

Find each inner product and state whether the vectors are perpendicular. Write *yes* or *no*.

4. $\langle 5, 2 \rangle \cdot \langle -3, 7 \rangle$

5. $\langle -8, 2 \rangle \cdot \langle 4.5, 18 \rangle$

6. $\langle -4, 9, 8 \rangle \cdot \langle 3, 2, -2 \rangle$

Find each inner product and state whether the vectors are perpendicular. Write *yes* or *no*.

11. $\langle 4, 8 \rangle \cdot \langle 6, -3 \rangle$

14. $\langle 7, 2 \rangle \cdot \langle 0, -2 \rangle$

17. $\langle 3, 1, 4 \rangle \cdot \langle 2, 8, -2 \rangle$

12. $\langle 3, 5 \rangle \cdot \langle 4, -2 \rangle$

15. $\langle 8, 4 \rangle \cdot \langle 2, 4 \rangle$

18. $\langle -2, 4, 8 \rangle \cdot \langle 16, 4, 2 \rangle$

13. $\langle 5, -1 \rangle \cdot \langle -3, 6 \rangle$

16. $\langle 4, 9, -3 \rangle \cdot \langle -6, 7, 5 \rangle$

19. $\langle 7, -2, 4 \rangle \cdot \langle 3, 8, 1 \rangle$

20. Find the inner product of \vec{a} and \vec{b} , \vec{b} and \vec{c} , and \vec{a} and \vec{c} if $\vec{a} = \langle 3, 12 \rangle$, $\vec{b} = \langle 8, -2 \rangle$, and $\vec{c} = \langle 3, -2 \rangle$. Are any of the pairs perpendicular? If so, which one(s)?

Use a ruler and a protractor to draw a vector with the given magnitude and direction. Then find the magnitude of the horizontal and vertical components of the vector. (Lesson 8-1)

1. 2.3 centimeters, 46°
2. 27 millimeters, 245°

Write the ordered pair or ordered triple that represents \overline{CD} . Then find the magnitude of \overline{CD} . (Lessons 8-2 and 8-3)

3. $C(-9, 2), D(-4, -3)$
4. $C(3, 7, -1), D(5, 7, 2)$

Find an ordered pair or ordered triple to represent \vec{r} in each equation if $\vec{s} = \langle 4, -3 \rangle$, $\vec{t} = \langle -6, 2 \rangle$, $\vec{u} = \langle 1, -3, -8 \rangle$, and $\vec{v} = \langle 3, 9, -1 \rangle$. (Lessons 8-2 and 8-3)

5. $\vec{r} = \vec{t} - 2\vec{s}$
6. $\vec{r} = 3\vec{u} + \vec{v}$

Find each inner product and state whether the vectors are perpendicular. Write *yes* or *no*. (Lesson 8-4)

7. $\langle 3, 6 \rangle \cdot \langle -4, 2 \rangle$
8. $\langle 3, -2, 4 \rangle \cdot \langle 1, -4, 0 \rangle$

9. Find the cross product $\langle 1, 3, 2 \rangle \times \langle 2, -1, -1 \rangle$. Then verify that the resulting vector is perpendicular to the given vectors. (Lesson 8-4)

10. **Entomology** Suppose the flight of a housefly passed through points at $(2, 0, 4)$ and $(7, 4, 6)$, in which each unit represents a meter. What is the magnitude of the displacement the housefly experienced in traveling between these points? (Lesson 8-3)

47. **SAT/ACT Practice** Let x be an integer greater than 1. What is the least value of x for which $a^2 = b^3 = x$ for some integers a and b ?

A 81 B 64 C 4 D 2 E 9

(A)

Example: Two cowboys have roped a bull. The first pulls with a force of 270 newtons at due north while the second pulls with a force of 360 newtons at due east. What is the resultant force on the bull? What is the direction?

(B)

Two rabbits are fighting over a carrot. The first pulls with a force of 40 newtons at due north while the second pulls with a force of 42 newtons at a direction of 300 degrees. What is the resultant force on the carrot and in what direction will the carrot move?

(C)

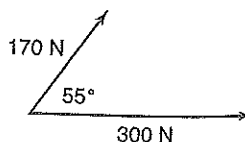
How much work is done is to push a box that weighs 200 lbs a distance of 10 feet along a ramp with an incline of 20 degrees?

(D)

How much work is done is to push a tire that weighs 60 lbs a distance of 100 feet along a ramp with an incline of 33 degrees?

Make a sketch to show the forces acting on a ship traveling at 23 knots at an angle of 17° with the current.

5. Find the magnitude and direction of the resultant vector for the diagram.



6. A 100-newton force and a 50-newton force act on the same object. The angle between the forces measures 90° . Find the magnitude of the resultant force and the angle between the resultant force and the 50-pound force.

Denzel pulls a wagon along level ground with a force of 18 newtons on the handle. If the handle makes an angle of 40° with the horizontal, find the horizontal and vertical components of the force.

8. A 33-newton force at 90° and a 44-newton force at 60° are exerted on an object. What is the magnitude and direction of a third force that produces equilibrium on the object?

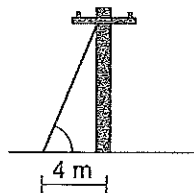
9. **Transportation** Two ferry landings are directly across a river from each other. A ferry that can travel at a speed of 12 miles per hour in still water is attempting to cross directly from one landing to the other. The current of the river is 4 miles per hour.

a. Make a sketch of the situation.

b. If a heading of 0° represents the line between the two landings, at what angle should the ferry's captain head?

