Chapter 1—Introduction and Vectors

MULTIPLE CHOICE

1. The density of an object is defined as:
   a. the volume occupied by each unit of mass.
   b. the amount of mass for each unit of volume.
   c. the weight of each unit of volume.
   d. the amount of the substance that has unit volume and unit mass.
   e. the amount of the substance that contains as many particles as 12 grams of the carbon-12 isotope.

   ANS: B PTS: 1 DIF: Easy

2. Find the average density of a red giant star with a mass of 20×10^{30} kg (approximately 10 solar masses) and a radius of 150×10^{9} m (equal to the Earth's distance from the sun).
   a. 1.41×10^{-4} kg/m^3
   b. 0.007 kg/m^3
   c. 1.41 kg/m^3
   d. 710 kg/m^3
   e. 1.41×10^{-3} kg/m^3

   ANS: E PTS: 2 DIF: Average

3. Find the average density of a white dwarf star if it has a mass equal to that of the sun (2.0×10^{30} kg) and a radius equal to that of the Earth (6.4×10^{6} m).
   a. 9.0×10^{6} kg/m^3
   b. 1.8×10^{7} kg/m^3
   c. 1.8×10^{9} kg/m^3
   d. 3.6×10^{10} kg/m^3
   e. 9.0×10^{7} kg/m^3

   ANS: C PTS: 2 DIF: Average

4. The term $\frac{1}{2}\rho v^2$ occurs in Bernoulli's equation in Chapter 15, with ρ being the density of a fluid and v its speed. The dimensions of this term are
   a. $M^{-1}L^{5}T^{2}$
   b. MLT^{2}
   c. $ML^{-1}T^{-2}$
   d. $M^{-1}L^{9}T^{-2}$
   e. $M^{-1}L^{3}T^{-2}$

   ANS: C PTS: 2 DIF: Average

5. Which of the following quantities has the same dimensions as kinetic energy, $\frac{1}{2}mv^2$?

   Note: $[a] = [g] = LT^{-2}$; $[h] = L$ and $[v] = LT^{-1}$.
   a. *ma*
   b. *mvx*
   c. *mvt*
   d. *mgh*

e. mgt

ANS: D PTS: 2 DIF: Average

6. The quantity with the same units as force times time, Ft, with dimensions MLT^{-1} is
   a. mv
   b. mvr
   c. mv^2r
   d. ma
   e. $\frac{mv^2}{r}$

   ANS: A PTS: 2 DIF: Average

7. The equation for the change of position of a train starting at $x = 0$ m is given by $x = \frac{1}{2}at^2 + bt^3$. The dimensions of b are
   a. T^{-3}
   b. LT^{-3}
   c. LT^{-2}
   d. LT^{-1}
   e. $L^{-1}T^{-1}$

   ANS: B PTS: 2 DIF: Average

8. One mole of the carbon-12 isotope contains 6.022×10^{23} atoms. What volume in m^3 would be needed to store one mole of cube-shaped children's blocks 2.00 cm long on each side?
   a. 4.8×10^{18}
   b. 1.2×10^{22}
   c. 6.0×10^{23}
   d. 1.2×10^{24}
   e. 4.8×10^{24}

   ANS: A PTS: 2 DIF: Average

9. John and Linda are arguing about the definition of density. John says the density of an object is proportional to its mass. Linda says the object's mass is proportional to its density and to its volume. Which one, if either, is correct?
   a. They are both wrong.
   b. John is correct, but Linda is wrong.
   c. John is wrong, but Linda is correct.
   d. They are both correct.
   e. They are free to redefine density as they wish.

   ANS: D PTS: 1 DIF: Easy

10. Spike claims that dimensional analysis shows that the correct expression for change in velocity, $\vec{v}_f - \vec{v}_i$, is $\vec{v}_f - \vec{v}_i = \frac{mt}{F}$, where m is mass, t is time, and F is the magnitude of force. Carla says that can't be true because the dimensions of force are $\left[\frac{ML}{T^2}\right]$. Which one, if either, is correct?
    a. Spike, because $[\vec{v}] = \left[\frac{ML}{T}\right]$.

b. Spike, because $[\vec{v}] = \left[\frac{T^2}{L}\right]$.

c. Carla, because $[\vec{v}] = \left[\frac{L}{T}\right]$.

d. Carla, because $[\vec{v}] = \left[\frac{L}{MT}\right]$.

e. Spike, because the dimensions of force are $\left[\vec{F}\right] = \left[\frac{T^2}{ML}\right]$.

ANS: C PTS: 2 DIF: Average

11. Which one of the quantities below has dimensions equal to $\left[\frac{ML}{T^2}\right]$?

a. mv
b. mv^2
c. $\frac{mv^2}{r}$
d. mrv
e. $\frac{mv^2}{r^2}$

ANS: C PTS: 2 DIF: Average

12. Which quantity can be converted from the English system to the metric system by the conversion factor $\frac{5\,280\text{ f}}{\text{mi}} \cdot \frac{12\text{ in}}{\text{f}} \cdot \frac{2.54\text{ cm}}{1\text{ in}} \cdot \frac{1\text{ m}}{100\text{ cm}} \cdot \frac{1\text{ h}}{3\,600\text{ s}}$?

a. feet per second
b. feet per hour
c. miles per second
d. miles per hour
e. miles per minute

ANS: D PTS: 2 DIF: Average

13. The answer to a question is $[MLT^{-1}]$. The question is "What are the dimensions of

a. mr?"
b. mvr?"
c. ma?"
d. mat?"
e. $\frac{mv^2}{r}$?"

