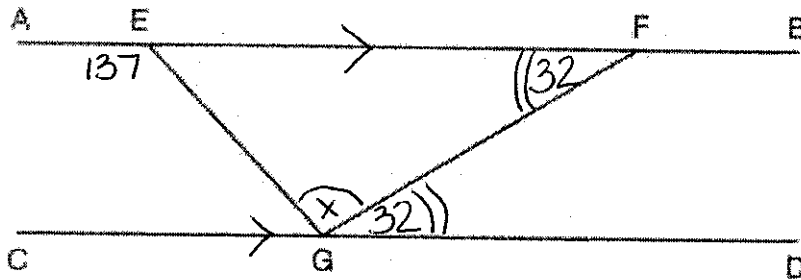


Part I

Answer all 24 questions in this part. Each correct answer will receive 2 credits. No partial credit will be allowed. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale. For each statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Record your answers on your separate answer sheet. [48]

Use this space for computations.

1 In the diagram below,  $\overline{AEFB} \parallel \overline{CGD}$ , and  $\overline{GE}$  and  $\overline{GF}$  are drawn.



$$\begin{array}{r} 137 = x + 32 \\ -32 \quad -32 \\ \hline 105 = x \end{array}$$

If  $m\angle EFG = 32^\circ$  and  $m\angle AEG = 137^\circ$ , what is  $m\angle EGF$ ?

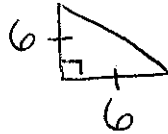
- (1)  $11^\circ$
- (2)  $43^\circ$
- (3)  $75^\circ$
- (4)  $105^\circ$

2 If  $\triangle ABC$  is mapped onto  $\triangle DEF$  after a line reflection and  $\triangle DEF$  is mapped onto  $\triangle XYZ$  after a translation, the relationship between  $\triangle ABC$  and  $\triangle XYZ$  is that they are always

- (1) congruent and similar
- (2) congruent but not similar
- (3) similar but not congruent
- (4) neither similar nor congruent

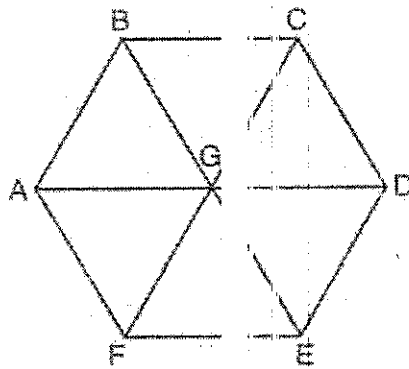
Use this space for computations.

3 An isosceles right triangle whose leg measure 6 is continuously rotated about one of its legs to form a three-dimensional object. The three-dimensional object is a



- (1) cylinder with a diameter of 6
- (2) cylinder with a diameter of 12
- (3) cone with a diameter of 6
- (4) cone with a diameter of 12

4 In regular hexagon  $ABCDEF$  shown below,  $\overline{AD}$ ,  $\overline{BE}$ , and  $\overline{CF}$  all intersect at  $G$ .



$A \rightarrow C \rightarrow F$   
 $B \rightarrow B \rightarrow E$   
 $G \rightarrow G \rightarrow G$

When  $\triangle ABG$  is reflected over point  $G$ ,  $\triangle ABG$  is mapped onto

- (1)  $\triangle FEC$
- (2)  $\triangle AFG$
- (3)  $\triangle CBG$
- (4)  $\triangle DEG$

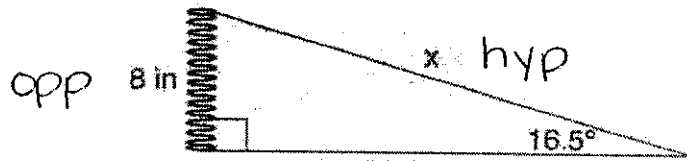
5 A right cylinder is cut perpendicular to its base. The shape of the cross section is a

- (1) circle
- (2) cylinder
- (3) rectangle
- (4) triangular prism



6 Yolanda is making a springboard to use for gymnastics. She has 8-inch-tall springs and wants to form a  $16.5^\circ$  angle with the base, as modeled in the diagram below.

Use this space for computations.



$$\frac{\sin 16.5}{1} = \frac{8}{X}$$

$$X \sin 16.5 = 8$$

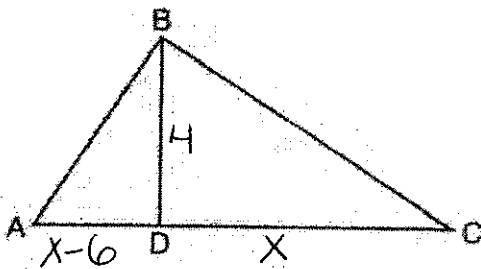
$$\frac{X \sin 16.5}{\sin 16.5} = \frac{8}{\sin 16.5}$$

$$X = 28.2$$

To the nearest tenth of an inch, what will be the length of the springboard,  $x$ ?

- (1) 2.3
- (2) 8.3
- (3) 27.0
- (4)  28.2

7 In the diagram below of right triangle  $ABC$ , altitude  $\overline{BD}$  is drawn to hypotenuse  $\overline{AC}$ .



$$\frac{x-6}{4} = \frac{4}{x}$$

$$x^2 - 6x = 16$$

$$x^2 - 6x - 16 = 0$$

$$(x-8)(x+2) = 0$$

$$x = 8 \quad | \quad x = -2$$

If  $BD = 4$ ,  $AD = x - 6$ , and  $CD = x$ , what is the length of  $\overline{CD}$ ?