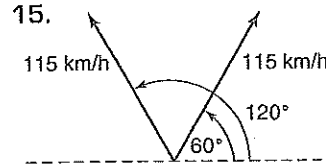
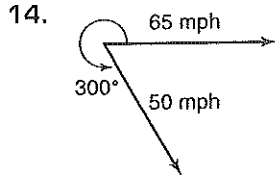
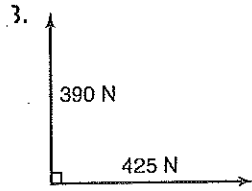
44. Solve $\triangle ABC$ if $A = 36^\circ$, $b = 13$, and $c = 6$. Round angle measures to the nearest minute and side measures to the nearest tenth. (*Lesson 5-8*)

45. **Utilities** A utility pole is braced by a cable attached to it at the top and anchored in a concrete block at ground level, a distance of 4 meters from the base of the pole. If the angle between the cable and the ground is 73° , find the height of the pole and the length of the cable to the nearest tenth of a meter. (*Lesson 5-4*)

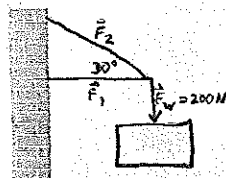


46. Solve $3 + \sqrt{3x - 4} \geq 10$. (*Lesson 4-7*)

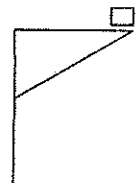
Find the magnitude and direction of the resultant vector for each diagram.



(A) Mr. Davis is hanging a sign for her restaurant. The sign is supported by two lightweight support bars as shown in the diagram. If the bars make a 30° angle with each other, and the sign weighs 200 pounds, what are the magnitudes of the forces exerted by the sign on each support bar?



(B) A box is stored on the ledge of a loft. The box weighs 40 lbs. The ledge is supported by a beam that makes a 45-45-90 degree triangle. Find the forces on the ledge and support beam.



(C) A box is sitting on a an incline of 25 degrees. The box weighs 40 lbs. How much force is required to move the box up the incline?

(D) Your Turn: A can is sitting in a driveway that has an incline of 9 degrees. The can weighs 1 lbs. How much force is required to kick the can up the incline?

16. What would be the force required to push a 100-pound object along a ramp that is inclined 10° with the horizontal?

17. What is the magnitude and direction of the resultant of a 105-newton force along the x -axis and a 110-newton force at an angle of 50° to one another?
18. To keep a 75-pound block from sliding down an incline, a 52.1-pound force is exerted on the block along the incline. Find the angle that the incline makes with the horizontal.
19. Find the magnitude and direction of the resultant of two forces of 250 pounds and 45 pounds at angles of 25° and 250° with the x -axis, respectively.
20. Three forces with magnitudes of 70 pounds, 40 pounds, and 60 pounds act on an object at angles 330° , 45° , and 135° , respectively, with the positive x -axis. Find the direction and magnitude of the resultant of these forces.
21. A 23-newton force acting at 60° above the horizontal and a second 23-newton force acting at 120° above the horizontal act concurrently on a point. What is the magnitude and direction of a third force that produces equilibrium?

22. An object is placed on a ramp and slides to the ground. If the ramp makes an angle of 40° with the ground and the object weighs 25 pounds, find the acceleration of the object. Assume that there is no friction.
23. A force of 36 newtons pulls an object at an angle of 20° north of due east. A second force pulls on the object with a force of 48 newtons at an angle of 42° south of due west. Find the magnitude and direction of the resultant force.
24. Three forces in a plane act on an object. The forces are 70 pounds, 115 pounds and 135 pounds. The 70 pound force is exerted along the positive x -axis. The 115 pound force is applied below the x -axis at a 120° angle with the 70 pound force. The angle between the 115-pound and 135-pound forces is 75° , and between the 135-pound and 70-pound forces is 165° .
- Make a diagram showing the forces.
 - Are the vectors in equilibrium? If not, find the magnitude and the direction of the resultant force.
25. **Physics** While pulling a stalled car, a tow truck's cable makes an angle of 50° above the road. If the tension on the tow truck's cable is 1600 newtons, how much work is done by the truck on the car pulling it 1.5 kilometers down the road?

26. **Critical Thinking** The handle of a lawnmower you are pushing makes an angle of 60° with the ground.
- How could you increase the horizontal forward force you are applying without increasing the total force?
 - What are some of the disadvantages of doing this?

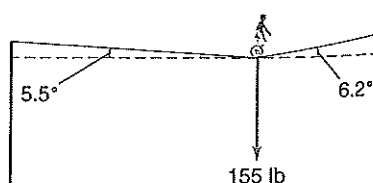
27. **Boating** A sailboat is headed east at 18 mph relative to the water. A current is moving the water south at 3 mph.
- What is the angle of the path of the sailboat?
 - What is the sailboat's speed with respect to the ocean floor?

34. If $A = (12, -5, 18)$ and $B = (0, -11, 21)$, write the ordered triple that represents \overline{AB} . (Lesson 8-3)

33. Find the inner product of \vec{u} and \vec{v} if $\vec{u} = \langle 9, 5, 3 \rangle$ and $\vec{v} = \langle -3, 2, 5 \rangle$. Are the vectors perpendicular? (Lesson 8-4)

28. **Physics** Suzanne is pulling a wagon loaded with gardening bricks totaling 100 kilograms. She is applying a force of 100 newtons on the handle at 25° with the ground. What is the horizontal force on the wagon?