ANS: D PTS: 2 DIF: Average

14. Which of the following products of ratios gives the conversion factor to convert miles per hour $\left(\frac{\text{mi}}{\text{h}}\right)$ to meters per second $\left(\frac{\text{m}}{\text{s}}\right)$?

a. $\frac{5\,280\text{ f}}{\text{mi}} \cdot \frac{12\text{ in}}{\text{f}} \cdot \frac{1\text{ in}}{2.54\text{ cm}} \cdot \frac{1\text{ m}}{100\text{ cm}} \cdot \frac{1\text{ h}}{3\,600\text{ s}}$

b. $\frac{5\,280\text{ f}}{\text{mi}} \cdot \frac{12\text{ in}}{\text{f}} \cdot \frac{2.54\text{ cm}}{1\text{ in}} \cdot \frac{100\text{ cm}}{1\text{ m}} \cdot \frac{1\text{ h}}{3\,600\text{ s}}$

c. $\frac{1\text{ mi}}{5\,280\text{ f}} \cdot \frac{1\text{ f}}{12\text{ in}} \cdot \frac{1\text{ in}}{2.54\text{ cm}} \cdot \frac{100\text{ cm}}{1\text{ m}} \cdot \frac{3\,600\text{ s}}{1\text{ h}}$

d. $\frac{5\,280\text{ f}}{\text{mi}} \cdot \frac{12\text{ in}}{\text{f}} \cdot \frac{2.54\text{ cm}}{1\text{ in}} \cdot \frac{1\text{ m}}{100\text{ cm}} \cdot \frac{1\text{ h}}{3\,600\text{ s}}$

e. $\frac{5\,280\text{ f}}{\text{mi}} \cdot \frac{12\text{ in}}{\text{f}} \cdot \frac{2.54\text{ cm}}{1\text{ in}} \cdot \frac{1\text{ m}}{100\text{ cm}} \cdot \frac{3\,600\text{ s}}{1\text{ h}}$

ANS: D PTS: 2 DIF: Average

15. Which of the following products of ratios gives the conversion factors to convert meters per second $\left(\frac{\text{m}}{\text{s}}\right)$ to miles per hour $\left(\frac{\text{mi}}{\text{h}}\right)$?

a. $\frac{5\,280\text{ f}}{\text{mi}} \cdot \frac{12\text{ in}}{\text{f}} \cdot \frac{2.54\text{ cm}}{1\text{ in}} \cdot \frac{100\text{ cm}}{1\text{ m}} \cdot \frac{3\,600\text{ s}}{1\text{ h}}$

b. $\frac{5\,280\text{ f}}{\text{mi}} \cdot \frac{12\text{ in}}{\text{f}} \cdot \frac{1\text{ in.}}{2.54\text{ cm}} \cdot \frac{1\text{ m}}{100\text{ cm}} \cdot \frac{1\text{ h}}{3\,600\text{ s}}$

c. $\frac{5\,280\text{ f}}{\text{mi}} \cdot \frac{12\text{ in}}{\text{f}} \cdot \frac{2.54\text{ cm}}{1\text{ in}} \cdot \frac{100\text{ cm}}{1\text{ m}} \cdot \frac{1\text{ h}}{3\,600\text{ s}}$

d. $\frac{1\text{ mi}}{5\,280\text{ f}} \cdot \frac{1\text{ f}}{12\text{ in}} \cdot \frac{1\text{ in}}{2.54\text{ cm}} \cdot \frac{100\text{ cm}}{1\text{ m}} \cdot \frac{3\,600\text{ s}}{1\text{ h}}$

e. $\frac{1\text{ mi}}{5\,280\text{ f}} \cdot \frac{1\text{ f}}{12\text{ in}} \cdot \frac{1\text{ in}}{2.54\text{ cm}} \cdot \frac{1\text{ m}}{100\text{ cm}} \cdot \frac{3\,600\text{ s}}{1\text{ h}}$

ANS: D PTS: 2 DIF: Average

16. One U.S. fluid gallon contains a volume of 231 cubic inches. How many liters of gasoline would you have to buy in Canada to fill a 14-gallon tank? (Note: $1\text{L} = 10^{+3}\text{ cm}^3$.)

a. 53
b. 21
c. 14
d. 8.0
e. 4.0

ANS: A PTS: 3 DIF: Challenging

17. The standard exam page is 8.50 inches by 11.0 inches. Its area in cm^2 is

a. 19.5
b. 36.8
c. 93.5
d. 237.
e. 603.

ANS: E PTS: 2 DIF: Average

18. A standard exam page is 8.5 inches by 11 inches. An exam that is 2.0 mm thick has a volume of

a. $1.9 \times 10^4\text{ mm}^3$.
b. $4.7 \times 10^4\text{ mm}^3$.
c. $1.2 \times 10^5\text{ mm}^3$.
d. $3.1 \times 10^5\text{ mm}^3$.

e. 3.1×10^3 mm^3.

ANS: C PTS: 3 DIF: Challenging

19. If you drove day and night without stopping for one year without exceeding the legal highway speed limit in the United States, the maximum number of miles you could drive would be closest to:
a. 8 700.
b. 300 000.
c. 500 000.
d. 1 000 000.
e. 32 000 000.

ANS: C PTS: 2 DIF: Average

20. If each frame of a motion picture film is 35 cm high, and 24 frames go by in a second, estimate how many frames are needed to show a two hour long movie.
a. 1 400
b. 25 000
c. 50 000
d. 170 000
e. This cannot be determined without knowing how many reels were used.

