

GEOMETRY

Wednesday, January 22, 2020 — 9:15 a.m. to 12:15 p.m., only

Student Name: _____

School Name: _____

The possession or use of any communications device is strictly prohibited when taking this examination. If you have or use any communications device, no matter how briefly, your examination will be invalidated and no score will be calculated for you.

Print your name and the name of your school on the lines above.

A separate answer sheet for **Part I** has been provided to you. Follow the instructions from the proctor for completing the student information on your answer sheet.

This examination has four parts, with a total of 35 questions. You must answer all questions in this examination. Record your answers to the Part I multiple-choice questions on the separate answer sheet. Write your answers to the questions in **Parts II, III, and IV** directly in this booklet. All work should be written in pen, except for graphs and drawings, which should be done in pencil. 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.

The formulas that you may need to answer some questions in this examination are found at the end of the examination. This sheet is perforated so you may remove it from this booklet.

Scrap paper is not permitted for any part of this examination, but you may use the blank spaces in this booklet as scrap paper. A perforated sheet of scrap graph paper is provided at the end of this booklet for any question for which graphing may be helpful but is not required. You may remove this sheet from this booklet. Any work done on this sheet of scrap graph paper will *not* be scored.

When you have completed the examination, you must sign the statement printed at the end of the answer sheet, indicating that you had no unlawful knowledge of the questions or answers prior to the examination and that you have neither given nor received assistance in answering any of the questions during the examination. Your answer sheet cannot be accepted if you fail to sign this declaration.

Notice...

A graphing calculator, a straightedge (ruler), and a compass must be available for you to use while taking this examination.

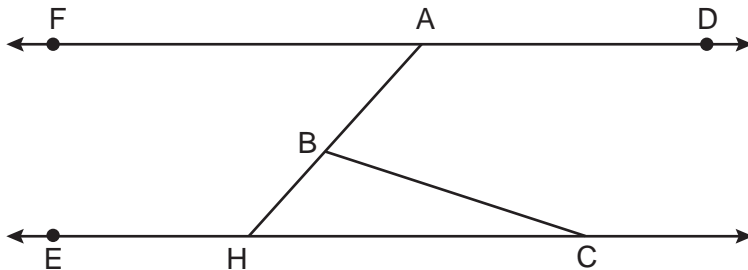
DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

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, $\overline{FAD} \parallel \overline{EHC}$, and \overline{ABH} and \overline{BC} are drawn.



If $m\angle FAB = 48^\circ$ and $m\angle ECB = 18^\circ$, what is $m\angle ABC$?

- (1) 18° (3) 66°
(2) 48° (4) 114°
- 2 A cone has a volume of 108π and a base diameter of 12. What is the height of the cone?
- (1) 27 (3) 3
(2) 9 (4) 4
- 3 Triangle JGR is similar to triangle MST . Which statement is *not* always true?
- (1) $\angle J \cong \angle M$ (3) $\angle R \cong \angle T$
(2) $\angle G \cong \angle T$ (4) $\angle G \cong \angle S$

Use this space for
computations.

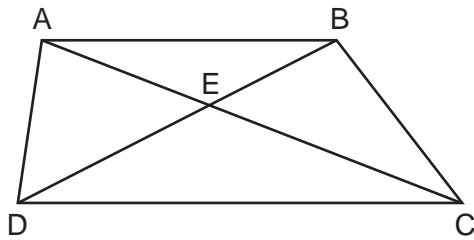
4 In parallelogram $ABCD$, diagonals \overline{AC} and \overline{BD} intersect at E .
Which statement proves $ABCD$ is a rectangle?

- (1) $\overline{AC} \cong \overline{BD}$ (3) $\overline{AC} \perp \overline{BD}$
(2) $\overline{AB} \perp \overline{BD}$ (4) \overline{AC} bisects $\angle BCD$

5 The endpoints of directed line segment PQ have coordinates of $P(-7,-5)$ and $Q(5,3)$. What are the coordinates of point A , on \overline{PQ} , that divide \overline{PQ} into a ratio of 1:3?

- (1) $A(-1,-1)$ (3) $A(3,2)$
(2) $A(2,1)$ (4) $A(-4,-3)$

6 In trapezoid $ABCD$ below, $\overline{AB} \parallel \overline{CD}$.

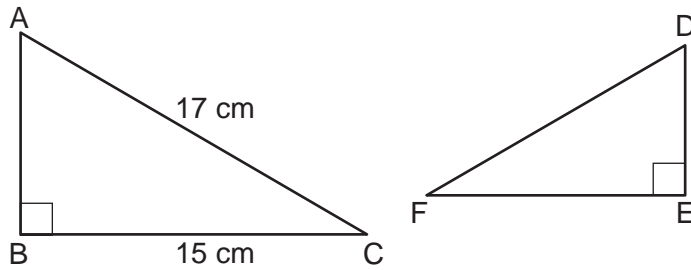


If $AE = 5.2$, $AC = 11.7$, and $CD = 10.5$, what is the length of \overline{AB} , to the nearest tenth?

- (1) 4.7 (3) 8.4
(2) 6.5 (4) 13.1

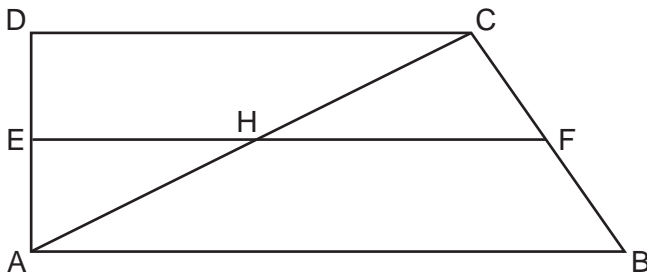
Use this space for
computations.

- 7 Kayla was cutting right triangles from wood to use for an art project. Two of the right triangles she cut are shown below.



If $\triangle ABC \sim \triangle DEF$, with right angles B and E , $BC = 15$ cm, and $AC = 17$ cm, what is the measure of $\angle F$, to the nearest degree?

- (1) 28° (2) 41° (3) 62° (4) 88°
- 8 The line represented by $2y = x + 8$ is dilated by a scale factor of k centered at the origin, such that the image of the line has an equation of $y - \frac{1}{2}x = 2$. What is the scale factor?
- (1) $k = \frac{1}{2}$ (2) $k = 2$ (3) $k = \frac{1}{4}$ (4) $k = 4$
- 9 In quadrilateral $ABCD$ below, $\overline{AB} \parallel \overline{CD}$, and E , H , and F are the midpoints of \overline{AD} , \overline{AC} , and \overline{BC} , respectively.



If $AB = 24$, $CD = 18$, and $AH = 10$, then FH is

- (1) 9 (2) 10 (3) 12 (4) 21

Use this space for computations.

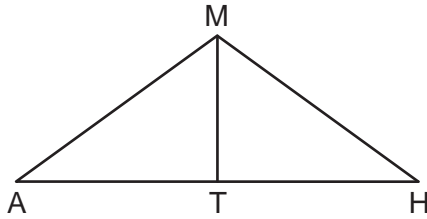
10 Jaden is comparing two cones. The radius of the base of cone A is twice as large as the radius of the base of cone B . The height of cone B is twice the height of cone A . The volume of cone A is

- (1) twice the volume of cone B
- (2) four times the volume of cone B
- (3) equal to the volume of cone B
- (4) equal to half the volume of cone B

11 A regular hexagon is rotated about its center. Which degree measure will carry the regular hexagon onto itself?

- (1) 45°
- (2) 90°
- (3) 120°
- (4) 135°

12 In triangle MAH below, \overline{MT} is the perpendicular bisector of \overline{AH} .

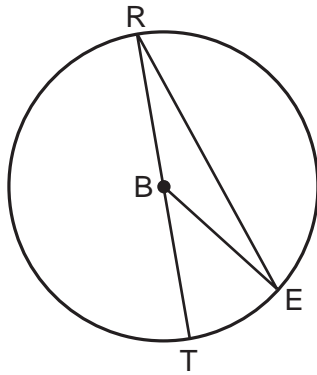


Which statement is *not* always true?

- (1) $\triangle MAH$ is isosceles.
- (2) $\triangle MAT$ is isosceles.
- (3) \overline{MT} bisects $\angle AMH$.
- (4) $\angle A$ and $\angle TMH$ are complementary.

13 In circle B below, diameter \overline{RT} , radius \overline{BE} , and chord \overline{RE} are drawn.

Use this space for computations.



If $m\angle TRE = 15^\circ$ and $BE = 9$, then the area of sector EBR is

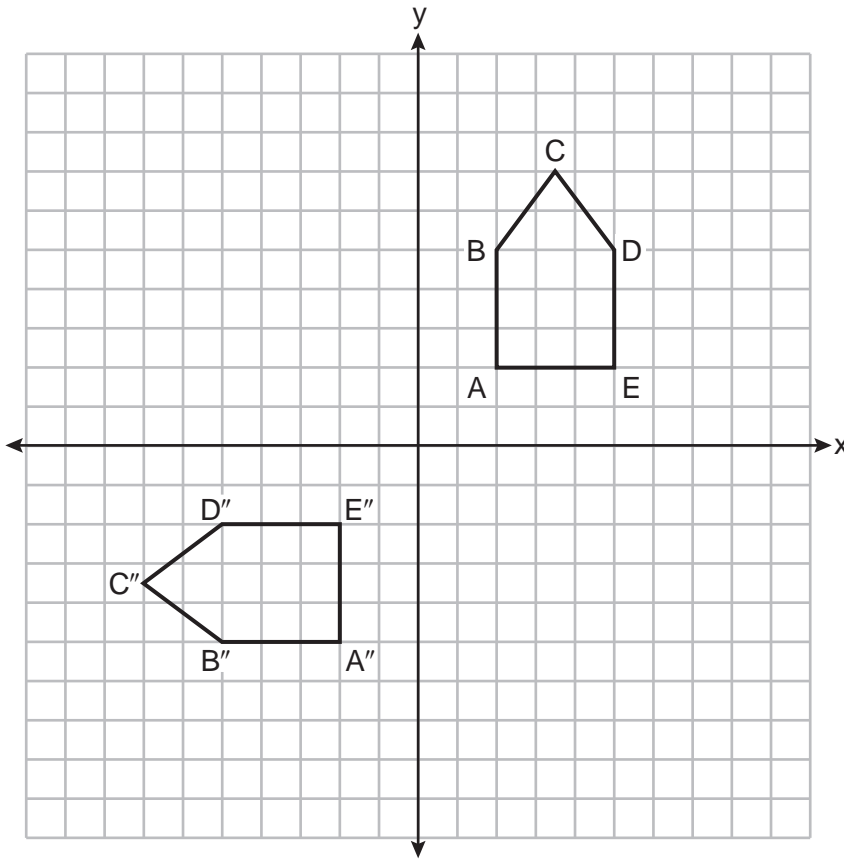
- (1) 3.375π
- (2) 6.75π
- (3) 33.75π
- (4) 37.125π

14 Lou has a solid clay brick in the shape of a rectangular prism with a length of 8 inches, a width of 3.5 inches, and a height of 2.25 inches. If the clay weighs 1.055 oz/in^3 , how much does Lou's brick weigh, to the nearest ounce?

- (1) 66
- (2) 64
- (3) 63
- (4) 60

Use this space for computations.

17 On the set of axes below, pentagon $ABCDE$ is congruent to $A''B''C''D''E''$.

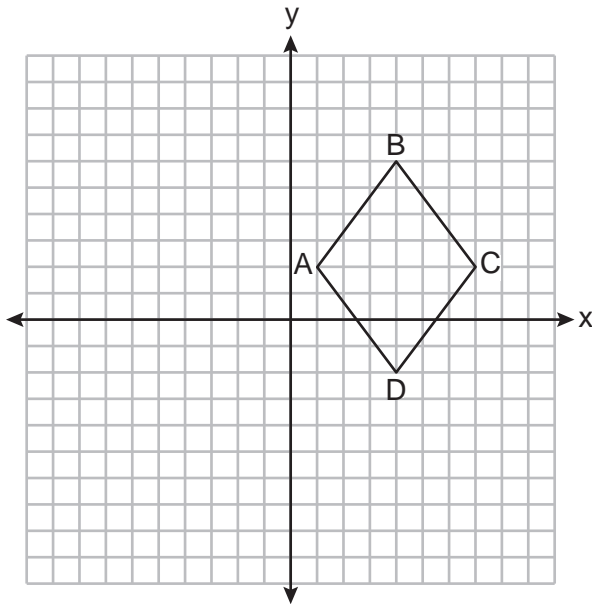


Which describes a sequence of rigid motions that maps $ABCDE$ onto $A''B''C''D''E''$?

- (1) a rotation of 90° counterclockwise about the origin followed by a reflection over the x -axis
- (2) a rotation of 90° counterclockwise about the origin followed by a translation down 7 units
- (3) a reflection over the y -axis followed by a reflection over the x -axis
- (4) a reflection over the x -axis followed by a rotation of 90° counterclockwise about the origin

Use this space for computations.

- 18** On the set of axes below, rhombus $ABCD$ has vertices whose coordinates are $A(1,2)$, $B(4,6)$, $C(7,2)$, and $D(4,-2)$.



What is the area of rhombus $ABCD$?

- (1) 20 (3) 25
(2) 24 (4) 48
- 19** Which figure(s) below can have a triangle as a two-dimensional cross section?
- I. cone
 - II. cylinder
 - III. cube
 - IV. square pyramid
- (1) I, only
(2) IV, only
(3) I, II, and IV, only
(4) I, III, and IV, only

Use this space for computations.

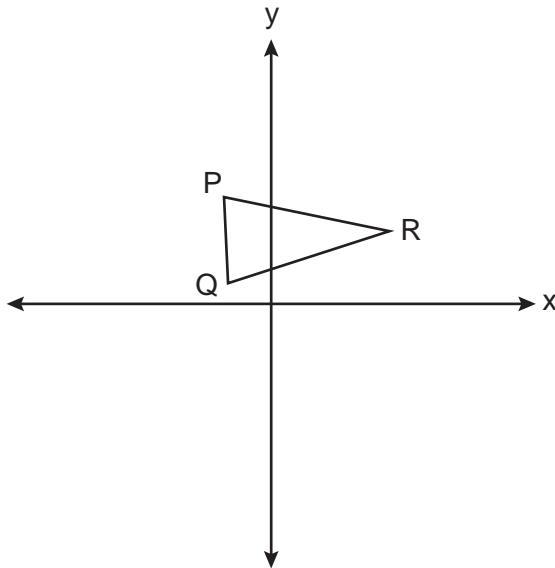
20 What is an equation of a circle whose center is at $(2, -4)$ and is tangent to the line $x = -2$?

- (1) $(x - 2)^2 + (y + 4)^2 = 4$
- (2) $(x - 2)^2 + (y + 4)^2 = 16$
- (3) $(x + 2)^2 + (y - 4)^2 = 4$
- (4) $(x + 2)^2 + (y - 4)^2 = 16$

21 For the acute angles in a right triangle, $\sin (4x)^\circ = \cos (3x + 13)^\circ$. What is the number of degrees in the measure of the *smaller* angle?

- (1) 11°
- (2) 13°
- (3) 44°
- (4) 52°

22 Triangle PQR is shown on the set of axes below.

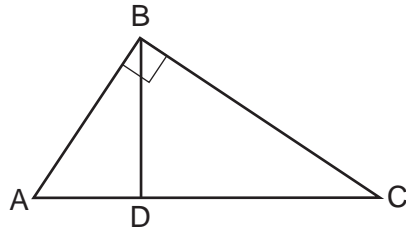


Which quadrant will contain point R'' , the image of point R , after a 90° clockwise rotation centered at $(0,0)$ followed by a reflection over the x -axis?

- (1) I
- (2) II
- (3) III
- (4) IV

Use this space for computations.

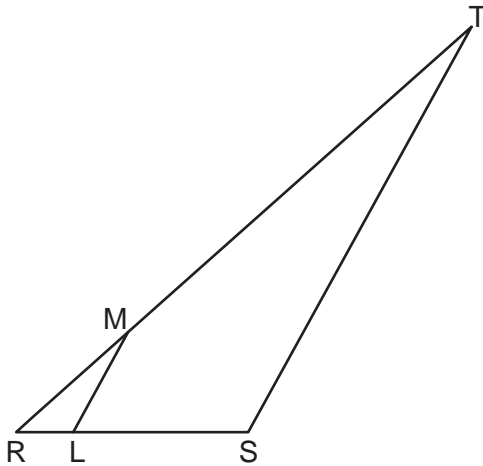
23 In the diagram below of right triangle ABC , altitude \overline{BD} is drawn.



Which ratio is always equivalent to $\cos A$?

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

24 In the diagram below of $\triangle RST$, L is a point on \overline{RS} , and M is a point on \overline{RT} , such that $\overline{LM} \parallel \overline{ST}$.



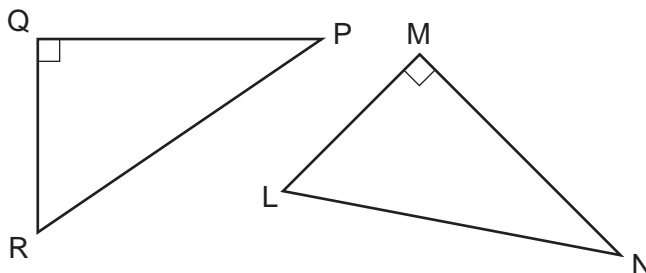
If $RL = 2$, $LS = 6$, $LM = 4$, and $ST = x + 2$, what is the length of \overline{ST} ?

- (1) 10 (3) 14
(2) 12 (4) 16
-

Part II

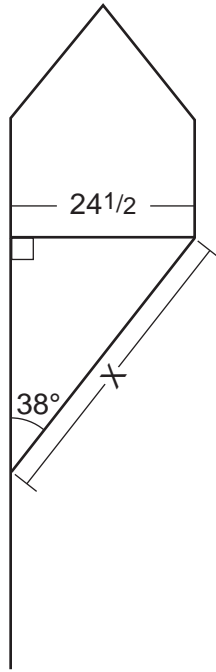
Answer all 7 questions in this part. Each correct answer will receive 2 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily 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 diagram below, right triangle PQR is transformed by a sequence of rigid motions that maps it onto right triangle NML .



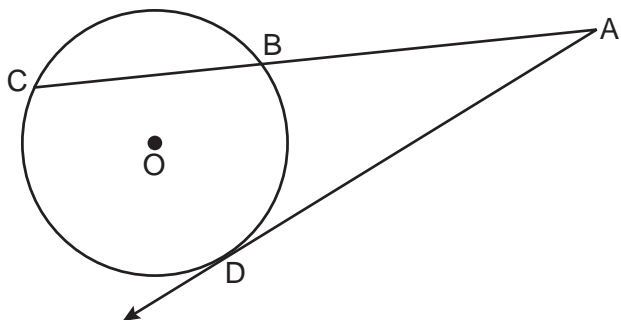
Write a set of three congruency statements that would show ASA congruency for these triangles.

26 Diego needs to install a support beam to hold up his new birdhouse, as modeled below. The base of the birdhouse is $24\frac{1}{2}$ inches long. The support beam will form an angle of 38° with the vertical post. Determine and state the approximate length of the support beam, x , to the nearest inch.



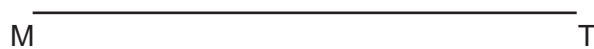
27 A rectangular tabletop will be made of maple wood that weighs 43 pounds per cubic foot. The tabletop will have a length of eight feet, a width of three feet, and a thickness of one inch. Determine and state the weight of the tabletop, in pounds.

28 In the diagram below of circle O , secant \overline{ABC} and tangent \overline{AD} are drawn.

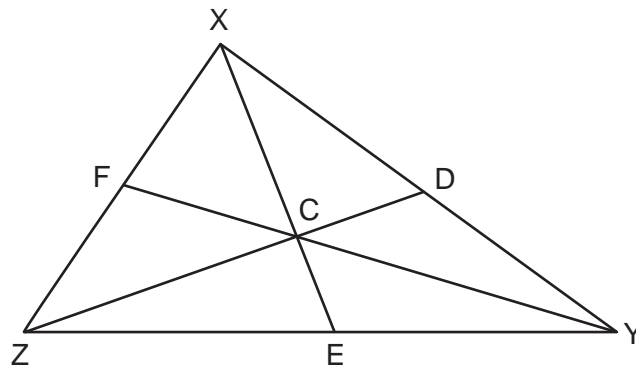


If $CA = 12.5$ and $CB = 4.5$, determine and state the length of \overline{DA} .

29 Given \overline{MT} below, use a compass and straightedge to construct a 45° angle whose vertex is at point M .
[Leave all construction marks.]



30 In $\triangle XYZ$ shown below, medians \overline{XE} , \overline{YF} , and \overline{ZD} intersect at C .



If $CE = 5$, $YF = 21$, and $XZ = 15$, determine and state the perimeter of triangle CFX .

31 Determine and state an equation of the line perpendicular to the line $5x - 4y = 10$ and passing through the point $(5,12)$.

