2. (1 point)

Find the equation of the sphere if one of its diameters has endpoints (-4, -3, 10) and (-2, 1, 16) which has been normalized so that the coefficient of x^2 is 1.

_____ = 0.

Answer(s) submitted:

- `(x+3)^2 + ( y+1)^2 + (z-13)^2 -14`

(correct)

---

3. (1 point) Find the lengths of the sides of the triangle with the vertices $A(2,-1,4)$, $B(-2,2,8)$, and $C(6,3,7)$.

1. $|AB| =$ _____
2. $|AC| =$ _____
3. $|BC| =$ _____
4. Is $\triangle ABC$ an isosceles triangle? [?/Yes/No]

Answer(s) submitted:

- `sqrt(41)`
- `sqrt(41)`
- `sqrt(66)`
- `Yes`

(correct)

---

4. (2 points) Find the distance from $(-9,7,-14)$ to each of the following:

1. The xy-plane.
Answer: _____
2. The yz-plane.
Answer: _____
3. The xz-plane.
Answer: _____
4. The x-axis.
Answer: _____
5. The y-axis.
Answer: _____
6. The z-axis.
Answer: _____

Answer(s) submitted:

- `14`
- `9`
- `7`
- `sqrt(245)`
- `sqrt(277)`
- `sqrt(130)`

(correct)

---

6. (1 point) **(a)** Find a unit vector from the point $P = (2,2)$ and toward the point $Q = (7,14)$.
$\vec{u} =$ _____
(b) Find a vector of length 39 pointing in the same direction.
$\vec{v} =$ _____

Answer(s) submitted:

- `<5/13, 12/13>`
- `<15, 36>`

(correct)

---

8. (1 point) Find the length of the vectors
(a) $\tilde{i} - 2\tilde{j} + 4\tilde{k}$: length = _____
(b) $2.2\tilde{i} + 1.2\tilde{j} + 0.4\tilde{k}$: length = _____

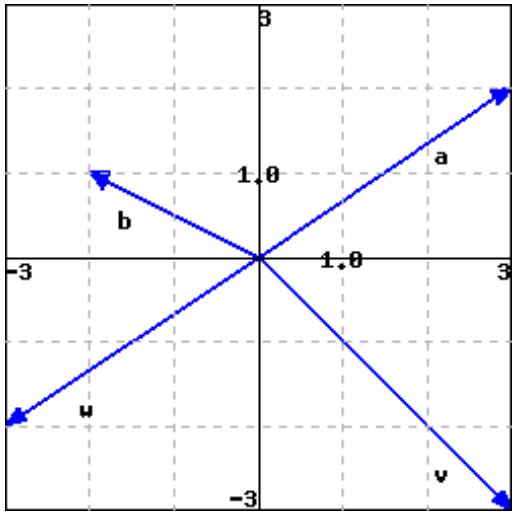
Answer(s) submitted:

- `sqrt(21)`
- `sqrt(6.44)`

(correct)

---

9. (1 point) Resolve the vectors shown in the figure below into components. (Here, the vectors $\vec{i} = \mathbf{i}$ and $\vec{j} = \mathbf{j}$.)



$\vec{a} =$ ___ **i** + ___ **j**
$\vec{b} =$ ___ **i** + ___ **j**
$\vec{v} =$ ___ **i** + ___ **j**
$\vec{w} =$ ___ **i** + ___ **j**

Answer(s) submitted:

- `3`
- `2`
- `-2`
- `1`
- `3`
- `-3`
- `-3`
- `-2`

(correct)

---

10. (1 point) Let $\mathbf{a} = \langle 2, -2, -1 \rangle$ and $\mathbf{b} = \langle 1, 3, -2 \rangle$.
Compute:

$\mathbf{a} + \mathbf{b}$ = (_____,_____,_____)
$\mathbf{a} - \mathbf{b}$ = (_____,_____,_____)
$2\mathbf{a}$ = (_____,_____,_____)
$3\mathbf{a} + 4\mathbf{b}$ = (_____,_____,_____)
$|\mathbf{a}|$ = _____

Answer(s) submitted:

- 3
- 1
- -3
- 1
- -5
- 1
- 4
- -4
- -2
- 10
- 6
- -11
- 3

(correct)

---

11. (1 point)
Let $\mathbf{v} = \vec{PQ}$, where $P = (4, -4), Q = (9, -5)$. Which of the vectors with the following given tails and heads are equivalent to $\mathbf{v}$?

