

## Physics 122: Applications of Vectors

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- If  $\mathbf{A} = 28 \text{ m [E75}^\circ\text{N]}$ ,  $\mathbf{B} = 35 \text{ m [E24}^\circ\text{S]}$ ,  $\mathbf{C} = 22 \text{ m [W50}^\circ\text{N]}$ , and  $\mathbf{D} = 40 \text{ m [W30}^\circ\text{S]}$  Find:
  - $\mathbf{A} + \mathbf{B}$  {57 m [E46°N]}
  - $4\mathbf{C} + 3\mathbf{D}$  {160 m [W2.6°N]}
  - $\mathbf{A} - \mathbf{B}$  {27.8 m [W27°N]}
  - $2\mathbf{D} - \mathbf{C}$  {79.2 m [W46°S]}
  - $4\mathbf{B} + \mathbf{D} - 3\mathbf{C}$  {136 m [E5.7°S]}
- What is the resultant displacement of 25 m [N], 18 m [S], and 12 m [E]? What is the average velocity if the trip took 37 seconds? { $d = 13.9 \text{ m [E30}^\circ\text{N]}$ ;  $v = 0.376 \text{ m/s [E30}^\circ\text{N]}$ }
- Find the acceleration of an object that goes from 15.0 m/s [S] to 15 m/s [W] in 2.0 seconds. { $a = 10.6 \text{ m/s}^2 \text{ [W45}^\circ\text{S]}$ }
- A car is initially moving 7.5 m/s [N]. After 3.0 seconds it is moving 10.0 m/s [E40°N]. Calculate:
  - The acceleration. { $a = 2.57 \text{ m/s}^2 \text{ [E8.1}^\circ\text{S]}$ }
  - The velocity after 6.0 s if the acceleration remains constant. { $v_f = 16.2 \text{ m/s [E19}^\circ\text{N]}$ }
- What is the acceleration of a car that changes its velocity from 20.0 m/s [N] to 20.0 m/s [E45°N] in a time of 5.00 s? { $a = 3.06 \text{ m/s}^2 \text{ [E23}^\circ\text{S]}$ }
- A 500 kg airplane is initially flying 200 m/s [E45°N] turns such that after 7.00 s the velocity is 140 m/s [E]. Find:
  - The acceleration. { $a = 20.2 \text{ m/s}^2 \text{ [W89}^\circ\text{S]}$ }
  - The average force acting during the turn. { $F = 10100 \text{ N [W89}^\circ\text{S]}$ }
- What is the force required to change the velocity of a 1200 kg car from 26.0 m/s [E] to 30.0 m/s [E30°S] in a time of 5.00 seconds? { $F = 3600 \text{ N [S]}$ }
- Three forces act simultaneously on an object. One force is 10.0 N [N], the second is 15 N [W], and the third is 15.0 N [E60°N]. Determine the net force? { $F = 24.2 \text{ N [W72}^\circ\text{N]}$ }
- On a boat you are sailing 6.5 m/s [E20°S]. A gust of wind provides an acceleration equal to 2.1 m/s<sup>2</sup> [E60°N] for 18 seconds.
  - What is your velocity after the 18 seconds? { $v = 39.4 \text{ m/s [E51}^\circ\text{N]}$ }
  - What is the displacement in during that time? { $d = 378 \text{ m [E42}^\circ\text{N]}$ }
- A glider is flying 9.2 m/s [E25°N]. A gust of wind changes the glider's trajectory to 11 m/s [E14°S] in 7.9 seconds.
  - What was the acceleration of the glider? { $a = 0.88 \text{ m/s}^2 \text{ [E70}^\circ\text{S]}$ }
  - What was the displacement of the glider during that time? { $d = 75 \text{ m [E3.7}^\circ\text{N]}$ }
  - What was the average force if the glider has a mass of 55 kg? { $F = 48 \text{ N [E70}^\circ\text{S]}$ }
- You are 37 km [W20°N] from Miramichi and must move to a position 15 km due West of the city. What displacement is required? { $d = 23 \text{ km [E31}^\circ\text{S]}$ }

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12. A coast guard boat (with a helicopter) is 75 km [E67°N] from port. A distress call comes in from a fishing vessel located 93 km [E26°S] from port.
- How far is the fishing boat from the coast guard boat? { $d = 122$  km [E64°S]}
  - What is the minimum velocity of the helicopter to reach the boat in distress within 0.5 hours? { $v = 244$  km/s [E64°S]}
13. When flying your awesome new plane you receive two distress calls from people stranding on two different islands. Island A is 150 km [E] of the airport and Island B is 175 km [E25°S]. You are located 65 km [W10°S]. You choose to rescue the closest group of people. Which island are you going to and what is your heading? {A, [E3°N]}
14. On a day when the wind is 80.0 km/h [E], an airplane is aimed [E65°N] and flown at a speed of 320 km/h. How far and in which direction will the plane fly in 0.33 hours? { $d = 1083$  km [E53°N]}
15. A boat's heading is directly across a river at 5.0 km/h. The river is flowing east at 3.0 km/h.
- What is the velocity of the boat relative to someone standing on the dock where the boat departed? { $v = 5.8$  km/h [E53°N]}
  - How far down stream does it land if the trip takes 0.5 h? { $d_E = 1.5$  km}
  - How wide is the river? { $d_N = 2.5$  km}
16. On a day when the wind is blowing 70 km/h [W40°S] you wish to fly to a destination 830 km [E60°S] in 1.5 hours. What heading and speed should you fly your plane? { $v = 545$  km/h [E53°S]}
17. A river has a current of 6.0 m/s [E]. What speed must a boat be able to travel to go straight across the river when it is aimed 75° upstream? { $v = 23.2$  m/s}
18. It is a distance of 500 m straight east to get across a river. The river has a current of 3.7 m/s due south. You have a boat that can travel 10 m/s.
- Which way should you aim your boat to get directly across the river? {E22°N}
  - How long will it take to cross the river? {54 s}
19. A boat can travel 7.5 m/s. Which way must it be aimed to travel directly across a river with a current of 3.6 m/s? {29° upstream}
20. A Canadian submarine is 185 km [E22°S] of Halifax. An enemy sub is spotted 425 km [E67°N] of Halifax. The enemy is heading directly towards Halifax at 45 km/h. What minimum velocity is required for the Canadian submarine to intercept the enemy sub 200 km from Halifax? { $v_{\text{sub}} = 54$  km/h [W70°N]}
21. Sir Physicalot is chasing the evil Knight Grammarahad from Vector Castle. At a certain time Grammarahad is 79 m [E50°N] of the castle and running with a speed of 6.1 m/s and Physicalot is standing 60 m due east of the castle. What average velocity is required by Physicalot to intercept Grammarahad in 45 seconds? { $v = 8.6$  m/s [E64°N]}
22. An object is moving 35 m/s [E40°N] and undergoes an acceleration of 3.7 m/s<sup>2</sup> [W10°N]. How much time is required for the displacement to be 609 m [W72°N]? { $t = 20$  s}