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 36 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.
Part I

Answer all 24 questions in this part. Each correct answer will receive 2 credits. 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. 

1. William is drawing pictures of cross sections of the right circular cone below.

Which drawing can not be a cross section of a cone?

- (1)
- (2)
- (3)
- (4)

2. An equation of a line perpendicular to the line represented by the equation \( y = -\frac{1}{2}x - 5 \) and passing through \((6, -4)\) is

- (1) \( y = -\frac{1}{2}x + 4 \)
- (2) \( y = -\frac{1}{2}x - 1 \)
- (3) \( y = 2x + 14 \)
- (4) \( y = 2x - 16 \)
3 In parallelogram $QRST$ shown below, diagonal $TR$ is drawn, $U$ and $V$ are points on $TS$ and $QR$, respectively, and $UV$ intersects $TR$ at $W$.

If $\angle S = 60^\circ$, $\angle SRT = 83^\circ$, and $\angle TWU = 35^\circ$, what is $\angle WVQ$?

(1) 37°  
(2) 60°  
(3) 72°  
(4) 83°

4 A fish tank in the shape of a rectangular prism has dimensions of 14 inches, 16 inches, and 10 inches. The tank contains 1680 cubic inches of water. What percent of the fish tank is empty?

(1) 10  
(2) 25  
(3) 50  
(4) 75

5 Which transformation would result in the perimeter of a triangle being different from the perimeter of its image?

(1) $(x,y) \rightarrow (y,x)$  
(2) $(x,y) \rightarrow (x, -y)$  
(3) $(x,y) \rightarrow (4x, 4y)$  
(4) $(x,y) \rightarrow (x + 2, y - 5)$
6 In the diagram below, $FE$ bisects $AC$ at $B$, and $GE$ bisects $BD$ at $C$.

Which statement is always true?

(1) $AB = DC$  
(2) $FB = EB$  
(3) $BD$ bisects $GE$ at $C$.  
(4) $AC$ bisects $FE$ at $B$.

7 As shown in the diagram below, a regular pyramid has a square base whose side measures 6 inches.

If the altitude of the pyramid measures 12 inches, its volume, in cubic inches, is

(1) 72  
(2) 144  
(3) 288  
(4) 432
Triangle $ABC$ and triangle $DEF$ are graphed on the set of axes below.

Which sequence of transformations maps triangle $ABC$ onto triangle $DEF$?

(1) a reflection over the $x$-axis followed by a reflection over the $y$-axis
(2) a $180^\circ$ rotation about the origin followed by a reflection over the line $y = x$
(3) a $90^\circ$ clockwise rotation about the origin followed by a reflection over the $y$-axis
(4) a translation 8 units to the right and 1 unit up followed by a $90^\circ$ counterclockwise rotation about the origin
9 In \( \triangle ABC \), the complement of \( \angle B \) is \( \angle A \). Which statement is always true?

(1) \( \tan \angle A = \tan \angle B \)  
(2) \( \sin \angle A = \sin \angle B \)  
(3) \( \cos \angle A = \tan \angle B \)  
(4) \( \sin \angle A = \cos \angle B \)

10 A line that passes through the points whose coordinates are (1,1) and (5,7) is dilated by a scale factor of 3 and centered at the origin. The image of the line

(1) is perpendicular to the original line  
(2) is parallel to the original line  
(3) passes through the origin  
(4) is the original line

11 Quadrilateral \( ABCD \) is graphed on the set of axes below.

![Diagram of quadrilateral ABCD]

When \( ABCD \) is rotated 90° in a counterclockwise direction about the origin, its image is quadrilateral \( A'B'C'D' \). Is distance preserved under this rotation, and which coordinates are correct for the given vertex?

(1) no and \( C'(1,2) \)  
(2) no and \( D'(2,4) \)  
(3) yes and \( A'(6,2) \)  
(4) yes and \( B'(-3,4) \)

Geometry (Common Core) – Jan. '16
12 In the diagram below of circle $O$, the area of the shaded sector $LOM$ is $2\pi$ cm$^2$.

If the length of $NL$ is 6 cm, what is $m\angle N$?

(1) $10^\circ$  
(2) $20^\circ$  
(3) $40^\circ$  
(4) $80^\circ$

13 In the diagram below, $\triangle ABC \sim \triangle DEF$.

If $AB = 6$ and $AC = 8$, which statement will justify similarity by SAS?

(1) $DE = 9$, $DF = 12$, and $\angle A \cong \angle D$
(2) $DE = 8$, $DF = 10$, and $\angle A \cong \angle D$
(3) $DE = 36$, $DF = 64$, and $\angle C \cong \angle F$
(4) $DE = 15$, $DF = 20$, and $\angle C \cong \angle F$

14 The diameter of a basketball is approximately 9.5 inches and the diameter of a tennis ball is approximately 2.5 inches. The volume of the basketball is about how many times greater than the volume of the tennis ball?

(1) 3591  
(2) 65  
(3) 55  
(4) 4

Geometry (Common Core) – Jan. '16
15 The endpoints of one side of a regular pentagon are (-1,4) and (2,3). What is the perimeter of the pentagon?

(1) $\sqrt{10}$
(2) $5\sqrt{2}$
(3) $5\sqrt{10}$
(4) $25\sqrt{2}$

16 In the diagram of right triangle $ABC$ shown below, $AB = 14$ and $AC = 9$.

\[ \begin{array}{c}
\text{A} \\
\text{9} \\
\text{14} \\
\text{C} \\
\end{array} \]

What is the measure of $\angle A$, to the nearest degree?

(1) 33
(2) 40
(3) 50
(4) 57

17 What are the coordinates of the center and length of the radius of the circle whose equation is $x^2 + 6x + y^2 - 4y = 23$?

(1) (3,-2) and 36
(2) (3,-2) and 6
(3) (-3,2) and 36
(4) (-3,2) and 6

18 The coordinates of the vertices of $\triangle RST$ are $R(-2,-3)$, $S(8,2)$, and $T(4,5)$. Which type of triangle is $\triangle RST$?

(1) right
(2) acute
(3) obtuse
(4) equiangular
19 Molly wishes to make a lawn ornament in the form of a solid sphere. The clay being used to make the sphere weighs .075 pound per cubic inch. If the sphere's radius is 4 inches, what is the weight of the sphere, to the nearest pound?

(1) 34 
(2) 20 
(3) 15 
(4) 4

20 The ratio of similarity of \( \triangle BOY \) to \( \triangle GRL \) is 1:2. If \( BO = x + 3 \) and \( GR = 3x - 1 \), then the length of \( GR \) is

(1) 5 
(2) 7 
(3) 10 
(4) 20

21 In the diagram below, \( DC, AC, DOB, CB, \) and \( AB \) are chords of circle \( O \), \( FDE \) is tangent at point \( D \), and radius \( AO \) is drawn. Sam decides to apply this theorem to the diagram: “An angle inscribed in a semi-circle is a right angle.”

Which angle is Sam referring to?

