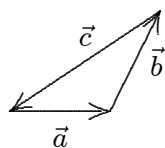


Chapter 3: VECTORS

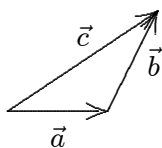
1. We say that the displacement of a particle is a vector quantity. Our best justification for this assertion is:
- A. displacement can be specified by a magnitude and a direction
 - B. operating with displacements according to the rules for manipulating vectors leads to results in agreement with experiments
 - C. a displacement is obviously not a scalar
 - D. displacement can be specified by three numbers
 - E. displacement is associated with motion

ans: B

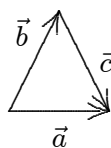
2. The vectors $\vec{a}$, $\vec{b}$, and $\vec{c}$ are related by $\vec{c} = \vec{b} - \vec{a}$. Which diagram below illustrates this relationship?



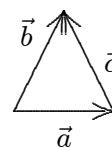
A



B



C



D

- E. None of these

ans: D

3. A vector of magnitude 3 CANNOT be added to a vector of magnitude 4 so that the magnitude of the resultant is:
- A. zero
 - B. 1
 - C. 3
 - D. 5
 - E. 7

ans: A

4. A vector of magnitude 20 is added to a vector of magnitude 25. The magnitude of this sum might be:
- A. zero
 - B. 3
 - C. 12
 - D. 47
 - E. 50

ans: C

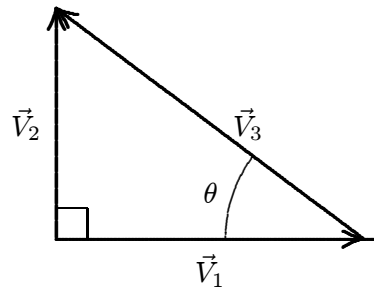
5. A vector $\vec{S}$ of magnitude 6 and another vector $\vec{T}$ have a sum of magnitude 12. The vector $\vec{T}$:
- A. must have a magnitude of at least 6 but no more than 18
 - B. may have a magnitude of 20
 - C. cannot have a magnitude greater than 12
 - D. must be perpendicular to $\vec{S}$
 - E. must be perpendicular to the vector sum

ans: A

6. The vector $-\vec{A}$ is:
- A. greater than $\vec{A}$ in magnitude
 - B. less than $\vec{A}$ in magnitude
 - C. in the same direction as $\vec{A}$
 - D. in the direction opposite to $\vec{A}$
 - E. perpendicular to $\vec{A}$

ans: D

7. The vector $\vec{V}_3$ in the diagram is equal to:



- A. $\vec{V}_1 - \vec{V}_2$
- B. $\vec{V}_1 + \vec{V}_2$
- C. $\vec{V}_2 - \vec{V}_1$
- D. $\vec{V}_1 \cos \theta$
- E. $\vec{V}_1 / (\cos \theta)$

ans: C

8. If $|\vec{A} + \vec{B}|^2 = A^2 + B^2$, then:
- A. $\vec{A}$ and $\vec{B}$ must be parallel and in the same direction
 - B. $\vec{A}$ and $\vec{B}$ must be parallel and in opposite directions
 - C. either $\vec{A}$ or $\vec{B}$ must be zero
 - D. the angle between $\vec{A}$ and $\vec{B}$ must be 60°
 - E. none of the above is true

ans: E

9. If $|\vec{A} + \vec{B}| = A + B$ and neither $\vec{A}$ nor $\vec{B}$ vanish, then:

- A. $\vec{A}$ and $\vec{B}$ are parallel and in the same direction
- B. $\vec{A}$ and $\vec{B}$ are parallel and in opposite directions
- C. the angle between $\vec{A}$ and $\vec{B}$ is 45°
- D. the angle between $\vec{A}$ and $\vec{B}$ is 60°
- E. $\vec{A}$ is perpendicular to $\vec{B}$