29. **Entertainment** A unicyclist is performing on a tightrope at a circus. The total weight of the performer and her unicycle is 155 pounds. How much tension is being exerted on each part of the cable?



30. **Critical Thinking** Chaz is using a rope tied to his tractor to remove an old tree stump from a field. Which method given below—a or b—will result in the greatest force applied to the stump? Assume that the tractor will exert the same amount of force using either method. Explain your answer.
- Tie the rope to the stump and pull.
 - Tie one end to the stump and the other end to a nearby pole. Then pull on the rope perpendicular to it at a point about halfway between the two.

46. If $\cos \theta = \frac{2}{3}$ and $0^\circ \leq \theta \leq 90^\circ$, find $\sin \theta$. (Lesson 7-1)

31. Travel A cruise ship is arriving at the port of Miami from the Bahamas. Two tugboats are towing the ship to the dock. They exert a force of 6000 tons along the axis of the ship. Find the tension in the towlines if each tugboat makes a 20° angle with the axis of the ship.

32. Physics A painting weighing 25 pounds is supported at the top corners by a taut wire that passes around a nail embedded in the wall. The wire forms a 120° angle at the nail. Assuming that the wire rests on the nail at its midpoint, find the pull on the wires.

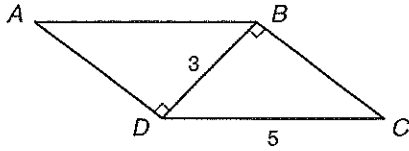
38. SAT/ACT Practice Let $*x$ be defined as $*x = x^3 - x$.
What is the value of $*4 - *(-3)$?

- A 84 B 55 C -10
D 22 E 4

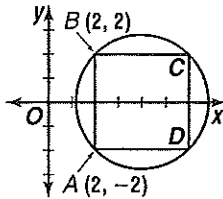
After you work each problem, record your answer on the answer sheet provided or on a piece of paper.

Multiple Choice

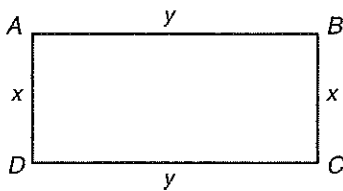
1. In parallelogram $ABCD$ below, $BD = 3$ and $CD = 5$. What is the area of $ABCD$?



- A 12 B 15 C 18 D 20
E It cannot be determined from the information given.
2. In square $ABCD$ below, what is the equation of circle Q that is circumscribed around the square?

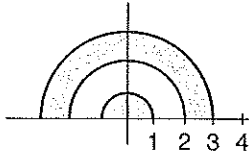


- A $(x - 4)^2 + y^2 = 4$ B $(x - 4)^2 + y^2 = 8$
C $(x + 4)^2 + y^2 = 8$ D $(x - 4)^2 + y^2 = 32$
E $(x + 4)^2 + y^2 = 32$
3. If the perimeter of the rectangle $ABCD$ is equal to p , and $x = \frac{2}{3}y$, what is the value of y in terms of p ?



- A $\frac{p}{10}$ B $\frac{3p}{10}$ C $\frac{p}{3}$ D $\frac{2p}{5}$ E $\frac{3p}{5}$
4. If two sides of a triangle have lengths of 40 and 80, which of the following cannot be the length of the third side?
- A 40 B 41 C 50 D 80 E 81
5. $\sqrt[3]{x^2} \cdot \sqrt[3]{x^3} =$
- A $x^{\frac{2}{9}}$ B $x^{\frac{1}{3}}$ C $x^{\frac{1}{2}}$ D $x^{\frac{2}{3}}$ E x

6. The figure below is made of three concentric semi-circles. What is the area of the shaded region in square units?



- A 3π B $\frac{9}{2}\pi$ C 6π D 7π E 9π

7. $\frac{1}{5} + \frac{2}{25} + \frac{3}{50} =$

- A 0.170 B 0.240 C 0.320
D 0.340 E 0.463

8. A 30-inch by 40-inch rectangular surface is to be completely covered with 1-inch square tiles, which cannot overlap one another and cannot overhang. If white tiles are to cover the interior and red tiles are to form a 1-inch wide border along the edge of the surface, how many red tiles will be needed?

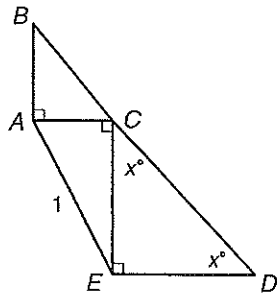
- A 70 B 136 C 140 D 142 E 144

9. Which of the following is the closest approximation of the area of a circle with radius x ?

- A $4x^2$
B $3x^2$
C $2x^2$
D x^2
E $0.75x^2$

10. **Grid-In**

In the figure, if $AE = 1$, what is the sum of the area of $\triangle ABC$ and the area of $\triangle CDE$?



(A)

Example: Two cowboys have roped a bull. The first pulls with a force of 270 newtons at due north while the second pulls with a force of 360 newtons at due east. What is the resultant force on the bull? What is the direction?

