AP Physics 1

Date:

Vector Addition Practice

Show all your work using separate sheets.

For each problem, <u>draw a sketch of the situation</u> and use trigonometry to solve the problem. To add/subtract vectors numerically by component,

- Clearly sketch the vectors (and their components) on a Cartesian plane. All vectors should be drawn as arrows not lines.
- make a table of the vectors and their components so that the x- and y-components can be added separately to find R_x and R_y
- sketch R_x, R_y and R on a Cartesian plane; find magnitude and direction of R using right triangle trig
- 1. F1 and F2 are vectors shown below (N is a unit of force, it stands for Newton, not north)



- a) Add the vectors F1 and F2: F1+F2 = R1. Add graphically and numerically
- b) Subtract the vector F2 from F1: F1 F2 = R2. Subtract graphically and numerically
- 2. Alex walks 0.40 km in a direction 60° west of north, then goes 0.50 km due west. Find the displacement by adding the vectors mathematically (by components).
- 3. A hiker's trip consists of three segments. Path A is 8.0 km long heading 60° north of east. Path B is 7.0 km long in a direction 30° north of west. Path C is 4.0 km long heading 70° east of south. Find the displacement of the hiker.
- 4. A car drives 60.0 miles directly north in one hour and then turns and drives 80.0 miles directly west in one hour and 15 minutes.
 - a) What is the total distance the car drove?
 - b) What is the car's total displacement for the trip? (magnitude and direction)
 - c) What was the car's average velocity for the trip? (magnitude and direction)
 - d) What was the car's average speed for trip?

- 5. Add together the following vectors graphically and numerically (by component), giving the magnitude and direction of the resultant and the equilibrant.
 - ⁻ Vector A: $300 \text{ m} @ 60^{\circ}$
 - ⁻ Vector B: 450 m @ 100°
 - Vector C: 120 m @ -120°

Component method:



- 6. A car drives 250. m in a direction 35.0° South of east.
 - a) How far South did they drive?
 - b) How far east did they drive?

The car then turns and drives for 400. m in a direction 65.0° north of east.

- c) What is the total displacement in the north/south direction for the two parts of the trip?
- d) What is the total displacement in the east/west direction for the two parts of the trip?
- e) What is the magnitude and direction of the total displacement of the car for the entire trip?
- 7. A plane <u>aims</u> north and moves with a velocity of 200 m/s (relative to the air) (v_{PA}). The wind blows to the east at 30 m/s (relative to the ground) (v_{AG}). The plane's velocity relative to the ground (v_{PG}) is equal to the sum of these two velocities ($V_{PG} = v_{PA} + v_{AG}$). Calculate the plane's total velocity.
- A river flows north at 4.00 m/s (relative to the ground) (v_{WG}). A boat <u>aims</u> east with a velocity of 6.00 m/s (relative to the water) (v_{BW}) trying to cross the river.
 - a) What is the boat's total velocity (v_{BG})?
 - b) if the river is 100. m wide, how long does it take the boat to get across the river?
 - c) how far downstream does the boat end up

Answers:

1a) $R1 = 583 \text{ N}, 71^{\circ}$ above the -x-axis 1b) $R2 = 583 \text{ N}, 9^{\circ}$ above -x axis 2) R = 0.87 km, 13.3° N of W 3) $R = 9.2 \text{ km } 79.6^{\circ} \text{ N of E}$ c) 44.44 mph, 53° W of N 4a) 140mi b) 100 mi d) 62.2 mph 5. c) 219.5 m 6a) 143 m b) 205 m d) 374 m e) 434 m, 30° N of E 202 m/s, 81.5° N of E 7. a) $v_{BG} = 7.21 \text{ m/s} @ 56^{\circ} \text{ E of N}$ b) t = 16.7 s; c) $\Delta x_N = 66.7 m$ 8.