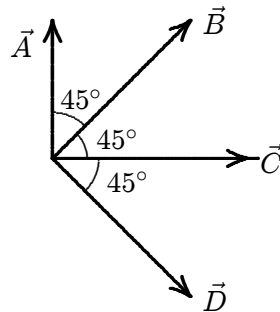
ans: A

10. If $|\vec{A} - \vec{B}| = A + B$ and neither $\vec{A}$ nor $\vec{B}$ vanish, then:

- A. $\vec{A}$ and $\vec{B}$ are parallel and in the same direction
- B. $\vec{A}$ and $\vec{B}$ are parallel and in opposite directions
- C. the angle between $\vec{A}$ and $\vec{B}$ is 45°
- D. the angle between $\vec{A}$ and $\vec{B}$ is 60°
- E. $\vec{A}$ is perpendicular to $\vec{B}$

ans: B

11. Four vectors $(\vec{A}, \vec{B}, \vec{C}, \vec{D})$ all have the same magnitude. The angle θ between adjacent vectors is 45° as shown. The correct vector equation is:



- A. $\vec{A} - \vec{B} - \vec{C} + \vec{D} = 0$
- B. $\vec{B} + \vec{D} - \sqrt{2}\vec{C} = 0$
- C. $\vec{A} + \vec{B} = \vec{B} + \vec{D}$
- D. $\vec{A} + \vec{B} + \vec{C} + \vec{D} = 0$
- E. $(\vec{A} + \vec{C})/\sqrt{2} = -\vec{B}$

ans: B

12. Vectors $\vec{A}$ and $\vec{B}$ lie in the xy plane. We can deduce that $\vec{A} = \vec{B}$ if:

- A. $A_x^2 + A_y^2 = B_x^2 + B_y^2$
- B. $A_x + A_y = B_x + B_y$
- C. $A_x = B_x$ and $A_y = B_y$
- D. $A_y/A_x = B_y/B_x$
- E. $A_x = A_y$ and $B_x = B_y$

ans: C

13. A vector has a magnitude of 12. When its tail is at the origin it lies between the positive x axis and the negative y axis and makes an angle of 30° with the x axis. Its y component is:
- A. $6/\sqrt{3}$
 - B. $-6\sqrt{3}$
 - C. 6
 - D. -6
 - E. 12

ans: D

14. If the x component of a vector $\vec{A}$, in the xy plane, is half as large as the magnitude of the vector, the tangent of the angle between the vector and the x axis is:
- A. $\sqrt{3}$
 - B. $1/2$
 - C. $\sqrt{3}/2$
 - D. $3/2$
 - E. 3

ans: D

15. If $\vec{A} = (6\text{ m})\hat{i} - (8\text{ m})\hat{j}$ then $4\vec{A}$ has magnitude:
- A. 10 m
 - B. 20 m
 - C. 30 m
 - D. 40 m
 - E. 50 m

ans: D

16. A vector has a component of 10 m in the $+x$ direction, a component of 10 m in the $+y$ direction, and a component of 5 m in the $+z$ direction. The magnitude of this vector is:
- A. zero
 - B. 15 m
 - C. 20 m
 - D. 25 m
 - E. 225 m

ans: B

17. Let $\vec{V} = (2.00\text{ m})\hat{i} + (6.00\text{ m})\hat{j} - (3.00\text{ m})\hat{k}$. The magnitude of $\vec{V}$ is:
- A. 5.00 m
 - B. 5.57 m
 - C. 7.00 m
 - D. 7.42 m
 - E. 8.54 m