(1) \( \angle AOB \) 
(2) \( \angle BAC \) 
(3) \( \angle DCB \) 
(4) \( \angle FDB \)
22 In the diagram below, \( CD \) is the altitude drawn to the hypotenuse \( AB \) of right triangle \( ABC \).

Which lengths would not produce an altitude that measures \( 6\sqrt{2} \)?

(1) \( AD = 2 \) and \( DB = 36 \)  
(3) \( AD = 6 \) and \( DB = 12 \)  
(2) \( AD = 3 \) and \( AB = 24 \)  
(4) \( AD = 8 \) and \( AB = 17 \)

23 A designer needs to create perfectly circular necklaces. The necklaces each need to have a radius of 10 cm. What is the largest number of necklaces that can be made from 1000 cm of wire?

(1) 15  
(2) 16  
(3) 31  
(4) 32

24 In \( \triangle SCU \) shown below, points \( T \) and \( O \) are on \( SU \) and \( CU \), respectively. Segment \( OT \) is drawn so that \( \angle C \equiv \angle OTU \).

If \( TU = 4 \), \( OU = 5 \), and \( OC = 7 \), what is the length of \( ST \)?

(1) 5.6  
(3) 11  
(2) 8.75  
(4) 15
25 Triangle $ABC$ is graphed on the set of axes below. Graph and label $\triangle A'B'C'$, the image of $\triangle ABC$ after a reflection over the line $x = 1$. 
In the diagram below of circle $O$ with diameter $BC$ and radius $OA$, chord $DC$ is parallel to chord $BA$.

If $m\angle BCD = 30^\circ$, determine and state $m\angle AOB$. 
Directed line segment $PT$ has endpoints whose coordinates are $P(-2,1)$ and $T(4,7)$. Determine the coordinates of point $J$ that divides the segment in the ratio 2 to 1.

[The use of the set of axes below is optional.]
28 As graphed on the set of axes below, Δ\(A'B'C'\) is the image of Δ\(ABC\) after a sequence of transformations.

Is Δ\(A'B'C'\) congruent to Δ\(ABC\)? Use the properties of rigid motion to explain your answer.
A carpenter leans an extension ladder against a house to reach the bottom of a window 30 feet above the ground. As shown in the diagram below, the ladder makes a 70° angle with the ground. To the nearest foot, determine and state the length of the ladder.
During an experiment, the same type of bacteria is grown in two petri dishes. Petri dish A has a diameter of 51 mm and has approximately 40,000 bacteria after 1 hour. Petri dish B has a diameter of 75 mm and has approximately 72,000 bacteria after 1 hour.

Determine and state which petri dish has the greater population density of bacteria at the end of the first hour.
31 Line \( \ell \) is mapped onto line \( m \) by a dilation centered at the origin with a scale factor of 2. The equation of line \( \ell \) is \( 3x - y = 4 \). Determine and state an equation for line \( m \).
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 The aspect ratio (the ratio of screen width to height) of a rectangular flat-screen television is 16:9. The length of the diagonal of the screen is the television's screen size. Determine and state, to the nearest inch, the screen size (diagonal) of this flat-screen television with a screen height of 20.6 inches.
Given the theorem, "The sum of the measures of the interior angles of a triangle is $180^\circ$," complete the proof for this theorem.

Given: $\triangle ABC$

Prove: $m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ$

Fill in the missing reasons below.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) $\triangle ABC$</td>
<td>(1) Given</td>
</tr>
<tr>
<td>(2) Through point $C$, draw $\overline{DCE}$ parallel to $AB$.</td>
<td>(2) _________</td>
</tr>
<tr>
<td>(3) $m\angle 1 = m\angle ACD$, $m\angle 3 = m\angle BCE$</td>
<td>(3) _________</td>
</tr>
<tr>
<td>(4) $m\angle ACD + m\angle 2 + m\angle BCE = 180^\circ$</td>
<td>(4) _________</td>
</tr>
<tr>
<td>(5) $m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ$</td>
<td>(5) _________</td>
</tr>
</tbody>
</table>
34 Triangle $XYZ$ is shown below. Using a compass and straightedge, on the line below, construct and label $\triangle ABC$, such that $\triangle ABC \cong \triangle XYZ$. [Leave all construction marks.]

Based on your construction, state the theorem that justifies why $\triangle ABC$ is congruent to $\triangle XYZ$. 

![Diagram of triangle XYZ and construction line]
Part IV

Answer the 2 questions in this part. Each correct answer will receive 6 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]

35 Given: Parallelogram $\text{ANDR}$ with $\overline{AW}$ and $\overline{DE}$ bisecting $\overline{NWD}$ and $\overline{REA}$ at points $W$ and $E$, respectively

Prove that $\triangle ANW \cong \triangle DRE$.

Prove that quadrilateral $\text{AWDE}$ is a parallelogram.
Cathy wants to determine the height of the flagpole shown in the diagram below. She uses a
survey instrument to measure the angle of elevation to the top of the flagpole, and determines it
to be 34.9°. She walks 8 meters closer and determines the new measure of the angle of elevation
to be 52.8°. At each measurement, the survey instrument is 1.7 meters above the ground.

Determine and state, to the nearest tenth of a meter, the height of the flagpole.
FOR TEACHERS ONLY

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

GEOMETRY (Common Core)

Thursday, January 28, 2016 — 9:15 a.m. to 12:15 p.m., only

SCORING KEY AND RATING GUIDE

Mechanics of Rating

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

Do not attempt to correct the student’s work by making insertions or changes of any kind. In scoring the open-ended 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 open-ended 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 rescoring 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.

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 Thursday, January 28, 2016. 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.
If the student's responses for the multiple-choice questions are being hand scored prior to being scanned, the scorer must be careful not to make any marks on the answer sheet except to record the scores in the designated score boxes. Marks elsewhere on the answer sheet will interfere with the accuracy of the scanning.

**Part I**

Allow a total of 48 credits, 2 credits for each of the following. Allow credit if the student has written the correct answer instead of the numeral 1, 2, 3, or 4.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(7)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>(8)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(9)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>(10)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>(11)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>(12)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>(13)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(14)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>(15)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>(16)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>(17)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>(18)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(19)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>(20)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>(21)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>(22)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>(23)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(24)</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

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/](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 (Common Core). 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/geometrycc/](http://www.nysedregents.org/geometrycc/).
General Rules for Applying Mathematics Rubrics

I. General Principles for Rating

The rubrics for the constructed-response questions on the Regents Examination in Geometry (Common Core) 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 (Common Core), 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's 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.


[1] One graphing error is made, but appropriate vertices are graphed and labeled.

or

[1] One conceptual error is made, such as reflecting $\triangle ABC$ over the line $y = 1$, but appropriate vertices are graphed and labeled.

or

[1] The image of $\triangle ABC$ is graphed correctly, but is not labeled or is labeled incorrectly.

[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] 120° or an equivalent radian measure is found, and appropriate work is shown, such as a labeled diagram.