(B)

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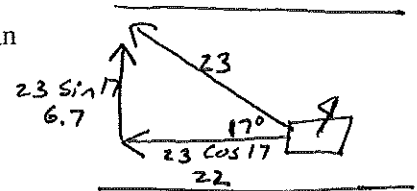
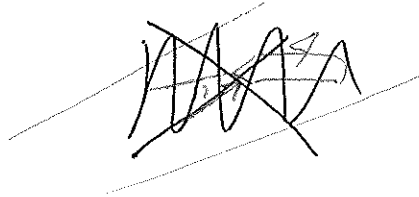
(C)

How much work is done is to push a box that weighs 200 lbs a distance of 10 feet along a ramp with an incline of 20 degrees?

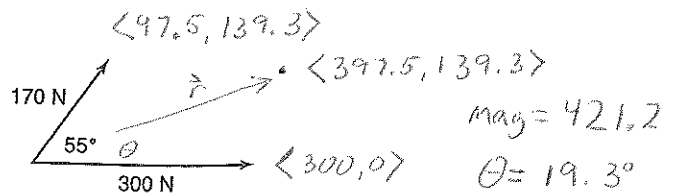
(D)

How much work is done is to push a tire that weighs 60 lbs a distance of 100 feet along a ramp with an incline of 33 degrees?

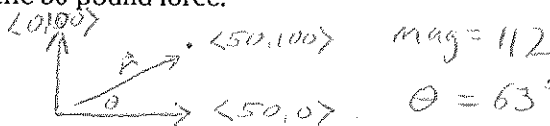
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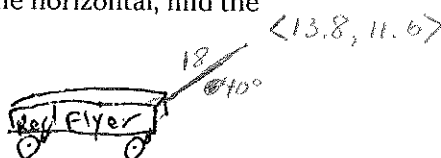
5. Find the magnitude and direction of the resultant vector for the diagram.



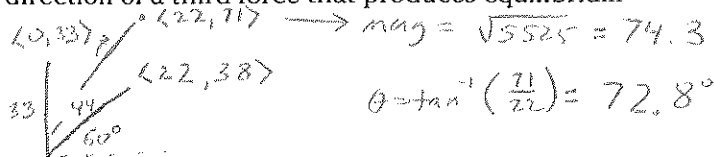
6. A 100-newton force and a 50-newton force act on the same object. The angle between the forces measures 90°. Find the magnitude of the resultant force and the angle between the resultant force and the 50-pound force.



Denzel pulls a wagon along level ground with a force of 18 newtons on the handle. If the handle makes an angle of 40° with the horizontal, find the horizontal and vertical components of the force.



8. A 33-newton force at 90° and a 44-newton force at 60° are exerted on an object. What is the magnitude and direction of a third force that produces equilibrium on the object?



equil. vector: -74.3 at 72.8°

9. **Transportation** Two ferry landings are directly across a river from each other. A ferry that can travel at a speed of 12 miles per hour in still water is attempting to cross directly from one landing to the other. The current of the river is 4 miles per hour.

- a. Make a sketch of the situation.
 b. If a heading of 0° represents the line between the two landings, at what angle should the ferry's captain head?



$$\sin \theta = \frac{4}{12}$$

$$\theta = \sin^{-1}\left(\frac{4}{12}\right)$$

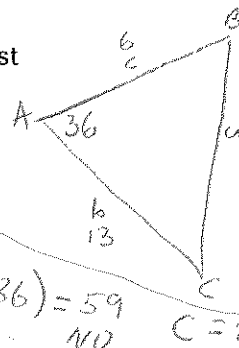
$$\theta = 19.5^\circ$$

44. Solve $\triangle ABC$ if $A = 36^\circ$, $b = 13$, and $c = 6$. Round angle measures to the nearest minute and side measures to the nearest tenth. (Lesson 5-8)

$$a^2 = 6^2 + 13^2 - 2(6)(13)\cos 36$$

$$a^2 = 78.8$$

$$a = 8.9$$



$$\frac{8.9}{\sin 36} = \frac{6}{\sin C}$$

$$C = 23 \text{ degrees}$$

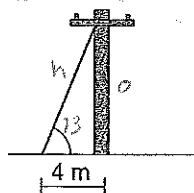
$$B = 121 \text{ degrees}$$

$$\frac{8.9}{\sin 36} = \frac{13}{\sin B}$$

$$B = \sin^{-1}(.86) = 59$$

$$C = 85$$

45. **Utilities** A utility pole is braced by a cable attached to it at the top and anchored in a concrete block at ground level, a distance of 4 meters from the base of the pole. If the angle between the cable and the ground is 73° , find the height of the pole and the length of the cable to the nearest tenth of a meter. (Lesson 5-4)



$$\tan 73 = \frac{h}{4}$$

$$h = 13.1$$

$$\cos 73 = \frac{4}{l}$$

$$l = 13.7$$

46. Solve $3 + \sqrt{3x - 4} \geq 10$. (Lesson 4-7)

$$\sqrt{3x - 4} \geq 7$$

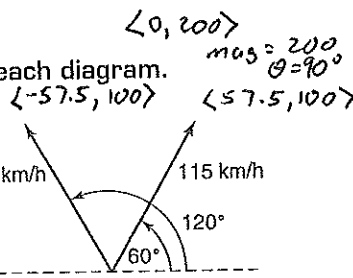
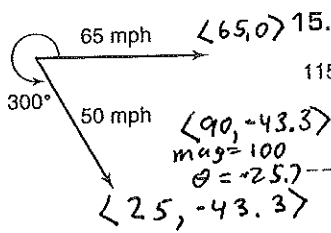
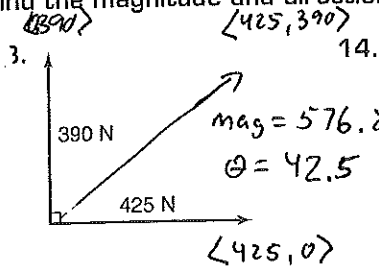
$$3x - 4 \geq 49$$

$$3x \geq 53$$

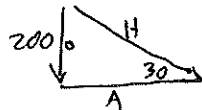
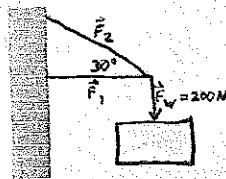
$$x \geq 17.7$$

$$x \geq 34.6$$

Find the magnitude and direction of the resultant vector for each diagram.