ANS: D PTS: 2 DIF: Average

21. One number has three significant figures and another number has four significant figures. If these numbers are added, subtracted, multiplied, or divided, which operation can produce the greatest number of significant figures?
a. the addition
b. the subtraction
c. the multiplication
d. the division
e. All the operations result in the same number of significant figures.

ANS: A PTS: 2 DIF: Average

22. A rectangle has a length of 1.323 m and a width of 4.16 m. Using significant figure rules, what is the area of this rectangle?
a. 5.503 68 m^2
b. 5.503 7 m^2
c. 5.504 m^2
d. 5.50 m^2
e. 5.5 m^2

ANS: D PTS: 2 DIF: Average

23. If $\vec{\mathbf{A}} = 12\hat{\mathbf{i}} - 16\hat{\mathbf{j}}$ and $\vec{\mathbf{B}} = -24\hat{\mathbf{i}} + 10\hat{\mathbf{j}}$, what is the magnitude of the vector $\vec{\mathbf{C}} = 2\vec{\mathbf{A}} - \vec{\mathbf{B}}$?
a. 42
b. 22
c. 64
d. 90
e. 13

ANS: C PTS: 2 DIF: Average

24. If $\vec{\mathbf{A}} = 12\hat{\mathbf{i}} - 16\hat{\mathbf{j}}$ and $\vec{\mathbf{B}} = -24\hat{\mathbf{i}} + 10\hat{\mathbf{j}}$, what is the direction of the vector $\vec{\mathbf{C}} = 2\vec{\mathbf{A}} - \vec{\mathbf{B}}$?

a. –49°
b. –41°
c. –90°
d. +49°
e. +21°

ANS: B PTS: 2 DIF: Average

25. Given that $\vec{\mathbf{A}} + 2\vec{\mathbf{B}} = x_1\hat{\mathbf{i}} + y_1\hat{\mathbf{j}}$ and $2\vec{\mathbf{A}} - \vec{\mathbf{B}} = x_2\hat{\mathbf{i}} + y_2\hat{\mathbf{j}}$, what is $\vec{\mathbf{A}}$?

a. $\vec{\mathbf{A}} = \frac{1}{5}\left(x_1 + 2x_2\right)\hat{\mathbf{i}} + \frac{1}{5}\left(y_1 + 2y_2\right)\hat{\mathbf{j}}$

b. $\vec{\mathbf{A}} = \frac{1}{5}\left(x_1 - 2x_2\right)\hat{\mathbf{i}} + \frac{1}{5}\left(y_1 - 2y_2\right)\hat{\mathbf{j}}$

c. $\vec{\mathbf{A}} = \frac{1}{5}\left(x_1 + 4x_2\right)\hat{\mathbf{i}} + \frac{1}{5}\left(y_1 + 2y_2\right)\hat{\mathbf{j}}$

d. $\vec{\mathbf{A}} = \frac{1}{5}\left(x_1 + 4x_2\right)\hat{\mathbf{i}} + \frac{1}{5}\left(y_1 + 4y_2\right)\hat{\mathbf{j}}$

e. $\vec{\mathbf{A}} = \frac{1}{5}\left(x_1 + 4x_2\right)\hat{\mathbf{i}} + \frac{1}{5}\left(y_1 - 4y_2\right)\hat{\mathbf{j}}$

ANS: A PTS: 2 DIF: Average

26. Given that $\vec{\mathbf{A}} + \vec{\mathbf{B}} = x_1\hat{\mathbf{i}} + y_1\hat{\mathbf{j}}$ and $\vec{\mathbf{A}} - \vec{\mathbf{B}} = x_2\hat{\mathbf{i}} + y_2\hat{\mathbf{j}}$, what is $\vec{\mathbf{A}}$?

a. $\vec{\mathbf{A}} = \frac{1}{2}\left(x_1 - x_2\right)\hat{\mathbf{i}} + \frac{1}{2}\left(y_1 - y_2\right)\hat{\mathbf{j}}$

b. $\vec{\mathbf{A}} = \frac{1}{2}\left(x_1 + x_2\right)\hat{\mathbf{i}} + \frac{1}{2}\left(y_1 - y_2\right)\hat{\mathbf{j}}$

c. $\vec{\mathbf{A}} = \frac{1}{2}\left(x_1 - x_2\right)\hat{\mathbf{i}} + \frac{1}{2}\left(y_1 + y_2\right)\hat{\mathbf{j}}$

d. $\vec{\mathbf{A}} = \frac{1}{2}\left(x_1 + x_2\right)\hat{\mathbf{i}} + \frac{1}{2}\left(y_1 + y_2\right)\hat{\mathbf{j}}$

e. $\vec{\mathbf{A}} = \frac{1}{2}\left(x_1 + x_2\right)\hat{\mathbf{i}}$

ANS: D PTS: 2 DIF: Average

27. Given that $\vec{\mathbf{A}} + \vec{\mathbf{B}} = x_1\hat{\mathbf{i}} + y_1\hat{\mathbf{j}}$ and $\vec{\mathbf{A}} - \vec{\mathbf{B}} = x_2\hat{\mathbf{i}} + y_2\hat{\mathbf{j}}$, what is $\vec{\mathbf{B}}$?

