Physics, Foundation Programme – Problem Solving Exercises 7

Vectors

1. A car is driven 125.0 km due west, then 65.0 km due south. What is the magnitude of its displacement? Solve this problem both graphically and mathematically.

   a: 140.9 km

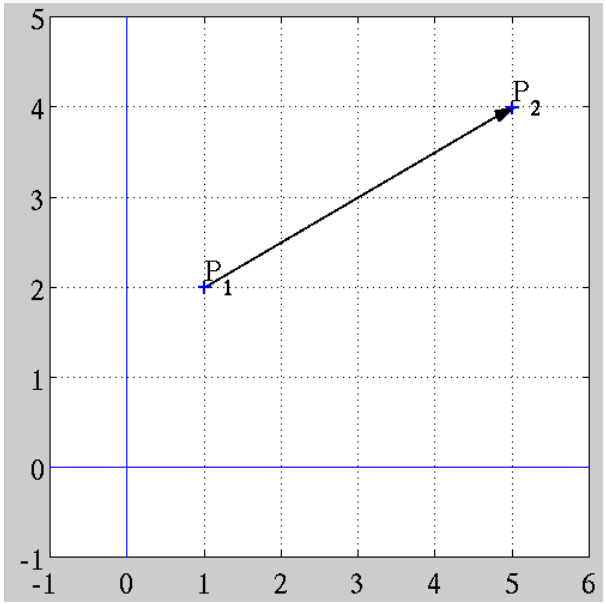
2. A hiker walks 4.5 km in one direction, then makes a 45° turn to the right and walks another 6.4 km. What is the magnitude of her displacement?

   a: 10.1 km

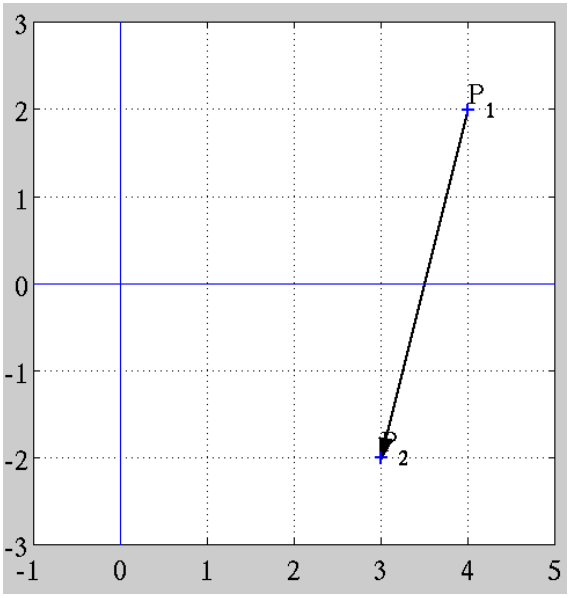
3. An ant is crawling on the sidewalk. At one moment, it is moving south a distance of 5.0 mm. It then turns southwest and crawls 4.0 mm. What is the magnitude of the ant's displacement?

   a: 8.3 mm

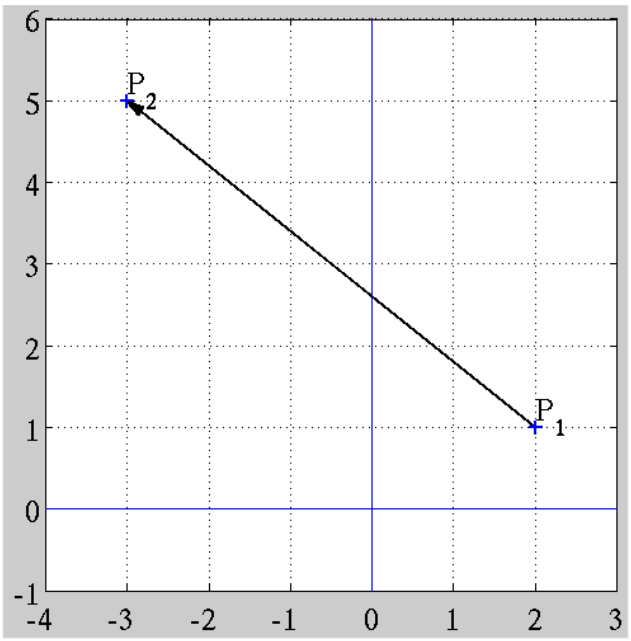
4. Find the components of the vector with the initial point P1 and terminal point P2. Use these components to write a vector that is equivalent to **P1 P2.**