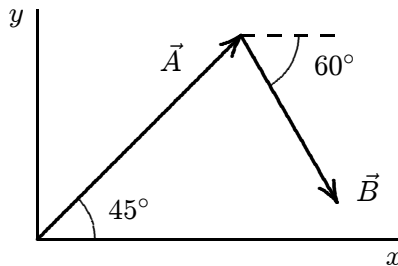
ans: C

18. A vector in the xy plane has a magnitude of 25 m and an x component of 12 m. The angle it makes with the positive x axis is:
- A. 26°
 - B. 29°
 - C. 61°
 - D. 64°
 - E. 241°
- ans: C
19. The angle between $\vec{A} = (25 \text{ m})\hat{i} + (45 \text{ m})\hat{j}$ and the positive x axis is:
- A. 29°
 - B. 61°
 - C. 151°
 - D. 209°
 - E. 241°
- ans: B
20. The angle between $\vec{A} = (-25 \text{ m})\hat{i} + (45 \text{ m})\hat{j}$ and the positive x axis is:
- A. 29°
 - B. 61°
 - C. 119°
 - D. 151°
 - E. 209°
- ans: C
21. Let $\vec{A} = (2 \text{ m})\hat{i} + (6 \text{ m})\hat{j} - (3 \text{ m})\hat{k}$ and $\vec{B} = (4 \text{ m})\hat{i} + (2 \text{ m})\hat{j} + (1 \text{ m})\hat{k}$. The vector sum $\vec{S} = \vec{A} + \vec{B}$ is:
- A. $(6 \text{ m})\hat{i} + (8 \text{ m})\hat{j} - (2 \text{ m})\hat{k}$
 - B. $(-2 \text{ m})\hat{i} + (4 \text{ m})\hat{j} - (4 \text{ m})\hat{k}$
 - C. $(2 \text{ m})\hat{i} - (4 \text{ m})\hat{j} + (4 \text{ m})\hat{k}$
 - D. $(8 \text{ m})\hat{i} + (12 \text{ m})\hat{j} - (3 \text{ m})\hat{k}$
 - E. none of these
- ans: A
22. Let $\vec{A} = (2 \text{ m})\hat{i} + (6 \text{ m})\hat{j} - (3 \text{ m})\hat{k}$ and $\vec{B} = (4 \text{ m})\hat{i} + (2 \text{ m})\hat{j} + (1 \text{ m})\hat{k}$. The vector difference $\vec{D} = \vec{A} - \vec{B}$ is:
- A. $(6 \text{ m})\hat{i} + (8 \text{ m})\hat{j} - (2 \text{ m})\hat{k}$
 - B. $(-2 \text{ m})\hat{i} + (4 \text{ m})\hat{j} - (4 \text{ m})\hat{k}$
 - C. $(2 \text{ m})\hat{i} - (4 \text{ m})\hat{j} + (4 \text{ m})\hat{k}$
 - D. $(8 \text{ m})\hat{i} + (12 \text{ m})\hat{j} - (3 \text{ m})\hat{k}$
 - E. none of these
- ans: B

23. If $\vec{A} = (2\text{ m})\hat{i} - (3\text{ m})\hat{j}$ and $\vec{B} = (1\text{ m})\hat{i} - (2\text{ m})\hat{j}$, then $\vec{A} - 2\vec{B} =$
- A. $(1\text{ m})\hat{j}$
 - B. $(-1\text{ m})\hat{j}$
 - C. $(4\text{ m})\hat{i} - (7\text{ m})\hat{j}$
 - D. $(4\text{ m})\hat{i} + (1\text{ m})\hat{j}$
 - E. $(-4\text{ m})\hat{i} + (7\text{ m})\hat{j}$

ans: A

24. In the diagram, $\vec{A}$ has magnitude 12 m and $\vec{B}$ has magnitude 8 m. The x component of $\vec{A} + \vec{B}$ is about:



- A. 5.5 m
- B. 7.6 m
- C. 12 m
- D. 14 m
- E. 15 m

ans: C

25. A certain vector in the xy plane has an x component of 4 m and a y component of 10 m. It is then rotated in the xy plane so its x component is doubled. Its new y component is about:
- A. 20 m
 - B. 7.2 m
 - C. 5.0 m
 - D. 4.5 m
 - E. 2.2 m

ans: B

26. Vectors $\vec{A}$ and $\vec{B}$ each have magnitude L . When drawn with their tails at the same point, the angle between them is 30° . The value of $\vec{A} \cdot \vec{B}$ is:
- A. zero
 - B. L^2
 - C. $\sqrt{3}L^2/2$
 - D. $2L^2$
 - E. none of these