(a)
- Select
- Equivalent
- Not Equivalent

$(2, -5)$, $(-3, -6)$

(b)
- Select
- Equivalent
- Not Equivalent

$(0, 0)$, $(5, -1)$

(c)
- Select
- Equivalent
- Not Equivalent

$(-4, 0)$, $(1, -1)$

(d)
- Select
- Equivalent
- Not Equivalent

$(3, -5)$, $(6, -6)$

Answer(s) submitted:

- Not Equivalent
- Equivalent
- Equivalent
- Not Equivalent

(correct)

---

12. (1 point) Find a vector $\mathbf{a}$ that has the same direction as $\langle -6, 9, 6 \rangle$ but has length 3.
Answer: $\mathbf{a}$ = _____
Answer(s) submitted:

- (3/sqrt(153))<-6,9,6>

(correct)

---

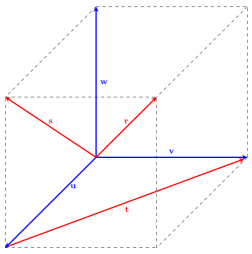
13. (1 point) Find a unit vector that has the same direction as the vector $6\mathbf{i} - \mathbf{j} + 4\mathbf{k}$.
Answer: $\mathbf{u}$ = _____
Answer(s) submitted:

- (1/sqrt(53))<6,-1,4>

(correct)

---

14. (1 point) Below is a diagram of the dotted cube with edges of length 2. Suppose vectors $\mathbf{u} = \langle 2, 0, 0 \rangle$, $\mathbf{v} = \langle 0, 2, 0 \rangle$, and $\mathbf{w} = \langle 0, 0, 2 \rangle$. Find the following vectors.



1. $\mathbf{u} + \mathbf{v} + 2\mathbf{w}$ = _____
2. $\mathbf{t}$ = _____
3. $\mathbf{t} - 2\mathbf{r}$ = _____
4. $\mathbf{u} + \mathbf{v} + \mathbf{w} + \mathbf{r} + \mathbf{s} + \mathbf{t}$ = _____

Note: *You can click on the graph to enlarge the image.*

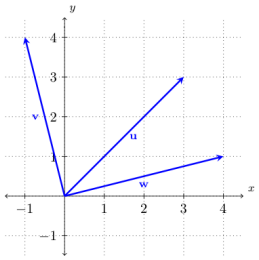
Answer(s) submitted:

- <2,2,4>
- <-2,2,0>
- <-6,-2,-4>
- <4,6,6>

(correct)

---

15. (1 point) Find the following expressions using the graph below of vectors $\mathbf{u}$, $\mathbf{v}$, and $\mathbf{w}$.



1. $\mathbf{u}+\mathbf{v}=$ _____
2. $2\mathbf{u}+\mathbf{w}=$ _____
3. $3\mathbf{v}-6\mathbf{w}=$ _____
4. $|\mathbf{w}|=$ _____

Note: *You can click on the graph to enlarge the image.*

Answer(s) submitted:

- `<2,7>`
- `<10,7>`
- `<-27,6>`
- `sqrt(17)`

(correct)

17. (1 point) A boat is heading due east at 34 km/hr (relative to the water). The current is moving toward the southwest at 13 km/hr.

(1) Give the vector representing the actual movement of the boat.
_____.

(2) How fast is the boat moving, relative to the ground?
_____ km/hr.

(3) By what angle does the current push the boat off its due east course? Your answer should be a positive angle less than π radians.
_____.

Answer(s) submitted:

- `<34-13/sqrt(2), -13/sqrt(2)>`
- `sqrt((34-13/sqrt(2))^2 + (-13/sqrt(2))^2)`
- `0.35486`

(correct)

18. (1 point) Perform the following operations on the vectors $\vec{u}=\langle 2,0,3\rangle$, $\vec{v}=\langle 5,-1,-1\rangle$, and $\vec{w}=\langle -5,5,1\rangle$.