[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] $\widehat{DB} = 60^\circ$, $\widehat{AC} = 60^\circ$, and $\widehat{AB} = 120^\circ$, but no further correct work is shown.

or

[1] $\angle ABO$ and $\angle BAO = 30^\circ$, but no further correct work is shown.

or

[1] $\angle AOB = 120^\circ$, 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] (2,5), and correct work is shown.

[1] Appropriate work is shown, but one computational error is made. Appropriate coordinates are stated.

or

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

or

[1] Appropriate work is shown to find 2 and 5, but the answer is not written as coordinates.

or

[1] Point J is graphed correctly, but the coordinates are not stated or are stated incorrectly.

or

[1] (2,5), 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.

(28) [2] Yes, and a correct explanation is written.

[1] Yes, and an incomplete explanation is stated.

or

[1] Yes, and a correct sequence of transformations is written.

or

[1] Yes, and a statement other than properties of rigid motions is used.

[0] Yes or an equivalent statement is stated, but no explanation 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.
(29) [2] 32, 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] \( \sin 70 = \frac{30}{x} \) or \( \cos 20 = \frac{30}{x} \) is written, but no further correct work is shown.

    or

[1] 32, 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.

(30) [2] A, and correct work is shown.

[1] Appropriate work is shown, but one computational error is made. An appropriate petri dish is stated.

    or

[1] Appropriate work is shown, but one conceptual error is made. An appropriate petri dish is stated.

    or

[1] Appropriate work is shown to find the population density of each petri dish, but no petri dish or an incorrect petri dish is stated.

[0] A, 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.
(31)  [2] $y = 3x - 8$ 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] $y = 3x - 8$, 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] 42, and correct work is shown.

[3] Appropriate work is shown, but one computational or rounding error is made. An appropriate screen size is found, to the nearest inch.

  or

[3] Correct work is shown to find the width. The diagonal 42 is stated, but no work is shown.

  or

[3] Correct work is shown to find the diagonal for 16 by 9 dimensions. The diagonal 42 is stated, but no work is shown.

[2] Appropriate work is shown, but two or more computational or rounding errors are made. An appropriate screen size is found, to the nearest inch.

  or

[2] Appropriate work is shown, but one conceptual error is made. An appropriate screen size is found, to the nearest inch.

  or

[2] Correct work is shown to find the width, but no further correct work is shown.

  or

[2] Using the aspect ratio 16:9 (w:h), correct work is shown to find the diagonal for 16 by 9 dimensions. No further correct work is shown.

[1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made. An appropriate screen size is found, to the nearest inch.

  or

[1] 42, 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.
(33) [4] All four reasons are correct.
[2] Two reasons are correct.
[1] One reason is correct.
[0] No reasons are correct.

(34) [4] A correct construction of \( \triangle ABC \cong \triangle XYZ \) is drawn showing all construction arcs. A correct theorem is stated to justify why the triangles are congruent.

[3] An appropriate construction of the congruent triangle is drawn, but one construction error is made. A correct theorem is stated to justify why the triangles are congruent.

\[ \text{or} \]

[3] A correct construction of \( \triangle ABC \cong \triangle XYZ \) is drawn. No theorem is stated or an incorrect theorem, based upon the construction, is stated.

\[ \text{or} \]

[3] An appropriate construction of a congruent triangle is drawn, but the triangle is not labeled or is labeled incorrectly. A correct theorem is stated to justify why the triangles are congruent.

[2] An appropriate construction of a congruent triangle is drawn, but one construction error is made. No theorem is stated or an incorrect theorem, based upon the construction, is stated.

\[ \text{or} \]

[2] An appropriate construction of a congruent triangle is drawn. The triangle is not labeled or is labeled incorrectly. No theorem is stated or an incorrect theorem, based upon the construction, is stated.

[1] All appropriate construction arcs are drawn, but the triangle is not drawn. No further correct work is shown.

\[ \text{or} \]

[1] An appropriate congruency theorem is stated, but a drawing that is not an appropriate construction is shown.

[0] A triangle congruency theorem is stated, but no work is shown.

\[ \text{or} \]

[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 each 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 concluding statements 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.

[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.

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

or

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

or

[3] A proof is written that shows $\triangle ANW \equiv \triangle DRE$, but no further correct work is shown.

or

[3] A proof is written that shows $\triangle AWDE$ is a parallelogram, but no further correct work is shown.

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

[1] One correct relevant statement and reason about the proof are written.

[0] The “given” and/or the “prove” statements are written, 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.
13.6, and correct work is shown.

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

or

Correct work is shown, but the height of the survey instrument is not added to the flagpole height.

Appropriate work is shown, but two computational or rounding errors are made.

or

Correct work is shown to find the distance between the second sighting and the flagpole. No further correct work is shown.

Appropriate work is shown, but three or more computational or rounding errors are made.

or

Appropriate work is shown, but one conceptual error is made.

or

The equation \((x + 8)(\tan 34.9) = x(\tan 52.8)\) or an equivalent equation is written. No further correct work is shown.

Appropriate work is shown, but one conceptual error and one computational or rounding error are made.

or

Equations \(\tan 52.8 = \frac{h}{x}\) and \(\tan 34.9 = \frac{h}{x + 8}\) are written. No further correct work is shown.

The equation \(\tan 52.8 = \frac{h}{x}\) or \(\tan 34.9 = \frac{h}{x + 8}\) is written. No further correct work is shown.

or

13.6, but no work is shown.

A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
<table>
<thead>
<tr>
<th>Question</th>
<th>Type</th>
<th>Credits</th>
<th>Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-GMD.B</td>
</tr>
<tr>
<td>2</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-GPE.B</td>
</tr>
<tr>
<td>3</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-CO.C</td>
</tr>
<tr>
<td>4</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-GMD.A</td>
</tr>
<tr>
<td>5</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-CO.B</td>
</tr>
<tr>
<td>6</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-CO.C</td>
</tr>
<tr>
<td>7</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-GMD.A</td>
</tr>
<tr>
<td>8</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-CO.A</td>
</tr>
<tr>
<td>9</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-SRT.C</td>
</tr>
<tr>
<td>10</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-SRT.A</td>
</tr>
<tr>
<td>11</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-CO.A</td>
</tr>
<tr>
<td>12</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-C.B</td>
</tr>
<tr>
<td>13</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-SRT.B</td>
</tr>
<tr>
<td>14</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-MG.A</td>
</tr>
<tr>
<td>15</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-GPE.B</td>
</tr>
<tr>
<td>16</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-SRT.C</td>
</tr>
<tr>
<td>17</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-GPE.A</td>
</tr>
<tr>
<td>18</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-GPE.B</td>
</tr>
<tr>
<td>19</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-MG.A</td>
</tr>
<tr>
<td>20</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-SRT.B</td>
</tr>
<tr>
<td>21</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-C.B</td>
</tr>
<tr>
<td>22</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-SRT.B</td>
</tr>
<tr>
<td>23</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-MG.A</td>
</tr>
<tr>
<td>24</td>
<td>Multiple Choice</td>
<td>2</td>
<td>G-SRT.B</td>
</tr>
<tr>
<td>25</td>
<td>Constructed Response</td>
<td>2</td>
<td>G-CO.B</td>
</tr>
<tr>
<td>26</td>
<td>Constructed Response</td>
<td>2</td>
<td>G-C.B</td>
</tr>
<tr>
<td>27</td>
<td>Constructed Response</td>
<td>2</td>
<td>G-GPE.B</td>
</tr>
<tr>
<td>28</td>
<td>Constructed Response</td>
<td>2</td>
<td>G-CO.B</td>
</tr>
<tr>
<td>29</td>
<td>Constructed Response</td>
<td>2</td>
<td>G-SRT.C</td>
</tr>
<tr>
<td>30</td>
<td>Constructed Response</td>
<td>2</td>
<td>G-MG.A</td>
</tr>
<tr>
<td>31</td>
<td>Constructed Response</td>
<td>2</td>
<td>G-SRT.A</td>
</tr>
<tr>
<td>32</td>
<td>Constructed Response</td>
<td>4</td>
<td>G-SRT.C</td>
</tr>
<tr>
<td>33</td>
<td>Constructed Response</td>
<td>4</td>
<td>G-CO.C</td>
</tr>
<tr>
<td>34</td>
<td>Constructed Response</td>
<td>4</td>
<td>G-CO.D</td>
</tr>
<tr>
<td>35</td>
<td>Constructed Response</td>
<td>6</td>
<td>G-CO.C</td>
</tr>
<tr>
<td>36</td>
<td>Constructed Response</td>
<td>6</td>
<td>G-SRT.C</td>
</tr>
</tbody>
</table>
Regents Examination in Geometry (Common Core)
January 2016
Chart for Converting Total Test Raw Scores to Final Examination Scores (Scale Scores)