(A) Ms. Davis is hanging a sign for her restaurant. The sign is supported by two lightweight support bars as shown in the diagram. If the bars make a 30° angle with each other, and the sign weighs 200 pounds, what are the magnitudes of the forces exerted by the sign on each support bar?



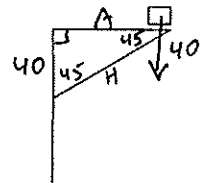
$$\sin 30 = \frac{200}{H} \quad H = 400$$

$$\tan 30 = \frac{200}{A} \quad A = 346.4$$

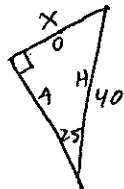
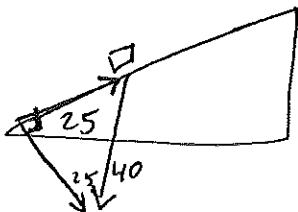
(B) A box is stored on the ledge of a loft. The box weighs 40 lbs. The ledge is supported by a beam that makes a 45-45-90 degree triangle. Find the forces on the ledge and support beam.

$$A = 40$$

$$H = 40\sqrt{2} = 56.6$$



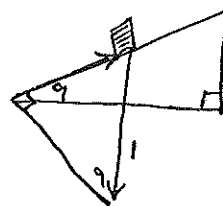
(C) A box is sitting on an incline of 25 degrees. The box weighs 40 lbs. How much force is required to move the box up the incline?



$$\sin 25 = \frac{x}{40}$$

$$x = 16.9$$

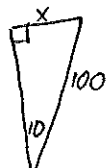
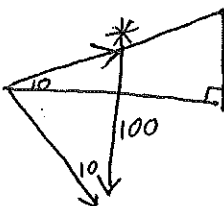
(D) Your Turn: A can is sitting in a driveway that has an incline of 9 degrees. The can weighs 1 lbs. How much force is required to kick the can up the incline?



$$\sin 9 = \frac{x}{1}$$

$$x = .156$$

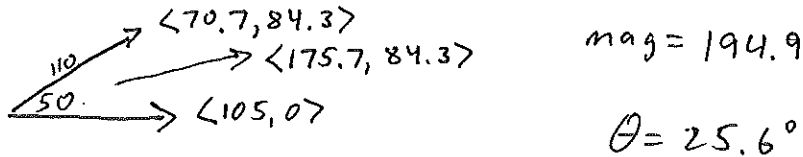
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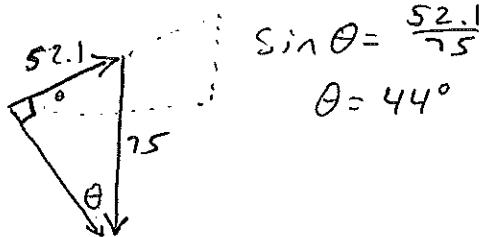
$$\sin 10 = \frac{x}{100}$$

$$x = 17.4$$

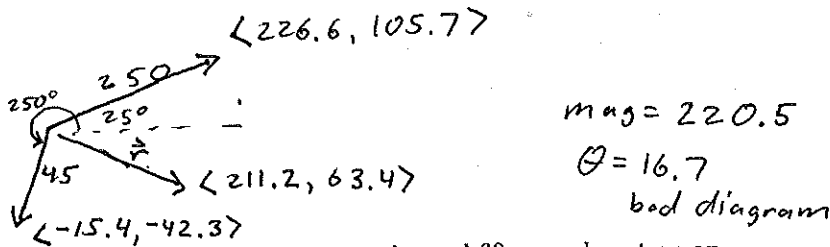
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18. To keep a 75-pound block from sliding down an incline, a 52.1-pound force is exerted on the block along the incline. Find the angle that the incline makes with the horizontal.



19. Find the magnitude and direction of the resultant of two forces of 250 pounds and 45 pounds at angles of 25° and 250° with the x-axis, respectively.



20. Three forces with magnitudes of 70 pounds, 40 pounds, and 60 pounds act on an object at angles 330° , 45° , and 135° , respectively, with the positive x-axis. Find the direction and magnitude of the resultant of these forces.

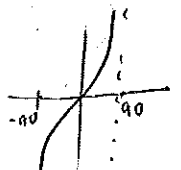
① 70 @ 330° $\langle 60.6, -35 \rangle$
 ② 40 @ 45° $\langle 28.3, 28.3 \rangle$
 ③ 60 @ 135° $\langle -42.4, 42.4 \rangle$
 $\text{mag} = 58.6$
 $\text{resultant} : \langle 46.5, 35.7 \rangle$ $\theta = 37.5^\circ$

21. A 23-newton force acting at 60° above the horizontal and a second 23-newton force acting at 120° above the horizontal act concurrently on a point. What is the magnitude and direction of a third force that produces equilibrium?

