Mega-Fun Vectors Review

1. Given the vector, find its components. Make a well-labeled sketch of the vector and the components. Calculate your answers.
   a. $\vec{A} = 96.0$ m/s, 97.0°
   b. $\vec{B} = 11$ km, 237°
   c. $\vec{C} = 8.0$ m/s^2, 0.0°
2. Given the components, find the vector. Make a well-labeled sketch of the vector and the components. Calculate your answers.
   d. $D_x = 701$ m, $D_y = -63.0$ m
   e. $E_x = -25$ m, $E_y = 11$ m
   f. $F_x = 0.0$ cm, $F_y = -20.0$ cm
3. A beautiful swan is swimming in a beautiful river that has a current of 3.0 m/s, 180.0° (west). If the beautiful swan heads at 90.0° (north) and swims at 2.0 m/s through the water, what will be its velocity relative to shore?
4. If the same beautiful swan wants to have a groundspeed of 3.0 m/s and a course of 270.0° in the same beautiful river what should be its heading and speed through the water?
5. Two students leave Knoxville for Spring Break. Johnny travels 423 km, 277.0°, Sally travels 451 km, 242.3°. Which student was closest to the equator and by how much?
6. A radar detects an Unidentified Flying Object at position 20$\underline{0}$ km, 45.0° from the base. After 2.00 minutes has elapsed the UFO is 23$\underline{0}$ km, 210.0° from the radar base. Find the average velocity of the UFO.
7. Water leaves the nozzle of a fire hose with velocity 35.0 m/s 40.0°. The fireman holding the nozzle stands 25.0 m away from the base of the burning building. (a) How far up the building does the water hit? (b) With what velocity does the water hit the building?
8. A rock is launched from a slingshot out over a lake with initial velocity 40.0 m/s, 60.0°. Assume the rock starts essentially at the level of the water. (a) How long will the rock be in the air? (b) How far out into the lake will it travel? (c) To what height above the lake will it soar? (d) If the sun shines straight down on the moving rock, what is the velocity of the rock's shadow moving across the water?
9. Bart Simpson is planning to jump a Cadillac on his skateboard. The ramps at either end of the car will be planks of wood resting on saw horses 1.00 m high. The Cadillac is 5.00 m long and its roof has a height of 1.60 m above the street. For maximum dramatic effect (and minimum chance of injury) Bart wants to just barely clear the roof and just barely make it to the down ramp. (a) How long should each plank of wood be? (b) How fast must Bart be going when he reaches the end of the up ramp? (P.S. Why is this the least injury prone way to jump the Caddy?)

10. Mr. Milligan is fleeing the physics police for breaking Newton's laws. He is driving his twin-turbo hemi v10 engine swapped Volkswagen bus at a speed of 150 mph (67.0 m/s). The road Mr. Milligan is on will end right before a large canyon 458 m across. Mr. Milligan planned ahead and has asked you to place a ramp in front of the edge of the canyon.

(a) What angle would you have to position the ramp so that Mr. Milligan can make it across the canyon? (b) If you change the angle of the ramp to 30 degrees after Mr. Milligan jumps, what is the minimum speed the physics police have to drive to also be able to make the jump? (c) In reality, Mr. Milligan would have to be moving faster than 150 mph to make the jump. Why is that? (Problem by Anders and Jeffrey, spring 2026)

Answers

1. $A_x = -11.7$ m/s, $A_y = 95.3$ m/s
   $B_x = -6.0$ km, $B_y = -9.2$ km
   $C_x = 8.0$ m/s^2, $C_y = 0.0$
2. $\vec{D} = 704$ m, 354.9°
   $\vec{E} = 27$ m, 156°
   $\vec{F} = 20.0$ cm, 270.0°
3. 3.6 m/s, 146°
4. 315°, 4.2 m/s
5. Johnny by 21 km
6. 12.8 Mm/h, 217.0°
7. a. 16.7 m
   b. 30.0 m/s, 26.5°
8. a. 7.07 s
   b. 141 m
   c. 61.2 m
   d. 20.0 m/s, 0.0°
9. a. 2.31 m
   b. 7.92 m/s
10. a. 44.5° or 45.5°
    b. 72.0 m/s (161 mph)
    c. Air resistance would decrease the speed and range of the VW bus (in spite of its awesome aerodynamic shape). To compensate the initial speed needs to be greater!