a. $\vec{\mathbf{B}} = \frac{1}{2}\left(x_1 - x_2\right)\hat{\mathbf{i}} + \frac{1}{2}\left(y_1 - y_2\right)\hat{\mathbf{j}}$

b. $\vec{\mathbf{B}} = \frac{1}{2}\left(x_1 + x_2\right)\hat{\mathbf{i}} + \frac{1}{2}\left(y_1 - y_2\right)\hat{\mathbf{j}}$

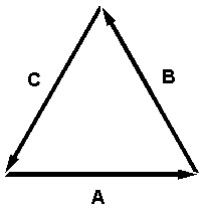
c. $\vec{\mathbf{B}} = \frac{1}{2}\left(x_1 - x_2\right)\hat{\mathbf{i}} + \frac{1}{2}\left(y_1 + y_2\right)\hat{\mathbf{j}}$

d. $\vec{\mathbf{B}} = \frac{1}{2}\left(x_1 + x_2\right)\hat{\mathbf{i}} + \frac{1}{2}\left(y_1 + y_2\right)\hat{\mathbf{j}}$

e. $\vec{\mathbf{B}} = \frac{1}{2}\left(y_1 - y_2\right)\hat{\mathbf{j}}$

ANS: A PTS: 2 DIF: Average

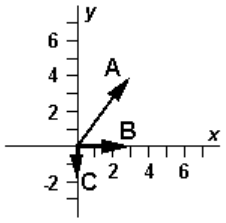
28. The diagram below shows 3 vectors which sum to zero, all of equal length. Which statement below is true?



a. $\vec{A} + \vec{B} = \vec{A} - \vec{C}$
b. $\vec{A} + \vec{B} = \vec{B} - \vec{C}$
c. $\vec{A} - \vec{B} = 2\vec{A} - \vec{C}$
d. $\vec{A} - \vec{B} = 2\vec{A} + \vec{C}$
e. $2\vec{A} + 2\vec{B} = 2\vec{C}$

ANS: D PTS: 1 DIF: Easy

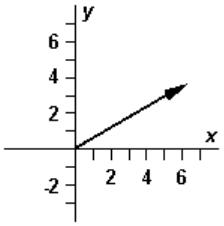
NARRBEGIN: instructions 4
Exhibit 3-3
The vectors $\vec{A}$, $\vec{B}$, and $\vec{C}$ are shown below.



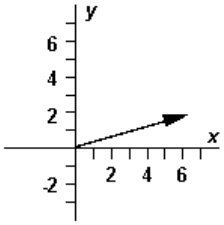
Use this exhibit to answer the following question(s).
NARREND

29. Refer to Exhibit 3-3. Which diagram below correctly represents $\vec{A} + \vec{B} + \vec{C}$?

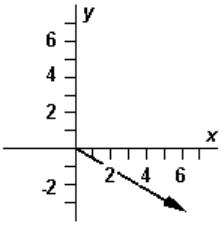
a.



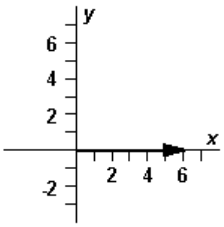
b.



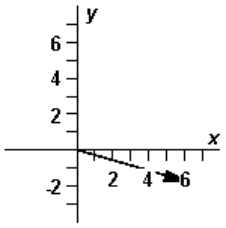
d.



e.



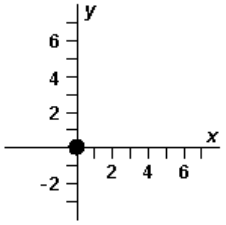
c.



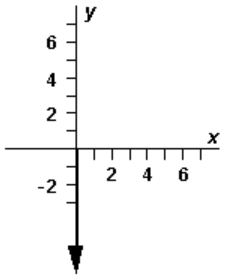
ANS: B PTS: 2 DIF: Average

30. Refer to Exhibit 3-3. Which diagram below correctly represents $\vec{\mathbf{A}} - \vec{\mathbf{B}} + 2\vec{\mathbf{C}}$?

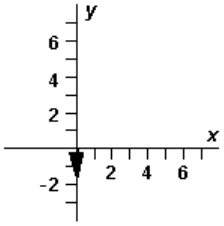
a.



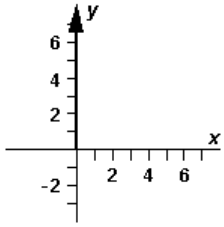
d.



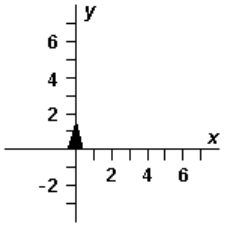
b.



e.



c.



ANS: A PTS: 2 DIF: Average

31. Dana says any vector $\vec{\mathbf{R}}$ can be represented as the sum of two vectors: $\vec{\mathbf{R}} = \vec{\mathbf{A}} + \vec{\mathbf{B}}$. Ardis says any vector $\vec{\mathbf{R}}$ can be represented as the difference of two vectors: $\vec{\mathbf{R}} = \vec{\mathbf{A}} - \vec{\mathbf{B}}$. Which one, if either, is correct?
    a. They are both wrong: every vector is unique.
    b. Dana is correct: Any vector can be represented as a sum of components and not as a difference.
    c. Ardis is correct: Any vector can be represented as a difference of vector components and not as a sum.
    d. They are both correct: A difference of vectors is a sum $\vec{\mathbf{R}} = \vec{\mathbf{A}} + \left(-\vec{\mathbf{B}}\right)$.
    e. They are both wrong: Vectors can be moved as long as they keep the same magnitude and direction.

