Indicate the answer choice that best completes the statement or answers the question.

1. Consider vectors $\mathbf{u} = \langle 1, 7 \rangle$ and $\mathbf{v} = \langle 3, -4 \rangle$. Write \mathbf{u} as the sum of two orthogonal vectors, one of which is the projection of \mathbf{u} onto \mathbf{v} .

Class:

a. <-3, 4> b. <-3, 4>, <6, -8> c. <-3, 4>, <4, 3> d. <4, 3>

2. Find the angle θ between $\mathbf{u} = \langle 7, 7 \rangle$ and $\mathbf{v} = \langle -4, 7 \rangle$.

a. 164.7° b. 74.7° c. 15.3° d. 105.3°

3. Find the area of the parallelogram with adjacent sides $\mathbf{u} = -6\mathbf{i} + 6\mathbf{j} + \mathbf{k}$ and $\mathbf{v} = 3\mathbf{i} - \mathbf{j} - \mathbf{k}$.

| a. about 3.7 square units | b. about 6.7 square units |
|----------------------------|----------------------------|
| c. about 26.6 square units | d. about 13.3 square units |

4. Find the dot product of $\mathbf{u} = \langle -7, -6, -4 \rangle$ and $\mathbf{v} = \langle -4, -8, 1 \rangle$. Are \mathbf{u} and \mathbf{v} orthogonal?

| a. 72; orthogonal | b. 72; not orthogonal |
|---------------------|-------------------------|
| c. –462; orthogonal | d. –462; not orthogonal |

5. Find the direction angle of $2\mathbf{i} + 12\mathbf{j}$.

a. 88.10° b. 260.54° c. 170.54° d. 80.54°

6. Find the dot product of $\mathbf{u} = \langle -10, -2, 6 \rangle$ and $\mathbf{v} = \langle 6, -4, 7 \rangle$. Are \mathbf{u} and \mathbf{v} orthogonal?

| a. -10 ; not orthogonal | b. –10; orthogonal |
|---------------------------|------------------------|
| c. 312; orthogonal | d. 312; not orthogonal |

7. While moving, Jacob pushes a dolly up a ramp with a constant force of 85 N. If the ramp has an incline of 10° with the horizontal, what amount of work (in joules) will Jacob have do to push the dolly 30 meters?

| a. about 443 joules | b. about 2511 joules |
|---------------------|----------------------|
| c. about 436 joules | d. about 2550 joules |

8. Find the volume of the parallelepiped with adjacent edges $\mathbf{t} = 9\mathbf{j} - 6\mathbf{j} + 2\mathbf{k}$, $\mathbf{u} = \mathbf{i} - \mathbf{j} + 3\mathbf{k}$ and $\mathbf{v} = -2\mathbf{i} - 10\mathbf{j} + 5\mathbf{k}$.

| a. 209 cubic units | b. 53 cubic units |
|--------------------|--------------------|
| c. 11 cubic units | d. 267 cubic units |

Date:

9. Find a unit vector **u** with the same direction as $\mathbf{x} = <12, 9>$.

$$\begin{array}{ll} a. & \frac{3}{<5}, \frac{4}{5} \\ c. & \frac{5}{<13}, \frac{12}{13} \\ \end{array} & \begin{array}{ll} b. & \frac{4}{<5}, \frac{3}{5} \\ d. & \frac{4}{<7}, \frac{3}{7} \\ \end{array} \\ \end{array}$$

10. An airplane is traveling due east with a velocity of 544 miles per hour. The wind blows at 67 miles per hour at an angle of $S74^{\circ}E$. What is the resultant speed and direction of the plane?

a. 611.4 miles per hour; S6.0°E
b. 608.7 miles per hour; S88.3°E
c. 566.1 miles per hour; S83.5°E
d. 614.4 miles per hour; S1.7°E

11. Use a ruler to determine which of the following descriptions corresponds to the arrow diagram shown below.



a. g = 2.6 meters per second at a true bearing of 120°
b. g = 260 meters per second at a true bearing of 120°
c. g = 2.6 meters per second at a bearing of N30°W
d. g = 260 meters per second at a bearing of N30°W

12. Which of the following vectors is shown in the graph below?



Name:

13. Which of the following points is shown in the graph below?



14. Given vectors $\mathbf{a} = \langle 7, -2 \rangle$ and $\mathbf{b} = \langle 5, 4 \rangle$, find $3\mathbf{a} - 2\mathbf{b}$.

| a. <-12, -8> | b. <16, -18> |
|--------------|--------------|
| c. <11, -14> | d. <10, -13> |

15. A commercial passenger jet is flying with an airspeed of 170 miles per hour on a heading of 048° . If a 28-mile-perhour wind is blowing from a true heading of 134° , determine the velocity and direction of the jet relative to the ground.

| a. | 171.3 mph, 039° | b. 170.4 mph, 039° |
|----|-----------------|--------------------|
| c. | 170.4 mph, 077° | d. 174.2 mph, 077° |

