

CVA Physics  
Reference Frames, Speed, Scalars and Vectors  
Quiz

Directions: Solve the following problems neatly showing your work and with your final answer highlighted or in a square. This is a quiz, so I cannot assist you. Remember academic integrity and do your own work. You are only allowed your notes and a calculator.

- 1) Joe and Sal from the show *Impractical Jokers* are sitting on two separate benches in Central Park, NYC. It is a beautiful day and the park is full of joggers and bicycle riders. Joe and Sal notice a particular bicycle rider and, in an effort to show that physics can indeed be fun, record the position of the bicycle rider. They record the bicyclist's speed with respect to the ground, but each has a separate reference frame. Below is the data that each collected:

Sal

Clock Reading (s)	Position (m)
0.0	40.0
1.0	30.0
2.0	20.0
3.0	10.0
4.0	0.0

Joe

Clock Reading (s)	Position (m)
0.0	0.0
1.0	10.0
2.0	20.0
3.0	30.0
4.0	40.0

For both Sal and Joe, sketch a motion diagram for each; that is, on a number line, indicate where each is located and the position of the cyclist in 10 m intervals. Then, construct a Position vs Time graph for both Sal and Joe.

- 2) Differentiate between a scalar and a vector, giving an example of each.
- 3) Given a particle in motion in two dimensions, is it possible for the distance the particle travelled in time  $t$  to be positive while the displacement during that same time interval is negative? Justify your answer.
- 4) An Indy 500 driver finishes the race. Assume that each lap is one mile and that the start line and the finish line are the same line painted on the track. What was the driver's total distance and displacement?
- 5) Forces of 12 N and 5 N both act on the same point, but their directions can be varied.
- What is the greatest possible resultant?
  - What is the least possible resultant?
  - If the two forces are at right angles, find the size and direction of the resultant.
- 6) Superman is flying to his Fortress of Solitude. He is exhausted after trying all day, with no success, to make the ratings of *Justice League* higher. I mean, really, how could a movie that had such iconic characters be so bad? Anyway, Superman flies east for 5000 km then flies  $40^\circ$  north-east for 1500 km.
- What distance did Superman fly?
  - What was Superman's displacement?

- 7) Vroom! It is an exciting day at Jacksonville Beach and many have come to watch Offshore Boat Racing. In one match a green boat races against a blue boat. When the flag is dropped, both boats race out from the same dock and speed away at of 101 km/h for half an hour (ignore acceleration times). The blue boat headed  $25.0^\circ$  south-west, and the green boat headed  $37.0^\circ$  south-west. During this half hour
- how much farther west does the blue boat travel, compared to the green boat; and,
  - how much farther south does the green boat travel, compared to the blue boat.
- 8) Consider the definition of speed.
- What is the speed of a rocket that travels 9000 meters in 12.12 seconds?
  - How long will your trip take (in hours) if you travel 350 km at an average speed of 80 km/hr?
  - How far (in meters) will you travel in 3 minutes running at a rate of 6 m/s?
  - A family travels to Cape Canaveral, Florida, in 10 hours. The distance is 816 km. Calculate the average speed.
  - How many seconds will it take for a satellite to travel 450 km at a rate of 120 m/s?
- 9) After renting a car to take a vacation, Lisa Carr (“Lease a Car” – get it?)(Har!) travelled a total distance of 440 miles. One hundred miles were on the interstate at 65 mph and the other on country roads at 55 mph. She stopped to take a 20-minute break twice. Her total trip took 8 hours. Ignoring acceleration times, what was her average speed?
- 10) It is the classic struggle between the tortoise and the hare! In this chapter of their epic battle to defend their honor and the honor of their breed, they decide to race 1000 m. The tortoise crawls the entire 1000 m at a speed of 0.2 m/s. The hare, however, runs the first 200 m at 2 m/s, stops and takes a nap for 1.3 hours, and then awakens to finish the last 800 m with an average speed of 3 m/s. Who wins the race and by how much time?
- 11) The International Space Station orbits at a speed of  $7.6 \times 10^3$  m/s. The average human eye blink lasts about 110 ms (milliseconds). How far does the space station travel in the blink of an astronaut’s eye?
- 12) A tourist in the Great Smoky Mountains National Park in Tennessee is being chased by an angry bear. The tourist runs toward his car at a speed of 4.0 m/s. The car is a distance  $d$  away. The bear starts off 26 m behind the tourist and is running at a rate of 6.0 m/s. What is the maximum possible value for  $d$  in order for the tourist to reach the car safely?
- 13) A woman and her dog are out for a morning run to the river, which is located 4.0 km away. The woman runs 2.5 m/s in a straight line toward the river. The dog is unleashed and runs back and forth at 4.5 m/s between his owner and the river, until the woman reaches the river. What is the total distance run by the dog? (Don’t over-think this one, students...)
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IMPORTANT: Sign the bottom of your assessment to indicate that the work you did is your own and that you did not use outside resources.