- (1) 5
- (2) 2
- (3)  8
- (4) 11

8 Rhombus  $STAR$  has vertices  $S(-1,2)$ ,  $T(2,3)$ ,  $A(3,0)$ , and  $R(0,-1)$ .

What is the perimeter of rhombus  $STAR$ ?

- (1)  $\sqrt{34}$
- (2)  $4\sqrt{34}$
- (3)  $\sqrt{10}$
- (4)   $4\sqrt{10}$

$$\sqrt{(-1-2)^2 + (2-3)^2}$$

$$\sqrt{(-3)^2 + (-1)^2}$$

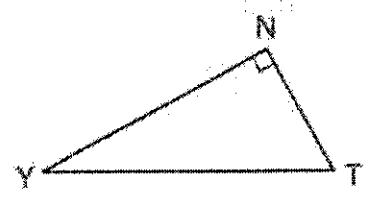
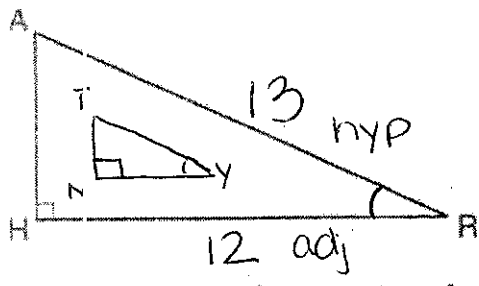
$$\sqrt{9+1}$$

$$\sqrt{10}$$

rhombus has 4  $\cong$  sides

Use this space for computations.

9 In the diagram below of  $\triangle HAR$  and  $\triangle NTY$ , angles  $H$  and  $N$  are right angles, and  $\triangle HAR \sim \triangle NTY$

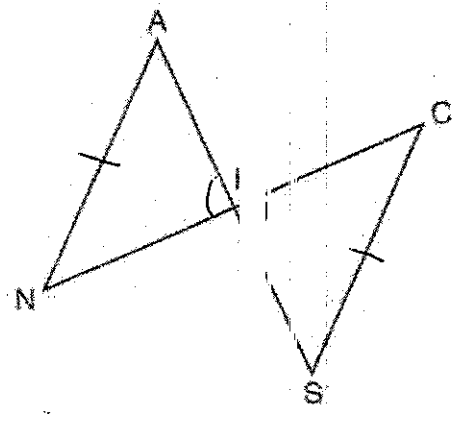


If  $AR = 13$  and  $HR = 12$ , what is the measure of angle  $Y$ , to the nearest degree?

- (1)  $23^\circ$
- (2)  $25^\circ$
- (3)  $65^\circ$
- (4)  $67^\circ$

$$\cos X = \frac{12}{13}$$

10 In the diagram below,  $\overline{AKS}$ ,  $\overline{NKS}$ ,  $\overline{AN}$ , and  $\overline{SC}$  are drawn such that  $\overline{AN} \cong \overline{SC}$ .



Which additional statement is sufficient to prove  $\triangle KAN \cong \triangle KSC$  by AAS?

- (1)  $\overline{AS}$  and  $\overline{NC}$  bisect each other  $\therefore SS$
- (2)  $K$  is the midpoint of  $\overline{NC}$ .  $\therefore S$
- (3)  $\overline{AS} \perp \overline{CN}$  already have
- (4)  $\overline{AN} \parallel \overline{SC}$

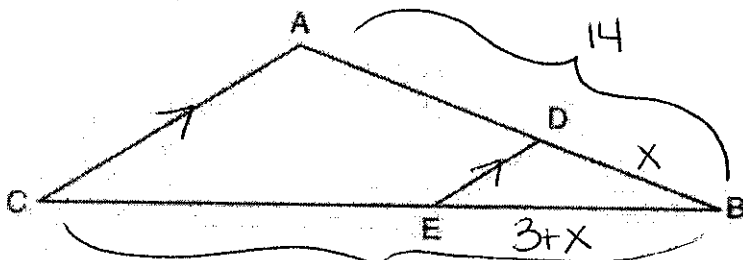
Use this space for computations.

11 Which equation represents a line that is perpendicular to the line represented by  $y = \frac{2}{3}x + 1$ ?

$m = \frac{2}{3}$   
 $\perp m = -\frac{3}{2}$

- (1)  $3x + 2y = 12 - 3x$
- (2)  $3x - 2y = 12$
- (3)  $y = \frac{3}{2}x + 2$
- (4)  $y = -\frac{2}{3}x + 4$

12 In the diagram of  $\triangle ABC$  below, points  $D$  and  $E$  are on sides  $\overline{AB}$  and  $\overline{CB}$  respectively, such that  $\overline{DE} \parallel \overline{AC}$ .



$$\frac{x}{14} = \frac{3+x}{21}$$

$$21x = 42 + 14x$$

$$\begin{array}{r} 21x = 42 + 14x \\ -14x \quad -14x \\ \hline 7x = 42 \end{array}$$

$$\frac{7x}{7} = \frac{42}{7}$$

$$x = 6$$

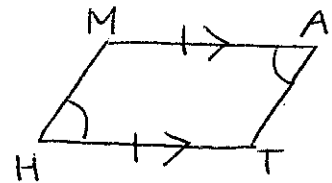
$$14 - 6 = 8$$

If  $EB$  is 3 more than  $DB$ ,  $AB = 14$ , and  $CB = 21$ , what is the length of  $AD$ ?