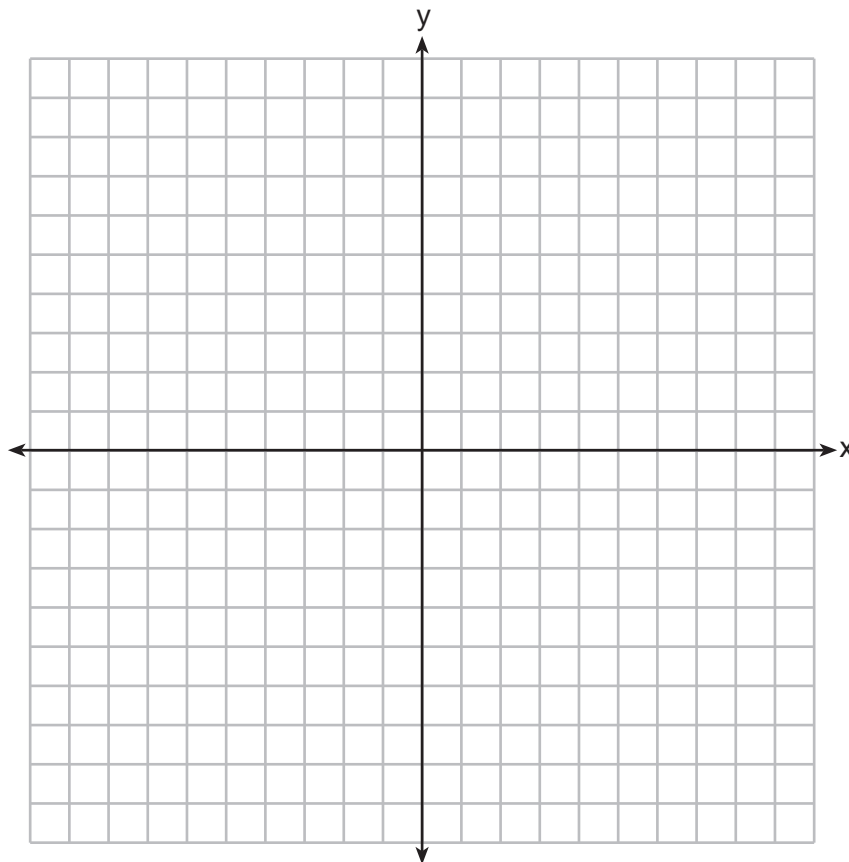
Part III

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]

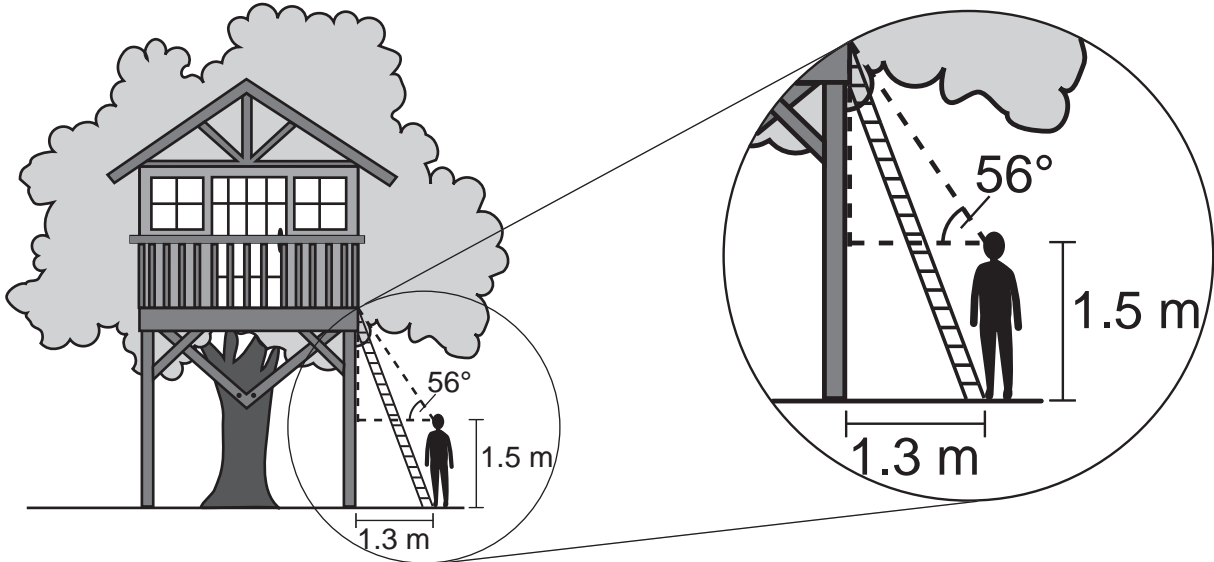
32 Quadrilateral *NATS* has coordinates $N(-4, -3)$, $A(1, 2)$, $T(8, 1)$, and $S(3, -4)$.

Prove quadrilateral *NATS* is a rhombus.

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

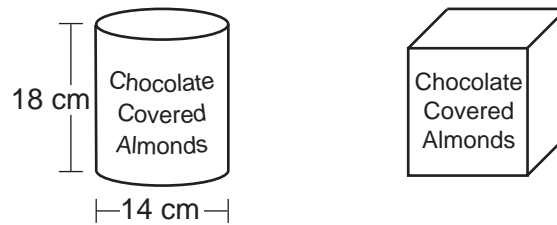


- 33** David has just finished building his treehouse and still needs to buy a ladder to be attached to the ledge of the treehouse and anchored at a point on the ground, as modeled below. David is standing 1.3 meters from the stilt supporting the treehouse. This is the point on the ground where he has decided to anchor the ladder. The angle of elevation from his eye level to the bottom of the treehouse is 56 degrees. David's eye level is 1.5 meters above the ground.



Determine and state the minimum length of a ladder, to the *nearest tenth of a meter*, that David will need to buy for his treehouse.

- 34 A manufacturer is designing a new container for their chocolate-covered almonds. Their original container was a cylinder with a height of 18 cm and a diameter of 14 cm. The new container can be modeled by a rectangular prism with a square base and will contain the same amount of chocolate-covered almonds.



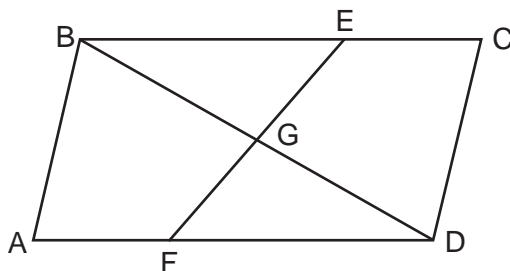
If the new container's height is 16 cm, determine and state, to the *nearest tenth of a centimeter*, the side length of the new container if both containers contain the same amount of almonds.

A store owner who sells the chocolate-covered almonds displays them on a shelf whose dimensions are 80 cm long and 60 cm wide. The shelf can only hold one layer of new containers when each new container sits on its square base. Determine and state the maximum number of new containers the store owner can fit on the shelf.

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]

- 35 In quadrilateral $ABCD$, E and F are points on \overline{BC} and \overline{AD} , respectively, and \overline{BGD} and \overline{EGF} are drawn such that $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, and $\overline{CE} \cong \overline{AF}$.



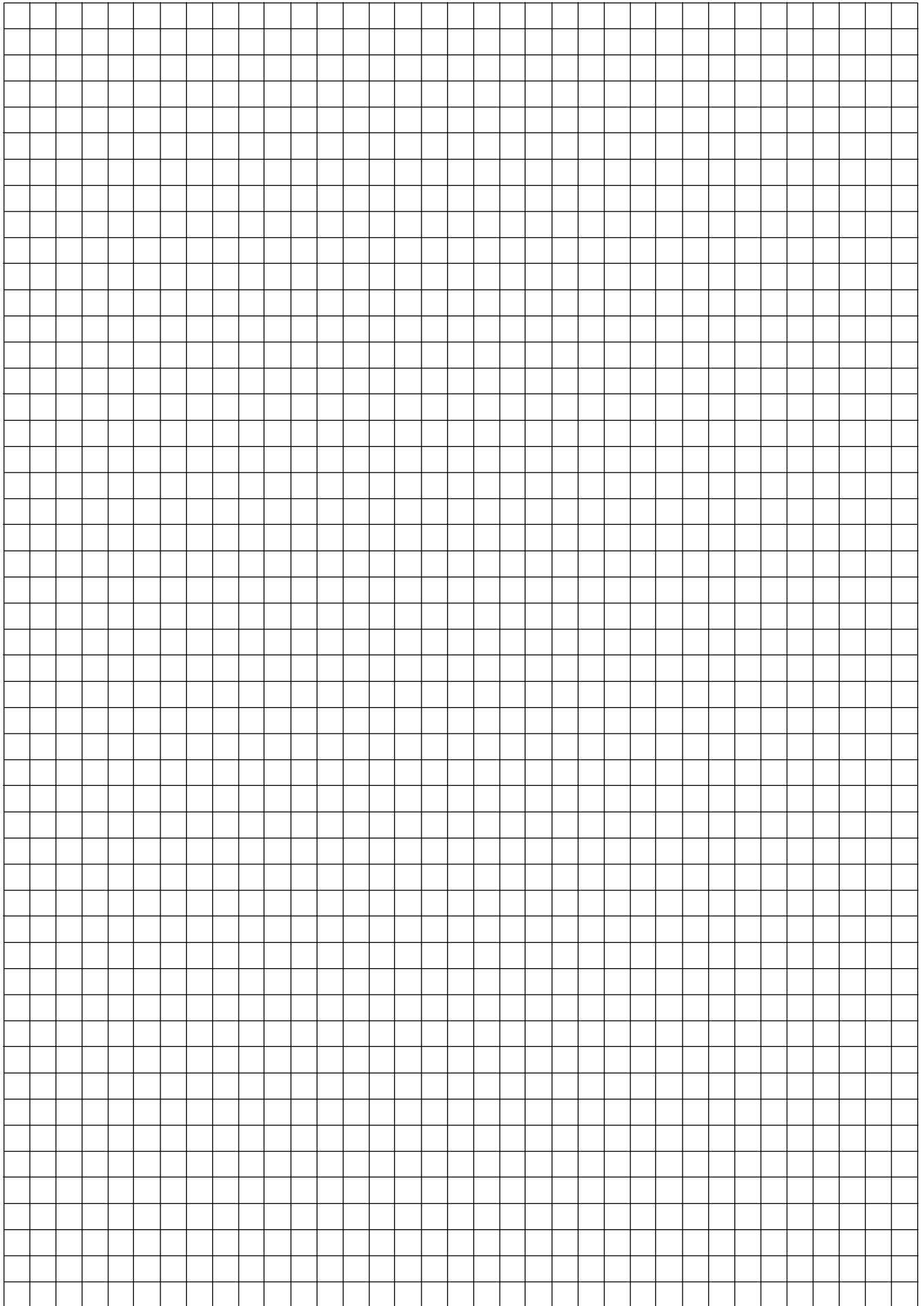
Prove: $\overline{FG} \cong \overline{EG}$

Work space for question 35 is continued on the next page.

Question 35 continued

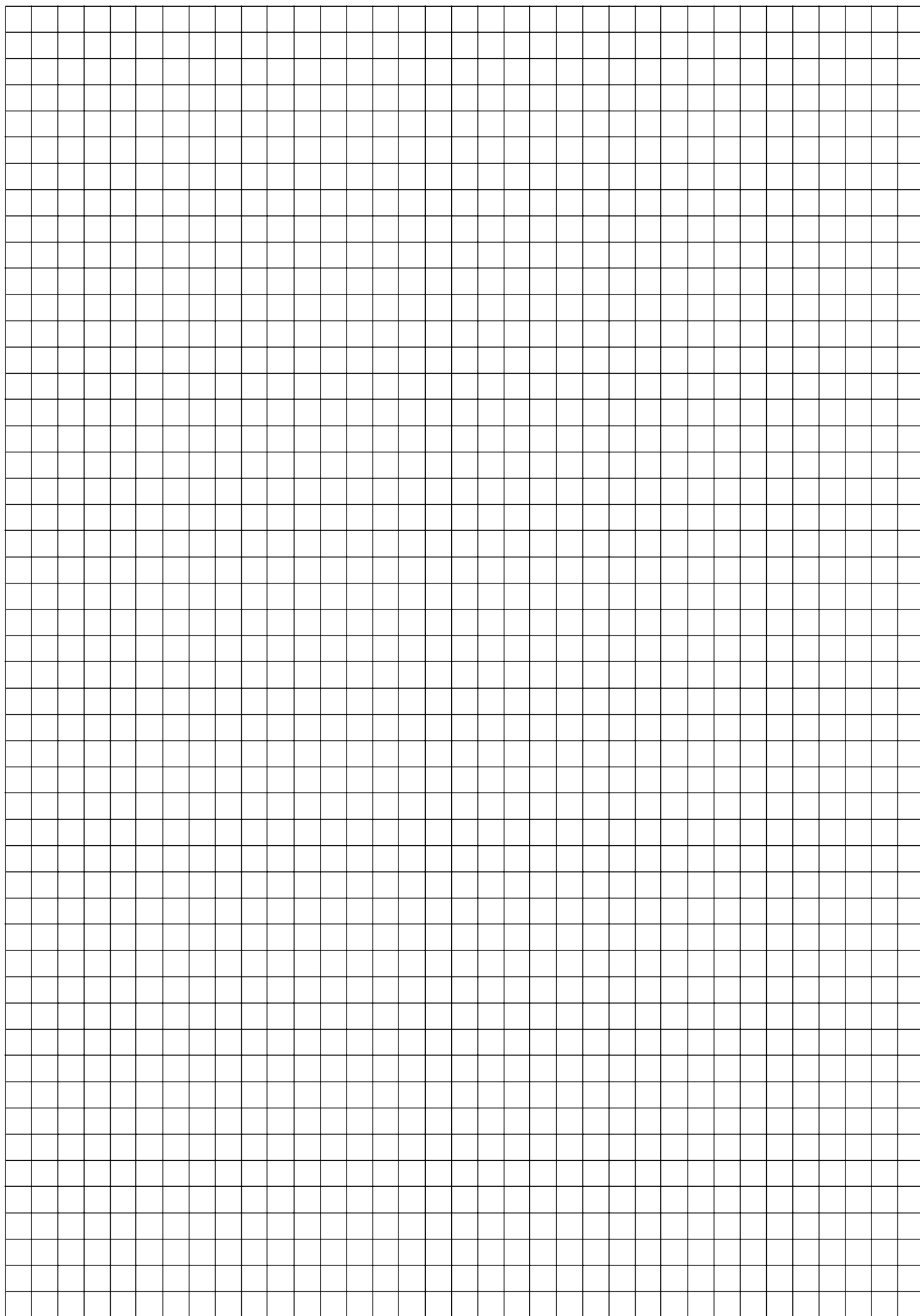
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Scrap Graph Paper — This sheet will *not* be scored.



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High School Math Reference Sheet

1 inch = 2.54 centimeters	1 kilometer = 0.62 mile	1 cup = 8 fluid ounces
1 meter = 39.37 inches	1 pound = 16 ounces	1 pint = 2 cups
1 mile = 5280 feet	1 pound = 0.454 kilogram	1 quart = 2 pints
1 mile = 1760 yards	1 kilogram = 2.2 pounds	1 gallon = 4 quarts
1 mile = 1.609 kilometers	1 ton = 2000 pounds	1 gallon = 3.785 liters
		1 liter = 0.264 gallon
		1 liter = 1000 cubic centimeters

Triangle	$A = \frac{1}{2}bh$
Parallelogram	$A = bh$
Circle	$A = \pi r^2$
Circle	$C = \pi d$ or $C = 2\pi r$
General Prisms	$V = Bh$
Cylinder	$V = \pi r^2 h$
Sphere	$V = \frac{4}{3}\pi r^3$
Cone	$V = \frac{1}{3}\pi r^2 h$
Pyramid	$V = \frac{1}{3}Bh$

Pythagorean Theorem	$a^2 + b^2 = c^2$
Quadratic Formula	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Arithmetic Sequence	$a_n = a_1 + (n - 1)d$
Geometric Sequence	$a_n = a_1 r^{n-1}$
Geometric Series	$S_n = \frac{a_1 - a_1 r^n}{1 - r}$ where $r \neq 1$
Radians	1 radian = $\frac{180}{\pi}$ degrees
Degrees	1 degree = $\frac{\pi}{180}$ radians
Exponential Growth/Decay	$A = A_0 e^{k(t - t_0)} + B_0$

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GEOMETRY

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GEOMETRY

Regents Examination in Geometry – January 2020

Scoring Key: Part I (Multiple-Choice Questions)

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Geometry	January '20	1	3	MC	2	1
Geometry	January '20	2	2	MC	2	1
Geometry	January '20	3	2	MC	2	1
Geometry	January '20	4	1	MC	2	1
Geometry	January '20	5	4	MC	2	1
Geometry	January '20	6	3	MC	2	1
Geometry	January '20	7	1	MC	2	1
Geometry	January '20	8	1	MC	2	1
Geometry	January '20	9	3	MC	2	1
Geometry	January '20	10	1	MC	2	1
Geometry	January '20	11	3	MC	2	1
Geometry	January '20	12	2	MC	2	1
Geometry	January '20	13	3	MC	2	1
Geometry	January '20	14	1	MC	2	1
Geometry	January '20	15	4	MC	2	1
Geometry	January '20	16	4	MC	2	1
Geometry	January '20	17	2	MC	2	1
Geometry	January '20	18	2	MC	2	1
Geometry	January '20	19	4	MC	2	1
Geometry	January '20	20	2	MC	2	1
Geometry	January '20	21	3	MC	2	1
Geometry	January '20	22	1	MC	2	1
Geometry	January '20	23	2	MC	2	1
Geometry	January '20	24	4	MC	2	1

Regents Examination in Geometry – January 2020

Scoring Key: Parts II, III, and IV (Constructed-Response Questions)

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Geometry	January '20	25	-	CR	2	1
Geometry	January '20	26	-	CR	2	1
Geometry	January '20	27	-	CR	2	1
Geometry	January '20	28	-	CR	2	1
Geometry	January '20	29	-	CR	2	1
Geometry	January '20	30	-	CR	2	1
Geometry	January '20	31	-	CR	2	1
Geometry	January '20	32	-	CR	4	1
Geometry	January '20	33	-	CR	4	1
Geometry	January '20	34	-	CR	4	1
Geometry	January '20	35	-	CR	6	1

Key
MC = Multiple-choice question
CR = Constructed-response question

The chart for determining students' final examination scores for the **January 2020 Regents Examination in Geometry** will be posted on the Department's web site at: <http://www.p12.nysed.gov/assessment/> on the day of the examination. Conversion charts provided for the previous administrations of the Regents Examination in Geometry must NOT be used to determine students' final scores for this administration.

FOR TEACHERS ONLY

The University of the State of New York
REGENTS HIGH SCHOOL EXAMINATION

GEOMETRY

Wednesday, January 22, 2020 — 9:15 a.m. to 12:15 p.m., only

RATING GUIDE

Updated information regarding the rating of this examination may be posted on the New York State Education Department's web site during the rating period. Check this web site at: <http://www.p12.nysed.gov/assessment/> and select the link "Scoring Information" for any recently posted information regarding this examination. This site should be checked before the rating process for this examination begins and several times throughout the Regents Examination period.

The Department is providing supplemental scoring guidance, the "Model Response Set," for the Regents Examination in Geometry. This guidance is intended to be part of the scorer training. Schools should use the Model Response Set along with the rubrics in the Scoring Key and Rating Guide to help guide scoring of student work. While not reflective of all scenarios, the Model Response Set illustrates how less common student responses to constructed-response questions may be scored. The Model Response Set will be available on the Department's web site at: <http://www.nysedregents.org/geometryre/>.

Mechanics of Rating

The following procedures are to be followed for scoring student answer papers for the Regents Examination in Geometry. More detailed information about scoring is provided in the publication *Information Booklet for Scoring the Regents Examination in Geometry*.

Do *not* attempt to correct the student's work by making insertions or changes of any kind. In scoring the constructed-response questions, use check marks to indicate student errors. Unless otherwise specified, mathematically correct variations in the answers will be allowed. Units need not be given when the wording of the questions allows such omissions.

Each student's answer paper is to be scored by a minimum of three mathematics teachers. No one teacher is to score more than approximately one-third of the constructed-response questions on a student's paper. Teachers may not score their own students' answer papers. On the student's separate answer sheet, for each question, record the number of credits earned and the teacher's assigned rater/scorer letter.

Schools are not permitted to rescore any of the constructed-response questions on this exam after each question has been rated once, regardless of the final exam score. Schools are required to ensure that the raw scores have been added correctly and that the resulting scale score has been determined accurately.

Raters should record the student's scores for all questions and the total raw score on the student's separate answer sheet. Then the student's total raw score should be converted to a scale score by using the conversion chart that will be posted on the Department's web site at: <http://www.p12.nysed.gov/assessment/> on Wednesday, January 22, 2020. Because scale scores corresponding to raw scores in the conversion chart may change from one administration to another, it is crucial that, for each administration, the conversion chart provided for that administration be used to determine the student's final score. The student's scale score should be entered in the box provided on the student's separate answer sheet. The scale score is the student's final examination score.

General Rules for Applying Mathematics Rubrics

I. General Principles for Rating

The rubrics for the constructed-response questions on the Regents Examination in Geometry are designed to provide a systematic, consistent method for awarding credit. The rubrics are not to be considered all-inclusive; it is impossible to anticipate all the different methods that students might use to solve a given problem. Each response must be rated carefully using the teacher's professional judgment and knowledge of mathematics; all calculations must be checked. The specific rubrics for each question must be applied consistently to all responses. In cases that are not specifically addressed in the rubrics, raters must follow the general rating guidelines in the publication *Information Booklet for Scoring the Regents Examination in Geometry*, use their own professional judgment, confer with other mathematics teachers, and/or contact the State Education Department for guidance. During each Regents Examination administration period, rating questions may be referred directly to the Education Department. The contact numbers are sent to all schools before each administration period.

II. Full-Credit Responses

A full-credit response provides a complete and correct answer to all parts of the question. Sufficient work is shown to enable the rater to determine how the student arrived at the correct answer.

When the rubric for the full-credit response includes one or more examples of an acceptable method for solving the question (usually introduced by the phrase “such as”), it does not mean that there are no additional acceptable methods of arriving at the correct answer. Unless otherwise specified, mathematically correct alternative solutions should be awarded credit. The only exceptions are those questions that specify the type of solution that must be used; e.g., an algebraic solution or a graphic solution. A correct solution using a method other than the one specified is awarded half the credit of a correct solution using the specified method.

III. Appropriate Work

Full-Credit Responses: The directions in the examination booklet for all the constructed-response questions state: “Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc.” The student has the responsibility of providing the correct answer **and** showing how that answer was obtained. The student must “construct” the response; the teacher should not have to search through a group of seemingly random calculations scribbled on the student paper to ascertain what method the student may have used.

Responses With Errors: Rubrics that state “Appropriate work is shown, but...” are intended to be used with solutions that show an essentially complete response to the question but contain certain types of errors, whether computational, rounding, graphing, or conceptual. If the response is incomplete; i.e., an equation is written but not solved or an equation is solved but not all of the parts of the question are answered, appropriate work has **not** been shown. Other rubrics address incomplete responses.