ANS: D PTS: 2 DIF: Average

32. Anthony has added the vectors listed below and gotten the result $\vec{\mathbf{R}} = 9\hat{\mathbf{i}} + 4\hat{\mathbf{j}} + 6\hat{\mathbf{k}}$. What errors has he made?

$\vec{A} = 3\hat{i} + 4\hat{j} - 5\hat{k}$
$\vec{B} = -3\hat{i} + 2\hat{j} + 8\hat{k}$
$\vec{C} = 3\hat{i} - 2\hat{j} + 2\hat{k}$

a. He lost the minus sign in vector $\vec{B}$.
b. He read the $2\hat{k}$ in $\vec{C}$ as $3\hat{k}$.
c. He lost the minus sign in vector $\vec{A}$.
d. All of the above are correct.
e. Only (a) and (b) above are correct.

ANS: E PTS: 2 DIF: Average

33. Given the statement that $\vec{A} - \vec{B} = -\vec{A} + \vec{C}$, what can we conclude?
a. $\vec{C} = \vec{A}$ and $\vec{B} = \vec{A}$.
b. $2\vec{A} = \vec{B} + \vec{C}$.
c. $\vec{C} = -\vec{B}$ and $-\vec{A} = \vec{A}$.
d. Any one of the answers above is correct.
e. Only (a) and (b) may be correct.

ANS: D PTS: 2 DIF: Average

34. Adding vectors $\vec{A}$ and $\vec{B}$ by the graphical method gives the same result for $\vec{A} + \vec{B}$ and $\vec{B} + \vec{A}$. If both additions are done graphically from the same origin, the resultant is the vector that goes from the tail of the first vector to the tip of the second vector, i.e, it is represented by a diagonal of the parallelogram formed by showing both additions in the same figure. Note that a parallelogram has 2 diagonals. Keara says that the sum of two vectors by the parallelogram method is $\vec{R} = 5\hat{i}$. Shamu says it is $\vec{R} = \hat{i} + 4\hat{j}$. Both used the parallelogram method, but one used the wrong diagonal. Which one of the vector pairs below contains the original two vectors?
a. $\vec{A} = -3\hat{i} - 2\hat{j}$; $\vec{B} = -2\hat{i} - 2\hat{j}$
b. $\vec{A} = +3\hat{i} - 2\hat{j}$; $\vec{B} = -2\hat{i} + 2\hat{j}$
c. $\vec{A} = -3\hat{i} - 2\hat{j}$; $\vec{B} = +2\hat{i} + 2\hat{j}$
d. $\vec{A} = +3\hat{i} - 2\hat{j}$; $\vec{B} = +2\hat{i} - 2\hat{j}$
e. $\vec{A} = +3\hat{i} + 2\hat{j}$; $\vec{B} = -2\hat{i} + 2\hat{j}$

ANS: E PTS: 3 DIF: Challenging

35. Given two non-zero vectors, $\vec{A}$ and $\vec{B}$, such that $\left|\vec{A}\right| = A = B = \left|\vec{B}\right|$, the sum $\vec{A} + \vec{B}$ satisfies
a. $0 \le \left|\vec{A} + \vec{B}\right| \le 2A$.
b. $0 < \left|\vec{A} + \vec{B}\right| < 2A$.
c. $A \le \left|\vec{A} + \vec{B}\right| \le 2A$.
d. $A < \left|\vec{A} + \vec{B}\right| < 2A$.
e. $0 \le \left|\vec{A} + \vec{B}\right| \le 4A$.

ANS: A PTS: 2 DIF: Average

NARRBEGIN: instructions

NOTE: The notation $\vec{\mathbf{A}} = [A, \theta]$ is a shorthand notation for $\vec{\mathbf{A}} = A\cos\theta\hat{\mathbf{i}} + A\sin\theta\hat{\mathbf{j}}$.
NARREND

36. If $\vec{\mathbf{A}} = [15, 80°]$ and $\vec{\mathbf{B}} = 12\hat{\mathbf{i}} - 16\hat{\mathbf{j}}$, what is the magnitude of $\vec{\mathbf{A}} - \vec{\mathbf{B}}$?
    a. 15
    b. 35
    c. 32
    d. 5.0
    e. 23

    ANS: C PTS: 2 DIF: Average

37. If $\vec{\mathbf{C}} = [10 \text{ m}, 30°]$ and $\vec{\mathbf{D}} = [25 \text{ m}, 130°]$, what is the magnitude of the sum of these two vectors?
    a. 20 m
    b. 35 m
    c. 15 m
    d. 25 m
    e. 50 m

    ANS: D PTS: 2 DIF: Average

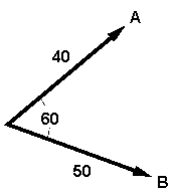
38. If $\vec{\mathbf{C}} = [10 \text{ m}, 30°]$ and $\vec{\mathbf{D}} = [25 \text{ m}, 130°]$, what is the direction of the sum of these two vectors?
    a. 17°
    b. 73°
    c. 107°
    d. 163°
    e. 100°

    ANS: C PTS: 2 DIF: Average

39. If $\vec{\mathbf{C}} = [2.5 \text{ cm}, 80°]$, i.e., the magnitude and direction of $\vec{\mathbf{C}}$ are 2.5 cm and 80°, $\vec{\mathbf{D}} = [3.5 \text{ cm}, 120°]$, and $\vec{\mathbf{E}} = \vec{\mathbf{D}} - 2\vec{\mathbf{C}}$, what is the direction of $\vec{\mathbf{E}}$ (to the nearest degree)?
    a. 247°
    b. 235°
    c. 243°
    d. 216°
    e. 144°