- (1) 6
- (2) 8
- (3) 9
- (4) 12

13 Quadrilateral  $MATH$  has both pairs of opposite sides congruent and parallel. Which statement about quadrilateral  $MATH$  is always true?

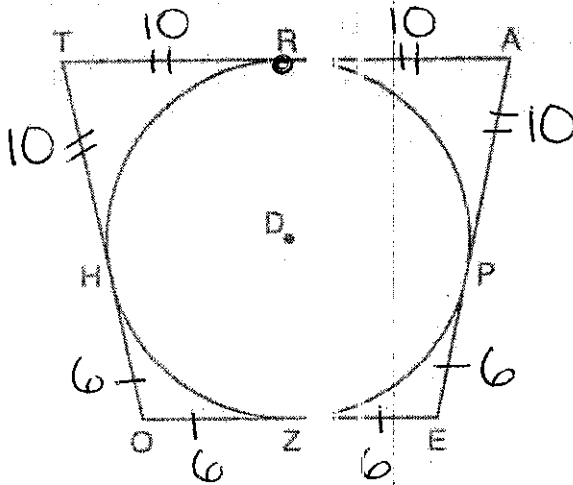
- (1)  $\overline{MT} \cong \overline{AH}$
- (2)  $\overline{MT} \perp \overline{AH}$
- (3)  $\angle MHT \cong \angle ATH$
- (4)  $\angle MAT \cong \angle MHT$



Parallelogram MATH

Use this space for computations.

14 In the figure shown below, quadrilateral  $TAEZ$  is circumscribed around circle  $D$ . The midpoint of  $\overline{TA}$  is  $R$ , and  $\overline{HO} \cong \overline{PE}$ .



$$4(10) + 4(6)$$

$$40 + 24$$

$$64$$

If  $AP = 10$  and  $EO = 12$ , what is the perimeter of quadrilateral  $TAEZ$ ?

- (1) 56 (2) 72  
 (3) 64 (4) 76

15 The coordinates of the endpoints of directed line segment  $ABC$  are  $A(-8, 7)$  and  $C(7, -13)$ . If  $AB:BC = 3:2$ , the coordinates of  $B$  are

- (1)  $(1, -5)$  (2)  $(-3, 0)$   
 (3)  $(-2, -1)$  (4)  $(3, -6)$

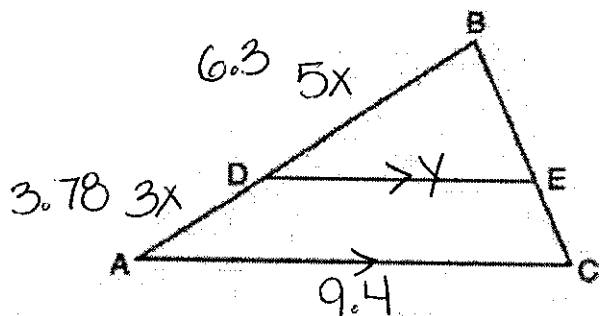
$$A(-8, 7) \xrightarrow{T \langle 15, -20 \rangle} C(7, -13)$$

$$15\left(\frac{3}{5}\right) \quad 20\left(\frac{3}{5}\right)$$

$$A(-8, 7) \xrightarrow{T \langle 9, -12 \rangle} B(1, -5)$$

- 16 In triangle  $ABC$ , points  $D$  and  $E$  are on sides  $\overline{AB}$  and  $\overline{BC}$ , respectively, such that  $\overline{DE} \parallel \overline{AC}$ , and  $AD:DB = 3:5$ .

Use this space for computations.



$$\frac{5}{3} = \frac{6.3}{x}$$

$$\frac{5x}{5} = \frac{18.9}{5}$$

If  $DB = 6.3$  and  $AC = 9.4$ , what is the length of  $\overline{DE}$ , to the nearest tenth?

- (1) 3.8  
(2) 5.6

- 5.9  
(4) 15.7

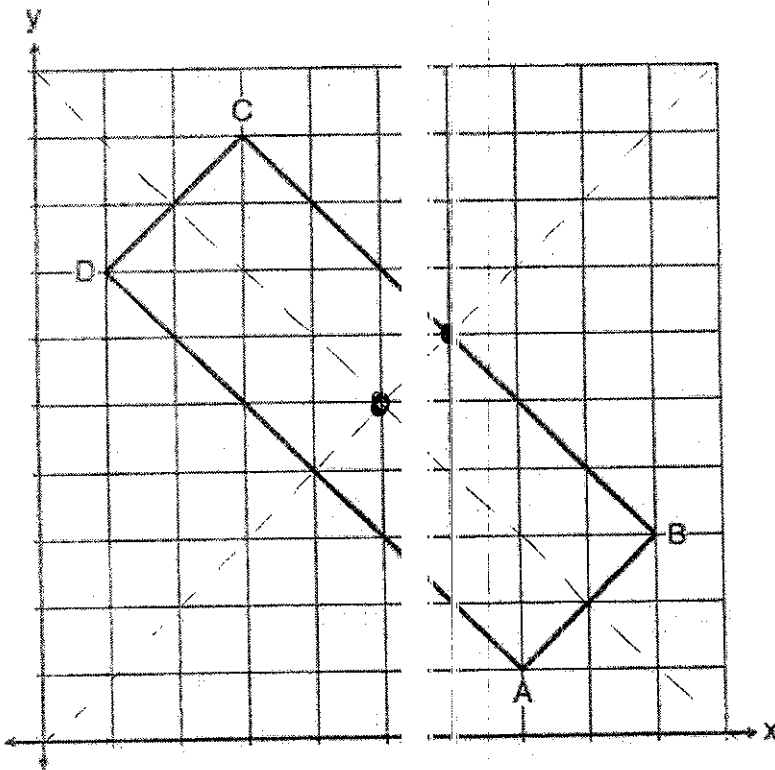
$$\frac{6.3}{y} = \frac{10.08}{9.4}$$

$$\frac{10.08y}{10.08} = \frac{59.22}{10.08}$$

$$y = 5.9$$

Use this space for computations.

