ch 3

vectors

Chapter 3: Vectors

Conceptual problems

3.C.3 (5.00) An aircraft carrier sails northeast at a speed of 6.0 knots. Its velocity vector is **v**. What direction and speed would a ship with velocity vector −**v** have?

[ ] knots [ ]

Section 0: Introduction

3.0.1 (5.00) Use the simulation in the interactive problem in Section 3.0 to answer the following questions. Assume that the simulation is reset before each part and give each answer in the form (*x*, *y*). (a) What is the displacement to Ed's Fuel Depot? (b) What is the displacement to Joe's Diner? (c) What is the displacement to Silver's Gym?

(a) ([ ] km, [ ] km)
(b) ([ ] km, [ ] km)
(c) ([ ] km, [ ] km)

Section 1: Scalars

3.1.2 (5.00) The volume of the Earth's oceans is approximately 1.4×10^{18} m^3. The Earth's radius is 6.4×10^6 m. What percentage of the Earth, by volume, is ocean?

[ ] %

Section 3: Polar notation

3.3.1 (5.00) The tugboat Lawowa is returning to port for the day. It has a speed of 7.00 knots. The heading to the Lawowa's port is *theta*° west of north. If due east is 0°, what is the tug's heading as a vector in polar notation?

(knots, °)

Section 4: Vector components and rectangular notation

3.4.4 Consider these four vectors:
(5.00) **A** goes from (0, 0) to (1, 2)
B from (1, −2) to (0, 2)
C from (−2, −1) to (−3, −3)
D from (−3, 1) to (−2, 3)
(a) Draw the vectors. Then answer the next two questions. (b) Which two vectors are equal? (c) Which vector is the negative of the two equal vectors?

(a) Submit anwer on paper.
(b)
(c)

Section 5: Adding and subtracting vectors graphically

3.5.1 Draw each of the following pairs of vectors on a coordinate system, using
(5.00) separate coordinate systems for parts a and b of the question. Then, on each coordinate system, also draw the vectors $-\mathbf{B}$, $\mathbf{A} + \mathbf{B}$, and $\mathbf{A} - \mathbf{B}$. Label all your vectors.

(a) $\mathbf{A} = (0, 5)$; $\mathbf{B} = (3, 0)$

(b) $\mathbf{A} = (4, 1)$; $\mathbf{B} = (2, -3)$

Submit answer on paper.

3.5.3 Consider the following vectors:
(7.00) **A** goes from (0, 2) to (4, 2)
B from (1, −2) to (2, 1)
C from (−1, 0) to (0, 0)
D from (−3, −5) to (2, −2)
E from (−3, −2) to (−4, −5)
F from (−1, 3) to (−3, 0)
(a) Draw the vectors. Using your sketch and your knowledge of graphical vector addition and subtraction, which vector listed above is equal to:
(b) **A** + **B**? (c) **E** − **F**? (d) −(**B** + **C**)? (e) Which two vectors sum to zero?

(a) Submit answer on paper.
(b)
(c)
(d)
(e)

3.5.4 The racing yacht *America* (USA) defeated the *Aurora* (England) in 1851 to win
(7.00) the 100 Guinea Cup. From the starting buoy the *America's* skipper sailed 400 meters at an angle 45° west of north, then 250 meters at an angle 30° east of

north, and finally 350 meters at an angle 60° west of north. Draw the path of the *America* on a coordinate system as a set of vectors placed tip to tail. Then draw the total displacement vector.

Submit answer on paper.

Section 6: Adding and subtracting vectors by components

3.6.1 Add the following vectors:
(5.00) (a) (12, 5) + (6, 3)
(b) (−3, 8) + (6, −2)
(c) (3, 8, −7) + (7, 2, 17)
(d) (*a*, *b*, *c*) + (*d*, *e*, *f*)

(a) (,)
(b) (,)
(c) (, ,)
(d)

Section 9: Multiplying rectangular vectors by a scalar

3.9.1 Perform the following calculations.
(5.00) (a) 6(3, −1, 8)
(b) −3(−3, 4, −5)
(c) −*a*(*a*, *b*, *c*)
(d) −2(*a*, 5, *c*) + 6 (3, −*b*, 2)

(a) (, ,)
(b) (, ,)
(c)
(d)

Section 10: Multiplying polar vectors by a scalar

3.10.1 Perform the following computations. Express each vector in polar notation with
(5.00) a positive magnitude and an angle between 0° and 360°.
(a) 2(4, 230°)
(b) −3(7, 20°)
(c) −4(8, 260°)

(a) (, °)

(b) (, °)

(c) (, °)

Section 16: Unit vectors

3.16.1 **(5.00)** A helicopter takes off from the origin with a constant velocity of (16.0**i** + 18.0**j** + 4.00**k**) m/s. What is its position when it reaches an altitude of 1500 meters? Altitude is measured in the **k** direction.

(**i** + **j** + **k**) m

Section 17: Interactive summary problem: back to base

3.17.1 **(5.00)** Use the information given in the interactive problem in Section 3.17 to calculate the following values. (a) The displacement vector for the red ship in rectangular notation. (b) The displacement vector for the yellow ship in polar notation. (c) The scalar multiple for the purple ship's displacement vector. Test your answers using the simulation.

(a) (km, km)

(b) (km, °)

(c) × (2.0 km, 1.0 km)

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