    ANS: D PTS: 3 DIF: Challenging

40. Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are shown. What is the magnitude of a vector $\vec{\mathbf{C}}$ if $\vec{\mathbf{C}} = \vec{\mathbf{A}} - \vec{\mathbf{B}}$?



    a. 46
    b. 10
    c. 30
    d. 78

e. 90

ANS: A PTS: 2 DIF: Average

41. A vector, $\vec{\mathbf{B}}$, when added to the vector $\vec{\mathbf{C}} = 3\hat{\mathbf{i}} + 4\hat{\mathbf{j}}$ yields a resultant vector which is in the positive *y* direction and has a magnitude equal to that of $\vec{\mathbf{C}}$. What is the magnitude of $\vec{\mathbf{B}}$?
a. 3.2
b. 6.3
c. 9.5
d. 18
e. 5

ANS: A PTS: 2 DIF: Average

42. If vector $\vec{\mathbf{B}}$ is added to vector $\vec{\mathbf{A}}$, the result is $6\hat{\mathbf{i}} + \hat{\mathbf{j}}$. If $\vec{\mathbf{B}}$ is subtracted from $\vec{\mathbf{A}}$, the result is $-4\hat{\mathbf{i}} + 7\hat{\mathbf{j}}$. What is the magnitude of $\vec{\mathbf{A}}$?
a. 5.1
b. 4.1
c. 5.4
d. 5.8
e. 8.2

ANS: B PTS: 2 DIF: Average

43. If vector $\vec{\mathbf{C}}$ is added to vector $\vec{\mathbf{B}}$, the result is $-9\hat{\mathbf{i}} - 8\hat{\mathbf{j}}$. If $\vec{\mathbf{B}}$ is subtracted from $\vec{\mathbf{C}}$, the result is $5\hat{\mathbf{i}} + 4\hat{\mathbf{j}}$. What is the direction of $\vec{\mathbf{B}}$ (to the nearest degree)?
a. 225°
b. 221°
c. 230°
d. 236°
e. 206°

ANS: B PTS: 2 DIF: Average

44. A vector $\vec{\mathbf{A}}$ is added to $\vec{\mathbf{B}} = 6\hat{\mathbf{i}} - 8\hat{\mathbf{j}}$. The resultant vector is in the positive *x* direction and has a magnitude equal to $\vec{\mathbf{A}}$. What is the magnitude of $\vec{\mathbf{A}}$?
a. 11
b. 5.1
c. 7.1
d. 8.3
e. 12.2

ANS: D PTS: 3 DIF: Challenging

45. A vector $\vec{\mathbf{A}}$ is added to $\vec{\mathbf{B}} = 6\hat{\mathbf{i}} - 8\hat{\mathbf{j}}$**.** The resultant vector is in the positive *x* direction and has a magnitude equal to that of $\vec{\mathbf{A}}$. What is the direction of $\vec{\mathbf{A}}$?
a. 74°
b. 100°
c. –81°
d. –62°
e. 106°

ANS: A PTS: 3 DIF: Challenging

46. If two collinear vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are added, the resultant has a magnitude equal to 4.0. If $\vec{\mathbf{B}}$ is subtracted from $\vec{\mathbf{A}}$, the resultant has a magnitude equal to 8.0. What is the magnitude of $\vec{\mathbf{B}}$?
a. 2.0
b. 3.0
c. 4.0
d. 5.0
e. 6.0

ANS: A PTS: 1 DIF: Easy

47. If two collinear vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are added, the resultant has a magnitude equal to 4.0. If $\vec{\mathbf{B}}$ is subtracted from $\vec{\mathbf{A}}$, the resultant has a magnitude equal to 8.0. What is the magnitude of $\vec{\mathbf{A}}$?
a. 2.0
b. 3.0
c. 4.0
d. 5.0
e. 6.0

ANS: E PTS: 1 DIF: Easy

48. When vector $\vec{\mathbf{A}}$ is added to vector $\vec{\mathbf{B}}$, which has a magnitude of 5.0, the vector representing their sum is perpendicular to $\vec{\mathbf{A}}$ and has a magnitude that is twice that of $\vec{\mathbf{A}}$. What is the magnitude of $\vec{\mathbf{A}}$?
a. 2.2
b. 2.5
c. 4.5
d. 5.0
e. 7.0

ANS: A PTS: 2 DIF: Average

49. Starting from one oasis, a camel walks 25 km in a direction 30° south of west and then walks 30 km toward the north to a second oasis. What distance separates the two oases?
a. 15 km
b. 48 km
c. 28 km
d. 53 km
e. 55 km

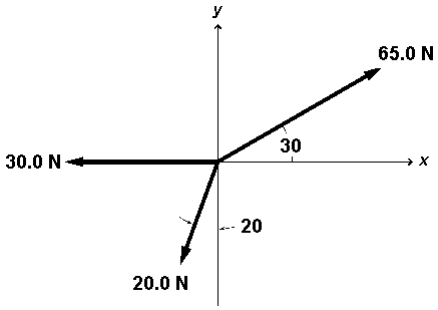
ANS: C PTS: 2 DIF: Average

50. Starting from one oasis, a camel walks 25 km in a direction 30° south of west and then walks 30 km toward the north to a second oasis. What is the direction from the first oasis to the second oasis?
a. 21° N of W
b. 39° W of N
c. 69° N of W
d. 51° W of N
e. 42° W of N

ANS: D PTS: 3 DIF: Challenging

NARRBEGIN: insrtuctions 2
Exhibit 3-1

The three forces shown act on a particle.