17 In the diagram below, rectangle  $ABCD$  has vertices whose coordinates are  $A(7,1)$ ,  $B(9,3)$ ,  $C(3,9)$ , and  $D(1,7)$ .

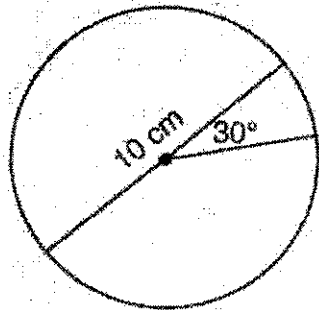


Which transformation will not carry the rectangle onto itself?

- (1) a reflection over the line  $y = 5$
- (2) a reflection over the line  $y = -x + 10$
- (3) a rotation of  $180^\circ$  about the point  $(6,6)$
- (4) a rotation of  $180^\circ$  about the point  $(5,5)$



18 A circle with a diameter of 10 cm and a central angle of  $30^\circ$  is drawn below.



Use this space for computations.

$$\frac{n}{360} \cdot \pi r^2$$

$$\frac{30}{360} \cdot \pi (5)^2$$

What is the area, to the nearest tenth of a square centimeter, of the sector formed by the  $30^\circ$  angle?

- (1) 5.2                                      (3) 13.1  
 (2) 6.5                                      (4) 26.2

19 A child's tent can be modeled as a pyramid with a square base whose sides measure 60 inches and whose height measures 84 inches. What is the volume of the tent, to the nearest cubic foot?

- (1) 35    (3) 82  
 (2) 58    (4) 175

\*conversions

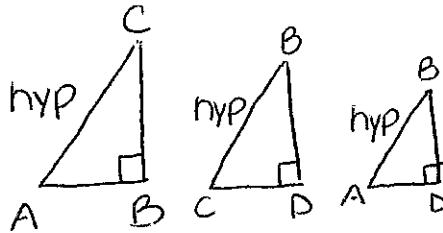
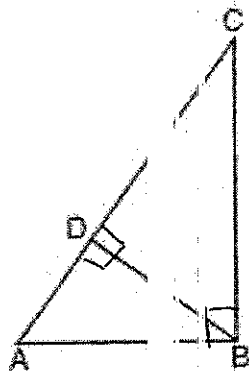
$$V = \frac{1}{3} Bh$$

$$\frac{1}{3} lwh$$

$$\frac{1}{3} (5)(5)(7)$$

Use this space for computations.

20 In the accompanying diagram of right triangle  $ABC$ , altitude  $\overline{BD}$  is drawn to hypotenuse  $\overline{AC}$ .



Which statement must always be true?

- (1)  $\frac{AD}{AB} = \frac{BC}{AC}$       (3)  $\frac{BD}{BC} = \frac{AB}{AD}$   
 (2)  $\frac{AD}{AB} = \frac{AB}{AC}$       (4)  $\frac{AB}{BC} = \frac{BD}{AC}$

21 An equation of circle  $O$  is  $x^2 + y^2 - 4x - 8y = -16$ . The statement that best describes circle  $O$  is that

- (1) center is  $(2, -4)$  and is tangent to the  $x$ -axis  
 (2) center is  $(2, -4)$  and is tangent to the  $y$ -axis  
 (3) center is  $(-2, 4)$  and is tangent to the  $x$ -axis  
 (4) center is  $(-2, 4)$  and is tangent to the  $y$ -axis

Handwritten work for Question 21:

$$(-\frac{8}{2})^2 = (-4)^2 = 16$$

$$(\frac{4}{2})^2 = (2)^2 = 4$$

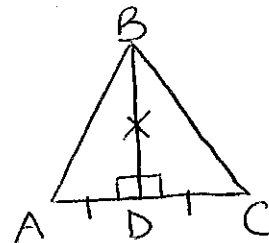
$$x^2 + 4x + 4 + y^2 - 8y + 16 = -16 + 4 + 16$$

$$(x+2)^2 + (y-4)^2 = 4$$

$C = (-2, 4)$        $r^2 = 4$   
 $r = 2$

22 In  $\triangle ABC$ ,  $\overline{BD}$  is the perpendicular bisector of  $\overline{AC}$ . Based upon this information, which statement below can be proven?

- I.  $\overline{BD}$  is a median.  
 II.  $\overline{BD}$  bisects  $\angle ABC$ .  
 III.  $\triangle ABC$  is isosceles.

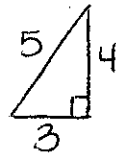


- (1) I and II, only      (3) II and III, only  
 (2) I and III, only      (4) I, II, and III

23 Triangle  $RJM$  has an area of 6 and a perimeter of 12. If the triangle is dilated by a scale factor of 3 centered at the origin, what are the area and perimeter of its image, triangle  $R'J'M'$ ?