IV. Multiple Errors

Computational Errors, Graphing Errors, and Rounding Errors: Each of these types of errors results in a 1-credit deduction. Any combination of two of these types of errors results in a 2-credit deduction. No more than 2 credits should be deducted for such mechanical errors in a 4-credit question and no more than 3 credits should be deducted in a 6-credit question. The teacher must carefully review the student's work to determine what errors were made and what type of errors they were.

Conceptual Errors: A conceptual error involves a more serious lack of knowledge or procedure. Examples of conceptual errors include using the incorrect formula for the area of a figure, choosing the incorrect trigonometric function, or multiplying the exponents instead of adding them when multiplying terms with exponents.

If a response shows repeated occurrences of the same conceptual error, the student should not be penalized twice. If the same conceptual error is repeated in responses to other questions, credit should be deducted in each response.

For 4- and 6-credit questions, if a response shows one conceptual error and one computational, graphing, or rounding error, the teacher must award credit that takes into account both errors. Refer to the rubric for specific scoring guidelines.

Part II

For each question, use the specific criteria to award a maximum of 2 credits. Unless otherwise specified, mathematically correct alternative solutions should be awarded appropriate credit.

(25) [2] Three correct congruency statements that indicate *ASA* congruence are written.

[1] Two correct congruency statements are written that lead to an *ASA* congruence.

or

[1] Three appropriate congruency statements are written for a method of proof other than *ASA*.

[0] Only one correct congruency statement is written.

or

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

(26) [2] 40, and correct work is shown.

[1] Appropriate work is shown, but one computational or rounding error is made.

or

[1] Appropriate work is shown, but one conceptual error is made.

or

[1] A correct trigonometric equation is written to find x , but no further correct work is shown.

or

[1] 40, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

- (27) [2] 86, and correct work is shown.
- [1] Appropriate work is shown, but one computational error is made.
- or*
- [1] Appropriate work is shown, but one conceptual error is made.
- or*
- [1] Appropriate work is shown to find the volume of the tabletop, but no further correct work is shown.
- or*
- [1] 86, but no work is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- (28) [2] 10, and correct work is shown.
- [1] Appropriate work is shown, but one computational error is made.
- or*
- [1] Appropriate work is shown, but one conceptual error is made.
- or*
- [1] A correct equation is written to find DA , but no further correct work is shown.
- or*
- [1] 10, but no work is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

- (29) [2] A correct construction is drawn showing all appropriate arcs.
- [1] Appropriate work is shown, but one construction error is made.
- or**
- [1] A correct construction is drawn, but the vertex is not at M .
- [0] A drawing that is not an appropriate construction is shown.
- or**
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- (30) [2] 24.5, and correct work is shown.
- [1] Appropriate work is shown, but one computational error is made.
- or**
- [1] Appropriate work is shown, but one conceptual error is made.
- or**
- [1] 24.5, but no work is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- (31) [2] $y - 12 = -\frac{4}{5}(x - 5)$ or an equivalent equation is written, and correct work is shown.
- [1] Appropriate work is shown, but one computational error is made.
- or**
- [1] Appropriate work is shown, but one conceptual error is made.
- or**
- [1] $y - 12 = -\frac{4}{5}(x - 5)$ or an equivalent equation is written, but no work is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
-

Part III

For each question, use the specific criteria to award a maximum of 4 credits. Unless otherwise specified, mathematically correct alternative solutions should be awarded appropriate credit.

(32) [4] Correct work is shown to prove $NATS$ is a rhombus, and a correct concluding statement is written.

[3] Appropriate work is shown, but one computational or graphing error is made.

or

[3] Correct work is shown to prove $NATS$ is a rhombus, but the concluding statement is missing or incorrect.

[2] Appropriate work is shown, but two or more computational or graphing errors are made.

or

[2] Appropriate work is shown, but one conceptual error is made.

or

[2] Correct work is shown to prove $NATS$ is a parallelogram, and a correct concluding statement is written. No further correct work is shown.

or

[2] Appropriate work is shown to prove that $\overline{NT} \perp \overline{AS}$ and \overline{NT} and \overline{AS} bisect each other, but the concluding statements are missing or incorrect. No further correct work is shown.

[1] Appropriate work is shown, but one conceptual error and one computational or graphing error are made.

or

[1] Appropriate work is shown to prove that $\overline{NT} \perp \overline{AS}$ or \overline{NT} and \overline{AS} bisect each other, but the concluding statements are missing or incorrect. No further correct work is shown.

or

[1] Appropriate work is shown to prove $NATS$ is a parallelogram, but the concluding statement(s) is missing or incorrect. No further correct work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

- (33) [4] 3.7, and correct work is shown.
- [3] Appropriate work is shown, but one computational or rounding error is made.
- or*
- [3] Correct work is shown to find the height of the stilt, but no further correct work is shown.
- [2] Appropriate work is shown, but two or more computational or rounding errors are made.
- or*
- [2] Appropriate work is shown, but one conceptual error is made.
- or*
- [2] Correct work is shown to find the altitude from the sight line to the top of the ladder, but no further correct work is shown.
- [1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
- or*
- [1] A correct relevant trigonometric equation is written, but no further correct work is shown.
- or*
- [1] 3.7, but no correct work is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

- (34) [4] 13.2 and 24, and correct work is shown.
- [3] Appropriate work is shown, but one computational or rounding error is made.
- or**
- [3] The side length of 13.2 is found correctly, but no further correct work is shown.
- [2] Appropriate work is shown, but two computational or rounding errors are made.
- [1] The volume of the cylinder is found correctly, but no further correct work is shown.
- or**
- [1] 13.2 and 24, but no work is shown.
- [0] 13.2 or 24, but no work is shown.
- or**
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
-

Part IV

For this question, use the specific criteria to award a maximum of 6 credits. Unless otherwise specified, mathematically correct alternative solutions should be awarded appropriate credit.

(35) [6] A complete and correct proof that includes a concluding statement is written.

[5] A proof is written that demonstrates a thorough understanding of the method of proof and contains no conceptual errors, but one statement and/or reason is missing or incorrect.

or

[5] $\triangle BEG \cong \triangle DFG$ is proven, but no further correct work is shown.

[4] A proof is written that demonstrates a good understanding of the method of proof and contains no conceptual errors, but two statements and/or reasons are missing or incorrect.

or

[4] A proof is written that demonstrates a good understanding of the method of proof, but one conceptual error is made.

[3] A proof is written that demonstrates a method of proof, but three statements and/or reasons are missing or incorrect.

or

[3] A proof is written that demonstrates a method of proof, but one conceptual error is made, and one statement and/or reason is missing or incorrect.

[2] A proof is written that demonstrates a good understanding of the method of proof, but two conceptual errors are made.

or

[2] Some correct relevant statements about the proof are made, but four statements and/or reasons are missing or incorrect.

or

[2] Parallelogram $ABCD$ and/or $\triangle ABD \cong \triangle CDB$ are/is proven, but no further correct work is shown.

[1] Only one correct relevant statement and reason are written.

[0] The “given” and/or the “prove” statements are rewritten in the style of a formal proof, but no further correct relevant statements are written.

or

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

**Map to the Learning Standards
Geometry
January 2020**

Question	Type	Credits	Cluster
1	Multiple Choice	2	G-CO.C
2	Multiple Choice	2	G-GMD.A
3	Multiple Choice	2	G-SRT.B
4	Multiple Choice	2	G-CO.C
5	Multiple Choice	2	G-GPE.B
6	Multiple Choice	2	G-SRT.B
7	Multiple Choice	2	G-SRT.C
8	Multiple Choice	2	G-SRT.A
9	Multiple Choice	2	G-SRT.B
10	Multiple Choice	2	G-GMD.A
11	Multiple Choice	2	G-CO.A
12	Multiple Choice	2	G-CO.C
13	Multiple Choice	2	G-C.B
14	Multiple Choice	2	G-MG.A
15	Multiple Choice	2	G-CO.B
16	Multiple Choice	2	G-SRT.B
17	Multiple Choice	2	G-CO.B
18	Multiple Choice	2	G-GPE.B
19	Multiple Choice	2	G-GMD.B
20	Multiple Choice	2	G-GPE.A
21	Multiple Choice	2	G-SRT.C
22	Multiple Choice	2	G-CO.A
23	Multiple Choice	2	G-SRT.C
24	Multiple Choice	2	G-SRT.B
25	Constructed Response	2	G-CO.B
26	Constructed Response	2	G-SRT.C
27	Constructed Response	2	G-MG.A
28	Constructed Response	2	G-C.A
29	Constructed Response	2	G-CO.D
30	Constructed Response	2	G-CO.C
31	Constructed Response	2	G-GPE.B
32	Constructed Response	4	G-GPE.B
33	Constructed Response	4	G-SRT.C
34	Constructed Response	4	G-MG.A
35	Constructed Response	6	G-CO.C

Regents Examination in Geometry
January 2020
Chart for Converting Total Test Raw Scores to
Final Examination Scores (Scale Scores)

The *Chart for Determining the Final Examination Score for the January 2020 Regents Examination in Geometry* will be posted on the Department's web site at: <http://www.p12.nysed.gov/assessment/> on Wednesday, January 22, 2020. Conversion charts provided for previous administrations of the Regents Examination in Geometry must NOT be used to determine students' final scores for this administration.

Online Submission of Teacher Evaluations of the Test to the Department

Suggestions and feedback from teachers provide an important contribution to the test development process. The Department provides an online evaluation form for State assessments. It contains spaces for teachers to respond to several specific questions and to make suggestions. Instructions for completing the evaluation form are as follows:

1. Go to <http://www.forms2.nysed.gov/emsc/osa/exameval/reexameval.cfm>.
2. Select the test title.
3. Complete the required demographic fields.
4. Complete each evaluation question and provide comments in the space provided.
5. Click the SUBMIT button at the bottom of the page to submit the completed form.

The University of the State of New York
REGENTS HIGH SCHOOL EXAMINATION

GEOMETRY

Wednesday, January 22, 2020 — 9:15 a.m. to 12:15 p.m.

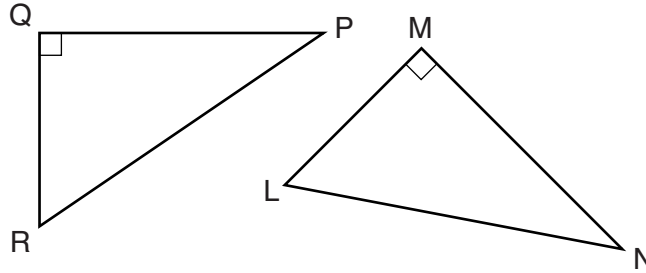
MODEL RESPONSE SET

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Question 25

25 In the diagram below, right triangle PQR is transformed by a sequence of rigid motions that maps it onto right triangle NML .



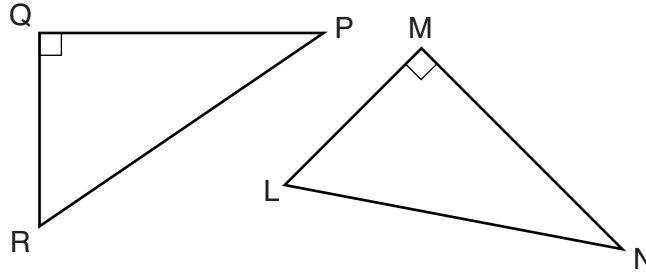
Write a set of three congruency statements that would show ASA congruency for these triangles.

$$\begin{aligned}\angle R &\cong \angle M \\ \angle P &\cong \angle N \\ \overline{QP} &\cong \overline{MN}\end{aligned}$$

Score 2: The student gave a complete and correct response.

Question 25

25 In the diagram below, right triangle PQR is transformed by a sequence of rigid motions that maps it onto right triangle NML .



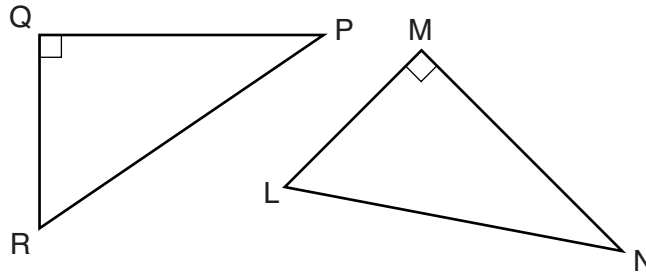
Write a set of three congruency statements that would show ASA congruency for these triangles.

$$\begin{aligned}\angle Q &\cong \angle M \\ \overline{QR} &\cong \overline{ML} \\ \angle R &\cong \angle L\end{aligned}$$

Score 2: The student gave a complete and correct response.

Question 25

25 In the diagram below, right triangle PQR is transformed by a sequence of rigid motions that maps it onto right triangle NML .



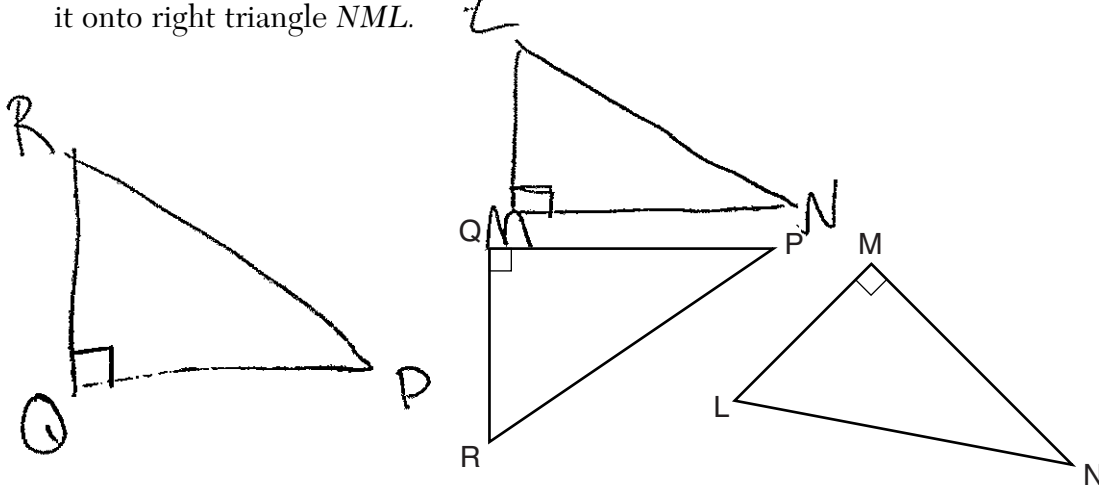
Write a set of three congruency statements that would show ASA congruency for these triangles.

$$\begin{aligned} \textcircled{1} \quad \angle Q &\cong \angle M \\ \textcircled{2} \quad \overline{PR} &\cong \overline{NL} \\ \textcircled{3} \quad \angle P &\cong \angle N \end{aligned}$$

Score 1: The student wrote congruency statements for AAS.

Question 25

25 In the diagram below, right triangle PQR is transformed by a sequence of rigid motions that maps it onto right triangle NML .



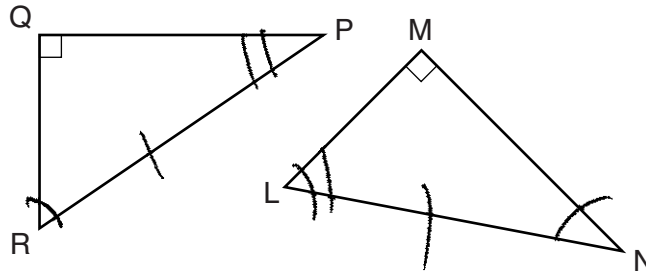
Write a set of three congruency statements that would show ASA congruency for these triangles.

- ① $\angle Q \cong \angle M$ because they are both right angles and all right angles are congruent (Angle)
- ② Since $\triangle PQR$ is formed by a rigid motion of $\triangle NML$ and rigid motions preserve shape and size then $\overline{QP} \cong \overline{MN}$, $\overline{QR} \cong \overline{ML}$, $\overline{RP} \cong \overline{LN}$, $\angle R \cong \angle L$, $\angle P \cong \angle N$
- ③ By ASA $\triangle PQR \cong \triangle NML$

Score 1: The student wrote all corresponding congruency statements, but did not specify which congruencies were for ASA.

Question 25

25 In the diagram below, right triangle PQR is transformed by a sequence of rigid motions that maps it onto right triangle NML .



ASA

Write a set of three congruency statements that would show ASA congruency for these triangles.

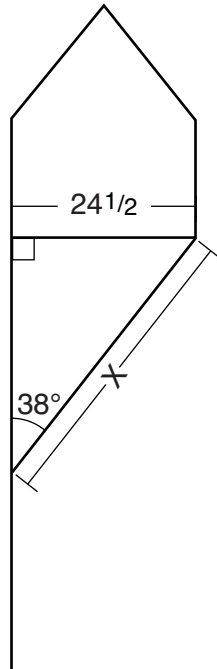
$$\begin{aligned} \angle R &\cong \angle N \\ \angle L &\cong \angle P \\ \overline{RP} &\cong \overline{LN} \end{aligned}$$

Score 0: The student stated only one correct corresponding congruency statement, $\overline{RP} \cong \overline{LN}$.

Question 26

26 Diego needs to install a support beam to hold up his new birdhouse, as modeled below. The base of the birdhouse is $24\frac{1}{2}$ inches long. The support beam will form an angle of 38° with the vertical post. Determine and state the approximate length of the support beam, x , to the nearest inch.

SOH CAH - TOA



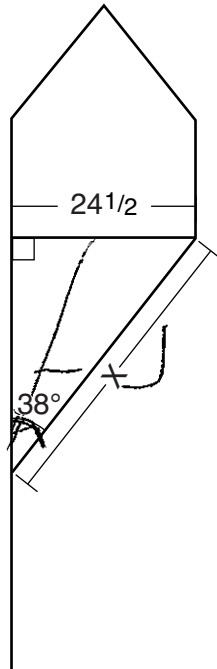
$$\sin 38^\circ = \frac{24\frac{1}{2}}{x}$$
$$x = 39.79459651$$

$x \approx 40$ inches

Score 2: The student gave a complete and correct response.

Question 26

26 Diego needs to install a support beam to hold up his new birdhouse, as modeled below. The base of the birdhouse is $24\frac{1}{2}$ inches long. The support beam will form an angle of 38° with the vertical post. Determine and state the approximate length of the support beam, x , to the nearest inch.



$$\sin 38 = \frac{24.5}{x}$$

∴

$$24.5 = \frac{\sin 38 x}{\sin 38}$$

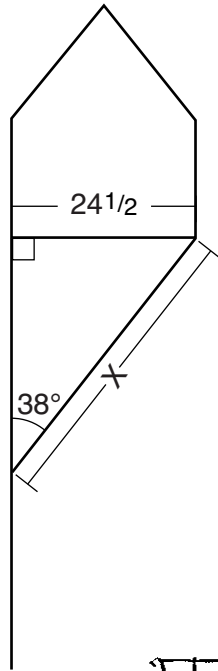
$$x \approx 82.667$$

83 in

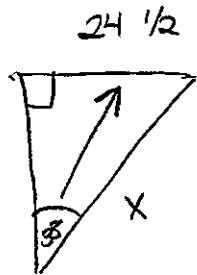
Score 1: The student made an error by using 38° as a radian measure.

Question 26

26 Diego needs to install a support beam to hold up his new birdhouse, as modeled below. The base of the birdhouse is $24\frac{1}{2}$ inches long. The support beam will form an angle of 38° with the vertical post. Determine and state the approximate length of the support beam, x , to the nearest inch.



SOH
CAH
TOA

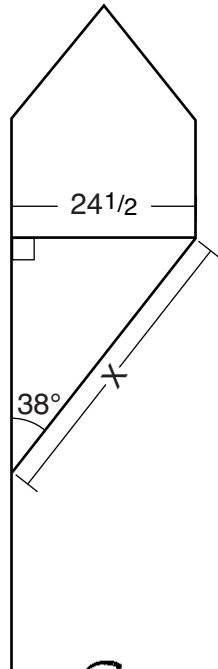


$$\begin{aligned} \tan(38) &= \frac{24.5}{x} \\ \frac{\tan(38) \cdot x}{\tan(38)} &= \frac{24.5}{\tan(38)} \\ x &= 31.35 \quad x \approx 31 \end{aligned}$$

Score 1: The student used an incorrect trigonometric equation, but solved it correctly.

Question 26

26 Diego needs to install a support beam to hold up his new birdhouse, as modeled below. The base of the birdhouse is $24\frac{1}{2}$ inches long. The support beam will form an angle of 38° with the vertical post. Determine and state the approximate length of the support beam, x , to the nearest inch.



$$\begin{aligned} A^2 + B^2 &= C^2 \\ 38^2 + 24^2 &= C^2 \\ 1444 + 576 &= C^2 \\ \sqrt{2020} &= C^2 \\ \boxed{C = 44.94} \end{aligned}$$

Score 0: The student gave a completely incorrect response.

Question 27

27 A rectangular tabletop will be made of maple wood that weighs 43 pounds per cubic foot. The tabletop will have a length of eight feet, a width of three feet, and a thickness of one inch. Determine and state the weight of the tabletop, in pounds.

$$43 \text{ lb} / \text{ft}^3$$

$$V = lwh$$

$$8 \cdot 3 \cdot \frac{1}{12} = 2$$

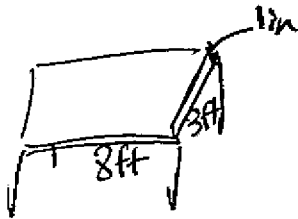
$$43 \cdot 2 =$$

$$86 \text{ pounds}$$

Score 2: The student gave a complete and correct response.

Question 27

27 A rectangular tabletop will be made of maple wood that weighs 43 pounds per cubic foot. The tabletop will have a length of eight feet, a width of three feet, and a thickness of one inch. Determine and state the weight of the tabletop, in pounds.