Use this exhibit to answer the following question(s)..
NARREND

51. Refer to Exhibit 3-1. What is the magnitude of the resultant of these three forces?
    a. 27.0 N
    b. 33.2 N
    c. 36.3 N
    d. 23.8 N
    e. 105 N

    ANS: D PTS: 2 DIF: Average

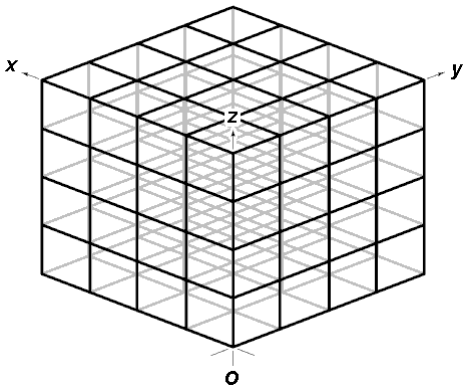
52. Refer to Exhibit 3-1. What is the direction of the resultant of these three forces?
    a. 35°
    b. 45°
    c. 65°
    d. 55°
    e. 85°

    ANS: A PTS: 3 DIF: Challenging

53. If vector $\vec{\mathbf{C}}$ is added to vector $\vec{\mathbf{D}}$, the result is a third vector that is perpendicular to $\vec{\mathbf{D}}$ and has a magnitude equal to $3\vec{\mathbf{D}}$. What is the ratio of the magnitude of $\vec{\mathbf{C}}$ to that of $\vec{\mathbf{D}}$?
    a. 1.8
    b. 2.2
    c. 3.2
    d. 1.3
    e. 1.6

    ANS: C PTS: 2 DIF: Average

NARRBEGIN: instructions 3
Exhibit 3-2
A child starts at one corner of a cubical jungle gym in a playground and climbs up to the diagonally opposite corner. The original corner is the coordinate origin, and the *x*, *y* and *z* axes are oriented along the jungle gym edges. The length of each side is 2 m.



Use this exhibit to answer the following question(s).
NARREND

54. Refer to Exhibit 3-2. The child's displacement is:
    a. $2\hat{\mathbf{i}} + 2\hat{\mathbf{j}} + 2\hat{\mathbf{k}}$
    b. $2.8\hat{\mathbf{i}} + 2.8\hat{\mathbf{j}} + 2\hat{\mathbf{k}}$
    c. $2\hat{\mathbf{i}} + 2\hat{\mathbf{j}} + 2.8\hat{\mathbf{k}}$
    d. $2\hat{\mathbf{i}} + 2\hat{\mathbf{j}} + 3.5\hat{\mathbf{k}}$
    e. $3.5\hat{\mathbf{i}} + 3.5\hat{\mathbf{j}} + 3.5\hat{\mathbf{k}}$

    ANS: A PTS: 1 DIF: Easy

55. Refer to Exhibit 3-2. What is the child's distance from her starting position?
    a. 2.8 m
    b. 3.5 m
    c. 6.0 m
    d. 6.9 m
    e. 12.0 m

    ANS: B PTS: 2 DIF: Average

56. The displacement of the tip of the 10 cm long minute hand of a clock between 12:15 A.M. and 12:45 P.M. is:
    a. 10 cm, 90°
    b. 10 cm, 180°
    c. 10 cm, 4 500°
    d. 20 cm, 180°
    e. 20 cm, 540°

    ANS: D PTS: 1 DIF: Easy

57. A student decides to spend spring break by driving 50 miles due east, then 50 miles 30 degrees south of east, then 50 miles 30 degrees south of that direction, and to continue to drive 50 miles deviating by 30 degrees each time until he returns to his original position. How far will he drive, and how many vectors must he sum to calculate his displacement?
    a. 0, 0
    b. 0, 8
    c. 0, 12
    d. 400 mi, 8
    e. 600 mi, 12

ANS: E PTS: 2 DIF: Average

58. Which statement is true about the unit vectors $\hat{\mathbf{i}}$, $\hat{\mathbf{j}}$ and $\hat{\mathbf{k}}$?
a. Their directions are defined by a left-handed coordinate system.
b. The angle between any two is 90 degrees.
c. Each has a length of 1 m.
d. If $\hat{\mathbf{i}}$ is directed east and $\hat{\mathbf{j}}$ is directed south, $\hat{\mathbf{k}}$ points up out of the surface.
e. All of the above.

ANS: B PTS: 1 DIF: Easy

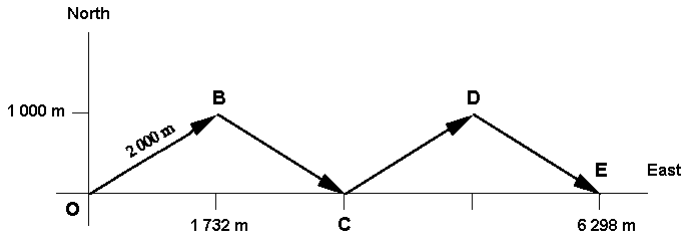
59. Vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ have equal magnitudes. Which statement is always true?
a. $\vec{\mathbf{A}} + \vec{\mathbf{B}} = 0$.
b. $\vec{\mathbf{A}} - \vec{\mathbf{B}} = 0$.
c. $\vec{\mathbf{A}} - \vec{\mathbf{B}}$ is perpendicular to $\vec{\mathbf{A}} + \vec{\mathbf{B}}$.
d. $\vec{\mathbf{B}} - \vec{\mathbf{A}}$ is perpendicular to $\vec{\mathbf{A}} - \vec{\mathbf{B}}$.
e. The magnitude of $\vec{\mathbf{A}} - \vec{\mathbf{B}}$ equals the magnitude of $\vec{\mathbf{A}} + \vec{\mathbf{B}}$.