16. Which of the following vectors is shown in the graph below?



 $\begin{array}{ll} a. \left< 5, 3, 2 \right> & b. \left< -5, -3, 2 \right> \\ c. \left< 5, -3, -2 \right> & d. \left< 5, -3, 2 \right> \end{array}$

17. Find the magnitude of \overrightarrow{WX} for W(-4, 9, -1) and X(9, -8, -2).

a. 451 b. $3\sqrt{51}$ c. $\sqrt{451}$ d. 454

18. Find the length and midpoint of the segment with the given endpoints.

(-9, -9, 10), (5, -4, 10)

a. 24.19, (-2, -6.5, 10) b. 14.87, (-2, -2.5, 10) c. 14.87, (-2, -6.5, 10) d. 24.19, (-2, -6.5, 0)

19. Find the magnitude of \overrightarrow{AB} with initial point A(-1, 1) and terminal point B(1, -1).

| a. √8 ≈ 2.8284 | b. √4 ≈ 0.8284 |
|-----------------|---------------------------|
| c. √15 ≈ 4.8284 | d. √10 ≈ 3.8284 |

20. Which of the following represents a vector quantity?

a. an athlete running 5.1 meters per second

- b. a car traveling at a speed of 57 miles per hour
- c. wind blowing at 3 knots
- d. a skydiver falling straight down at 58 kilometers per hour

21. A commercial passenger jet is flying with an airspeed of 131 knots on a heading of 050° . If a 92-knot wind is blowing from a true heading of 125° , determine the velocity and direction of the jet relative to the ground.

| a. | 139.2 knots, 035° | b. 139.2 knots, 010° |
|----|-------------------|----------------------|
| c. | 178.5 knots, 035° | d. 150 knots, 010° |

22. Find the component form of \overrightarrow{AB} with initial point A(-8, -1) and terminal point B(7, 5).

a. <5, 17> b. <15, 6> c. <16, 5> d. <16, 11>

23. Use a ruler to determine which of the following descriptions corresponds to the arrow diagram shown below.

Class:



1 in.: 60 lb

a. $\mathbf{k} = 68$ pounds of force at 80° to the horizontal

b. $\mathbf{k} = 60$ pounds of force at 80° to the horizontal

c. $\mathbf{k} = 68$ pounds of force at a true bearing of 80°

d. $\mathbf{k} = 72$ pounds of force at a bearing of 080°

24. Find the magnitude of the horizontal and vertical components of a force of 459 newtons at a bearing of 56° from the horizontal. Round to the nearest whole number.

- a. horizontal component: 257 N, vertical component: 202 N
- b. horizontal component: 381 N, vertical component: 78 N
- c. horizontal component: 257 N, vertical component: 381 N
- d. horizontal component: 381 N, vertical component: 257 N

25. Use a ruler to determine which of the following descriptions corresponds to the arrow diagram shown below.



a. s = 5 feet per second at a true bearing of 210°

- b. s = 8 feet per second 210° to the horizontal
- c. s = 8 feet per second at a true bearing of 210°
- d. s = 5 feet per second 210° to the horizontal

26. Find the resultant of the pair of vectors shown below. State the magnitude of the resultant in centimeters and its direction relative to the horizontal.



27. Which of the following points is shown in the graph below?



28. Find the magnitude of the horizontal and vertical components of a velocity of 18 miles per hour at an angle of 42° with the ground. Round to the nearest whole number.

a. horizontal component: 13 mph, vertical component: 49 mph

b. horizontal component: 13 mph, vertical component: 12 mph

c. horizontal component: 12 mph, vertical component: 13 mph

d. horizontal component: 63 mph, vertical component: 12 mph

29. Which of the following points is shown in the graph below?

- a. (-5, 2, 3) b. (-5, 2, -3) c. (5, 2, -3) d. (-5, -2, -3)
- 30. Find the cross product $<-6, 2, -9 > \times <-1, -3, 8 >$. Is the resulting vector perpendicular to the given vectors?

a. <59, 20, -17>; yes b. <-11, 57, 20>; yes c. <-17, 57, 59>; no d. <-17, 59, 26>; no

31. Given vectors $\mathbf{u} = \langle 6, 1 \rangle$ and $\mathbf{v} = \langle -4, 2 \rangle$, find $3\mathbf{u} - 2\mathbf{v}$.

a. <9, 5> b. <31, 3> c. <26, -1> d. <25, 0>

32. Use a metric ruler and a protractor to find $\vec{a} + 2\vec{b}$. Then find the magnitude and amplitude of the resultant.

b, 135°

a. 7.4 cm, 15° b. 4.4 cm, 13° c. 2.4 cm, 8° d. 6.4 cm, 18°

33. Find the resultant of the pair of vectors shown below. State the magnitude of the resultant in centimeters and its direction relative to the horizontal.



c. 3.8 cm, 212° d. 3.8 cm, 58°

34. Which of the following vectors is shown in the graph below?



35. Find the magnitude of \overrightarrow{AB} with initial point A(-2, 1) and terminal point B(-1, 6).

a. $\sqrt{22} \approx 3.099$ b. $\sqrt{33} \approx 7.099$ c. $\sqrt{28} \approx 6.099$ d. $\sqrt{26} \approx 5.099$

36. Use a ruler to determine which of the following descriptions corresponds to the arrow diagram shown below.



- b. b = 118 pounds of force at a bearing of 060°
- c. $\mathbf{b} = 118$ pounds of force at 60° to the horizontal
- d. $\mathbf{b} = 25$ pounds of force N60°E
- 37. Which of the following points is shown in the graph below?