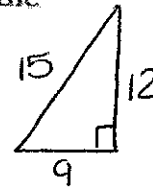
Use this space for computations.

- (1) area of 9 and perimeter of 15
- (2) area of 18 and perimeter of 36
- (3) area of 54 and perimeter of 36
- (4) area of 54 and perimeter of 108



$$A = 6$$

$$P = 12$$



$$A = 54$$

$$P = 36$$

24 If  $\sin(2x + 7)^\circ = \cos(4x - 7)^\circ$ , what is the value of  $x$ ?

- (1) 7
- (2) 15
- (3) 21
- (4) 30

cofunctions

$$2x + 7 + 4x - 7 = 90$$

$$6x = 90$$

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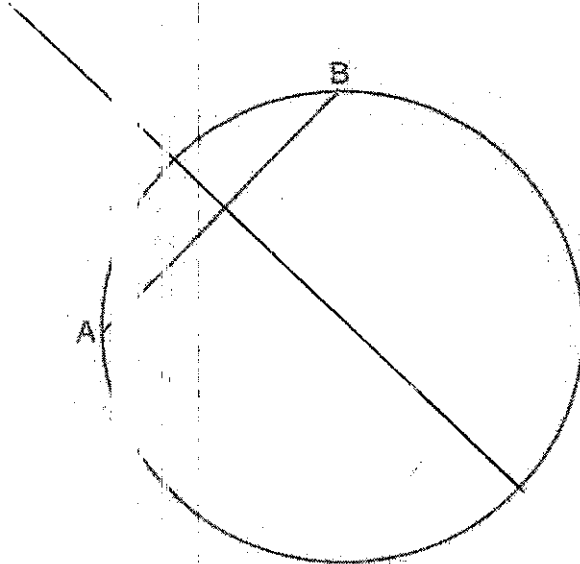

$$x = 15$$

Part II

Answer all 7 questions in this part. Each correct answer will receive 2 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [14]

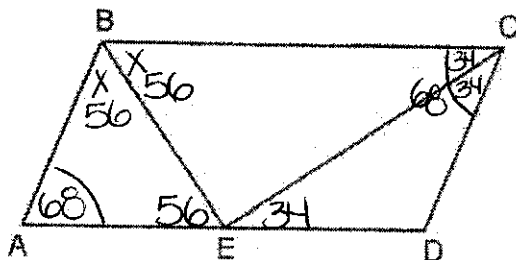
25 In the circle below,  $\overline{AB}$  is a chord. Using a compass and straightedge, construct a diameter of the circle. [Leave all construction marks.]

$\perp$  bisector



26 In parallelogram  $ABCD$  shown below, the bisectors of  $\angle ABC$  and  $\angle DCB$  meet at  $E$ , a point on  $\overline{AD}$ .

$$\begin{array}{r} 2x + 68 = 180 \\ -68 \quad -68 \\ \hline 2x = 112 \\ \hline 2 \quad 2 \\ \hline x = 56 \end{array}$$



$$\frac{68}{2} = 34$$

If  $m\angle A = 68^\circ$ , determine and state  $m\angle BEC$ .

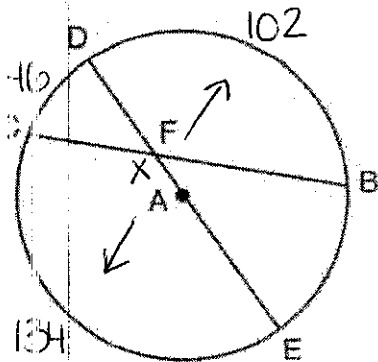
$$56 + \angle BEC + 34 = 180$$

$$\angle BEC + 90 = 180$$

$$\boxed{\angle BEC = 90}$$

27 In circle A below, chord  $\overline{BC}$  and diameter  $\overline{DAE}$  intersect at F.

$$\begin{array}{r} 180 \\ - 46 \\ \hline 134 \end{array}$$



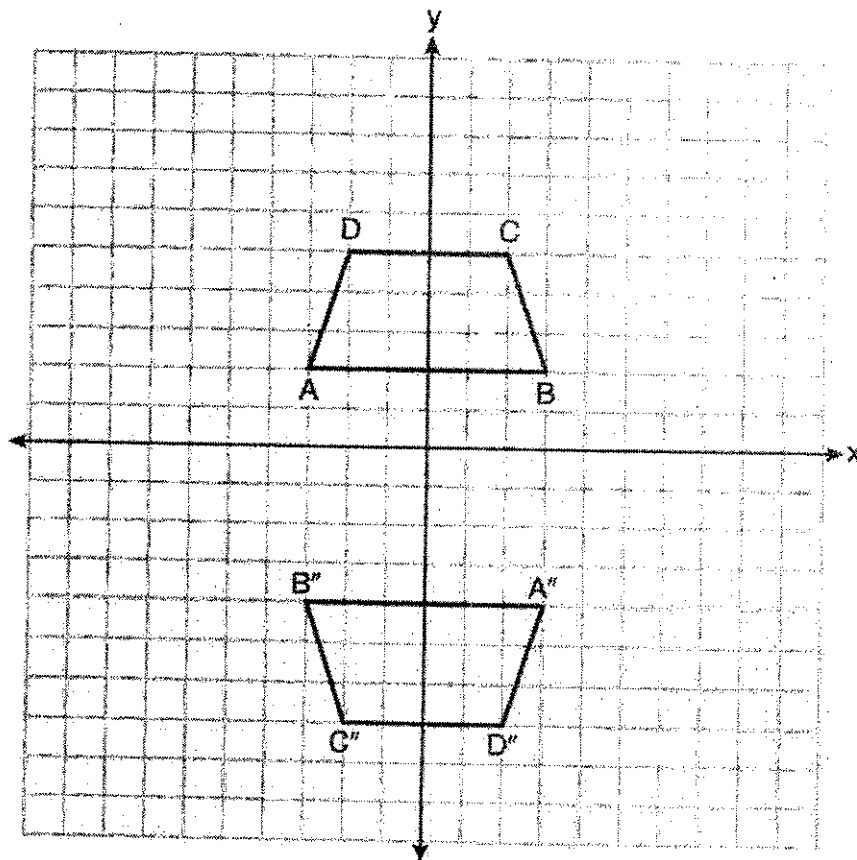
If  $m\widehat{CD} = 46^\circ$  and  $m\widehat{DB} = 102^\circ$ , what is  $m\angle CFE$ ?