ANS: C PTS: 3 DIF: Challenging

60. When three vectors, $\vec{\mathbf{A}}$, $\vec{\mathbf{B}}$, and $\vec{\mathbf{C}}$ are placed head to tail, the vector sum $\vec{\mathbf{A}} + \vec{\mathbf{B}} + \vec{\mathbf{C}} = 0$. If the vectors all have the same magnitude, the angle between the directions of any two adjacent vectors is
a. 30°
b. 60°
c. 90°
d. 120°
e. 150°

ANS: D PTS: 1 DIF: Easy

NARRBEGIN: instructions 5
Exhibit 3-4
The diagram below shows the path taken by a sailboat tacking sideways because it cannot sail directly into the wind.



Use this exhibit to answer the following question(s).
NARREND

61. Refer to Exhibit 3-4. The total distance it travels is
a. 1 000 m.
b. 1 732 m.
c. 2 000 m.
d. 6 298 m.
e. 8 000 m.

ANS: E PTS: 1 DIF: Easy

62. Refer to Exhibit 3-4. The total displacement of the sailboat, the vector sum of its displacements **OB**, **BC**, **CD** and **DE**, is
a. 1 732 m, East.
b. 2 000 m, Northeast.
c. 6 298 m, East.
d. 8 000 m, Southeast.
e. 8 000 m, East.

ANS: C PTS: 1 DIF: Easy

63. The vector $\vec{\mathbf{A}}$ has components +5 and +7 along the *x* and *y* axes respectively. Along a set of axes rotated 90 degrees counterclockwise relative to the original axes, the vector's components are
a. –7; –5.
b. 7; –5.
c. –7; 5.
d. 7; 5.
e. 7; 0.

ANS: B PTS: 1 DIF: Easy

64. The vector $\vec{\mathbf{A}}$ has components +5 and +7 along the *x* and *y* axes respectively. If the vector is now rotated 90 degrees counterclockwise relative to the original axes, the vector's components are now
a. –7; –5.
b. 7; –5.
c. –7; 5.
d. 7; 5.
e. 7; 0.

ANS: C PTS: 1 DIF: Easy

65. The rectangular coordinates of a point are (5.00, *y*) and the polar coordinates of this point are (*r*, 67.4°). What is the value of the polar coordinate *r* in this case?
a. 1.92
b. 4.62
c. 12.0
d. 13.0
e. More information is needed.

ANS: D PTS: 2 DIF: Average

66. In what quadrant are both the sine and tangent negative?
a. 1st
b. 2nd
c. 3rd
d. 4th
e. This cannot happen.

ANS: D PTS: 1 DIF: Easy

67. A problem may be solved more easily when alternative representations are used. The best strategy is to formulate representations in an order that assists in understanding the physical principles involved. Of the orders given below, the one that will work best most often is

a. pictorial representation, mathematical representation, tabular representation, mental representation.
b. pictorial representation, mental representation, mathematical representation, tabular representation.
c. mathematical representation, pictorial representation, tabular representation, mental representation.
d. mathematical representation, tabular representation, mental representation, pictorial representation.
e. mental representation, pictorial representation, tabular representation, mathematical representation.

ANS: E PTS: 1 DIF: Easy

PROBLEM

68. The standard kilogram is a platinum-iridium cylinder 39 mm in height and 39 mm in diameter. What is the density of the material?

ANS:
21 475 kg/m^3

PTS: 2 DIF: Average

69. A 2.00 m by 3.00 m plate of aluminum has a mass of 324 kg. What is the thickness of the plate? (The density of aluminum is 2.70×10^3 kg/m^3.)

ANS:
2.00 cm

PTS: 2 DIF: Average

70. What is the mass of air in a room that measures 5.0 m × 8.0 m × 3.0 m? (The density of air is 1/800 that of water).

ANS:
150 kg

PTS: 2 DIF: Average

71. The basic function of a carburetor of an automobile is to atomize the gasoline and mix it with air to promote rapid combustion. As an example, assume that 30 cm^3 of gasoline is atomized into N spherical droplets, each with a radius of 2.0×10^{-5} m. What is the total surface area of these N spherical droplets?

ANS:
45 000 cm^2

PTS: 3 DIF: Challenging

72. Two vectors starting at the same origin have equal and opposite *x* components. Is it possible for the two vectors to be perpendicular to each other? Justify your answer.

ANS:

Yes. If the *y* components are of the right magnitudes, the angle can be 90 degrees. (This will occur if $\theta_2 = \theta_1 + \frac{\pi}{2}$ and $A = B \tan \theta_1$.)

PTS: 3 DIF: Challenging

73. A vector starts at coordinate (3.0, 4.0) and ends at coordinate (–2.0, 16.0). What are the magnitude and direction of this vector?

ANS:
13.0 m, 113°.

PTS: 2 DIF: Average

74. What two vectors are each the same magnitude as and perpendicular to $7\hat{\mathbf{i}} + 24\hat{\mathbf{j}}$?

ANS:
$-24\hat{\mathbf{i}} + 7\hat{\mathbf{j}}$ and $24\hat{\mathbf{i}} - 7\hat{\mathbf{j}}$.

PTS: 3 DIF: Challenging