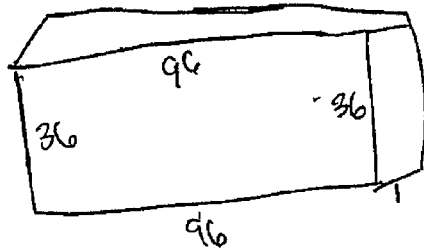
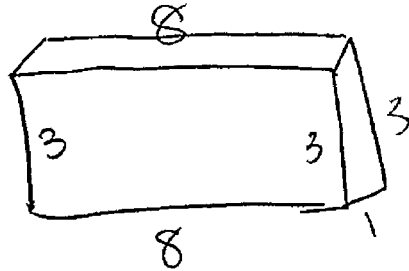


$$\begin{aligned} 12\text{in} &= 1\text{ft} \\ \frac{1\text{ft}}{12\text{in}} &= 0.083333 \\ 8 \cdot 3 \cdot 0.083333 &= 1.999992 \\ 43 \cdot 1.999992 &= 85.99967 \\ &\downarrow \\ &86 \\ &\text{weight of table} \end{aligned}$$

Score 2: The student gave a complete and correct response.

Question 27

27 A rectangular tabletop will be made of maple wood that weighs 43 pounds per cubic foot. The tabletop will have a length of eight feet, a width of three feet, and a thickness of one inch. Determine and state the weight of the tabletop, in pounds.



Weight = 43 (288)
 $W = 12,384 \text{ lbs}$

$$V = Bh$$

$$V = 96(1)$$

$$V = 96(36)$$

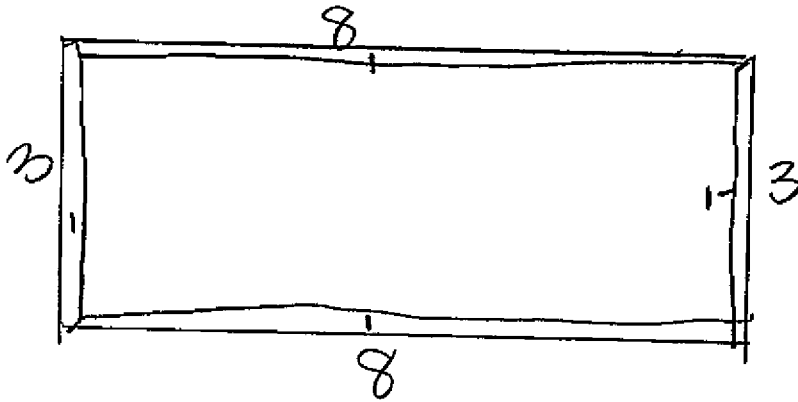
$$V = 3456 \text{ in}^3$$

$$V = 288 \text{ ft}^3$$

Score 1: The student made an error when converting 3456 cubic inches to 288 cubic feet.

Question 27

27 A rectangular tabletop will be made of maple wood that weighs 43 pounds per cubic foot. The tabletop will have a length of eight feet, a width of three feet, and a thickness of one inch. Determine and state the weight of the tabletop, in pounds.



$$V = l \cdot w \cdot h$$

$$V = 8 \cdot 1 \cdot 3$$

$$24 \text{ feet}^3 \cdot 43 \text{ pounds}$$

1032 pounds

Score 1: The student did not convert the 1-inch thickness to feet.

Question 27

27 A rectangular tabletop will be made of maple wood that weighs 43 pounds per cubic foot. The tabletop will have a length of eight feet, a width of three feet, and a thickness of one inch. Determine and state the weight of the tabletop, in pounds.

$$1 \text{ inch} = \frac{1}{12} \text{ foot} = 0.083$$

$$8 \times 3 \times 0.083 = 1.992$$

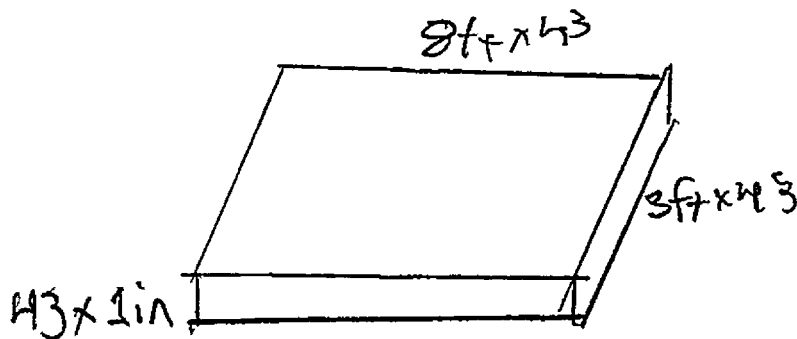
$$\begin{array}{r} \times 43 \\ \hline \end{array}$$

$$85.656$$

Score 1: The student made a rounding error when stating the weight of the table.

Question 27

27 A rectangular tabletop will be made of maple wood that weighs 43 pounds per cubic foot. The tabletop will have a length of eight feet, a width of three feet, and a thickness of one inch. Determine and state the weight of the tabletop, in pounds.



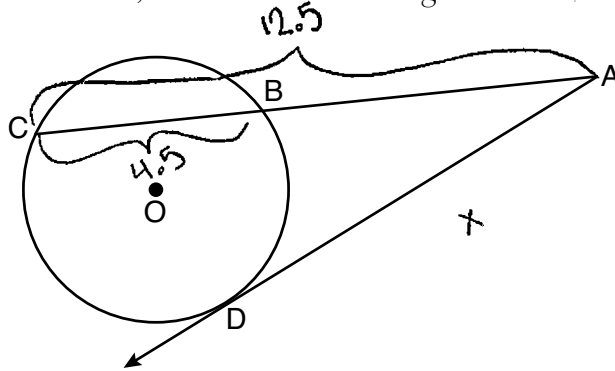
$$L = 344 \text{ cf}$$
$$W_{\text{ft}} = 129 \text{ cf}$$
$$\text{Thick} = 3 \text{ in}$$

$$V = L \times W \times h$$
$$V = h \times W \times T$$
$$V = 344 \times 129 \times \frac{3}{12}$$
$$W_{\text{T}} = 1609 \text{ pounds}$$

Score 0: The student gave a completely incorrect response.

Question 28

28 In the diagram below of circle O , secant \overline{ABC} and tangent \overline{AD} are drawn.



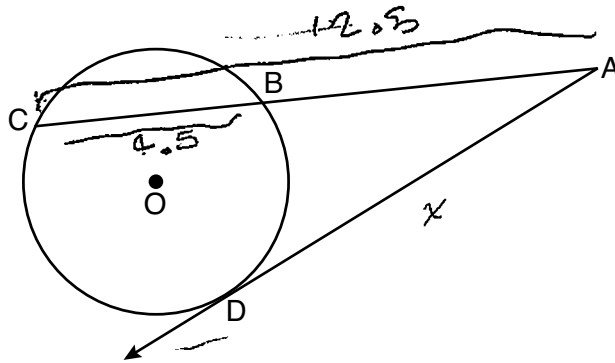
If $CA = 12.5$ and $CB = 4.5$, determine and state the length of \overline{DA} .

$$\begin{aligned} & \text{(outside)(whole)} = \text{(outside)(outside)} \\ & (AB)(AC) = (AD)(AD) \\ & \begin{array}{l} 12.5 - 4.5 \\ \vee \\ \overline{AB} = 8 \end{array} \quad \nearrow \\ & (8)(12.5) = x(x) \\ & \sqrt{100} = \sqrt{x^2} \\ & x = 10 \\ & \boxed{DA = 10} \end{aligned}$$

Score 2: The student gave a complete and correct response.

Question 28

28 In the diagram below of circle O , secant \overline{ABC} and tangent \overline{AD} are drawn.



If $CA = 12.5$ and $CB = 4.5$, determine and state the length of \overline{DA} .

$$\overline{DA} = 7.5$$

$$x^2 = 12.5(4.5)$$

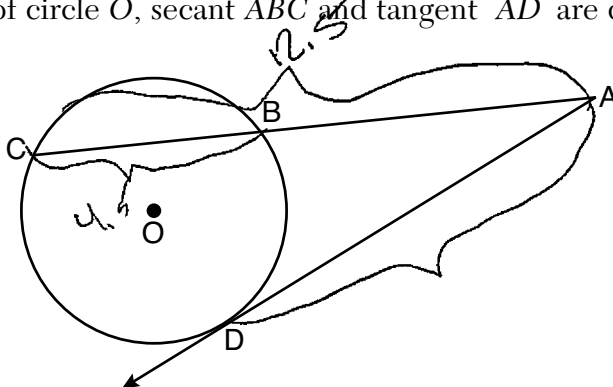
$$\sqrt{x^2} = \sqrt{56.25}$$

$$x = 7.5$$

Score 1: The student made an error by using 4.5 instead of 8.

Question 28

28 In the diagram below of circle O , secant \overline{ABC} and tangent \overline{AD} are drawn.



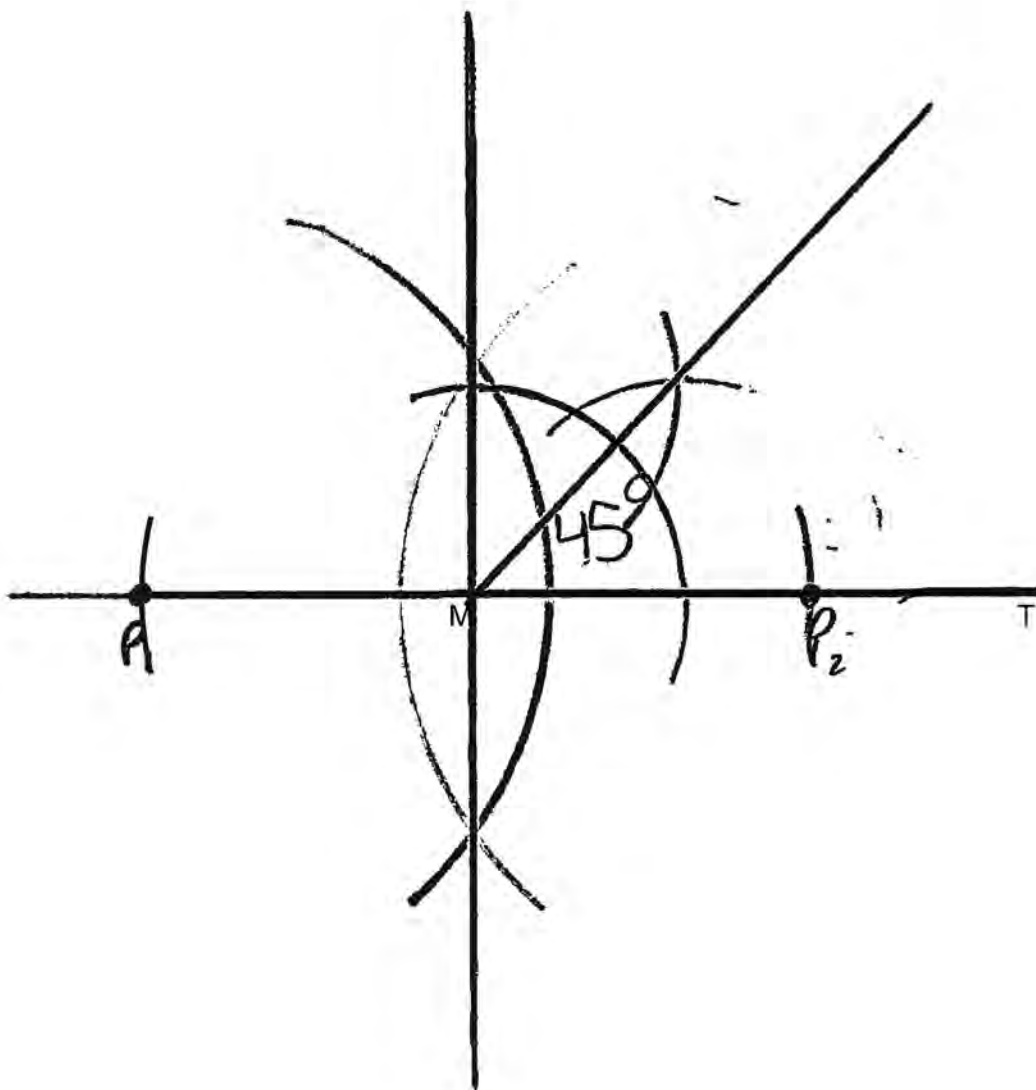
If $CA = 12.5$ and $CB = 4.5$, determine and state the length of \overline{DA} .

$$17(8) = (x)(x)$$
$$136 = x^2$$
$$\overline{DA} = 11.6$$

Score 0: The student made an error with $AC = 12.5 + 4.5$ and made a rounding error to find DA .

Question 29

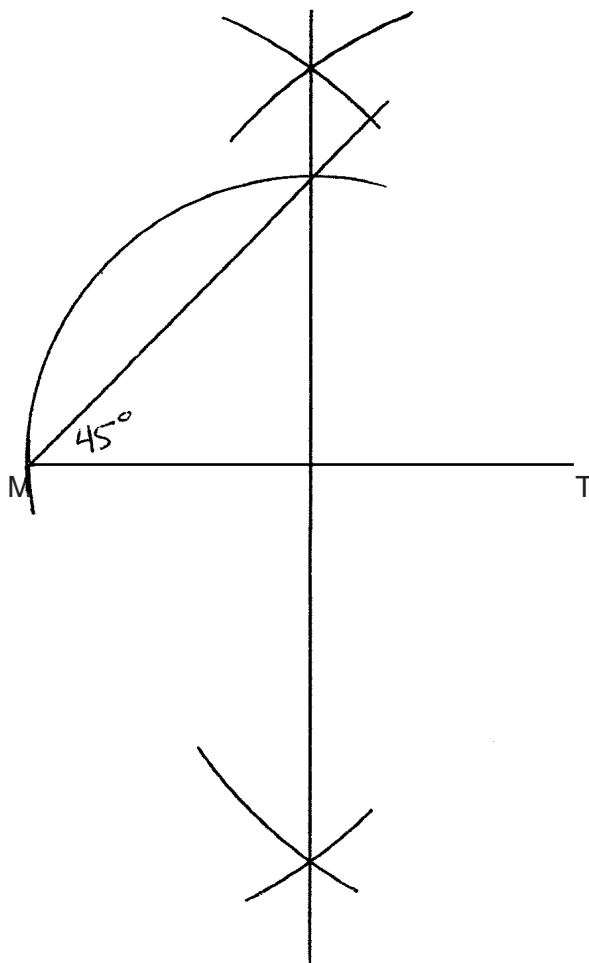
29 Given \overline{MT} below, use a compass and straightedge to construct a 45° angle whose vertex is at point M .
[Leave all construction marks.]



Score 2: The student gave a complete and correct response.

Question 29

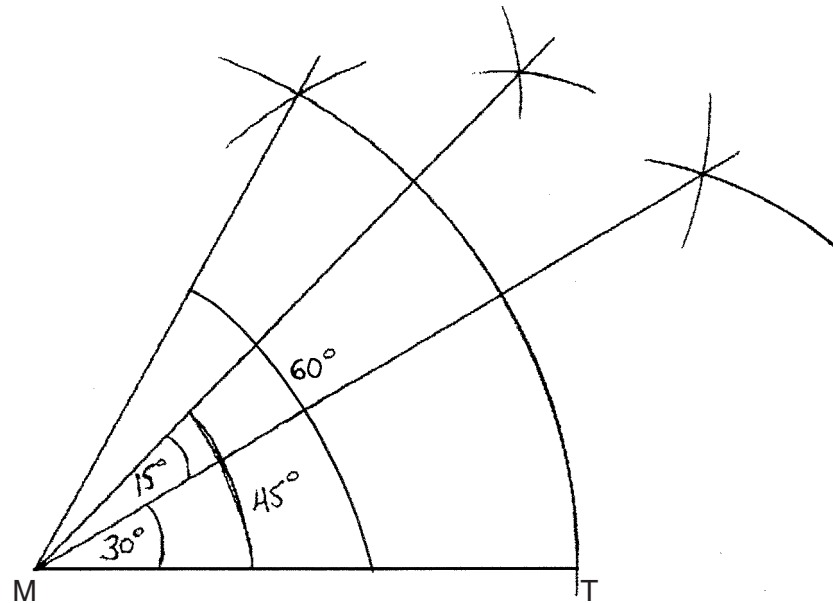
29 Given \overline{MT} below, use a compass and straightedge to construct a 45° angle whose vertex is at point M .
[Leave all construction marks.]



Score 2: The student gave a complete and correct response.

Question 29

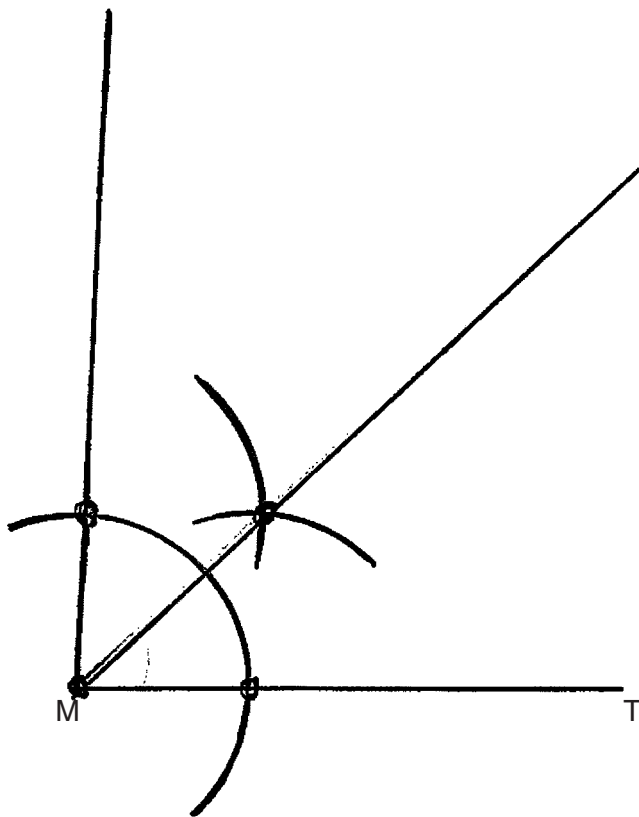
29 Given \overline{MT} below, use a compass and straightedge to construct a 45° angle whose vertex is at point M .
[Leave all construction marks.]



Score 2: The student gave a complete and correct response. The student constructed a 60° angle using an equilateral triangle and then bisected that 60° angle to get a 30° angle. Lastly, the student bisected a 30° angle to combine the other 30° angle with the 15° angle to get a 45° angle.

Question 29

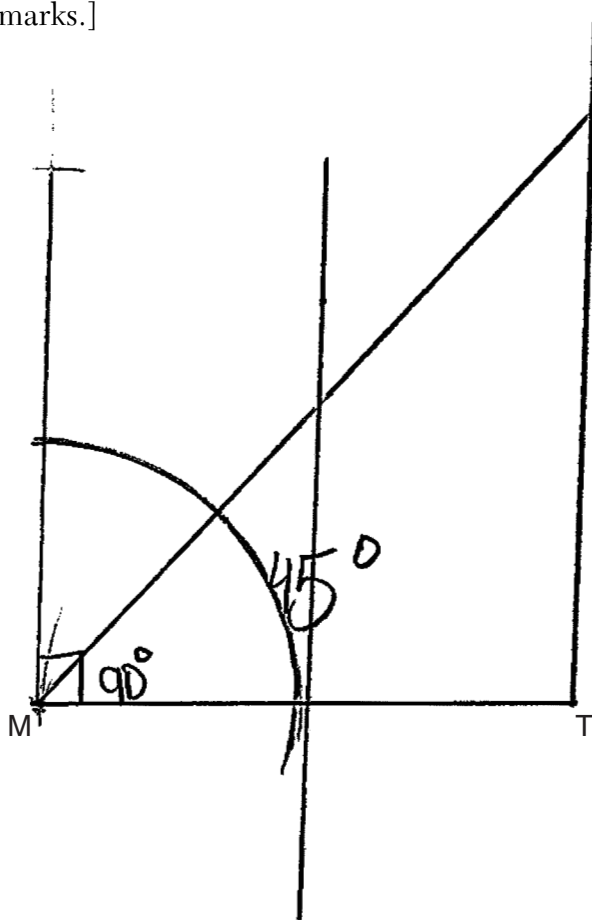
29 Given \overline{MT} below, use a compass and straightedge to construct a 45° angle whose vertex is at point M .
[Leave all construction marks.]



Score 1: The student did not construct the line perpendicular to \overline{MT} through M , but correctly bisected the angle.

Question 29

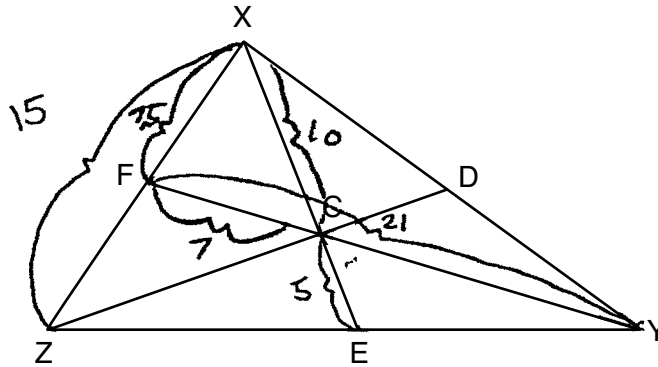
29 Given \overline{MT} below, use a compass and straightedge to construct a 45° angle whose vertex is at point M .
[Leave all construction marks.]



Score 0: The student gave a completely incorrect response.