The Chart for Determining the Final Examination Score for the January 2016 Regents Examination in Geometry (Common Core) will be posted on the Department’s web site at: http://www.p12.nysed.gov/assessment/ on Thursday, January 28, 2016. Conversion charts provided for previous administrations of the Regents Examination in Geometry (Common Core) 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:


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 (COMMON CORE)

Thursday, January 28, 2016 — 9:15 a.m. to 12:15 p.m.

MODEL RESPONSE SET

Table of Contents

Question 25 . . . . . . . . . . . . . . . . . . . . . 2
Question 26 . . . . . . . . . . . . . . . . . . . . . . 8
Question 27 . . . . . . . . . . . . . . . . . . . . . . 15
Question 28 . . . . . . . . . . . . . . . . . . . . . . 21
Question 29 . . . . . . . . . . . . . . . . . . . . . . 26
Question 30 . . . . . . . . . . . . . . . . . . . . . . 31
Question 31 . . . . . . . . . . . . . . . . . . . . . . 34
Question 32 . . . . . . . . . . . . . . . . . . . . . . 39
Question 33 . . . . . . . . . . . . . . . . . . . . . . 48
Question 34 . . . . . . . . . . . . . . . . . . . . . . 55
Question 35 . . . . . . . . . . . . . . . . . . . . . . 62
Question 36 . . . . . . . . . . . . . . . . . . . . . . 72
25 Triangle $ABC$ is graphed on the set of axes below. Graph and label $\triangle A'B'C'$, the image of $\triangle ABC$ after a reflection over the line $x = 1$.

**Score 2:** The student has a complete and correct response.
Triangle $ABC$ is graphed on the set of axes below. Graph and label $\triangle A'B'C'$, the image of $\triangle ABC$ after a reflection over the line $x = 1$.

$A' (5, 0)$
$B' (2, 4)$
$C' (2, 0)$

Score 2: The student graphed the image of $\triangle ABC$ correctly, then stated and labeled its coordinates.
25 Triangle $ABC$ is graphed on the set of axes below. Graph and label $\triangle A'B'C'$, the image of $\triangle ABC$ after a reflection over the line $x = 1$.

Score 1: The student did a reflection over the line $x = \frac{1}{2}$. 
Triangle $ABC$ is graphed on the set of axes below. Graph and label $\triangle A'B'C'$, the image of $\triangle ABC$ after a reflection over the line $x = 1$.

**Score 1:** The student labeled $\triangle A'B'C'$ incorrectly.
25 Triangle $ABC$ is graphed on the set of axes below. Graph and label $\triangle A'B'C'$, the image of $\triangle ABC$ after a reflection over the line $x = 1$.

Score 1: The student stated and labeled the correct coordinates for $A'$, $B'$, and $C'$. 
25 Triangle $ABC$ is graphed on the set of axes below. Graph and label $\triangle A'B'C'$, the image of $\triangle ABC$ after a reflection over the line $x = 1$.

Score 0: The student graphed the image of $A$ incorrectly, and labeled the triangle incorrectly.
26 In the diagram below of circle $O$ with diameter $BC$ and radius $OA$, chord $DC$ is parallel to chord $BA$.

If $m\angle BCD = 30^\circ$, determine and state $m\angle AOB$.

\[
\begin{align*}
\text{m} \angle AOB &= 120 \\
\text{m} \angle AOB &= 180 - \frac{30 \times 60}{60} = 120
\end{align*}
\]

Score 2: The student has a complete and correct response.
26 In the diagram below of circle $O$ with diameter $BC$ and radius $OA$, chord $DC$ is parallel to chord $BA$.

If $m\angle BCD = 30^\circ$, determine and state $m\angle AOB$.

$m\angle AOB = 120$°

Score 2: The student has a complete and correct response.
26 In the diagram below of circle $O$ with diameter $\overline{BC}$ and radius $\overline{OA}$, chord $\overline{DC}$ is parallel to chord $\overline{BA}$.

If $m \angle BCD = 30^\circ$, determine and state $m \angle AOB$.  

\[ \frac{120}{360} = \frac{x}{2\pi} \]

\[ \frac{240 \pi}{360} = \frac{360x}{360} \]

\[ \frac{240 \pi}{360} = x \]

\[ x = \frac{2\pi}{3} \]

\[ \angle AOB = \frac{2\pi}{3} \text{ radians} \]

**Score 2:** The student has a complete and correct response.
26 In the diagram below of circle O with diameter BC and radius OA, chord DC is parallel to chord BA.

If m∠BCD = 30°, determine and state m∠AOB.

Score 1: The student labeled the arcs correctly, but did not find the angle.
26 In the diagram below of circle $O$ with diameter $BC$ and radius $OA$, chord $DC$ is parallel to chord $BA$.

If $m\angle BCD = 30^\circ$, determine and state $m\angle AOB$.

Score 1: The student labeled the angles and arcs correctly, but did not find $m\angle AOB$. 
26 In the diagram below of circle $O$ with diameter $BC$ and radius $OA$, chord $DC$ is parallel to chord $BA$.

If $m\angle BCD = 30^\circ$, determine and state $m\angle AOB$.

**Score 1:** The student marked off equal radii, but showed no work to find the angle.
26 In the diagram below of circle $O$ with diameter $BC$ and radius $OA$, chord $DC$ is parallel to chord $BA$.