$\vec{u}\cdot\vec{w}=$ _____

$(\vec{u}\cdot\vec{v})\vec{u}=$ _____

$((\vec{w}\cdot\vec{w})\vec{u})\cdot\vec{u}=$ _____

$\vec{u}\cdot\vec{v}+\vec{v}\cdot\vec{w}=$ _____

Answer(s) submitted:

- `-7`
- `<14,0,21>`
- `663`
- `-24`

(correct)

19. (1 point) **Distance and Dot Products:** Consider the vectors

$$\mathbf{u}=\langle -3,10,-5\rangle \text{ and } \mathbf{v}=\langle 5,-1,3\rangle.$$

Compute $\|\mathbf{u}\|=$ _____
Compute $\|\mathbf{v}\|=$ _____
Compute $\mathbf{u}\cdot\mathbf{v}=$ _____

Answer(s) submitted:

- `sqrt(134)`
- `sqrt(35)`
- `-40`

(correct)

20. (1 point)
What is the angle in radians between the vectors
a = (5, 8, 4) and
b = (2, 6, 6)?
Angle: _____ (radians)

Answer(s) submitted:

- `cos^-1 (82/(sqrt(105)sqrt(76)))`

(correct)

21. (1 point)

Find the scalar and vector projection of the vector $\mathbf{b}=\langle 3,1,-1\rangle$ onto the vector $\mathbf{a}=\langle -3,5,-1\rangle$.

Scalar projection (i.e., component): _____
Vector projection $\langle$ _____,_____,_____$\rangle$

Answer(s) submitted:

- `-3/sqrt(35)`
- `9/35`
- `-15/35`
- `3/35`

(correct)

23. (1 point)
A woman exerts a horizontal force of 1 pounds on a box as she pushes it up a ramp that is 1 feet long and inclined at an angle of 30 degrees above the horizontal.
Find the work done on the box.
Work: _____ ft-lb

Answer(s) submitted:

- `sqrt(3)/2`

(correct)

24. (1 point) For what values of b are the vectors $\langle -13, b, 9\rangle$ and $\langle b, b^2, b\rangle$ orthogonal?

Answer (separate with commas) $b =$ _____

Answer(s) submitted:

- `0, 2, -2`

(correct)

25. (1 point) Determine whether the given vectors are *orthogonal* , *parallel* , or *neither* .

- choose one
- Orthogonal
- Parallel
- Neither

1. $\mathbf{v} = \langle 1, 2, -1\rangle$ and $\mathbf{w} = \langle -10, -20, 10\rangle$.

- choose one
- Orthogonal
- Parallel
- Neither

2. $\mathbf{v} = \langle 5, 8, 14\rangle$ and $\mathbf{w} = \langle 8, -5, 0\rangle$.

- choose one
- Orthogonal
- Parallel
- Neither

3. $\mathbf{v} = \langle 10, 20, -30\rangle$ and $\mathbf{w} = \langle -30, 20, 10\rangle$.

Note: *You only have two attempts at this problem.*

Answer(s) submitted:

- `Parallel`
- `Orthogonal`
- `Neither`

(correct)

26. (1 point) Find $\mathbf{a} \cdot \mathbf{b}$ if $|\mathbf{a}| = 10$, $|\mathbf{b}| = 6$, and the angle between $\mathbf{a}$ and $\mathbf{b}$ is $\frac{\pi}{10}$ radians.

$\mathbf{a} \cdot \mathbf{b} =$ _____

Answer(s) submitted:

- `60(cos(pi/10))`

(correct)

27. (1 point) Find the angle θ between the vectors $\mathbf{a} = 5\mathbf{i} - \mathbf{j} - 4\mathbf{k}$ and $\mathbf{b} = 2\mathbf{i} + \mathbf{j} - 3\mathbf{k}$.

Answer (in radians): $\theta =$ _____

Answer(s) submitted:

- `pi/6`

(correct)