Question 30

30 In $\triangle XYZ$ shown below, medians \overline{XE} , \overline{YF} , and \overline{ZD} intersect at C .



If $CE = 5$, $YF = 21$, and $XZ = 15$, determine and state the perimeter of triangle CFX .

$$7 + 7.5 + 10 = 24.5$$

$$21/3 = 7$$

$$\triangle CFX \text{ perimeter} = 24.5$$

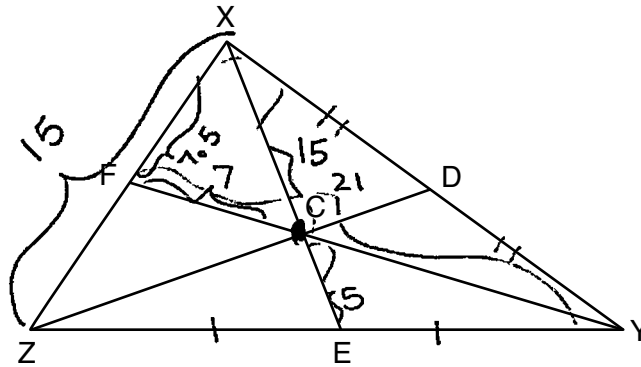
$$5 \cdot 2 = 10$$

$$15/2 = 7.5$$

Score 2: The student gave a complete and correct response.

Question 30

30 In $\triangle XYZ$ shown below, medians \overline{XE} , \overline{YF} , and \overline{ZD} intersect at C .



If $CE = 5$, $YF = 21$, and $XZ = 15$, determine and state the perimeter of triangle CFX .

$$15 \div 2 = 7.5$$

$$21 \times \frac{1}{3} = 7$$

$$5 \div \frac{1}{3} = 15$$

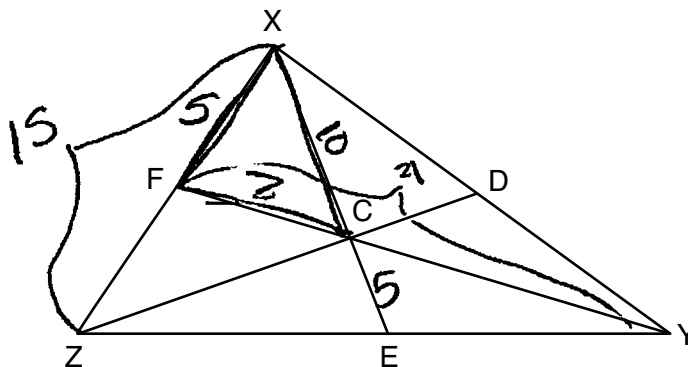
$$15 + 7.5 + 7 = 29.5$$

perimeter = 29.5 units

Score 1: The student made an error in determining XC .

Question 30

30 In $\triangle XYZ$ shown below, medians \overline{XE} , \overline{YF} , and \overline{ZD} intersect at C .



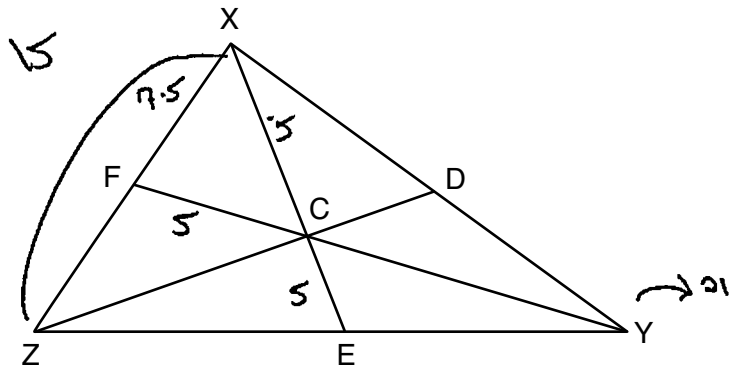
If $CE = 5$, $YF = 21$, and $XZ = 15$, determine and state the perimeter of triangle CFX .

Perimeter = 22

Score 1: The student found correct lengths for \overline{CF} and \overline{CX} .

Question 30

30 In $\triangle XYZ$ shown below, medians \overline{XE} , \overline{YF} , and \overline{ZD} intersect at C .



If $CE = 5$, $YF = 21$, and $XZ = 15$, determine and state the perimeter of triangle CFX .

$$\frac{15}{7.5} = \frac{x+5}{5}$$

$$7.5x + 37.5 = 7.5$$

$$\begin{array}{r} 7.5x + 37.5 = 7.5 \\ -37.5 \quad -37.5 \\ \hline 7.5x = -37.5 \\ \frac{7.5x}{7.5} = \frac{-37.5}{7.5} \\ x = -5 \end{array}$$

$$7.5 + 5 + 5 = 17.5$$

Perimeter of $\triangle CFX = 17.5$

Score 0: The student did not show enough correct relevant work to receive any credit.

Question 31

31 Determine and state an equation of the line perpendicular to the line $5x - 4y = 10$ and passing through the point $(5,12)$.

$$5x - 4y = 10$$
$$+4y \quad +4y$$

$$4y + 10 = 5x$$
$$-10 \quad -10$$

$$\frac{4y = 5x - 10}{4}$$

$$y = \frac{5}{4}x - \frac{5}{2}$$

$$m = \frac{5}{4}$$

$$m_{\perp} = -\frac{4}{5}$$

$$(y - 12) = -\frac{4}{5}(x - 5)$$

Score 2: The student gave a complete and correct response.

Question 31

31 Determine and state an equation of the line perpendicular to the line $5x - 4y = 10$ and passing through the point $(5,12)$.

$$5x - 4y = 10$$

$$\frac{-4y}{-4} = \frac{-5x + 10}{-4}$$

$$y = \frac{5}{4}x + \frac{-5}{2}$$

$$m_{\perp} = -\frac{4}{5}$$

$$y = mx + b$$

$$12 = \left(-\frac{4}{5}\right)(5) + b$$

$$12 = -4 + b$$

$$12 + 4 = b$$

$$16 = b$$

$$y = -\frac{4}{5}x + 16$$

Score 2: The student gave a complete and correct response.

Question 31

31 Determine and state an equation of the line perpendicular to the line $5x - 4y = 10$ and passing through the point $(5,12)$.

$$5x - 4y = 10$$

$$\frac{5x}{4} - \frac{10}{4} = \frac{4y}{4}$$

$$\left(\frac{5}{4}\right)x - 2.5 = y$$

$$m = \frac{5}{4}$$

$$y - y_1 = m(x - x_1)$$

$$\begin{array}{r} y - 12 = \frac{5}{4}(x - 5) \\ \underline{+12} \qquad \qquad \qquad \underline{+12} \end{array}$$

$$y = \frac{5}{4}(x - 5) + 12$$

Score 1: The student wrote an equation of the line parallel and passing through $(5,12)$.

Question 31

31 Determine and state an equation of the line perpendicular to the line $5x - 4y = 10$ and passing through the point $(5,12)$.

$$\frac{4y}{4} = \frac{5x - 10}{4}$$

$$y = -\frac{4}{5}x + 8$$

$$y = \frac{5}{4}x - \frac{5}{2}$$

$$8 = b$$

$$y = -\frac{4}{5}x + b$$

$$12 = -\frac{4}{5}(5) + b$$

$$12 = 4 + b$$

Score 1: The student made one computational error in determining the y -intercept.

Question 31

31 Determine and state an equation of the line perpendicular to the line $5x - 4y = 10$ and passing through the point $(5,12)$.

$$-5 + 4y = -10$$

$$\frac{4y = 5x - 10}{4 \quad 4 \quad 4}$$

$$(y - y_1) = m(x - x_1)$$

$$(y - 12) = m(x - 5)$$

$$y = \frac{-5}{4}x - 2.5$$

Score 0: The student did not show enough correct relevant work to receive any credit.

Question 31

31 Determine and state an equation of the line perpendicular to the line $5x - 4y = 10$ and passing through the point $(5,12)$.

$$y = m \cdot x + b$$
$$5x - 4y = 10$$
$$5x \quad -5x$$
$$-4y = \frac{10}{1} - 5x$$
$$-4y = \frac{1}{10} - 5x$$
$$y = 12$$

Score 0: The student gave a completely incorrect response.

Question 32

32 Quadrilateral *NATS* has coordinates $N(-4, -3)$, $A(1, 2)$, $T(8, 1)$, and $S(3, -4)$.

Prove quadrilateral *NATS* is a rhombus.

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

$$AT = \sqrt{(8-1)^2 + (1-2)^2}$$

$$TS = \sqrt{(8-3)^2 + (1+4)^2}$$

$$NS = \sqrt{(3+4)^2 + (-4+3)^2}$$

$$NA = \sqrt{(1+4)^2 + (2+3)^2}$$

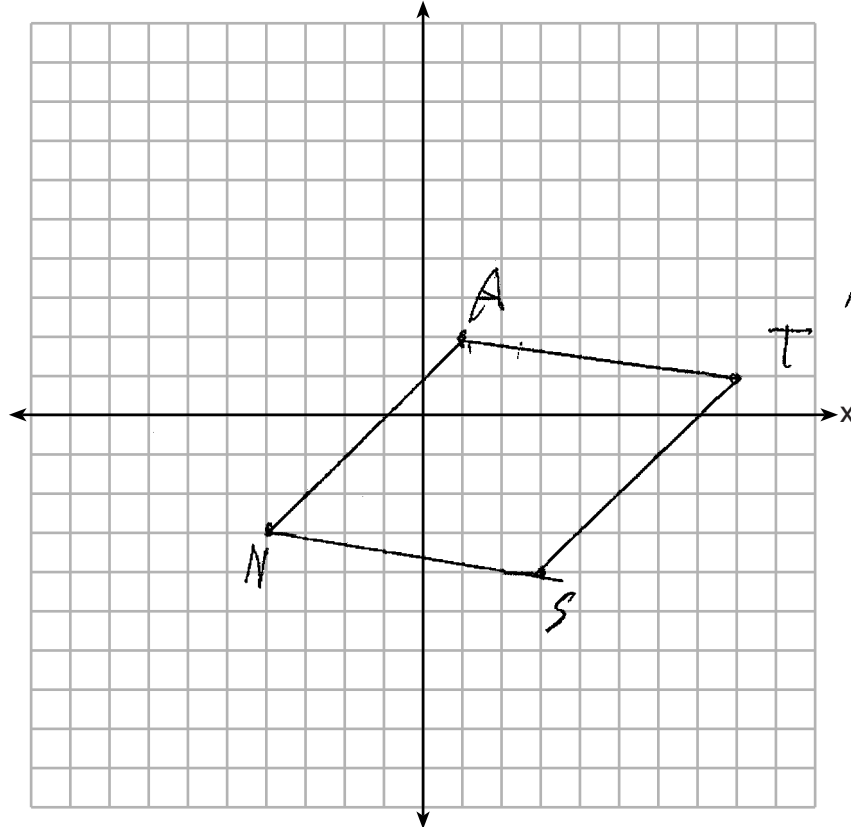
$$\sqrt{5^2 + 5^2} = \sqrt{25+25} = \sqrt{50} = 5\sqrt{2} = TS$$

$$\sqrt{7^2 + (-1)^2} = \sqrt{49+1} = \sqrt{50} = 5\sqrt{2} = AT$$

$$\sqrt{49+1} = \sqrt{50} = 5\sqrt{2} = NS$$

$$\sqrt{5^2 + 5^2} = \sqrt{50} = 5\sqrt{2} = NA$$

$5\sqrt{2}$
 $5\sqrt{2} = AT$
 $5\sqrt{2}$
 $5\sqrt{2}$
 $NA = 5\sqrt{2}$



All sides
 are equal
 in the quadrilateral
 NATS is a Rhombus

Score 4: The student gave a complete and correct response.

Question 32

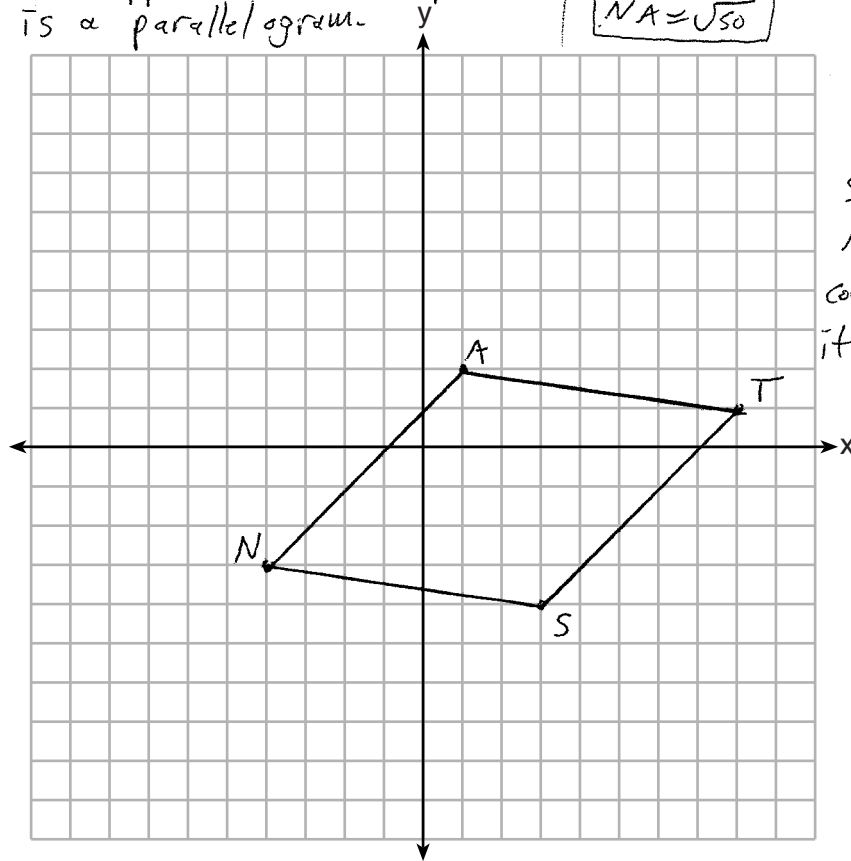
32 Quadrilateral $NATS$ has coordinates $N(-4, -3)$, $A(1, 2)$, $T(8, 1)$, and $S(3, -4)$.

Prove quadrilateral $NATS$ is a rhombus.
 [The use of the set of axes below is optional.]

$$\begin{array}{l} \text{slope } \overline{NA} = \frac{2 - (-3)}{1 - (-4)} \\ \quad = \frac{5}{5} \\ \boxed{m_{\overline{NA}} = 1} \end{array} \quad \begin{array}{l} \text{slope } \overline{AT} = \frac{1 - 2}{8 - 1} \\ \quad = \frac{-1}{7} \\ \boxed{m_{\overline{AT}} = -\frac{1}{7}} \end{array} \quad \begin{array}{l} \text{slope } \overline{TS} = \frac{-4 - 1}{3 - 8} \\ \quad = \frac{-5}{-5} \\ \boxed{m_{\overline{TS}} = 1} \end{array} \quad \begin{array}{l} \text{slope } \overline{NS} = \frac{-4 - (-3)}{3 - (-4)} \\ \quad = \frac{-1}{7} \\ \boxed{m_{\overline{NS}} = -\frac{1}{7}} \end{array}$$

Since \overline{NA} + \overline{TS} have the same slope, $\overline{NA} \parallel \overline{TS}$
 Since \overline{AT} + \overline{NS} have the same slope, $\overline{AT} \parallel \overline{NS}$
 Since both pairs of opposite sides are parallel,
 quad $NATS$ is a parallelogram.

$$\begin{array}{l} \overline{NA} = \sqrt{(1 - (-4))^2 + (2 - (-3))^2} \\ \quad = \sqrt{5^2 + 5^2} \\ \quad = \sqrt{25 + 25} \\ \boxed{\overline{NA} = \sqrt{50}} \end{array} \quad \begin{array}{l} \overline{AT} = \sqrt{(8 - 1)^2 + (1 - 2)^2} \\ \quad = \sqrt{7^2 + (-1)^2} \\ \quad = \sqrt{49 + 1} \\ \boxed{\overline{AT} = \sqrt{50}} \end{array}$$



Since parallelogram $NATS$ has 2 \cong consecutive sides, it is a rhombus.

Score 4: The student gave a complete and correct response.

Question 32

32 Quadrilateral *NATS* has coordinates $N(-4, -3)$, $A(1, 2)$, $T(8, 1)$, and $S(3, -4)$.

Prove quadrilateral *NATS* is a rhombus.
 [The use of the set of axes below is optional.]

Quadrilateral *NATS* is a ~~rhombus~~ ^{parallelogram} because it has 2 pairs of opposite sides \parallel . It is a rhombus because it has diagonals that are \perp .

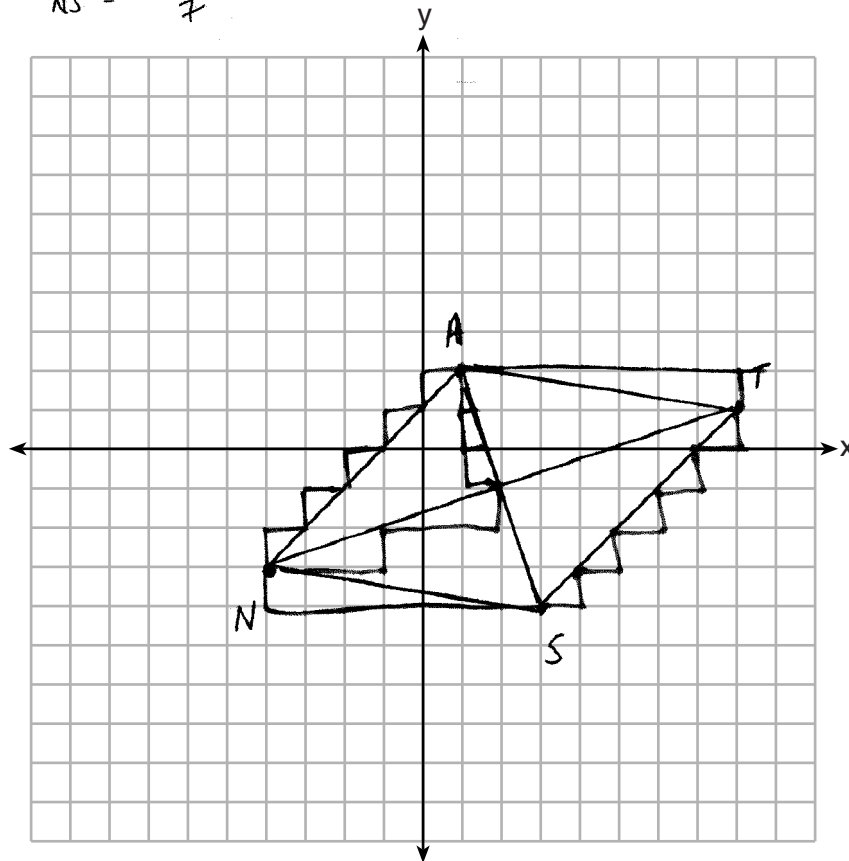
$$m = \frac{\text{rise}}{\text{run}} \quad m_{\overline{NA}} = \frac{1}{1} > \overline{NA} \parallel \overline{ST}$$

$$m_{\overline{ST}} = \frac{1}{1}$$

$$m_{\overline{AS}} = \frac{-3}{1} \quad m_{\overline{AT}} = \frac{-1}{7} > \overline{AT} \parallel \overline{NS}$$

$$m_{\overline{NT}} = \frac{1}{3} \quad m_{\overline{NS}} = \frac{-1}{7}$$

\perp



Score 4: The student gave a complete and correct response.

Question 32

32 Quadrilateral *NATS* has coordinates $N(-4, -3)$, $A(1, 2)$, $T(8, 1)$, and $S(3, -4)$.

Prove quadrilateral *NATS* is a rhombus.

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

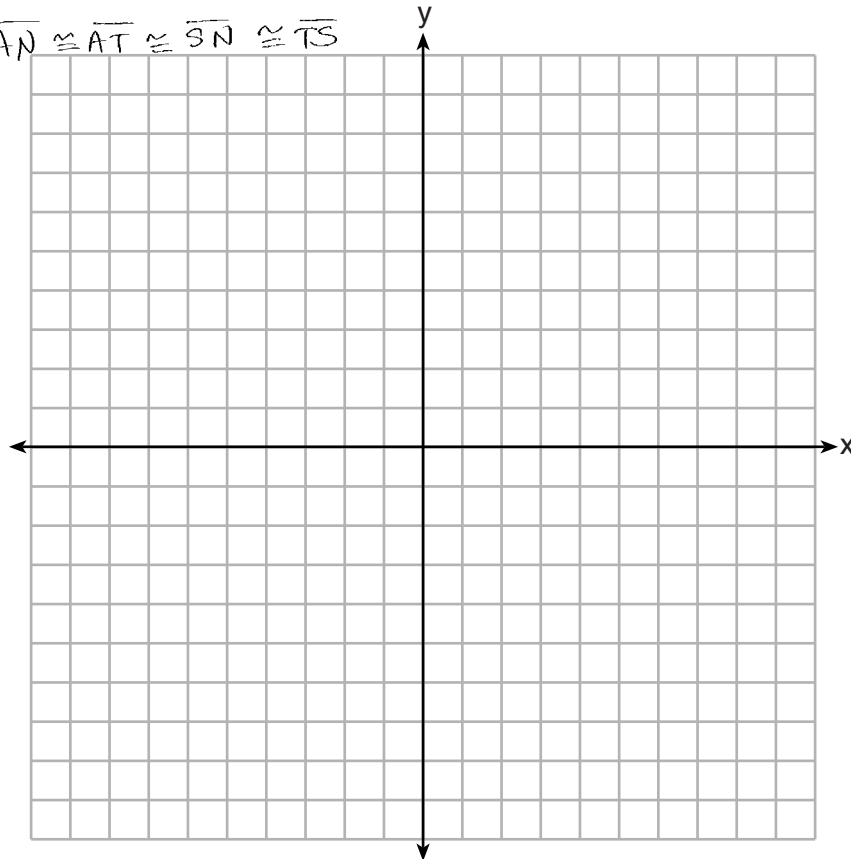
$$\overline{AN} = \sqrt{(1 - -4)^2 + (2 - -3)^2} = \sqrt{25 + 25} = \sqrt{50}$$

$$\overline{AT} = \sqrt{(8 - 1)^2 + (1 - 2)^2} = \sqrt{49 + 1} = \sqrt{50}$$

$$\overline{SN} = \sqrt{(3 - -4)^2 + (-4 - -3)^2} = \sqrt{49 + 1} = \sqrt{50}$$

$$\overline{TS} = \sqrt{(8 - 3)^2 + (1 - -4)^2} = \sqrt{25 + 25} = \sqrt{50}$$

$$\overline{AN} \cong \overline{AT} \cong \overline{SN} \cong \overline{TS}$$



Score 3: The student did not write a concluding statement.