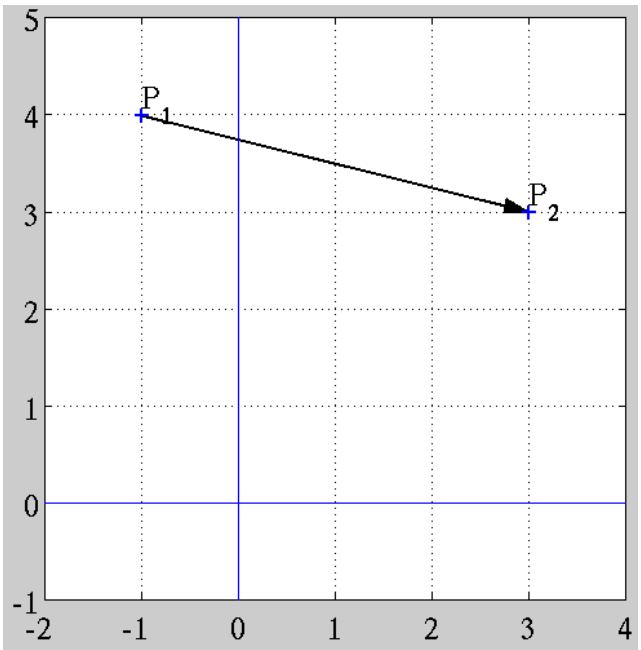
A: **v**=<4, 2>



A: **v**=<-1, -4>



A: **v**=<-5, 4>



A: **v**=<4, -1>

a) $P_1(4,2); P_2(-3,-3)$ a: **v**=<-7, -5>

b) $P_1(0,-3); P_2(0,4)$ a: **v**=<0, 7>

5. Find the magnitude and direction of each vector. (The direction is the angle which the vector makes with the positive x-axis.)

   a) $\mathbf{v} = \langle -3, 4 \rangle$ a: $\|\mathbf{v}\| = 5, \alpha = 126.87^\circ$

   b) $\mathbf{v} = \langle 6, 10 \rangle$ a: $\|\mathbf{v}\| = 2\sqrt{34}, \alpha = 59.036^\circ$

   c) $\mathbf{v} = \langle 20, -40 \rangle$ a: $\|\mathbf{v}\| = 20\sqrt{5}, \alpha = 296.57^\circ$

6. A plane is flying at an airspeed of 500 km/h at a heading of 124 °. A wind of 60 km/h is blowing from the west. Find the ground speed of the plane.

   A: v=551 km/h, ground heading $\alpha = 120.5^\circ$

7. A person who can row 4.2 km/h in still water wants to row due east across a river. The river is flowing from the north at a rate of 1.4 km/h. Determine the heading of the boat required for the boat to travel due east across the river.

A: $\alpha = 70.529^\circ$

8. Find the magnitude of the force necessary to keep a 1,000-kg car from sliding down a ramp inclined at an angle of 5.6°. Round to the nearest tens of newtons. (The gravitation force acting on the car is 9,807 newtons).

A: F=960 N

9. A force of 480 newtons keeps an 120-kilogram object from sliding down an inclined ramp (the gravitation force acting on the object is 1177 N). Find the angle of the ramp. Round to the nearest tenth of a degree.

A: $\alpha = 24.1^\circ$

10. A 68-kg (gravitation force 667 newtons) box is dragged 5 meters along a level floor. Find the work done if a force of 340 newtons, with a direction angle of 32° is used. Round to the nearest joule.

A: W=1442 J

11. A rope is bing used to pull a box up a ramp that is inclined at 15°. The rope exerts a force of 500 newtons on the box, and the rope makes an angle of 30° with the plane of the ramp. Find the work done in moving the box 7 meters. Round to the nearest joule

a: 3031 joules