

Answer all questions in the blue notebook provided. Show all your work and indicate your reasoning in order to receive most credit.

- Given three vectors $\vec{a} = (1, 1)$, $\vec{b} = (3, 0)$, and $\vec{c} = (0, 1)$ find the following.
 - $\vec{a} + 2\vec{b} + 3\vec{c}$
 - $2\vec{a} - \vec{b} - 2\vec{c}$
- One strategy in a snowball fight is to throw a snowball at a high angle over level ground. While your opponent is watching the first one, a second snowball is thrown at a low angle timed to arrive before or at the same time as the first one. Both snowballs are thrown with a speed of 10.0 m/s. The first one is thrown at an angle of 65° with respect to the horizontal.
 - At what angle should the second (low angle) snowball be thrown to arrive at the same point as the first?
 - How many seconds later should the second snowball be thrown after the first to arrive at the same time? (Assume $g = 10.0 \text{ m/s}^2$.)
- A light string can support a stationary hanging object just before breaking. (Assume $g = 10.0 \text{ m/s}^2$.) The same object attached to the string rotates on a horizontal, frictionless table in a circle of radius 0.1 m, while the other end of the string is held fixed. What range of speeds can the object have before the string breaks?
- In a local bar, a customer slides an empty beer mug down the counter for a refill. The bartender is momentarily distracted and does not see the mug, which slides off the counter and strikes the floor 1.0 m from the base of the counter. The height of the counter is 1.25 m. (Assume $g = 10.0 \text{ m/s}^2$.)
 - With what velocity did the mug leave the counter?
 - What was the magnitude of the mug's velocity just before it hit the floor?
- A camper hangs a 20 kg pack symmetrically between two trees, using two 5 m pieces of rope. What is the tension in each rope? The distance between the trees is 8 m. (Assume $g = 10.0 \text{ m/s}^2$.)

6. A woman at an airport is towing her 10.0 kg suitcase at constant speed by pulling on a strap at an angle θ above the horizontal. She pulls on the strap with a 25.0 N force, and the friction force on the suitcase is 20.0 N. (Assume $g = 10.0 \text{ m/s}^2$.)
- (a) What angle does the strap make with the horizontal?
 - (b) What normal force does the ground exert on the suitcase?