Question 32

32 Quadrilateral *NATS* has coordinates $N(-4, -3)$, $A(1, 2)$, $T(8, 1)$, and $S(3, -4)$

Prove quadrilateral *NATS* is a rhombus.
 [The use of the set of axes below is optional.]

$$\begin{aligned} \overline{NA} &\cong \overline{ST} \\ \overline{AT} &\cong \overline{NS} \\ \overline{NA} &\cong \overline{AT} \end{aligned}$$

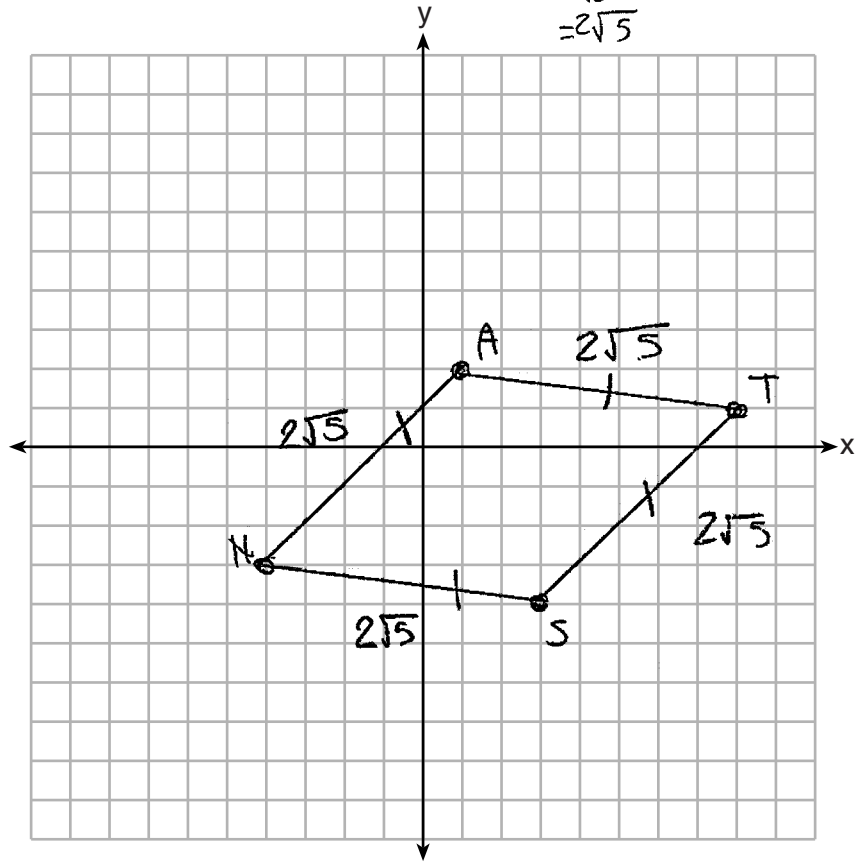
$$\begin{aligned} \overline{NS} &= \sqrt{(-4-1)^2 + (-3-8)^2} \\ &= \sqrt{-5^2 + -8^2} \\ &= \sqrt{25+25} \\ &= \sqrt{50} \\ &= 2\sqrt{5} \end{aligned}$$

$$\begin{array}{r} \textcircled{5} \overline{)50} \\ \underline{\textcircled{10}} \\ 0 \\ \underline{\textcircled{0}} \\ 0 \end{array}$$

$$\begin{aligned} \overline{NA} &= \sqrt{(2+3)^2 + (1+4)^2} \\ &= \sqrt{5^2 + 5^2} \\ &= \sqrt{25+25} \\ &= \sqrt{50} \end{aligned}$$

$$\begin{aligned} \overline{AT} &= \sqrt{(1-2)^2 + (8-1)^2} \\ &= \sqrt{-1^2 + 7^2} \\ &= \sqrt{1+49} \\ &= \sqrt{50} \\ &= 2\sqrt{5} \end{aligned}$$

$$\begin{aligned} \overline{NS} &= \sqrt{(-4+3)^2 + (-3+4)^2} \\ &= \sqrt{1^2 + 1^2} \\ &= \sqrt{1+1} \\ &= \sqrt{2} \\ &= \sqrt{2} \end{aligned}$$



Score 2: The student made a simplification error and did not write a concluding statement.

Question 32

32 Quadrilateral *NATS* has coordinates $N(-4,-3)$, $A(1,2)$, $T(8,1)$, and $S(3,-4)$.

Prove quadrilateral *NATS* is a rhombus.

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

$$d = \sqrt{(y_2 - y_1)^2 + (x_2 - x_1)^2}$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$d_{AS} = \sqrt{(2+4)^2 + (1-3)^2} \quad d_{NT} = \sqrt{(1+3)^2 + (8+4)^2} \quad m_{AS} = \frac{2+4}{1-3} = \frac{6}{-2} = -3$$

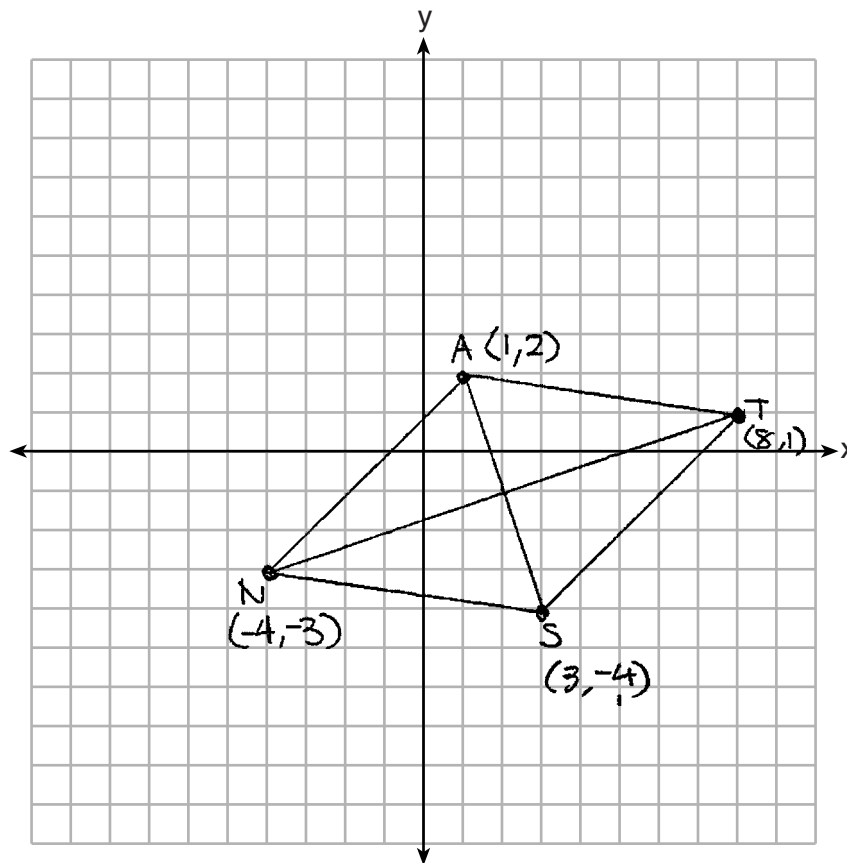
$$d = \sqrt{6^2 + (-2)^2} \quad d = \sqrt{4^2 + 12^2} \quad m_{NT} = \frac{1+3}{8+4} = \frac{4}{12} = \frac{1}{3}$$

$$d = \sqrt{36+4} \quad d = \sqrt{16+144}$$

$$d = \sqrt{40} \quad d = \sqrt{160}$$

$$\left. \begin{array}{l} m_{AS} = -3 \\ m_{NT} = \frac{1}{3} \end{array} \right\} AS \perp NT$$

Quadrilateral *NATS* is a rhombus because the diagonals are perpendicular to each other



Score 2: The student made a conceptual error by concluding that a quadrilateral with perpendicular diagonals is a rhombus.

Question 32

32 Quadrilateral *NATS* has coordinates $N(-4, -3)$, $A(1, 2)$, $T(8, 1)$, and $S(3, -4)$.

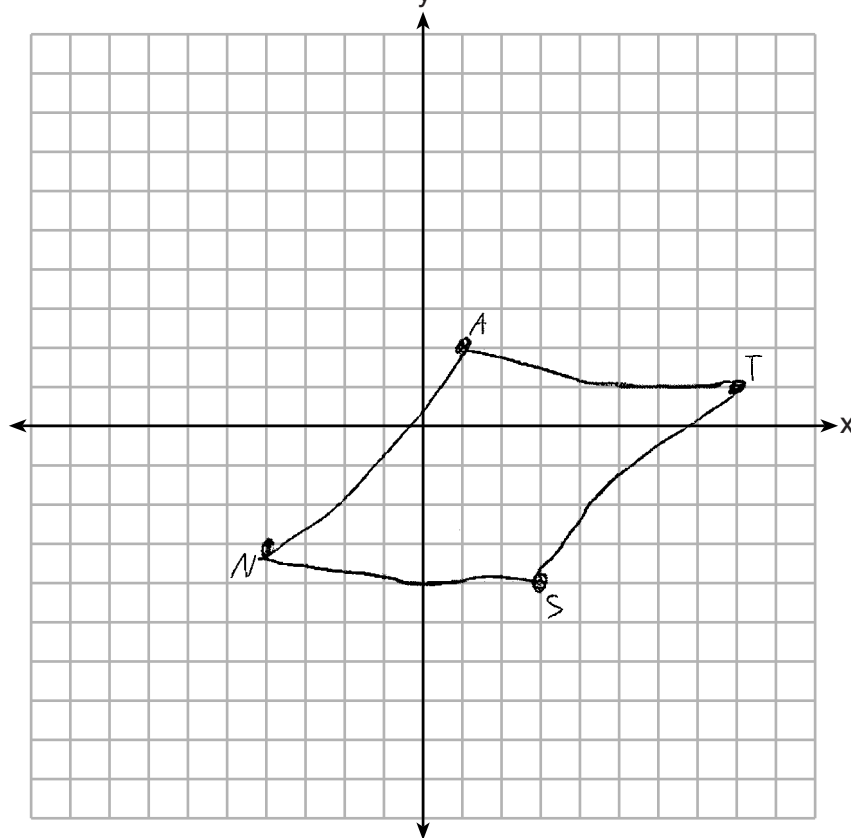
Prove quadrilateral *NATS* is a rhombus.
 [The use of the set of axes below is optional.]

$$\begin{aligned} \text{Slope } NA &= \frac{2 - (-3)}{1 - (-4)} = 1 \\ \text{Slope } TS &= \frac{-4 - 1}{3 - 8} = 1 \end{aligned} \quad \left. \vphantom{\begin{aligned} \text{Slope } NA \\ \text{Slope } TS \end{aligned}} \right\} \overline{NA} \parallel \overline{TS}$$

yes this is a rhombus because both sides are congruent

$$\text{Distance } NA = \sqrt{(1 - (-4))^2 + (2 - (-3))^2} = \sqrt{50} = 5\sqrt{2}$$

$$\text{Distance } TS = \sqrt{(3 - 8)^2 + (-4 - 1)^2} = \sqrt{50} = 5\sqrt{2}$$



Score 1: The student had correct work to prove *NATS* is a parallelogram, but the concluding statement was incorrect.

Question 32

32 Quadrilateral *NATS* has coordinates $N(-4, -3)$, $A(1, 2)$, $T(8, 1)$, and $S(3, -4)$.

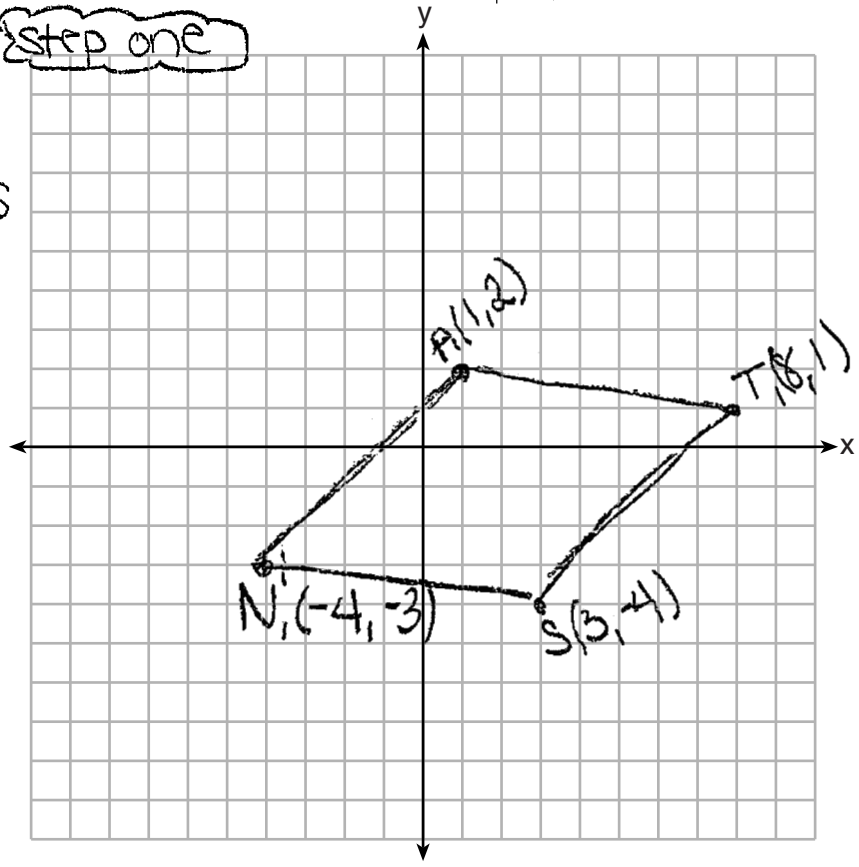
Prove quadrilateral *NATS* is a rhombus.
 [The use of the set of axes below is optional.]

step 2: $m = \frac{y_2 - y_1}{x_2 - x_1}$
 step 3: $A(1, 2)$ $T(8, 1)$ $m = \frac{1 - 2}{8 - 1} = \frac{-1}{7}$
 $T(8, 1)$ $S(3, -4)$ $m = \frac{-4 - 1}{3 - 8} = \frac{-5}{-5} = 1$
 $S(3, -4)$ $N(-4, 3)$ $m = \frac{3 - -4}{-4 - 3} = \frac{7}{-7} = -1$
 $N(-4, 3)$ $A(1, 2)$ $m = \frac{2 - 3}{1 - -4} = \frac{-1}{5} = -\frac{1}{5}$

Step one

Step 4:
 quad *NATS*
 is not a
 rhombus

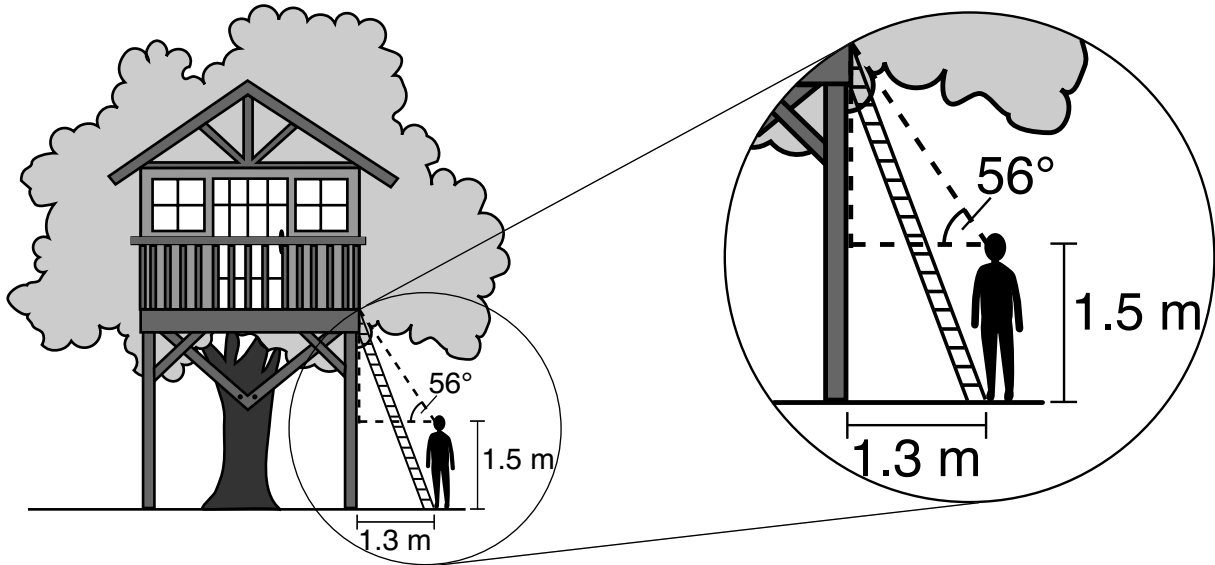
$A \not\cong T$
 $T \cong S$
 $S \cong N$
 $N \cong A$



Score 0: The student did not show enough correct relevant work to receive any credit.

Question 33

33 David has just finished building his treehouse and still needs to buy a ladder to be attached to the ledge of the treehouse and anchored at a point on the ground, as modeled below. David is standing 1.3 meters from the stilt supporting the treehouse. This is the point on the ground where he has decided to anchor the ladder. The angle of elevation from his eye level to the bottom of the treehouse is 56 degrees. David's eye level is 1.5 meters above the ground.



Determine and state the minimum length of a ladder, to the nearest tenth of a meter, that David will need to buy for his treehouse.

$$\begin{array}{l}
 \begin{array}{c} x \\ \triangle \\ 1.3 \end{array} \quad \begin{array}{l} 1.3 \\ \tan 56 = \frac{x}{1.3} \\ x = 1.3 \tan 56 \\ x = 1.927329 \\ \hline + 1.5 \\ \text{Stilt} = 3.427329 \end{array}
 \end{array}$$

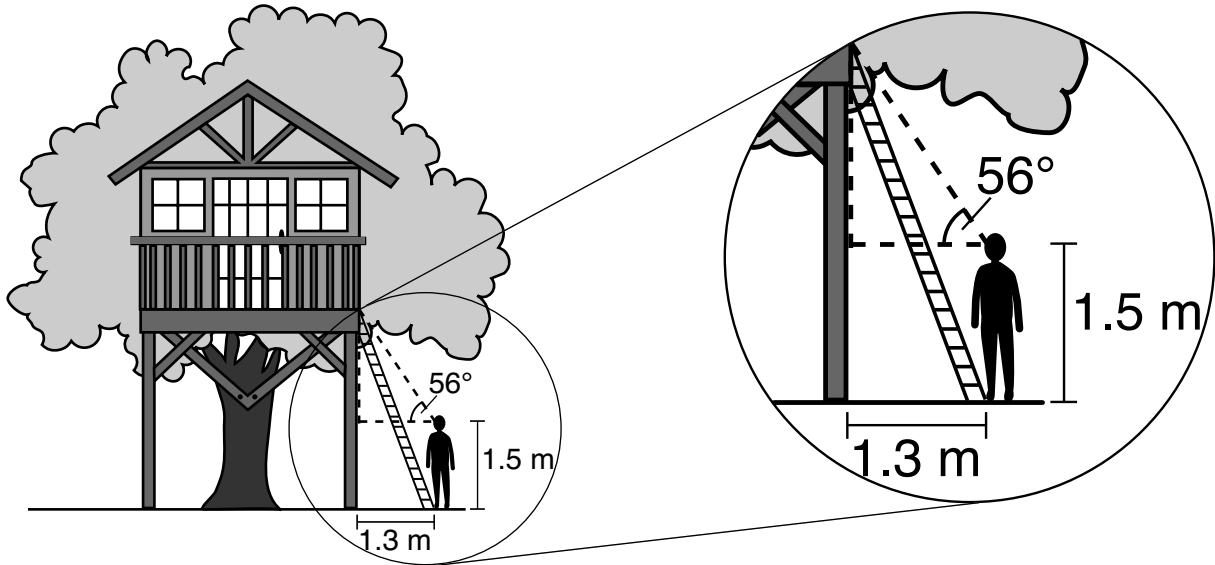
$$\begin{array}{l}
 \begin{array}{c} y \\ \triangle \\ 1.3 \end{array} \quad \begin{array}{l} \tan \theta = \frac{3.427329}{1.3} \\ \theta = \tan^{-1}(3.427329/1.3) \\ \theta = 69.228395 \end{array}
 \end{array}$$

$$\begin{array}{l}
 \frac{\cos \theta}{1} = \frac{1.3}{y} \quad y = 3.665 \\
 \text{3.7}
 \end{array}$$

Score 4: The student gave a complete and correct response.

Question 33

33 David has just finished building his treehouse and still needs to buy a ladder to be attached to the ledge of the treehouse and anchored at a point on the ground, as modeled below. David is standing 1.3 meters from the stilt supporting the treehouse. This is the point on the ground where he has decided to anchor the ladder. The angle of elevation from his eye level to the bottom of the treehouse is 56 degrees. David's eye level is 1.5 meters above the ground.



Determine and state the minimum length of a ladder, to the *nearest tenth of a meter*, that David will need to buy for his treehouse.