If $m\angle BCD = 30^\circ$, determine and state $m\angle AOB$. 

\[ \angle BCD = 30^\circ \]

\[ 180 - 30 = 150 \]

\[ \angle AOB = 150^\circ \]

Score 0: The student had a completely incorrect response.
27 Directed line segment PT has endpoints whose coordinates are P(−2, 1) and T(4, 7). Determine the coordinates of point J that divides the segment in the ratio 2 to 1.

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

Score 2: The student has a complete and correct response.
27 Directed line segment $PT$ has endpoints whose coordinates are $P(-2,1)$ and $T(4,7)$. Determine the coordinates of point $J$ that divides the segment in the ratio 2 to 1.

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

\[ J = \left( \frac{2}{3} \left( 4 - (-2) \right) - 2, \frac{2}{3} \left( 7 - 1 \right) + 1 \right) \]

\[ = \left( \frac{2}{3} \cdot 6 - 2, \frac{2}{3} \cdot 6 + 1 \right) \]

\[ = \left( 4 - 2, 4 + 1 \right) \]

\[ = \left( 2, 5 \right) \]

Score 2: The student has a complete and correct response.
27 Directed line segment $PT$ has endpoints whose coordinates are $P(-2,1)$ and $T(4,7)$. Determine the coordinates of point $J$ that divides the segment in the ratio 2 to 1.

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

\[ D = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2} \]
\[ D = \sqrt{(-2-4)^2 + (1-7)^2} \]
\[ D = \sqrt{(-6)^2 + (-6)^2} \]
\[ D = \sqrt{36 + 36} \]
\[ D = \sqrt{72} \]

Score 1: The student graphed $PJ:JT = 1:2$ instead of $PJ:JT = 2:1$. Unnecessary correct work was shown.
27 Directed line segment $PT$ has endpoints whose coordinates are $P(-2,1)$ and $T(4,7)$. Determine the coordinates of point $J$ that divides the segment in the ratio 2 to 1.

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

Score 1: The student located point $J$ graphically, but did not state its coordinates.
27 Directed line segment $PT$ has endpoints whose coordinates are $P(-2,1)$ and $T(4,7)$. Determine the coordinates of point $J$ that divides the segment in the ratio 2 to 1.

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

$$\frac{PJ}{PT} = \frac{2}{3}$$

$$\rho(\frac{2}{3}, \frac{1}{3})$$

$$J = \left(\frac{-2}{2+4}, \frac{-4}{2+4}\right) = \left(-\frac{1}{3}, \frac{2}{3}\right)$$

Score 1: The student did not write the solution as coordinates.
27 Directed line segment $PT$ has endpoints whose coordinates are $P(-2,1)$ and $T(4,7)$. Determine the coordinates of point $J$ that divides the segment in the ratio 2 to 1.

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

Score 0: The student only graphed $PT$. 
28 As graphed on the set of axes below, $\triangle A'B'C'$ is the image of $\triangle ABC$ after a sequence of transformations.

Is $\triangle A'B'C'$ congruent to $\triangle ABC$? Use the properties of rigid motion to explain your answer.

Yes.

$\triangle ABC$ is reflected over the y-axis and then translated down 3. These are rigid motions and in rigid motions distance stays the same.

Score 2: The student has a complete and correct response.
28 As graphed on the set of axes below, ΔA′B′C′ is the image of ΔABC after a sequence of transformations.

ΔABC
↓
Reflection over y axis
↓
Translate (0, -3)

Is ΔA′B′C′ congruent to ΔABC? Use the properties of rigid motion to explain your answer.

ΔA′B′C′ is congruent to ΔABC because ΔABC reflected across the y-axis then translates by (0, -3). This is considered to be an isometry because the size stays the same.

Score 2: The student has a complete and correct response.
28 As graphed on the set of axes below, \( \triangle A'B'C' \) is the image of \( \triangle ABC \) after a sequence of transformations.

Is \( \triangle A'B'C' \) congruent to \( \triangle ABC \)? Use the properties of rigid motion to explain your answer.

Yes because no dilation or change was done to the shape, it was reflected over the y-axis and then translated \((0, -3)\).

**Score 1:** The student correctly described the transformation, but the explanation was not complete for congruence.
28 As graphed on the set of axes below, ΔA'B'C' is the image of ΔABC after a sequence of transformations.

Is ΔA'B'C' congruent to ΔABC? Use the properties of rigid motion to explain your answer.

\[ AB = A'B' \]
\[ BC = B'C' \]
\[ AC = A'C' \]

\[ \cong \text{ by SSS} \]

**Score 1:** The student wrote an appropriate explanation about congruency, but not based on rigid motions.
28 As graphed on the set of axes below, $\triangle A'B'C'$ is the image of $\triangle ABC$ after a sequence of transformations.

Is $\triangle A'B'C'$ congruent to $\triangle ABC$? Use the properties of rigid motion to explain your answer.

Yes, because triangles are congruent.

Score 0: The student had no correct explanation.
29 A carpenter leans an extension ladder against a house to reach the bottom of a window 30 feet above the ground. As shown in the diagram below, the ladder makes a 70° angle with the ground. To the nearest foot, determine and state the length of the ladder.

\[ x \cdot \sin 70 = \frac{30}{\sin 70} \cdot x \]

\[ x \cdot \frac{30}{\sin 70} = \frac{30}{\sin 70} \cdot x \]

\[ x = \frac{30}{\sin 70} \]

\[ x \approx 32 \text{ ft} \]

The length of the ladder is 32 feet.

Score 2: The student has a complete and correct response.
29 A carpenter leans an extension ladder against a house to reach the bottom of a window 30 feet above the ground. As shown in the diagram below, the ladder makes a $70^\circ$ angle with the ground. To the nearest foot, determine and state the length of the ladder.

$$30^2 + 10.91^2 = c^2$$
$$900 + 119.0281 = c^2$$
$$c = \sqrt{1019.0281} = 31.922$$

Length of the ladder = 32 ft

$$\tan 70^\circ = \frac{30}{y}$$
$$30 = \frac{2.75y}{2.75}$$
$$y = 10.91$$

**Score 2:** The student has a complete and correct response.
29 A carpenter leans an extension ladder against a house to reach the bottom of a window 30 feet above the ground. As shown in the diagram below, the ladder makes a 70° angle with the ground. To the nearest foot, determine and state the length of the ladder.

![Diagram of a ladder and a window]

\[
\cos 20^\circ = \frac{30}{x}
\]

\[x \cos 20^\circ = 30\]

Score 1: The student wrote a correct trigonometric equation, but no further correct work was shown.
29 A carpenter leans an extension ladder against a house to reach the bottom of a window 30 feet above the ground. As shown in the diagram below, the ladder makes a 70° angle with the ground. To the nearest foot, determine and state the length of the ladder.

\[ \sin 70 = \frac{X}{30} \]

\[ 30 \sin 70 = X \]

\[ 28.19 \ldots = X \]

\[ 28 \text{ feet} \]

**Score 1:** The student wrote an incorrect trigonometric equation.
29 A carpenter leans an extension ladder against a house to reach the bottom of a window 30 feet above the ground. As shown in the diagram below, the ladder makes a 70° angle with the ground. To the nearest foot, determine and state the length of the ladder.

\[ \tan 70^\circ = \frac{30}{x} \]

\[ x = \tan(70)^\circ \times 30 \approx 37 \text{ feet} \]

**Score 0:** The student’s work was completely incorrect.
30 During an experiment, the same type of bacteria is grown in two petri dishes. Petri dish $A$ has a diameter of 51 mm and has approximately 40,000 bacteria after 1 hour. Petri dish $B$ has a diameter of 75 mm and has approximately 72,000 bacteria after 1 hour.