① 23 @ 60° $\langle 11.5, 19.9 \rangle$
 ② 23 @ 120° $\langle -11.5, 19.9 \rangle$
 $\vec{F} = \langle 0, 39.8 \rangle$

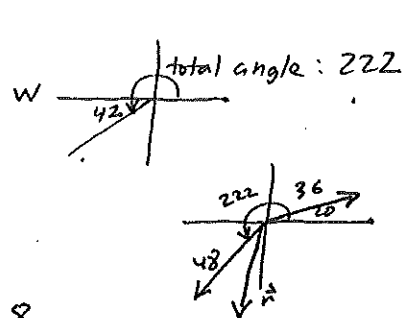
$\text{mag} = 39.8$
 $\theta = 90^\circ$

equilibrium
 $-39.8 @ 90^\circ$



22. An object is placed on a ramp and slides to the ground. If the ramp makes an angle of 40° with the ground and the object weighs 25 pounds, find the acceleration of the object. Assume that there is no friction.

23. A force of 36 newtons pulls an object at an angle of 20° north of due east. A second force pulls on the object with a force of 48 newtons at an angle of 42° south of due west. Find the magnitude and direction of the resultant force.



① $36 @ 20^\circ = \langle 33.8, 12.3 \rangle$
 ② $48 @ 222^\circ = \langle -36, -32 \rangle$

res = $\langle -2.2, -19.7 \rangle$

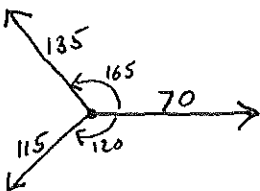
3rd Quad

mag = ~~19.8~~

$\theta = 83.6 + 180 = 263.6^\circ$

24. Three forces in a plane act on an object. The forces are 70 pounds, 115 pounds and 135 pounds. The 70 pound force is exerted along the positive x-axis. The 115 pound force is applied below the x-axis at a 120° angle with the 70 pound force. The angle between the 115-pound and 135-pound forces is 75° , and between the 135-pound and 70-pound forces is 165° .

- Make a diagram showing the forces.
- Are the vectors in equilibrium? If not, find the magnitude and the direction of the resultant force.



1) $70 @ 0^\circ = \langle 70, 0 \rangle$
 2) $115 @ 240^\circ = \langle -57.5, -100 \rangle$
 3) $135 @ 165^\circ = \langle -130, 35 \rangle$

result = $\langle -117.5, -65 \rangle$

3rd quad.

Not in equil.

mag = 134

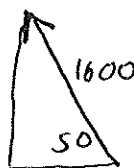
$\theta = 29$ - not in 3rd

+180

$\theta = 209^\circ$

25. **Physics** While pulling a stalled car, a tow truck's cable makes an angle of 50° above the road. If the tension on the tow truck's cable is 1600 newtons, how much work is done by the truck on the car pulling it 1.5 kilometers down the road?

$\langle 1028.5, 1225.7 \rangle$ $W = F \cdot d$ $\langle 1.5, 0 \rangle$

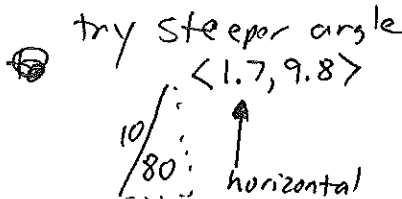
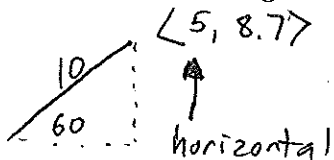


$W = \langle 1028.5, 1225.7 \rangle \cdot \langle 1.5, 0 \rangle$

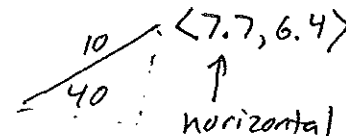
$1542.75 + 0 = 1542.75$

26. **Critical Thinking** The handle of a lawnmower you are pushing makes an angle of 60° with the ground.

- How could you increase the horizontal forward force you are applying without increasing the total force?
- What are some of the disadvantages of doing this?



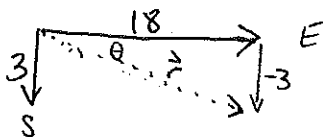
try lower angle



Lower = more horiz. force but, it's less comfortable

27. **Boating** A sailboat is headed east at 18 mph relative to the water. A current is moving the water south at 3 mph.

- What is the angle of the path of the sailboat? -9.5°
- What is the sailboat's speed with respect to the ocean floor? 18.2 mph



$$|\vec{r}| = \sqrt{3^2 + 18^2} = 18.2$$

$$\theta = \tan^{-1}\left(\frac{-3}{18}\right) = -9.5^\circ$$

34. If $A = (12, -5, 18)$ and $B = (0, -11, 21)$, write the ordered triple that represents \vec{AB} . (Lesson 8-3)

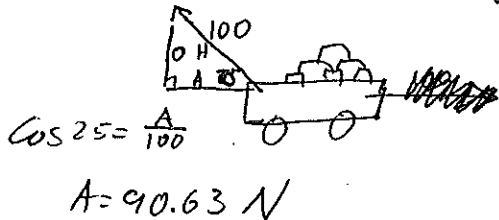
$$\begin{aligned} \vec{AB} &= B - A = \langle 0 - 12, -11 - (-5), 21 - 18 \rangle \\ &= \langle -12, -6, 3 \rangle \end{aligned}$$