$$X = \frac{134 + 102}{2}$$

$$X = \frac{236}{2}$$

$$X = 118$$

28 Trapezoids  $ABCD$  and  $A''B''C''D''$  are graphed on the set of axes below.

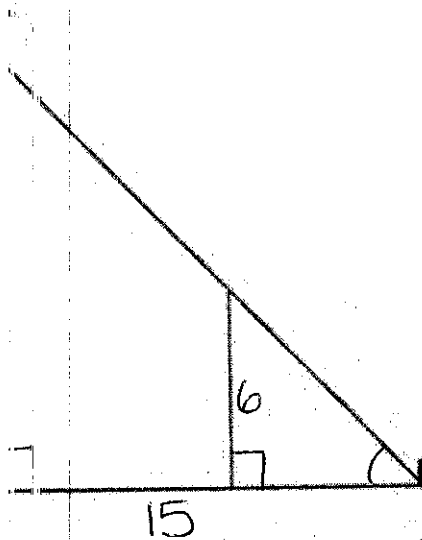


Describe a sequence of transformations that maps trapezoid  $ABCD$  onto trapezoid  $A''B''C''D''$ .

reflection over  $y$ -axis

reflection over  $y = -1$

29 In the model below, a support wire for a telephone pole is attached to the pole and anchored to a stake in the ground 15 feet from the base of the telephone pole. Jamal places a 6-foot wooden pole parallel to the telephone pole, such that one end of the pole is on the ground and the top of the pole is touching the support wire. He measures the distance between the bottom of the pole and the stake in the ground.



Jamal says he can approximate how high the support wire attaches to the telephone pole by using similar triangles. Explain why the triangles are similar.

The  $\Delta$ s are  $\sim$  b/c of AA  $\sim$

- shared  $\angle$  made by stake w/ground
- both  $\Delta$ s have a right  $\angle$



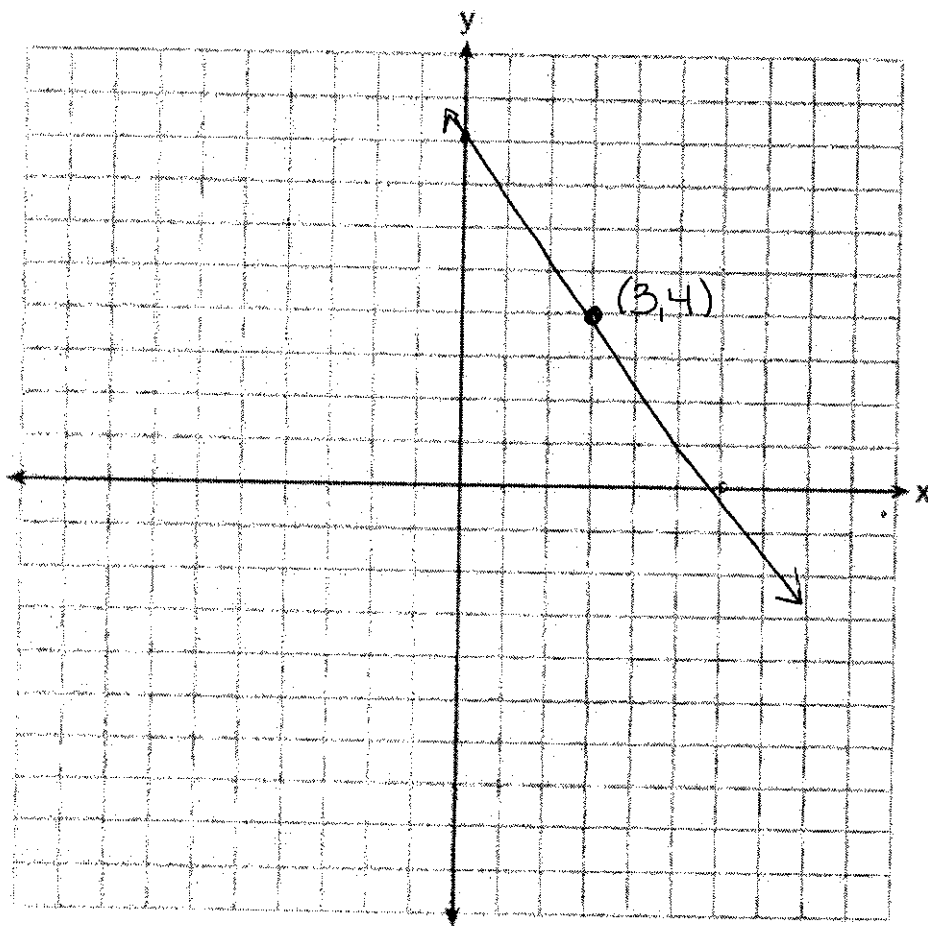
30 Aliyah says that when the line  $4x + 3y = 24$  is dilated by a scale factor of 2 centered at the point  $(3,4)$ , the equation of the dilated line is  $y = -\frac{4}{3}x + 16$ . Is Aliyah correct? Explain why.