Determine and state which petri dish has the greater population density of bacteria at the end of the first hour.

$$A^0 = \pi r^2$$
$$A = \pi \cdot 25.5^2$$
$$A = 2042.820623$$

$$A^B = \pi \cdot 37.5^2$$
$$A = 4417.864669172000$$

Score 2: The student has a complete and correct response.
During an experiment, the same type of bacteria is grown in two petri dishes. Petri dish A has a diameter of 51 mm and has approximately 40,000 bacteria after 1 hour. Petri dish B has a diameter of 75 mm and has approximately 72,000 bacteria after 1 hour.

Determine and state which petri dish has the greater population density of bacteria at the end of the first hour.

\[
\frac{51}{40,000} = \frac{x}{1} \\
51x = 40,000 \\
x = \frac{40,000}{51} \\
x = \frac{784.31}{78} \\
x = 9.80
\]

Petri dish B had the greater population density at the end of the first hour.

Score 1: The student calculated density based on the diameter of the petri dish and chose an appropriate dish.
During an experiment, the same type of bacteria is grown in two petri dishes. Petri dish A has a diameter of 51 mm and has approximately 40,000 bacteria after 1 hour. Petri dish B has a diameter of 75 mm and has approximately 72,000 bacteria after 1 hour.

Determine and state which petri dish has the greater population density of bacteria at the end of the first hour.

\[ A = \pi r^2 \]
\[ A = \pi (25.5)^2 \]
\[ A = 650.25\pi \]

\[ B = \pi r^2 \]
\[ B = \pi (37.5)^2 \]
\[ B = 1406.25\pi \]

Petri dish B has a greater population density.

Score 0: The student found the area of both petri dishes, but did not calculate a density to compare them.
31 Line \( \ell \) is mapped onto line \( m \) by a dilation centered at the origin with a scale factor of 2. The equation of line \( \ell \) is \( 3x - y = 4 \). Determine and state an equation for line \( m \).

\[
\begin{align*}
3x - y &= 4 \\
\Rightarrow 3x &= y + 4 \\
\Rightarrow y &= 3x - 4
\end{align*}
\]

Score 2: The student has a complete and correct response.
31 Line $\ell$ is mapped onto line $m$ by a dilation centered at the origin with a scale factor of 2. The equation of line $\ell$ is $3x - y = 4$. Determine and state an equation for line $m$.

\[
\begin{align*}
  (2, 2) &\rightarrow (4, 4) \\
  (3, 5) &\rightarrow (6, 10) \\
  m &= \frac{10 - 4}{6 - 4} = \frac{6}{2} = 3 \\
  y &= 3x + b \\
  10 &= 3(6) + b \\
  10 &= 18 + b \\
  &-8 = b \\
  y &= 3x - 8
\end{align*}
\]

**Score 2:** The student has a complete and correct response.
31 Line \( \ell \) is mapped onto line \( m \) by a dilation centered at the origin with a scale factor of 2. The equation of line \( \ell \) is \( 3x - y = 4 \). Determine and state an equation for line \( m \).

\[
\begin{align*}
3x - y &= 4 \\
-1y &= -3x + 4 \\
\frac{-1y}{-1} &= \frac{-3x}{-1} + \frac{4}{-1} \\
y &= 3x - 4 \\
y &= 6x - 8
\end{align*}
\]

**Score 1:** The student multiplied both the slope and \( y \)-intercept by a scale factor of 2.
31 Line ℓ is mapped onto line m by a dilation centered at the origin with a scale factor of 2. The equation of line ℓ is $3x - y = 4$. Determine and state an equation for line m.

\[
\begin{align*}
3x - y &= 4 \\
-3x &= -3x \\
\underline{-3x} &= \underline{-3x + 4} \\
-1 &= -1 \\
\underline{-1} &= \underline{-1} \\
y &= \frac{3}{1}x - 4
\end{align*}
\]

Score 0: The student found an equation for $m \perp ℓ$, which is not relevant to the problem.
31 Line $\ell$ is mapped onto line $m$ by a dilation centered at the origin with a scale factor of 2. The equation of line $\ell$ is $3x - y = 4$. Determine and state an equation for line $m$.

\[
\begin{align*}
2x - y &= 4 \\
-3x &= -3x \\
\frac{-y}{-1} &= \frac{-3x + 4}{-1} \\
y &= 3x - 4
\end{align*}
\]

Score 0: The student solved the given equation for $y$, but made no attempt to do a dilation.
32 The aspect ratio (the ratio of screen width to height) of a rectangular flat-screen television is 16:9. The length of the diagonal of the screen is the television's screen size. Determine and state, to the nearest inch, the screen size (diagonal) of this flat-screen television with a screen height of 20.6 inches.

\[ \frac{16}{9} = \frac{x}{20.6} \]

\[ \frac{16 \times 20.6}{9} = x \]

\[ x = 36.6 \]

\[ a^2 + b^2 = c^2 \]

\[ 36.6^2 + 20.6^2 = c^2 \]

\[ 1334.56 + 424.36 = c^2 \]

\[ 1758.92 = c^2 \]

\[ c = \sqrt{1758.92} \approx 42 \]

42 inch

Score 4: The student has complete and correct work.
32 The aspect ratio (the ratio of screen width to height) of a rectangular flat-screen television is 16:9. The length of the diagonal of the screen is the television’s screen size. Determine and state, to the nearest inch, the screen size (diagonal) of this flat-screen television with a screen height of 20.6 inches.

\[ 20.6^2 + 36.6^2 = x^2 \]

\[ x = 42 \]

**Score 3:** The student showed no work to find the width, but used the Pythagorean Theorem to find the screen size.
Question 32

32 The aspect ratio (the ratio of screen width to height) of a rectangular flat-screen television is 16:9. The length of the diagonal of the screen is the television’s screen size. Determine and state, to the nearest inch, the screen size (diagonal) of this flat-screen television with a screen height of 20.6 inches.

\[
\frac{q_x}{q} = \frac{20.6}{q} \\
x = 2.3
\]

\[
x \approx 42 \text{ inches}
\]

Score 3: The student showed correct work to find the width, but no work to find 42.
32 The aspect ratio (the ratio of screen width to height) of a rectangular flat-screen television is 16:9. The length of the diagonal of the screen is the television's screen size. Determine and state, to the nearest inch, the screen size (diagonal) of this flat-screen television with a screen height of 20.6 inches.