ans: C

27. Let $\vec{A} = (2\text{ m})\hat{i} + (6\text{ m})\hat{j} - (3\text{ m})\hat{k}$ and $\vec{B} = (4\text{ m})\hat{i} + (2\text{ m})\hat{j} + (1\text{ m})\hat{k}$. Then $\vec{A} \cdot \vec{B} =$
- $(8\text{ m})\hat{i} + (12\text{ m})\hat{j} - (3\text{ m})\hat{k}$
 - $(12\text{ m})\hat{i} - (14\text{ m})\hat{j} - (20\text{ m})\hat{k}$
 - 23 m^2
 - 17 m^2
 - none of these
- ans: D
28. Two vectors have magnitudes of 10 m and 15 m. The angle between them when they are drawn with their tails at the same point is 65° . The component of the longer vector along the line of the shorter is:
- 0
 - 4.2 m
 - 6.3 m
 - 9.1 m
 - 14 m
- ans: C
29. Let $\vec{S} = (1\text{ m})\hat{i} + (2\text{ m})\hat{j} + (2\text{ m})\hat{k}$ and $\vec{T} = (3\text{ m})\hat{i} + (4\text{ m})\hat{k}$. The angle between these two vectors is given by:
- $\cos^{-1}(14/15)$
 - $\cos^{-1}(11/225)$
 - $\cos^{-1}(104/225)$
 - $\cos^{-1}(11/15)$
 - cannot be found since $\vec{S}$ and $\vec{T}$ do not lie in the same plane
- ans: D
30. Two vectors lie with their tails at the same point. When the angle between them is increased by 20° their scalar product has the same magnitude but changes from positive to negative. The original angle between them was:
- 0
 - 60°
 - 70°
 - 80°
 - 90°
- ans: D
31. If the magnitude of the sum of two vectors is less than the magnitude of either vector, then:
- the scalar product of the vectors must be negative
 - the scalar product of the vectors must be positive
 - the vectors must be parallel and in opposite directions
 - the vectors must be parallel and in the same direction
 - none of the above
- ans: A

32. If the magnitude of the sum of two vectors is greater than the magnitude of either vector, then:
- the scalar product of the vectors must be negative
 - the scalar product of the vectors must be positive
 - the vectors must be parallel and in opposite directions
 - the vectors must be parallel and in the same direction
 - none of the above
- ans: E
33. Vectors $\vec{A}$ and $\vec{B}$ each have magnitude L . When drawn with their tails at the same point, the angle between them is 60° . The magnitude of the vector product $\vec{A} \times \vec{B}$ is:
- $L^2/2$
 - L^2
 - $\sqrt{3}L^2/2$
 - $2L^2$
 - none of these
- ans: C
34. Two vectors lie with their tails at the same point. When the angle between them is increased by 20° the magnitude of their vector product doubles. The original angle between them was about:
- 0
 - 18°
 - 25°
 - 45°
 - 90°
- ans: B
35. Two vectors have magnitudes of 10 m and 15 m. The angle between them when they are drawn with their tails at the same point is 65° . The component of the longer vector along the line perpendicular to the shorter vector, in the plane of the vectors, is:
- 0
 - 4.2 m
 - 6.3 m
 - 9.1 m
 - 14 m
- ans: E
36. The two vectors $(3\text{ m})\hat{i} - (2\text{ m})\hat{j}$ and $(2\text{ m})\hat{i} + (3\text{ m})\hat{j} - (2\text{ m})\hat{k}$ define a plane. It is the plane of the triangle with both tails at one vertex and each head at one of the other vertices. Which of the following vectors is perpendicular to the plane?
- $(4\text{ m})\hat{i} + (6\text{ m})\hat{j} + (13\text{ m})\hat{k}$
 - $(-4\text{ m})\hat{i} + (6\text{ m})\hat{j} + (13\text{ m})\hat{k}$
 - $(4\text{ m})\hat{i} - (6\text{ m})\hat{j} + (13\text{ m})\hat{k}$
 - $(4\text{ m})\hat{i} + (6\text{ m})\hat{j} - (13\text{ m})\hat{k}$
 - $(4\text{ m})\hat{i} + (6\text{ m})\hat{j}$
- ans: A

37. Let $\vec{R} = \vec{S} \times \vec{T}$ and $\theta \neq 90^\circ$, where θ is the angle between $\vec{S}$ and $\vec{T}$ when they are drawn with their tails at the same point. Which of the following is NOT true?

A. $|\vec{R}| = |\vec{S}||\vec{T}|\sin\theta$

B. $-\vec{R} = \vec{T} \times \vec{S}$

C. $\vec{R} \cdot \vec{S} = 0$

D. $\vec{R} \cdot \vec{T} = 0$

E. $\vec{S} \cdot \vec{T} = 0$

ans: E

38. The value of $\hat{i} \cdot (\hat{j} \times \hat{k})$ is:

A. zero

B. +1

C. -1

D. 3

E. $\sqrt{3}$

ans: B

39. The value of $\hat{k} \cdot (\hat{k} \times \hat{i})$ is:

A. zero

B. +1

C. -1

D. 3

E. $\sqrt{3}$

ans: A