38. Find the resultant of the pair of vectors shown below. State the magnitude of the resultant in centimeters and its direction relative to the horizontal.



a. 1.7 cm, 47° b. 5.4 cm, 313° c. 1.7 cm, 47° d. 1.7 cm, 313°

39. Use a metric ruler and a protractor to find $\vec{a} - 2\vec{b}$. Then find the magnitude and amplitude of the resultant.

Class:

135° a. 2.4 cm, 8° b. 4.4 cm, 13°

c. 6.4 cm, 18° d. 7.4 cm, 15°

40. An airplane is taking off headed due north with an air speed of 150 miles per hour at an angle of 30° relative to the horizontal. The wind is blowing with a velocity of 24 miles per hour at an angle of S57°E. Find a vector that represents the resultant velocity of the plane relative to the point of takeoff. Let **i** point east, **j** point north, and **k** point up.

| a. (0, 150, 61.9) | b. (<mark>150, 61.9, 0</mark>) |
|----------------------|----------------------------------|
| c. (20.1, 116.8, 75) | d. (13.1, 109.8, 75) |

41. Use a ruler to determine which of the following descriptions corresponds to the arrow diagram shown below.



a. $\mathbf{x} = 50$ miles per hour at a bearing of 045°

b. $\mathbf{x} = 170$ miles per hour at a bearing of 045°

c. $\mathbf{x} = 50$ miles per hour at a bearing of S45°E

d. x = 170 miles per hour at a bearing of S45°E

42. Which of the following points is shown in the graph below?



43. Use a metric ruler and a protractor to find $\vec{a} - \vec{b}$. Then find the magnitude and amplitude of the resultant.



d. 7 cm, 38°

c. 2 cm, 31°

44. Use a metric ruler and a protractor to find $2\vec{a} - 2\vec{b}$. Then find the magnitude and amplitude of the resultant.

135°

a. 8 cm, 41° b. 4 cm, 31° c. 9 cm, 38° d. 6 cm, 36°

45. Which of the following vectors is shown in the graph below?



 $\begin{array}{ll} a. \left< -2, -1, -4 \right> & b. \left< -2, 1, -4 \right> \\ c. \left< 2, 1, -4 \right> & d. \left< -2, 1, 4 \right> \end{array}$

46. Find the resultant of the pair of vectors shown below. State the magnitude of the resultant in centimeters and its direction relative to the horizontal.



| a. 4.9 cm, 102° | b. 3.7 cm, 12° |
|-----------------|-----------------|
| c. 4.9 cm, 12° | d. 4.9 cm, 348° |

47. If **u** = <9, -2, -5> and **v** = <-2, 5, 5>, find 3**u** - 2**v**.

| a. <-21, -10, 36> | b. <36, -27, -10> |
|-------------------|-------------------|
| c. <31, -16, -25> | d. <30, -15, -27> |

48. Find the resultant of the pair of vectors shown below. State the magnitude of the resultant in centimeters and its direction relative to the horizontal.

f g

a. 4.0 cm, 210° b. 2.3 cm, 98° c. 2.3 cm, 30° d. 2.3 cm, 210°

49. Use a metric ruler and a protractor to find $-\vec{a} + \vec{b}$. Then find the magnitude and amplitude of the resultant.



c. 4 cm, 216° d. 2 cm, 211°

50. Which of the following vectors is shown in the graph below?





Answer Key

| 1. c | | | |
|-------|--|--|--|
| 2. b | | | |
| 3. d | | | |
| 4. b | | | |
| 5. d | | | |
| б. а | | | |
| 7. b | | | |
| 8. d | | | |
| 9. b | | | |
| 10. b | | | |
| 11. d | | | |
| 12. a | | | |
| 13. b | | | |
| 14. c | | | |
| 15. c | | | |
| 16. d | | | |
| 17. b | | | |
| 18. c | | | |
| 19. a | | | |
| 20. d | | | |
| 21. a | | | |
| 22. b | | | |
| 23. c | | | |
| 24. c | | | |
| | | | |

25. b

| 26. d | | | |
|-------|--|--|--|
| 27. a | | | |
| 28. b | | | |
| 29. b | | | |
| 30. b | | | |
| 31. c | | | |
| 32. c | | | |
| 33. a | | | |
| 34. b | | | |
| 35. d | | | |
| 36. b | | | |
| 37. c | | | |
| 38. d | | | |
| 39. a | | | |
| 40. c | | | |
| 41. d | | | |
| 42. b | | | |
| 43. c | | | |
| 44. b | | | |
| 45. b | | | |
| 46. c | | | |
| 47. c | | | |
| 48. d | | | |
| 49. d | | | |
| 50. a | | | |