$\tan 56 = \frac{x}{1.3}$
 $x = 1.3(\tan 56)$
 $x = 1.927329259$

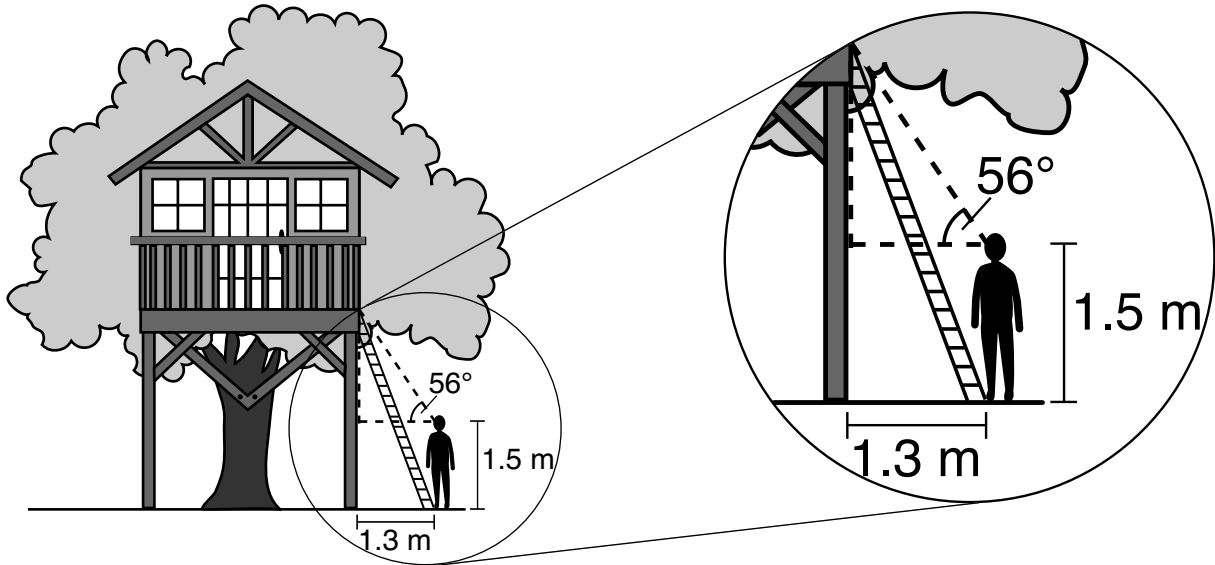
$(3.427329259)^2 + (1.3)^2 = c^2$
 $11.74658585 + 1.69 = c^2$
 $13.43658585 = c^2$
 $3.66594884 = c$

3.7 meters

Score 4: The student gave a complete and correct response.

Question 33

33 David has just finished building his treehouse and still needs to buy a ladder to be attached to the ledge of the treehouse and anchored at a point on the ground, as modeled below. David is standing 1.3 meters from the stilt supporting the treehouse. This is the point on the ground where he has decided to anchor the ladder. The angle of elevation from his eye level to the bottom of the treehouse is 56 degrees. David's eye level is 1.5 meters above the ground.



Determine and state the minimum length of a ladder, to the *nearest tenth of a meter*, that David will need to buy for his treehouse.

$\tan 56 = \frac{x}{1.3}$
 $1.3 \tan 56 = x$
 $1.927329259 = x$
 ≈ 1.93

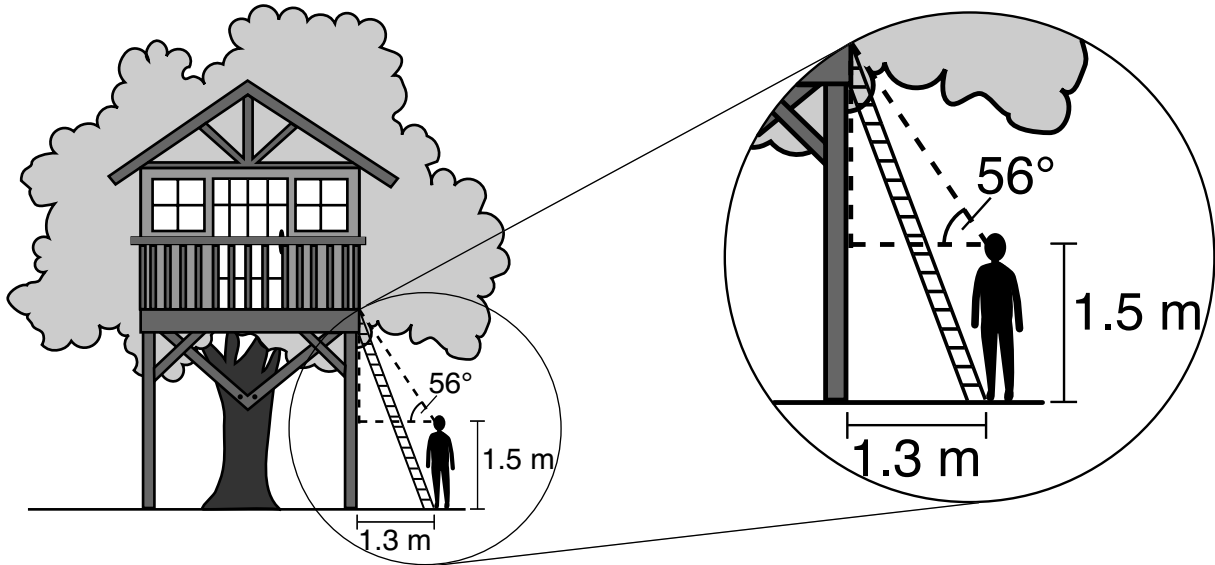
$+1.93$
 1.5
3.43
 round up

$3.43^2 + 1.3^2 = 12$
 $11.7649 + 1.69 = \sqrt{13.4549}$
 $3.668092147 = \delta$
3.5 m

Score 3: The student made one rounding error when finding the length of the ladder.

Question 33

33 David has just finished building his treehouse and still needs to buy a ladder to be attached to the ledge of the treehouse and anchored at a point on the ground, as modeled below. David is standing 1.3 meters from the stilt supporting the treehouse. This is the point on the ground where he has decided to anchor the ladder. The angle of elevation from his eye level to the bottom of the treehouse is 56 degrees. David's eye level is 1.5 meters above the ground.



Determine and state the minimum length of a ladder, to the nearest tenth of a meter, that David will need to buy for his treehouse.

Handwritten student work:

$$\begin{array}{r}
 1.927329259 \\
 + 1.5 \\
 \hline
 3.427329259
 \end{array}$$

$$1.3 \cdot \tan 56 = \frac{x}{1.3} \cdot 1.3$$

$$1.3 \tan 56 = x$$

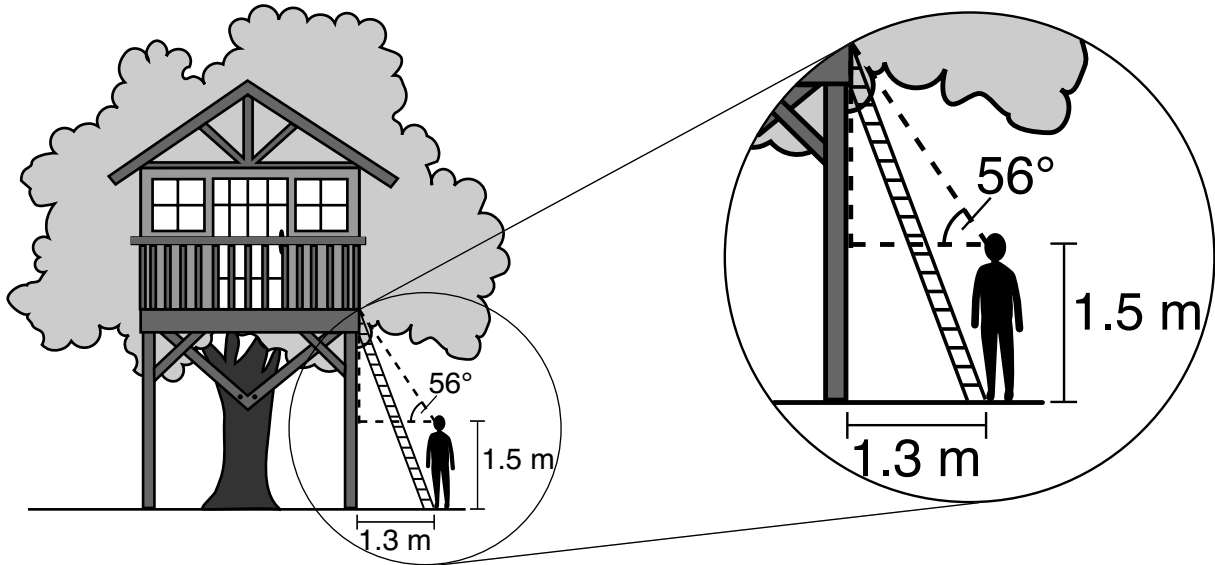
$$x = 1.927329259 \text{ m} + 1.5 \text{ m}$$

he would need to buy at least a 3.4 meter tall ladder to reach his treehouse.

Score 3: The student found the length of the stilt, but no further correct work was shown.

Question 33

33 David has just finished building his treehouse and still needs to buy a ladder to be attached to the ledge of the treehouse and anchored at a point on the ground, as modeled below. David is standing 1.3 meters from the stilt supporting the treehouse. This is the point on the ground where he has decided to anchor the ladder. The angle of elevation from his eye level to the bottom of the treehouse is 56 degrees. David's eye level is 1.5 meters above the ground.



Determine and state the minimum length of a ladder, to the *nearest tenth of a meter*, that David will need to buy for his treehouse.

$$\tan 56 = \frac{x}{1.3}$$

$$x = 1.3 \cdot \tan 56$$

$$x = 1.9273295907$$

Minimum length =
1.9 meters

$$\tan 56 = \frac{0.42732925907}{1}$$

$$0.427... = y \cdot \tan 56$$

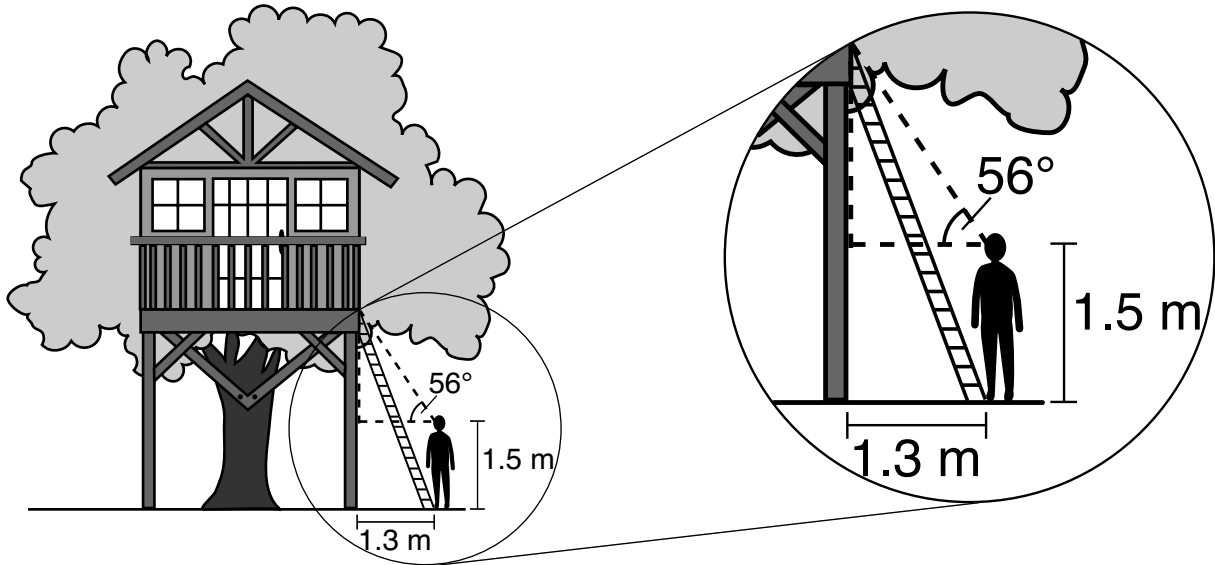
$$\tan 56$$

$$y = 0.288257224736$$

Score 2: The student found the altitude from the sight line to the top of the ladder, but no further correct work was shown.

Question 33

33 David has just finished building his treehouse and still needs to buy a ladder to be attached to the ledge of the treehouse and anchored at a point on the ground, as modeled below. David is standing 1.3 meters from the stilt supporting the treehouse. This is the point on the ground where he has decided to anchor the ladder. The angle of elevation from his eye level to the bottom of the treehouse is 56 degrees. David's eye level is 1.5 meters above the ground.



Determine and state the minimum length of a ladder, to the nearest tenth of a meter, that David will need to buy for his treehouse.

$$\frac{\tan(56)}{1} = \frac{x}{1.3}$$

$$x = \tan(56)$$

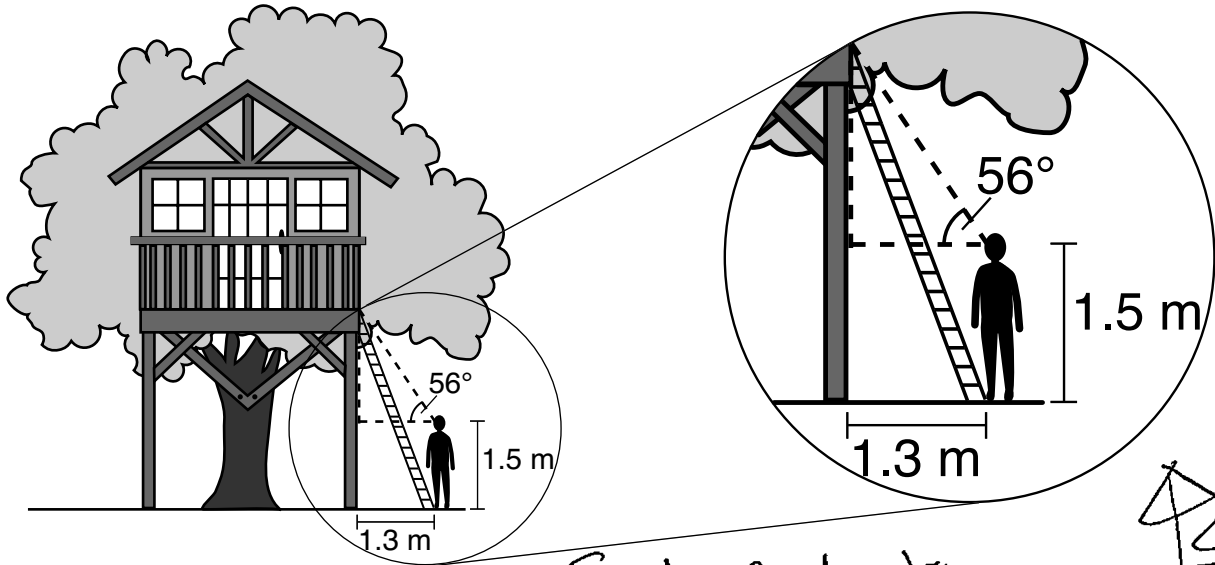
$$x \approx 3.2$$

The minimum length of ladder David will need to buy is 3.2 meters of ladder.

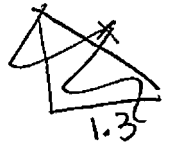
Score 1: The student wrote a correct relevant trigonometric equation, but no further correct work was shown.

Question 33

33 David has just finished building his treehouse and still needs to buy a ladder to be attached to the ledge of the treehouse and anchored at a point on the ground, as modeled below. David is standing 1.3 meters from the stilt supporting the treehouse. This is the point on the ground where he has decided to anchor the ladder. The angle of elevation from his eye level to the bottom of the treehouse is 56 degrees. David's eye level is 1.5 meters above the ground.

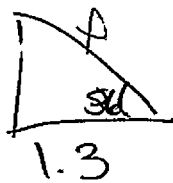


Soh cah toa



Determine and state the minimum length of a ladder, to the *nearest tenth of a meter*, that David will need to buy for his treehouse.

Add 1.5
at END!!



$$\cos 56 = \frac{x}{1.3} \cdot 1.3$$

$$x = .72695$$

$$+ 1.5$$

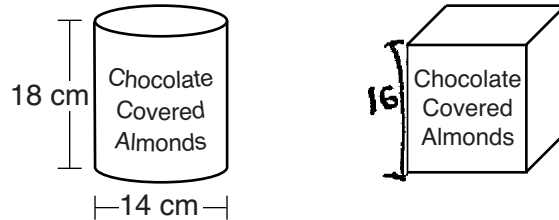
$$2.22695$$

the minimum length
of a ladder david will
have to buy is
2.2 meters

Score 0: The student did not show enough correct relevant work to receive any credit.

Question 34

34 A manufacturer is designing a new container for their chocolate-covered almonds. Their original container was a cylinder with a height of 18 cm and a diameter of 14 cm. The new container can be modeled by a rectangular prism with a square base and will contain the same amount of chocolate-covered almonds.



If the new container's height is 16 cm, determine and state, to the *nearest tenth of a centimeter*, the side length of the new container if both containers contain the same amount of almonds.

$$\pi(49)(18) = 16x^2$$

$$882\pi = 16x^2$$

$$55.125\pi = x^2$$

$$13.1597 = x$$

$$13.2 = x$$

cm

A store owner who sells the chocolate-covered almonds displays them on a shelf whose dimensions are 80 cm long and 60 cm wide. The shelf can only hold one layer of new containers when each new container sits on its square base. Determine and state the maximum number of new containers the store owner can fit on the shelf.

~~$30(60) = 41800 \text{ cm}^2$~~

$$13.2 \cdot 4 = 52.8$$

41 π cm^2
6 almonds

60 ||||
80

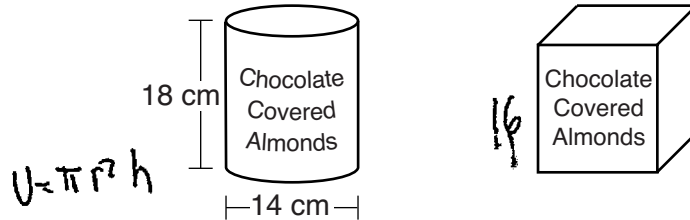
$$\frac{80}{13.2} \approx 6$$

24 New Containers

Score 4: The student gave a complete and correct response.

Question 34

34 A manufacturer is designing a new container for their chocolate-covered almonds. Their original container was a cylinder with a height of 18 cm and a diameter of 14 cm. The new container can be modeled by a rectangular prism with a square base and will contain the same amount of chocolate-covered almonds.



If the new container's height is 16 cm, determine and state, to the *nearest tenth of a centimeter*, the side length of the new container if both containers contain the same amount of almonds.

$$V = \pi r^2 h$$

$$V = \pi (7)^2 (18)$$

$$V = 2770.88472$$

$$V = Bh$$

$$2770.88472 = (16)x^2$$

$$173.2 = x^2$$

13.1

A store owner who sells the chocolate-covered almonds displays them on a shelf whose dimensions are 80 cm long and 60 cm wide. The shelf can only hold one layer of new containers when each new container sits on its square base. Determine and state the maximum number of new containers the store owner can fit on the shelf.

$$\frac{80}{13.1} = 6$$

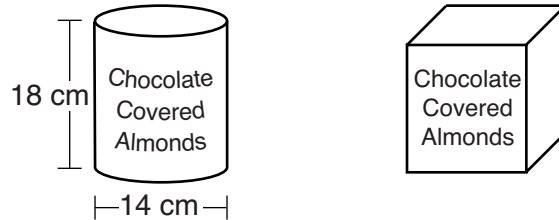
$$\frac{60}{13.1} = 4$$

24

Score 3: The student made one rounding error in determining the side length of the container.

Question 34

34 A manufacturer is designing a new container for their chocolate-covered almonds. Their original container was a cylinder with a height of 18 cm and a diameter of 14 cm. The new container can be modeled by a rectangular prism with a square base and will contain the same amount of chocolate-covered almonds.



If the new container's height is 16 cm, determine and state, to the nearest tenth of a centimeter, the side length of the new container if both containers contain the same amount of almonds.

$V = \pi r^2 h$
 $\pi (7)^2 (18)$
 $2770.88\dots$

$x^2(16) = 2770.8847$
 $\frac{x^2(16)}{16} = \frac{2770.8847}{16}$
 $x^2 = \sqrt{173.1802}$
 $x = 13.2$

The side will be 13.2 centimeter

A store owner who sells the chocolate-covered almonds displays them on a shelf whose dimensions are 80 cm long and 60 cm wide. The shelf can only hold one layer of new containers when each new container sits on its square base. Determine and state the maximum number of new containers the store owner can fit on the shelf.

80
 4800
 60

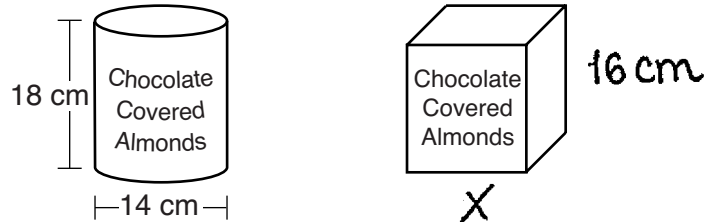
$13.2 \cdot 13.2 =$
 174.24 Square Base
 $4800 \div 174.24 = 27.54$

27 Containers

Score 3: The student found the side length of 13.2, but no further correct work was shown.

Question 34

34 A manufacturer is designing a new container for their chocolate-covered almonds. Their original container was a cylinder with a height of 18 cm and a diameter of 14 cm. The new container can be modeled by a rectangular prism with a square base and will contain the same amount of chocolate-covered almonds.



If the new container's height is 16 cm, determine and state, to the *nearest tenth of a centimeter*, the side length of the new container if both containers contain the same amount of almonds.

Old Container

$$V = \pi r^2 h$$

$$V = \pi 7^2 \cdot 18$$

$$V = \pi 49 \cdot 18$$

$$V = \pi 882$$

$$V = 882\pi \text{ cm}^3$$

New Container

$x = \text{side length of container}$

$$\frac{882\pi}{16} = \frac{(x^2) 16}{16}$$

$$\sqrt{x^2} = \sqrt{173.180295\dots}$$

$$x \approx 13 \text{ cm}$$

A store owner who sells the chocolate-covered almonds displays them on a shelf whose dimensions are 80 cm long and 60 cm wide. The shelf can only hold one layer of new containers when each new container sits on its square base. Determine and state the maximum number of new containers the store owner can fit on the shelf.

