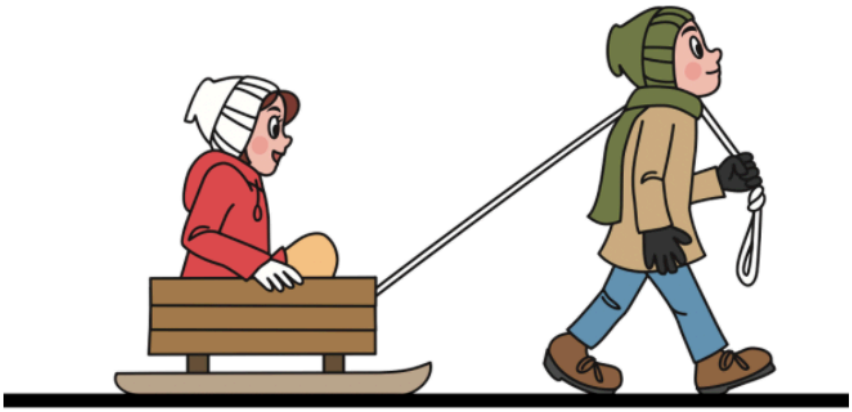
Three projectiles are launched such that their paths follow the trajectories shown below. What can you say about the total times that each projectile is in the air t_1, t_2, and t_3? Ignore air resistance for this question.



- ○ $t_1 = t_2 > t_3$
- ○ $t_3 > t_2 > t_1$
- ○ $t_1 > t_2 = t_3$
- ○ $t_3 = t_2 > t_1$

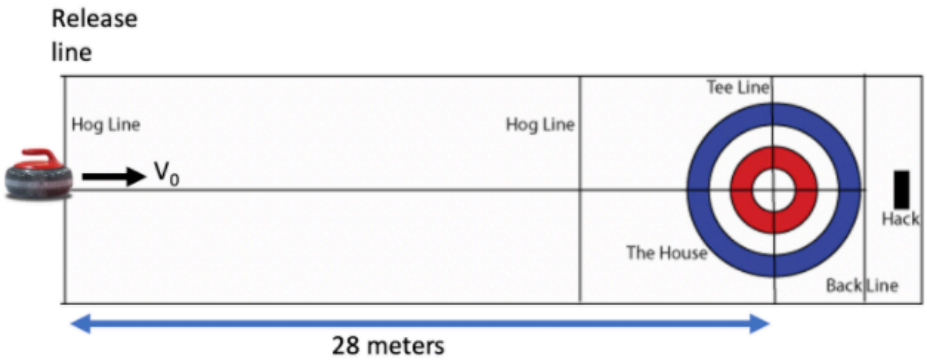
Question 6 — 3 pts

A child is pulling their friend on a sled across a level field as shown in the figure. The sled's velocity is decreasing as the parent tires out. What is the correct free body diagram for this situation?



Question 7 — 10 pts

In the sport of curling, a 20kg stone is pushed across a sheet of ice with the goal of having it stop at the center of a target. A player pushes the stone until the release line, then lets the stone go. The figure below shows the layout of the ice. Be sure to answer both parts A and B here.



A) If the player releases the stone with an initial velocity of 5 m/s and the friction between the stone and the ice gives the stone an constant acceleration of -1.3 $\frac{m}{s^2}$ (assuming motion to the right is in the +x direction), how far from the target does the stone stop? Assume only motion in one-dimension.

B) How long does it take for the stone to come to a stop?

Question 8 — 12 pts

You decide to go on a hot air balloon ride and are using a map to follow your course. Assume you start at the origin of your map (0,0), and your coordinate system has the typical directions of East = $\hat{i}$, North = $\hat{j}$. Ignore the altitude for this problem. For the first hour, you travel with a velocity of 8 m/s, 10 degrees North of east (+10 degrees from x-axis). For the second hour, the wind shifts and you travel 12 m/s 30 degrees South of East (+330 degrees from +x-axis). For the final 2 hours of your journey, your velocity is 4 m/s due south (+270 degrees from +x-axis).

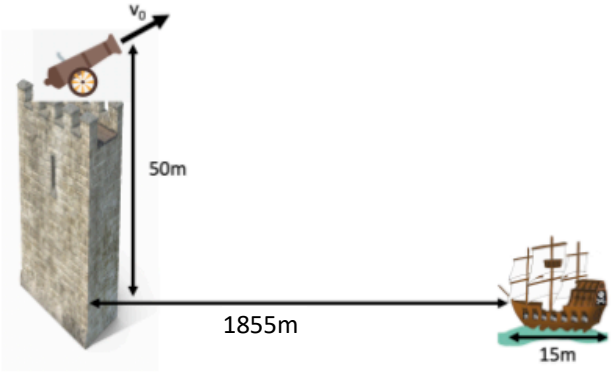
A) What are your displacement vectors for each of the three legs of your journey, $\vec{r_1}, \vec{r_2}, \text{and } \vec{r_3}$? Write the 3 vectors in component form ($\vec{r} = r_x\hat{i} + r_y\hat{j}$)

B) Sketch the journey using the coordinate system given. Be as accurate as possible given that you don't have graph paper. You should still be able to have the proportions and angles of each vector correct.

C) What is your final displacement from where you start? Give your answer as a distance and an angle from the +x-axis and draw it on your sketch.

Question 9 — 15 pts

A cannon is mounted on a castle wall 50m above the water. A pirate ship is spotted and is 1855m away from the wall. The cannonball is fired at an initial velocity of 150 m/s at an angle of 25 degrees. The cannonball is in the air for 13.7 seconds.



Note that this problem is slightly different than what was on the exam. I noticed an inconsistency with the given velocity and time that I wanted to clear up for the corrections. I graded this problem on the method rather than on the final numbers.

A) What are the position functions of the cannonball as a function of time: x(t) and y(t)?

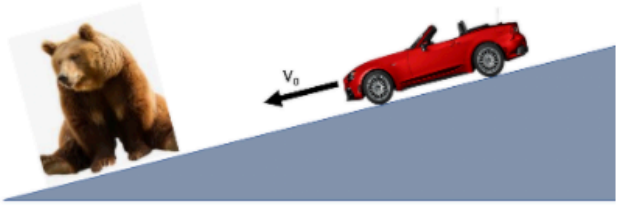
B) What are the velocity functions of the cannonball as a function of time: $v_x(t) \text{and } v_y(t)$?

C) Does the cannonball hit the pirate ship? Be sure to justify your answer!

D) If the Cannon was moved to the base of the wall so that it was at the same vertical height as the pirate ship, at what angle could it fire to hit the boat? Assume the initial speed of the cannonball is unchanged |v|=150m/s.

Question 10 — 7 pts

You are driving a 1250kg car down a hill when you spot a bear sitting in the road just ahead. You slam on the brakes, locking the tires so they don't spin, and skid to a halt. You are traveling at 20m/s when you slam on the brakes and it takes 2.5 seconds to come to a stop. Assume the force applied to the car to stop it is constant.



A) Draw a Free body diagram for the car. Also draw the Net force and label it $\overrightarrow{F_{net}}$.

B) What is the net force required to stop the car while you are braking?