

Part A

You only have this period to finish this section. You must do a minimum of 40 points on this section and 100 points on the two sections combined. Please give all final answers in three significant figures. Include sketches in your solutions for all vector problems. The numbers in parentheses after the problem indicate how many points the problem is worth.

If you see (RO) following a problem you only need to write reasons.

If you see (SO) following a problem you only need to provide a solution.

A1. Add 45.6N West to 90.4N South. (10)(SO)

A2. How fast does a quarterback need to throw the football to have a receiver that is 25.0m away catch the ball if he throws the ball at an angle of 53.0° to the horizontal? The receiver catches the ball at the same height it was thrown and is running away from the quarterback at a constant rate of 3.00 m/s for the whole time the ball is in the air. (30)

A3. You are out hunting one day and spot a bird 3.35m up in a tree that is 14.50m away. If you fire your bow from your shoulder 0.50m above the ground and the arrow leaves at a velocity of 21.0m/s at what angle do you need to aim to hit the bird? (30)

A4. A small plane is flying toward Beverly airport at a velocity of 42.0m/s North. The wind is blowing from the South East at 18.0m/s. What is the displacement of the plane after 5.00 min? (20)

A5. Add 240m/s @ 34.2° N of E to 190m/s @ 45.5° W of S. (20) (SO)

A6. You are competing in the high jump during a track meet this spring. You know that to clear the 5'7" bar you need to raise your center of mass 1.20m while traveling a horizontal displacement of 0.70m. If you leave the ground with a velocity of 2.50m/s at what angle do you need to jump to clear the bar? (20)

A7. Shiv is out in his boat one day and needs to go to a point that is 205.0m due West of where he is now. He knows that in this area there is a current of 3.25m/s South East. If his boat has a top speed in still water of 12.0m/s in which direction should he steer? How long does the trip take him? (30)

A8. Sophie has taken up a new hobby of motorcycle jumping. She is setting up a new stunt where she is attempting to jump as many busses as possible. Her takeoff ramp makes an angle of 12° with the horizontal and her landing ramp is the same. Her takeoff point is right at the height of the first bus. Each of the busses is 2.14 m wide. If she leaves the ramp with a speed of 38.5 m/s, how many busses can she jump? (20)

Part B

You must do this section in one sitting. Do enough points so both parts combine to be a minimum of 100 points.

Include sketches in your solutions for all vector problems.

B1. Add $3.45\text{m/s}^2 @ 34.5^\circ$ North of East to $8.55\text{m/s}^2 @ 55.5^\circ$ South of West. (10)(SO)

B2. Margaret is hiking one weekend in the mountains and has a gps with her. During the walk she tracks her position in all three dimensions. She travels 200.m West while traveling 125m North and gaining 45.0m of altitude. What is the magnitude of her displacement? What is her displacement vector? (20)

B3. You are walking up a flight of stairs at 1.20m/s while on a train that is traveling at 9.5m/s. If the stairs make an angle of 53.0° with the horizontal and face backwards what is your velocity with respect to the ground? (20)

B4. Dan is a pirate captain ruling the seven seas. His cannons are located on deck a distance of 4.50m above the water. One day while stopped at an island he is training Abby who is new to the crew. If the cannon fires the ball with speed of 21.0m/s what are the maximum and minimum ranges of the cannon if it can be adjusted to fire between 20° and 60° from horizontal? (30)

B5. Add $34.5\mathbf{i} + 23.0\mathbf{j} + 52.9\mathbf{k}$ to $19.4\mathbf{i} - 27.9\mathbf{j} + 12.35\mathbf{k}$ (10) (SO)

B6. You are playing a new type of golf where there are different obstacles to clear. Rather than water and sand there are walls. On the first hole you start 65.0m from the first wall that is 2.73m high across the fairway. At what angle should you hit the ball to just clear the wall if you hit the ball at 30.0m/s? (20)

B7. While trapped on a rocky tropical island Madeline wants to try and get a message out in a bottle. The edges of this island are cliffs that are 22.9m high. The problem with dropping the bottle is that at the bottom of the cliffs are rocks that extend out 10.40m from the cliff face. How fast horizontally does Madeline need to throw the bottle to have it clear the rocks below? (10)

B8. A diver springs upwards from a board that is 5.00 m above the water. At the instant her body contacts the water her speed is 12.70 m/s and her body makes an angle of 75.0° with respect to the horizontal surface of the water. How far out from the board is she when she enters the water? (30)