33. Find the inner product of \vec{u} and \vec{v} if $\vec{u} = \langle 9, 5, 3 \rangle$ and $\vec{v} = \langle -3, 2, 5 \rangle$. Are the vectors perpendicular? (Lesson 8-4)

$$\begin{aligned} \vec{u} \cdot \vec{v} &= 9(-3) + 5(2) + 3(5) \\ &= -2 \end{aligned}$$

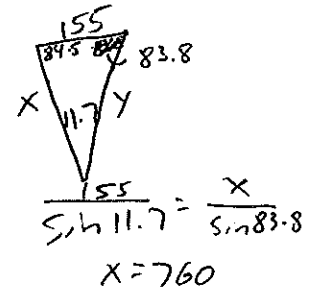
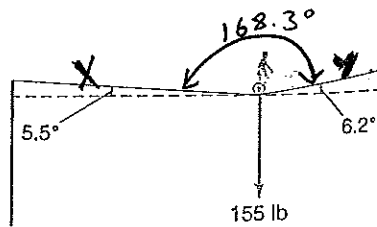
NOT \perp

28. **Physics** Suzanne is pulling a wagon loaded with gardening bricks totaling 100 kilograms. She is applying a force of 100 newtons on the handle at 25° with the ground. What is the horizontal force on the wagon? ---



don't use the 100 Kg.

29. **Entertainment** A unicyclist is performing on a tightrope at a circus. The total weight of the performer and her unicycle is 155 pounds. How much tension is being exerted on each part of the cable?

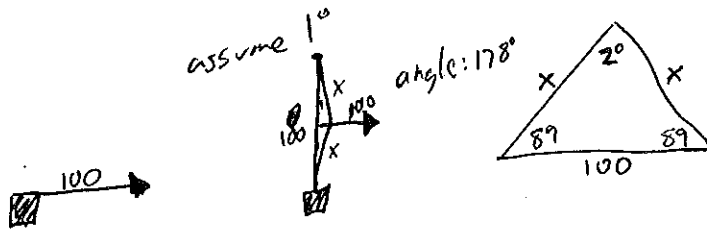


$\frac{155}{\sin 11.7} = \frac{Y}{\sin 84.5}$

$Y = 761$

30. **Critical Thinking** Chaz is using a rope tied to his tractor to remove an old tree stump from a field. Which method given below—a or b—will result in the greatest force applied to the stump? Assume that the tractor will exert the same amount of force using either method. Explain your answer.

- Tie the rope to the stump and pull.
- Tie one end to the stump and the other end to a nearby pole. Then pull on the rope perpendicular to it at a point about halfway between the two.

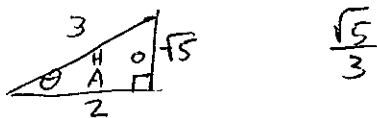


$\frac{100}{\sin 2} = \frac{X}{\sin 89}$

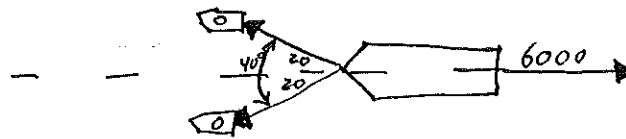
$X = 2804.9$

go with b.

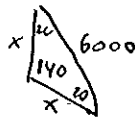
46. If $\cos \theta = \frac{2}{3}$ and $0^\circ \leq \theta \leq 90^\circ$, find $\sin \theta$. (Lesson 7-1)



31. **Travel** A cruise ship is arriving at the port of Miami from the Bahamas. Two tugboats are towing the ship to the dock. They exert a force of 6000 tons along the axis of the ship. Find the tension in the towlines if each tugboat makes a 20° angle with the axis of the ship.



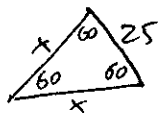
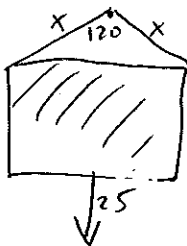
$$180 - 40 = 140$$



$$\frac{6000}{\sin 140} = \frac{x}{\sin 20}$$

$$x = 3192.5 \text{ tons}$$

32. **Physics** A painting weighing 25 pounds is supported at the top corners by a taut wire that passes around a nail embedded in the wall. The wire forms a 120° angle at the nail. Assuming that the wire rests on the nail at its midpoint, find the pull on the wires.



$$x = 25 \cdot \frac{1}{\sqrt{3}} = 16.5$$

38. **SAT/ACT Practice** Let $*x$ be defined as $*x = x^3 - x$. What is the value of $*4 - *(-3)$?

- (A) 84 B 55 C -10
D 22 E 4

$$*4 = 4^3 - 4$$

$$64 - 4 = 60$$

$$*(-3) = (-3)^3 - (-3)$$

$$-27 + 3$$

$$-24$$

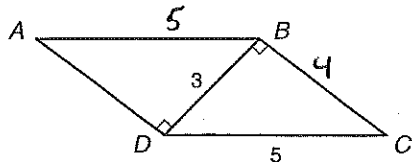
$$60 - (-24)$$

$$84$$

After you work each problem, record your answer on the answer sheet provided or on a piece of paper.

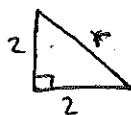
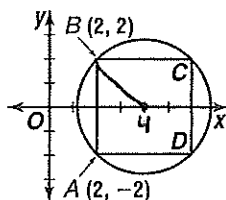
Multiple Choice

1. In parallelogram $ABCD$ below, $BD = 3$ and $CD = 5$. What is the area of $ABCD$?



- A 12 B 15 C 18 D 20
E It cannot be determined from the information given.