\[ a^2 + b^2 = c^2 \]
\[ 16^2 + 9^2 = c^2 \]
\[ 256 + 81 = c^2 \]
\[ 337 = c^2 \]
\[ 18.4 = c \]

**Score 2:** The student used the aspect ratio to find the diagonal, but did not find the screen size.
32 The aspect ratio (the ratio of screen width to height) of a rectangular flat-screen television is 16:9. The length of the diagonal of the screen is the television’s screen size. Determine and state, to the nearest inch, the screen size (diagonal) of this flat-screen television with a screen height of 20.6 inches.

\[ 27.6^2 + 20.6^2 = x^2 \]
\[ 710.76 + 424.36 = x^2 \]
\[ 1135.12 = x^2 \]
\[ x = 34 \text{ in} \]

(screen size is 34 in)

Score 2: The student made a conceptual error in finding the width, but found an appropriate screen size.
32 The aspect ratio (the ratio of screen width to height) of a rectangular flat-screen television is 16:9. The length of the diagonal of the screen is the television's screen size. Determine and state, to the nearest inch, the screen size (diagonal) of this flat-screen television with a screen height of 20.6 inches.

\[ \frac{9x}{16} = 20.6 \]
\[ 16 \cdot x = 36.6 \]
\[ x = 2.3 \]
\[ a^2 + b^2 = c^2 \]
\[ 20.6^2 + 36.6^2 = 49.1990123 \]
\[ c = \sqrt{49.1990123} \approx 20.7 \]

Diagonal \( \approx \) 21 in

**Score 2:** The student showed correct work to find the width, but no further correct work was shown.
32 The aspect ratio (the ratio of screen width to height) of a rectangular flat-screen television is 16:9. The length of the diagonal of the screen is the television’s screen size. Determine and state, to the nearest inch, the screen size (diagonal) of this flat-screen television with a screen height of 20.6 inches.

\[ \text{Height} : \text{Width} = 9 : 16 \]

\[ 20.6 \times \frac{16}{9} = 36.6 \]

\[ x = 5.2 \text{ inches} \]

Score 2: The student stated a correct width and screen size, but did not show work.
32 The aspect ratio (the ratio of screen width to height) of a rectangular flat-screen television is 16:9. The length of the diagonal of the screen is the television’s screen size. Determine and state, to the nearest inch, the screen size (diagonal) of this flat-screen television with a screen height of 20.6 inches.

\[20.6^2 + 36.8^2 = x^2\]

\[\sqrt{1778.6} = \sqrt{x^2}\]

\[y = 2.3\]

**Score 1:** The student showed no work to find an incorrect width, but used it appropriately to find the screen size. The screen size was not stated to the nearest inch.
32. The aspect ratio (the ratio of screen width to height) of a rectangular flat-screen television is 16:9. The length of the diagonal of the screen is the television's screen size. Determine and state, to the nearest inch, the screen size (diagonal) of this flat-screen television with a screen height of 20.6 inches.

\[ \frac{a^2 + b^2}{c^2} = \frac{16}{9} \]
\[ a^2 + 16.25 = c^2 \]
\[ 14.25e = 400 \]
\[ 3.37 \approx 400 \]
\[ -3.37 \approx -3.37 \]

**Score 0:** The student had no correct work.
33 Given the theorem, “The sum of the measures of the interior angles of a triangle is $180^\circ$,” complete the proof for this theorem.

![Diagram of triangle ABC with points A, B, C, D, and E]

Given: $\triangle ABC$

Prove: $m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ$

Fill in the missing reasons below.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) $\triangle ABC$</td>
<td>(1) Given</td>
</tr>
<tr>
<td>(2) Through point C, draw $\overline{DCE}$ parallel to $\overline{AB}$.</td>
<td>(2) To a given line there is only one parallel line that can be drawn through a given point not on the line.</td>
</tr>
<tr>
<td>(3) $m\angle 1 = m\angle ACD$, $m\angle 3 = m\angle BCE$</td>
<td>(3) When two $\parallel$ lines are cut by a transversal alternate interior $\angle$s are $\cong$.</td>
</tr>
<tr>
<td>$m\angle ACD + m\angle 2 + m\angle BCE = 180^\circ$</td>
<td>(4) The sum of the angles on one side of a line is equal to $180^\circ$.</td>
</tr>
<tr>
<td>(5) $m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ$</td>
<td>(5) Substitution</td>
</tr>
</tbody>
</table>

**Score 4:** The student has a complete and correct response.
33 Given the theorem, “The sum of the measures of the interior angles of a triangle is $180^\circ$,” complete the proof for this theorem.

Given: $\triangle ABC$

Prove: $m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ$

Fill in the missing reasons below.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) $\triangle ABC$</td>
<td>(1) Given</td>
</tr>
<tr>
<td>(2) Through point C, draw $\overline{DCE}$ parallel to $\overline{AB}$.</td>
<td>(2) Euclid’s Parallel Postulate</td>
</tr>
<tr>
<td>(3) $m\angle 1 = m\angle ACD$, $m\angle 3 = m\angle BCE$</td>
<td>(3) If $\parallel$ lines, then alternate interior $\angle$s of (2).</td>
</tr>
<tr>
<td>(4) $m\angle ACD + m\angle 2 + m\angle BCE = 180^\circ$</td>
<td>(4) If 3 $\angle$s form a line, then they are supplementary.</td>
</tr>
<tr>
<td>(5) $m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ$</td>
<td>(5) Substitution Property (3,4)</td>
</tr>
</tbody>
</table>

Score 3: The student had three correct reasons.
33 Given the theorem, “The sum of the measures of the interior angles of a triangle is 180°,” complete the proof for this theorem.

![Diagram of a triangle ABC with angles 1, 2, and 3, and line DE parallel to AB.]

Given: $\triangle ABC$

Prove: $m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ$

Fill in the missing reasons below.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) $\triangle ABC$</td>
<td>(1) Given</td>
</tr>
<tr>
<td>(2) Through point C, draw $\overline{DC}$ parallel to $AB$.</td>
<td>(2) An auxiliary line can be drawn</td>
</tr>
<tr>
<td>(3) $m\angle 1 = m\angle ACD$, $m\angle 3 = m\angle BCE$</td>
<td>(3) If lines are parallel, alternate angles are congruent</td>
</tr>
<tr>
<td>(4) $m\angle ACD + m\angle 2 + m\angle BCE = 180^\circ$</td>
<td>(4) If angles form a straight line, it equals $180^\circ$</td>
</tr>
<tr>
<td>(5) $m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ$</td>
<td>(5) Sum of angles in a triangle equals $180^\circ$</td>
</tr>
</tbody>
</table>

**Score 3:** The student had three correct reasons.
Question 33

33 Given the theorem, “The sum of the measures of the interior angles of a triangle is 180°,” complete the proof for this theorem.