[The use of the set of axes below is optional.]

$$\begin{array}{r} 4x + 3y = 24 \\ -4x \quad -4x \\ \hline 3y = -4x + 24 \\ \frac{3y}{3} = \frac{-4x + 24}{3} \\ y = -\frac{4}{3}x + 8 \end{array}$$

No

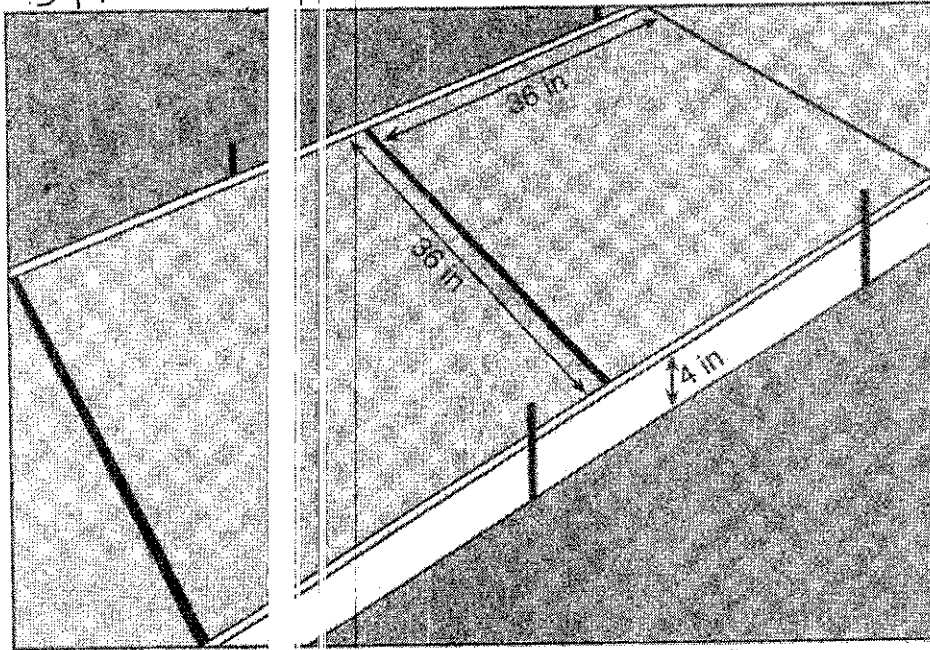
When the center of dilation is on the line the equation stays the same



\*conversions

31 Ian needs to replace two concrete sections in his sidewalk, as modeled below. Each section is 36 inches by 36 inches and 4 inches deep. He can mix his own concrete for \$3.25 per cubic foot.

3A      3A       $\frac{1}{2}$  ft



$$\frac{1}{x} = \frac{12}{4}$$

$$12x = 4$$

$$x = \frac{4}{12} = \frac{1}{3}$$

How much money will it cost Ian to replace the two concrete sections?

$$2 lwh$$

$$2(3)(3)\left(\frac{1}{3}\right)$$

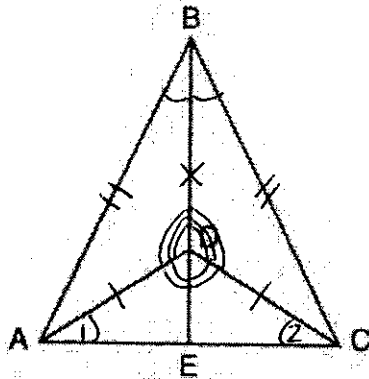
$$6$$

$$6(3.25) = \boxed{\$19.50}$$

Part III

Answer all 3 questions in this part. Each correct answer will receive 4 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [12]

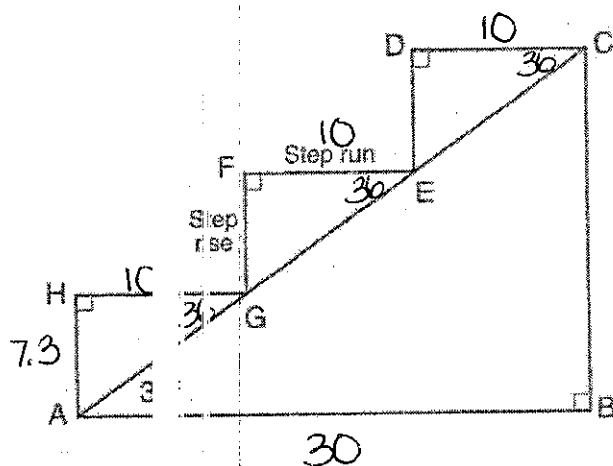
- 32 Given:  $\triangle ABC$ ,  $\overline{AEC}$ ,  $\overline{BDE}$  with  $\angle ABE \cong \angle CBE$ , and  $\angle ADE \cong \angle CDE$   
 Prove:  $\overline{BDE}$  is the perpendicular bisector of  $\overline{AC}$



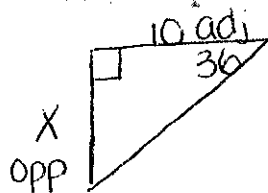
Fill in the missing statement and reasons below.