$V = 16 \cdot 60 \cdot 80$ shelf

$V = 76,800 \text{ cm}^3$ container

$$V = 16 \cdot 13 \cdot 13 = 2,704 \text{ cm}^3$$

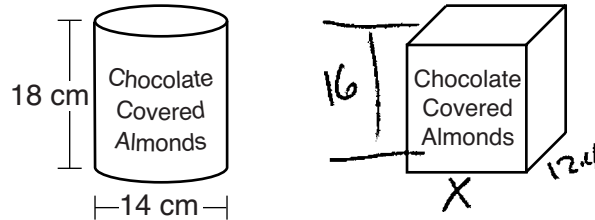
$$\frac{76,800 \text{ cm}^3}{2,704 \text{ cm}^3} \approx 28$$

28 containers

Score 2: The student made a rounding error in finding the side length of the new container. No further correct work was shown.

Question 34

34 A manufacturer is designing a new container for their chocolate-covered almonds. Their original container was a cylinder with a height of 18 cm and a diameter of 14 cm. The new container can be modeled by a rectangular prism with a square base and will contain the same amount of chocolate-covered almonds.



If the new container's height is 16 cm, determine and state, to the *nearest tenth of a centimeter*, the side length of the new container if both containers contain the same amount of almonds.

$$\frac{16}{18} = \frac{x}{14}$$

$$\frac{18x}{18} = \frac{224}{18}$$

$$x = 12.4 \text{ cm}$$

The side length of the container would be 12.4 cm.

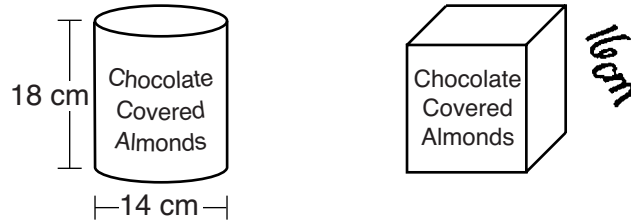
A store owner who sells the chocolate-covered almonds displays them on a shelf whose dimensions are 80 cm long and 60 cm wide. The shelf can only hold one layer of new containers when each new container sits on its square base. Determine and state the maximum number of new containers the store owner can fit on the shelf.

The diagram shows a rectangular shelf with a length of 80 cm and a width of 60 cm. Handwritten calculations show: $60 \div 12.4 = 4.8$, $80 \div 12.4 = 6.5$, and $6(4) = 24$. A handwritten note states: 'The shelf can hold 24 containers of chocolate covered almonds.'

Score 1: The student had a completely incorrect response to find the side length of the new container. The student used the incorrect side length to find an appropriate number of new containers.

Question 34

34 A manufacturer is designing a new container for their chocolate-covered almonds. Their original container was a cylinder with a height of 18 cm and a diameter of 14 cm. The new container can be modeled by a rectangular prism with a square base and will contain the same amount of chocolate-covered almonds.



If the new container's height is 16 cm, determine and state, to the nearest tenth of a centimeter, the side length of the new container if both containers contain the same amount of almonds.

$$V_C = \pi r^2 h$$

$$V_C = \pi (7)^2 (18)$$

$$V_C = 2770.88472 \text{ cm}^3$$

$$V_B = Bh$$

$$2770.88472 = x(16)$$

$$\frac{2770.88472}{16} = \frac{16x}{16}$$

$$x = \frac{173.180295}{2}$$

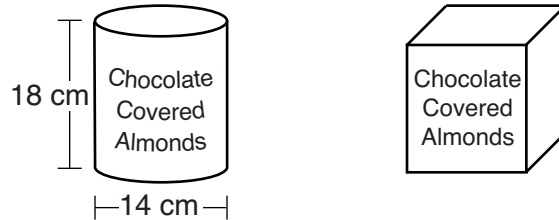
$$x = 86.6 \text{ cm}$$

A store owner who sells the chocolate-covered almonds displays them on a shelf whose dimensions are 80 cm long and 60 cm wide. The shelf can only hold one layer of new containers when each new container sits on its square base. Determine and state the maximum number of new containers the store owner can fit on the shelf.

Score 1: The student correctly found the volume of the cylinder, but no further correct work was shown.

Question 34

34 A manufacturer is designing a new container for their chocolate-covered almonds. Their original container was a cylinder with a height of 18 cm and a diameter of 14 cm. The new container can be modeled by a rectangular prism with a square base and will contain the same amount of chocolate-covered almonds.



If the new container's height is 16 cm, determine and state, to the *nearest tenth of a centimeter*, the side length of the new container if both containers contain the same amount of almonds.

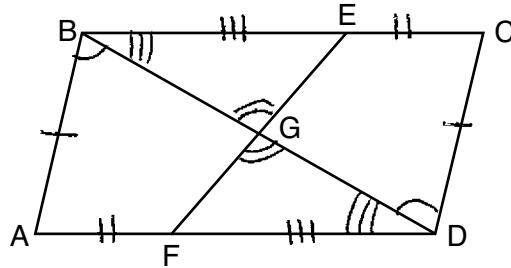
$$V = \pi r^2 h$$
$$V = \pi 14^2 \cdot 18$$
$$V = 11,083.5$$

A store owner who sells the chocolate-covered almonds displays them on a shelf whose dimensions are 80 cm long and 60 cm wide. The shelf can only hold one layer of new containers when each new container sits on its square base. Determine and state the maximum number of new containers the store owner can fit on the shelf.

Score 0: The student gave a completely incorrect response.

Question 35

35 In quadrilateral $ABCD$, E and F are points on \overline{BC} and \overline{AD} , respectively, and \overline{BGD} and \overline{EGF} are drawn such that $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, and $\overline{CE} \cong \overline{AF}$.



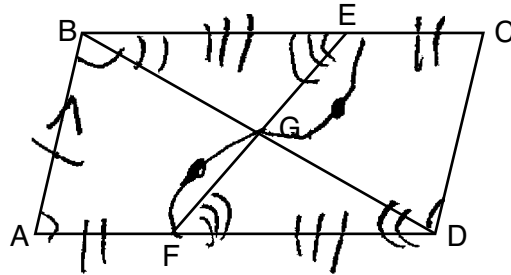
Prove: $\overline{FG} \cong \overline{EG}$

Statement	Reason
① Quad $ABCD$, E and F are points on \overline{BC} and \overline{AD} . and \overline{BGD} and \overline{EGF} are drawn. $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, and $\overline{CE} \cong \overline{AF}$	① Given
② $\overline{BD} \cong \overline{BD}$	② Reflexive property.
③ $\triangle ABD \cong \triangle CDB$	③ SAS
④ $\overline{BC} \cong \overline{DA}$	④ CPCTC
⑤ $\overline{BE} + \overline{CE} \cong \overline{AF} + \overline{DF}$	⑤ segment addition post.
⑥ $\overline{BE} \cong \overline{DF}$	⑥ subtraction property
⑦ $\angle BGE \cong \angle DGF$	⑦ vertical \angle 's are \cong
⑧ $\angle CBD \cong \angle ADB$	⑧ CPCTC
⑨ $\triangle EBG \cong \triangle FDG$	⑨ AAS
⑩ $\overline{FG} \cong \overline{EG}$	⑩ CPCTC

Score 6: The student gave a complete and correct response.

Question 35

35 In quadrilateral $ABCD$, E and F are points on \overline{BC} and \overline{AD} , respectively, and \overline{BGD} and \overline{EGF} are drawn such that $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, and $\overline{CE} \cong \overline{AF}$.



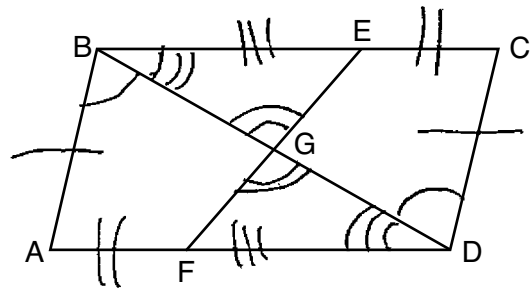
Prove: $\overline{FG} \cong \overline{EG}$

Statements	Reasons
① quad $ABCD$, $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, $\overline{CE} \cong \overline{AF}$	① Given
② $\overline{AB} \parallel \overline{CD}$	② If alt. int. \angle s \cong , then lines are \parallel .
③ $ABCD$ is a \square	③ A quad with a pair of opp. sides that are \cong and \parallel is a \square .
④ $\angle A \cong \angle C$	④ opp. \angle s of a \square are \cong .
⑤ $\triangle ABD \cong \triangle DCB$	⑤ ASA \cong ASA
⑥ $\angle EBG \cong \angle FDG$, $\angle BEG \cong \angle DFG$	⑥ If lines \parallel , ^{then} alt. int. \angle s \cong .
⑦ $\overline{BC} \cong \overline{AD}$	⑦ CPCTC
⑧ $\overline{AD} - \overline{AF} \cong \overline{BC} - \overline{EC}$ $\overline{DF} \cong \overline{BE}$	⑧ Subtraction post.
⑨ $\triangle BEG \cong \triangle DFG$	⑨ ASA \cong ASA
⑩ $\overline{FG} \cong \overline{EG}$	⑩ CPCTC

Score 5: The student did not prove $\overline{AD} \parallel \overline{BC}$ to prove step 6.

Question 35

35 In quadrilateral $ABCD$, E and F are points on \overline{BC} and \overline{AD} , respectively, and \overline{BGD} and \overline{EGF} are drawn such that $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, and $\overline{CE} \cong \overline{AF}$.



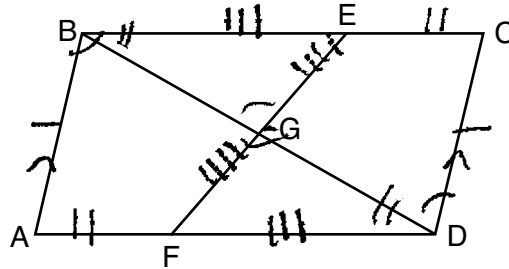
Prove: $\overline{FG} \cong \overline{EG}$

Statement	Reason
① In quadrilateral $ABCD$, E and F are points on \overline{BC} and \overline{AD} . \overline{BGD} and \overline{EGF} are drawn such that $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, and $\overline{CE} \cong \overline{AF}$.	① Given
② $\overline{AB} \parallel \overline{CD}$	② If 2 lines are cut by a transversal so that alternate interior angles are \cong , the lines are parallel.
③ Quadrilateral $ABCD$ is a parallelogram	③ If one pair of opposite sides in a quadrilateral are \cong and parallel, the it is a parallelogram.
④ $\angle BEG \cong \angle GDF$	④ Vertical \angle s are \cong .
⑤ $\overline{BC} \parallel \overline{AD}$	⑤ Opposite sides in a parallelogram are parallel.
⑥ $\angle EBG \cong \angle GDF$	⑥ If 2 parallel lines are cut by a transversal, alternate interior angles are congruent.
⑦ $\overline{AD} \cong \overline{BC}$	⑦ Opposite sides in a parallelogram are congruent.
⑧ $\overline{AD} = \overline{AF} + \overline{FD}$ $\overline{BC} = \overline{BE} + \overline{EC}$	⑧ A segment = the sum of its parts.
⑨ $\overline{BE} + \overline{EC} = \overline{AF} + \overline{FD}$	⑨ Substitution property of equality.
⑩ $\overline{BE} \cong \overline{FD}$	⑩ Subtraction property of equality.
⑪ $\triangle BEG \cong \triangle DFG$	⑪ AAS \cong AAS.
⑫ $\overline{FG} \cong \overline{EG}$	⑫ Corresponding parts of congruent triangles are congruent.

Score 5: The student incorrectly named the vertical angles in step 4.

Question 35

35 In quadrilateral $ABCD$, E and F are points on \overline{BC} and \overline{AD} , respectively, and \overline{BGD} and \overline{EGF} are drawn such that $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, and $\overline{CE} \cong \overline{AF}$.



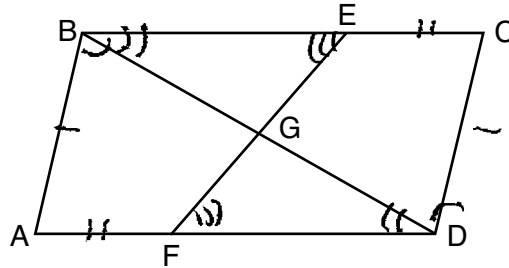
Prove: $\overline{FG} \cong \overline{EG}$

Statement	Reason
1) Quad $ABCD$ $\angle ABG \cong \angle CDG$ $\overline{AB} \cong \overline{CD}$ $\overline{CE} \cong \overline{AF}$	1) Given
2) $\angle BGE \cong \angle DGF$	2) vertical \angle 's are \cong
3) $\overline{BA} \parallel \overline{CD}$	3) lines are \parallel iff they have \cong alt int \angle 's
4) $ABCD$ is a parallelogram	4) $ABCD$ has a pair of sides that are \parallel and \cong
5) $\angle EBG \cong \angle GDF$	5) alt int \angle 's are \cong if lines are \parallel
6) $\overline{BE} \cong \overline{FD}$	6) In a parallelogram opposite sides are \cong and $\overline{EC} \cong \overline{AF}$ so part + part = whole
7) $\triangle BGE \cong \triangle DGF$	7) AAS Thm \cong
8) $\overline{FG} \cong \overline{GE}$	8) CPCTC

Score 4: The student did not prove $\overline{AD} \parallel \overline{BC}$ to prove step 5 and did not show subtraction to prove step 6.

Question 35

35 In quadrilateral $ABCD$, E and F are points on \overline{BC} and \overline{AD} , respectively, and \overline{BGD} and \overline{EGF} are drawn such that $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, and $\overline{CE} \cong \overline{AF}$.



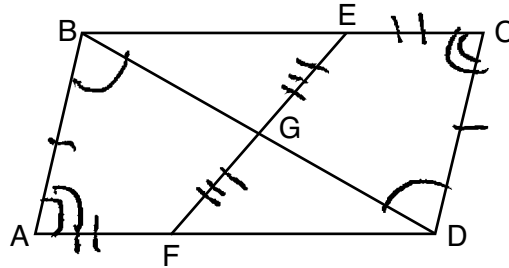
Prove: $\overline{FG} \cong \overline{EG}$

Statement	Reason
1) In quadrilateral $ABCD$, E and F are points on \overline{BC} and \overline{AD} , respectively, and \overline{BGD} and \overline{EGF} are drawn such that $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, and $\overline{CE} \cong \overline{AF}$	1) Given
2) $\angle EBG \cong \angle FDG$, $\angle BEG \cong \angle DFG$	2) parallel lines cut by a transversal form congruent opposite interior angles
3) $\overline{BC} \cong \overline{AD}$	3) opposite sides of a parallelogram are congruent
4) $\overline{BC} \cong \overline{BE} + \overline{EC}$ $\overline{AD} \cong \overline{DF} + \overline{AF}$	4) a segment is congruent to the sum of its parts
5) $\overline{BC} - \overline{EC} \cong \overline{AD} - \overline{AF}$ $\overline{BE} \cong \overline{DF}$	5) subtraction
6) $\triangle FGD \cong \triangle BGE$	6) ASA \cong ASA
7) $\overline{FG} \cong \overline{EG}$	7) CPCTC

Score 3: The student made one conceptual error by not proving $ABCD$ is a parallelogram. The student did not prove $\overline{AD} \parallel \overline{BC}$ to prove step 2.

Question 35

35 In quadrilateral $ABCD$, E and F are points on \overline{BC} and \overline{AD} , respectively, and \overline{BGD} and \overline{EGF} are drawn such that $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, and $\overline{CE} \cong \overline{AF}$.



Prove: $\overline{FG} \cong \overline{EG}$

① quadrilateral $ABCD$, E + F are points on \overline{BC} and \overline{AD} , \overline{BGD} and \overline{EGF}
 $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, $\overline{CE} \cong \overline{AF}$

② $\overline{AB} \parallel \overline{CD}$

③ parallelogram $ABCD$

④ $\overline{AFD} \cong \overline{CEB}$

⑤ $\angle A \cong \angle C$

⑥ $\triangle BAD \cong \triangle DCB$

⑦ $\overline{FG} \cong \overline{EG}$

① Given

② parallel lines \rightarrow alternate interior angles congruent

③ parallelogram \rightarrow opposite sides parallel and congruent

④ parallelogram have opposite sides congruent

⑤ parallelogram have opposite angles \cong

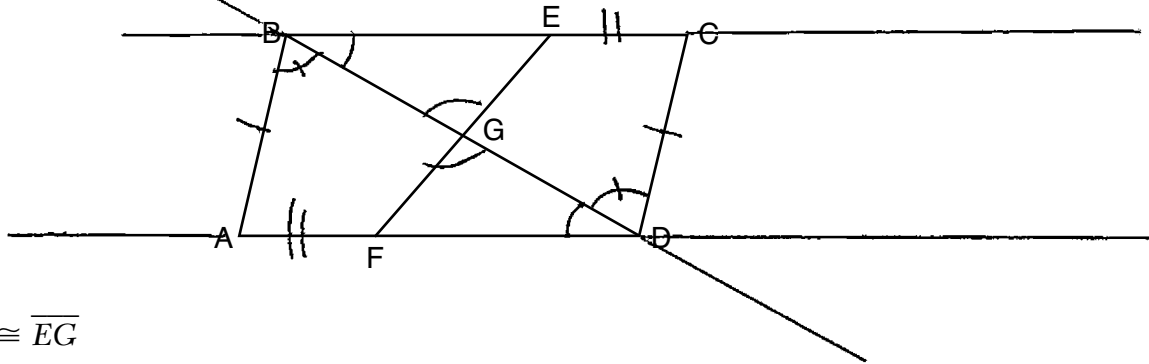
⑥ SAS

⑦ corresponding parts of congruent triangles are congruent

Score 2: The student proved $ABCD$ is a parallelogram and $\triangle ABD \cong \triangle CDB$.

Question 35

35 In quadrilateral $ABCD$, E and F are points on \overline{BC} and \overline{AD} , respectively, and \overline{BGD} and \overline{EGF} are drawn such that $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, and $\overline{CE} \cong \overline{AF}$.



Prove: $\overline{FG} \cong \overline{EG}$

Statements

- ① quadrilateral $ABCD$, E and F are points on \overline{BC} and \overline{AD} , respectively, \overline{BGD} and \overline{EGF} are drawn such that $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, and $\overline{CE} \cong \overline{AF}$
- ② $\overline{BC} \parallel \overline{AD}$
- ③ $\angle GBE \cong \angle GDF$
- ④ $\angle BGE \cong \angle DGF$
- ⑤ $\triangle FGD \sim \triangle EGB$
- ⑥ $\overline{BE} \cong \overline{FD}$
- ⑦ $\overline{FG} \cong \overline{EG}$

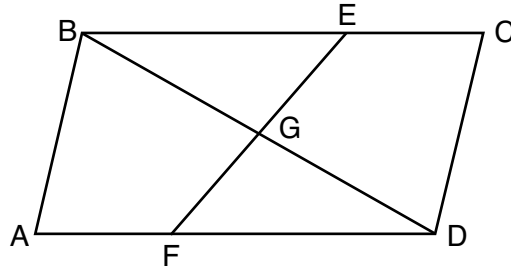
Reasons

- ① Given
- ② A quadrilateral with two congruent sides has \parallel lines
- ③ 2 \parallel lines cut by a transversal forms Congruent \angle s-
- ④ vertical \angle 's are \cong
- ⑤ AA similarity theorem
- ⑥ CPCTC
- ⑦ G is the md. pt. of \overline{FE}

Score 1: The student had only one correct relevant statement and reason in step 4.

Question 35

35 In quadrilateral $ABCD$, E and F are points on \overline{BC} and \overline{AD} , respectively, and \overline{BGD} and \overline{EGF} are drawn such that $\angle ABG \cong \angle CDG$, $\overline{AB} \cong \overline{CD}$, and $\overline{CE} \cong \overline{AF}$.



Prove: $\overline{FG} \cong \overline{EG}$

Statements

Reasons

1. $\angle ABG \cong \angle CDG$

$\overline{AB} \cong \overline{CD}, \overline{CE} \cong \overline{AF}$

2. $ABCD$ is parallelogram

3. $\overline{FG} \cong \overline{EG}$

1. Given

2. opp. sides \cong

3. parallelogram's diagonals bisect each other

Score 0: The student gave a completely incorrect response.

Regents Examination in Geometry – January 2020

Chart for Converting Total Test Raw Scores to Final Exam Scores (Scale Scores)

(Use for the January 2020 exam only.)

Raw Score	Scale Score	Performance Level	Raw Score	Scale Score	Performance Level	Raw Score	Scale Score	Performance Level
80	100	5	53	79	3	26	60	2
79	99	5	52	79	3	25	59	2
78	98	5	51	78	3	24	57	2
77	97	5	50	78	3	23	56	2
76	95	5	49	77	3	22	55	2
75	94	5	48	77	3	21	53	1
74	93	5	47	76	3	20	52	1
73	92	5	46	76	3	19	50	1
72	92	5	45	75	3	18	48	1
71	91	5	44	75	3	17	46	1
70	90	5	43	74	3	16	44	1
69	89	5	42	73	3	15	42	1
68	88	5	41	73	3	14	40	1
67	87	5	40	72	3	13	38	1
66	87	5	39	72	3	12	36	1
65	86	5	38	71	3	11	34	1
64	86	5	37	70	3	10	31	1
63	85	5	36	70	3	9	29	1
62	84	4	35	69	3	8	26	1
61	83	4	34	68	3	7	23	1
60	83	4	33	67	3	6	20	1
59	82	4	32	66	3	5	17	1
58	82	4	31	65	3	4	14	1
57	81	4	30	64	2	3	11	1
56	81	4	29	63	2	2	7	1
55	80	4	28	62	2	1	4	1
54	80	4	27	61	2	0	0	1

To determine the student’s final examination score (scale score), find the student’s total test raw score in the column labeled “Raw Score” and then locate the scale score that corresponds to that raw score. The scale score is the student’s final examination score. Enter this score in the space labeled “Scale Score” on the student’s answer sheet.

Schools are not permitted to rescore any of the open-ended questions on this exam after each question has been rated once, regardless of the final exam score. Schools are required to ensure that the raw scores have been added correctly and that the resulting scale score has been determined accurately.

Because scale scores corresponding to raw scores in the conversion chart change from one administration to another, it is crucial that for each administration the conversion chart provided for that administration be used to determine the student’s final score. The chart above is usable only for this administration of the Regents Examination in Geometry.