2. In square $ABCD$ below, what is the equation of circle Q that is circumscribed around the square?



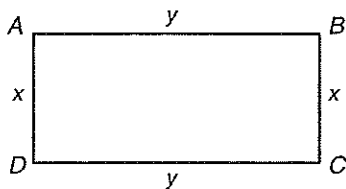
$$4 + 4 = r^2$$

$$8 = r^2$$

Circle
 $x^2 + y^2 = r^2$

- A $(x - 4)^2 + y^2 = 4$ B $(x - 4)^2 + y^2 = 8$
C $(x + 4)^2 + y^2 = 8$ D $(x - 4)^2 + y^2 = 32$
E $(x + 4)^2 + y^2 = 32$

3. If the perimeter of the rectangle $ABCD$ is equal to p , and $x = \frac{2}{3}y$, what is the value of y in terms of p ?



$$x + y + x + y = p$$

$$\frac{2}{3}y + y + \frac{2}{3}y + y = p$$

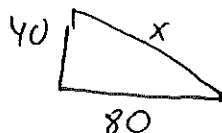
$$3\frac{1}{3}y = p$$

$$\frac{\frac{10}{3}y}{\frac{10}{3}} = \frac{p}{\frac{10}{3}}$$

$$\frac{p \cdot 3}{10}$$

- A $\frac{p}{10}$ B $\frac{3p}{10}$ C $\frac{p}{3}$ D $\frac{2p}{5}$ E $\frac{3p}{5}$

4. If two sides of a triangle have lengths of 40 and 80, which of the following cannot be the length of the third side?



- A 40 B 41 C 50 D 80 E 81

5. $\sqrt[3]{x^2} \cdot \sqrt[9]{x^3} =$

- A $x^{\frac{2}{9}}$ B $x^{\frac{1}{3}}$ C $x^{\frac{1}{2}}$ D $x^{\frac{2}{3}}$ E x

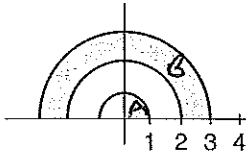
$$x^{\frac{2}{3}} \cdot x^{\frac{2}{9}} = x$$

$$x^{\frac{2}{3} + \frac{2}{9}} = x$$

$$x^{\frac{2}{3} \cdot \frac{3}{3} + \frac{2}{9}} = x$$

$$x^{\frac{2}{3} + \frac{2}{9}} = x$$

6. The figure below is made of three concentric semi-circles. What is the area of the shaded region in square units?



- (A) 3π B $\frac{9}{2}\pi$ C 6π D 7π E 9π

$$A = \frac{1}{2} \pi 1^2 = \frac{\pi}{2}$$

$$B = \frac{1}{2} (\pi 3^2 - \pi 2^2)$$

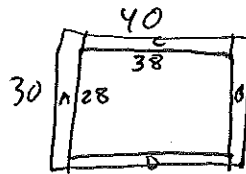
$$\frac{1}{2} (9\pi - 4\pi) = \frac{5}{2} \pi$$

$$A + B = \frac{\pi}{2} + \frac{5\pi}{2} = 3\pi$$

7. $\frac{1}{5} + \frac{2}{25} + \frac{3}{50} =$

- A 0.170 B 0.240 C 0.320
 (D) 0.340 E 0.463

8. A 30-inch by 40-inch rectangular surface is to be completely covered with 1-inch square tiles, which cannot overlap one another and cannot overhang. If white tiles are to cover the interior and red tiles are to form a 1-inch wide border along the edge of the surface, how many red tiles will be needed?



$$A = 30$$

$$B = 30$$

$$C = 38$$

$$D = 38$$

$$136$$

- A 70 (B) 136 C 140 D 142 E 144

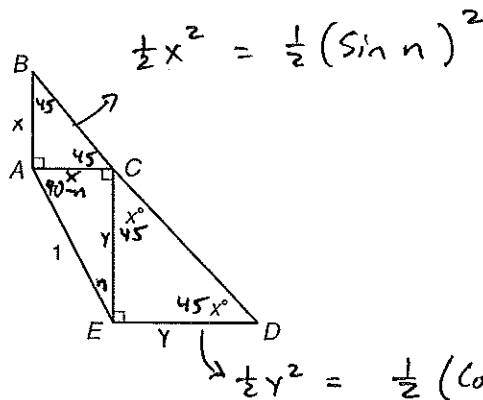
9. Which of the following is the closest approximation of the area of a circle with radius x ?

- A $4x^2$
 (B) $3x^2$
 C $2x^2$
 D x^2
 E $0.75x^2$

$$3.14 x^2$$

10. Grid-In

In the figure, if $AE = 1$, what is the sum of the area of $\triangle ABC$ and the area of $\triangle CDE$?



$$\frac{1}{2} x^2 = \frac{1}{2} (\sin n)^2$$

$$\frac{1}{2} y^2 = \frac{1}{2} (\cos n)^2$$

$$\sin n = \frac{x}{1}$$

$$\cos n = \frac{y}{1}$$

$$\text{total} = \frac{1}{2} (\sin n)^2 + \frac{1}{2} (\cos n)^2$$

$$= \frac{1}{2} [\sin^2 n + \cos^2 n]$$

$$= \frac{1}{2} [1]$$

$$= \frac{1}{2}$$