Statements	Reasons
(1) $\triangle ABC$ , $\overline{AEC}$ , $\overline{BDE}$ with $\angle ABE \cong \angle CBE$ and $\angle ADE \cong \angle CDE$	(1) Given
(2) $\overline{BD} \cong \overline{BD}$	(2) Reflexive
(3) $\angle BDA$ and $\angle ADE$ are supplementary. $\angle BDC$ and $\angle CDE$ are supplementary.	(3) Linear pairs of angles are supplementary.
(4) $\angle BDA \cong \angle BDC$	(4) Supplements of congruent angles are congruent.
(5) $\triangle ABD \cong \triangle CBD$	(5) ASA
(6) $\overline{AD} \cong \overline{CD}$ , $\overline{AB} \cong \overline{CB}$	(6) CPCTC
(7) $\overline{BDE}$ is the perpendicular bisector of $\overline{AC}$ .	(7) $\triangle ADC$ is isosceles; $\angle 1 \cong \angle 2$ ; $\triangle ADE \cong \triangle CDE$ ASA $\overline{AE} \cong \overline{CE}$ b/c CPCTC

33 A homeowner is building three steps leading to a deck, as modeled by the diagram below. All three step rises,  $\overline{HA}$ ,  $\overline{FG}$ , and  $\overline{DE}$ , are congruent, and all three step runs,  $\overline{HG}$ ,  $\overline{FE}$ , and  $\overline{DC}$ , are congruent. Each step rise is perpendicular to the step run it joins. The measure of  $\angle CAB = 36^\circ$  and  $m\angle CBA = 90^\circ$ .



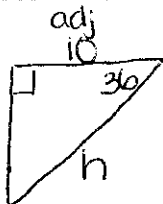
If each step run is parallel to  $\overline{AB}$  and has a length of 10 inches, determine and state the length of each step rise, to the nearest *hundredth* of an inch.



$$\tan 36^\circ = \frac{X}{10}$$

$$\boxed{X = 7.3}$$

Determine and state the length of  $\overline{AC}$ , to the nearest inch.



$$\cos 36^\circ = \frac{10}{h}$$

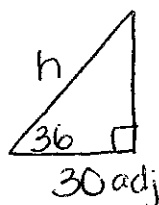
$$h \cos 36^\circ = 10$$

$$\frac{h \cos 36^\circ}{\cos 36^\circ} = \frac{10}{\cos 36^\circ}$$

$$h = 12.3$$

$$\frac{12.3 \times 3}{1} = 37$$

$$\boxed{37}$$



$$\cos 36^\circ = \frac{30}{h}$$

$$h \cos 36^\circ = 30$$

$$\frac{h \cos 36^\circ}{\cos 36^\circ} = \frac{30}{\cos 36^\circ}$$

$$\boxed{h = 37}$$

OR

34 A bakery sells hollow chocolate spheres. The larger diameter of each sphere is 4 cm. The thickness of the chocolate of each sphere is 0.5 cm. Determine and state, to the nearest tenth of a cubic centimeter, the amount of chocolate in each hollow sphere.

$$V = \frac{4}{3} \pi r^3$$

$$\frac{4}{3} \pi (2)^3 - \frac{4}{3} \pi (1.5)^3$$

$$33.5103 - 14.13716694$$

$$\boxed{19.4}$$

The bakery packages 8 of them into a box. If the density of the chocolate is  $1.308 \text{ g/cm}^3$ , determine and state, to the nearest gram, the total mass of the chocolate in the box.

$$D = \frac{M}{V}$$

$$\frac{1.308}{1} = \frac{M}{19.4}$$

$$M = 25.3752 \text{ for 1 sphere}$$

$$\begin{array}{r} x \quad \quad 8 \\ \hline \boxed{203} \end{array}$$

Part IV

Answer the question in this part. A correct answer will receive 6 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. Utilize the information provided for the question to determine your answer. Note that diagrams are not necessarily drawn to scale. For the question in this part, a correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [6]

part. A correct answer will receive 6 credits. Clearly indicate appropriate formula substitutions, diagrams, graphs, charts, etc. for the question to determine your answer. Note that diagrams are not necessarily drawn to scale. For the question in this part, a correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [6]

35 The vertices of quadrilateral  $MATH$  have coordinates  $M(-4,2)$ ,  $A(-1,-3)$ ,  $T(9,3)$ , and  $H(6,8)$ .

Prove that quadrilateral  $MATH$  is a parallelogram. opposite sides are  $\parallel$

[The use of the set of axes on the next page is optional.]

$$MA = \frac{2 - (-3)}{-4 - (-1)} = \frac{5}{-3} \leftarrow$$

$$AT = \frac{-3 - 3}{-1 - 9} = \frac{-6}{-10} = \frac{3}{5} \leftarrow \parallel$$

$$TH = \frac{3 - 8}{9 - 6} = \frac{-5}{3} \leftarrow$$

$$HM = \frac{8 - 2}{6 - (-4)} = \frac{6}{10} = \frac{3}{5} \leftarrow \parallel$$

Question 35 is continued on the next page

**Question 35 continued**

Prove that quadrilateral *MATH* is a rectangle.

[The use of the set of axes below is optional.]

*MATH*

A parallelogram with a right  $\angle$  is a rectangle