![Diagram of triangle ABC with angles 1, 2, and 3 labeled]

Given: \( \triangle ABC \)

Prove: \( m\angle 1 + m\angle 2 + m\angle 3 = 180° \)

Fill in the missing reasons below.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) ( \triangle ABC )</td>
<td>(1) Given</td>
</tr>
<tr>
<td>(2) Through point C, draw ( \overline{DCE} ) parallel to ( AB )</td>
<td>(2) Draw parallel lines</td>
</tr>
<tr>
<td>(3) ( m\angle 1 = m\angle ACD ), ( m\angle 3 = m\angle BCE )</td>
<td>(3) Opposite interior angles are congruent</td>
</tr>
<tr>
<td>(4) ( m\angle ACD + m\angle 2 + m\angle BCE = 180° )</td>
<td>(4) ( \triangle BCE ) is straight, therefore ( = 180° )</td>
</tr>
<tr>
<td>(5) ( m\angle 1 + m\angle 2 + m\angle 3 = 180° )</td>
<td>(5) Substitution property</td>
</tr>
</tbody>
</table>

Score 2: The student had two correct reasons.
33 Given the theorem, “The sum of the measures of the interior angles of a triangle is 180°,” complete the proof for this theorem.

![Diagram of a triangle with points A, B, C, D, and E]

Given: \( \triangle ABC \)

Prove: \( m\angle 1 + m\angle 2 + m\angle 3 = 180° \)

Fill in the missing reasons below.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) ( \triangle ABC )</td>
<td>(1) Given</td>
</tr>
<tr>
<td>(2) Through point ( C ), draw ( \overline{DCE} ) parallel to ( AB )</td>
<td>(2) A line can be drawn ( \parallel ) to a given line through a point not on the line.</td>
</tr>
<tr>
<td>(3) ( m\angle 1 = m\angle ACD ), ( m\angle 3 = m\angle BCE )</td>
<td>(3) If lines ( \parallel ) Alternate interior ( \angle )s are ( \cong )</td>
</tr>
<tr>
<td>(4) ( m\angle ACD + m\angle 2 + m\angle BCE = 180° )</td>
<td>(4) <strong>Addition Property</strong></td>
</tr>
<tr>
<td>(5) ( m\angle 1 + m\angle 2 + m\angle 3 = 180° )</td>
<td>(5) <strong>Transitive Property</strong></td>
</tr>
</tbody>
</table>

**Score 2:** The student had two correct reasons.
33 Given the theorem, “The sum of the measures of the interior angles of a triangle is 180°,” complete the proof for this theorem.

![Diagram of triangle ABC with angles 1, 2, and 3 labeled.]

Given: \( \triangle ABC \)

Prove: \( m\angle 1 + m\angle 2 + m\angle 3 = 180° \)

Fill in the missing reasons below.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) ( \triangle ABC )</td>
<td>(1) Given</td>
</tr>
<tr>
<td>(2) Through point C, draw ( \overline{DCE} ) parallel to ( AB ).</td>
<td>(2) <strong>2 parallel lines intersected</strong> by a transversal</td>
</tr>
<tr>
<td>(3) ( m\angle 1 = m\angle ACD ), ( m\angle 3 = m\angle BCE )</td>
<td>(3) Alt. int. angles theorem</td>
</tr>
<tr>
<td>(4) ( m\angle ACD + m\angle 2 + m\angle BCE = 180° )</td>
<td>(4) Sum of the parts = the whole</td>
</tr>
<tr>
<td>(5) ( m\angle 1 + m\angle 2 + m\angle 3 = 180° )</td>
<td>(5) Substitution</td>
</tr>
</tbody>
</table>

**Score 1:** The student had one correct reason.
33 Given the theorem, “The sum of the measures of the interior angles of a triangle is 180°,” complete the proof for this theorem.

![Diagram of triangle ABC with angles 1, 2, and 3]

Given: \( \triangle ABC \)

Prove: \( m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ \)

Fill in the missing reasons below.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) ( \triangle ABC )</td>
<td>(1) Given</td>
</tr>
<tr>
<td>(2) Through point ( C ), draw ( \overline{DCE} ) parallel to ( AB ).</td>
<td>(2) A line that one transversal and ( AB ) parallel</td>
</tr>
<tr>
<td>(3) ( m\angle 1 = m\angle ACD ), ( m\angle 3 = m\angle BCE )</td>
<td>(3) Interior angles ( \angle ) parallel by ( \angle ) transversal ( \angle ) congruent</td>
</tr>
<tr>
<td>(4) ( m\angle ACD + m\angle 2 + m\angle BCE = 180^\circ )</td>
<td>(4) Addition postulate</td>
</tr>
<tr>
<td>(5) ( m\angle 1 + m\angle 2 + m\angle 3 = 180^\circ )</td>
<td>(5) 2 parallel lines cut by ( \angle ) transversal ( \angle ) make ( \angle ) congruent</td>
</tr>
</tbody>
</table>

**Score 0:** The student had no correct reasons.
34 Triangle $XYZ$ is shown below. Using a compass and straightedge, on the line below, construct and label $\triangle ABC$, such that $\triangle ABC \cong \triangle XYZ$. [Leave all construction marks.]

Based on your construction, state the theorem that justifies why $\triangle ABC$ is congruent to $\triangle XYZ$.

Score 4: The student has a complete and correct response.
34 Triangle \( \triangle XYZ \) is shown below. Using a compass and straightedge, on the line below, construct and label \( \triangle ABC \), such that \( \triangle ABC \cong \triangle XYZ \). [Leave all construction marks.]

Based on your construction, state the theorem that justifies why \( \triangle ABC \) is congruent to \( \triangle XYZ \).

**Score 4:** The student has a complete and correct response.
34 Triangle XYZ is shown below. Using a compass and straightedge, on the line below, construct and label $\triangle ABC$, such that $\triangle ABC \cong \triangle XYZ$. [Leave all construction marks.]

Based on your construction, state the theorem that justifies why $\triangle ABC$ is congruent to $\triangle XYZ$.

Score 3: The student showed a correct construction, but stated an incorrect theorem.
34 Triangle \( XYZ \) is shown below. Using a compass and straightedge, on the line below, construct and label \( \triangle ABC \), such that \( \triangle ABC \cong \triangle XYZ \). [Leave all construction marks.]

Based on your construction, state the theorem that justifies why \( \triangle ABC \) is congruent to \( \triangle XYZ \).

\[
\text{Score 2: } \quad \text{The student had an appropriate construction of a congruent triangle, but the triangle was not labeled correctly and no theorem was stated.}
\]
34 Triangle $XYZ$ is shown below. Using a compass and straightedge, on the line below, construct and label $\triangle ABC$, such that $\triangle ABC \cong \triangle XYZ$. [Leave all construction marks.]

Based on your construction, state the theorem that justifies why $\triangle ABC$ is congruent to $\triangle XYZ$.

**Score 1:** The student made a drawing that was not a construction, but stated an appropriate theorem.
34 Triangle $XYZ$ is shown below. Using a compass and straightedge, on the line below, construct and label $\triangle ABC$, such that $\triangle ABC \cong \triangle XYZ$. [Leave all construction marks.]

Based on your construction, state the theorem that justifies why $\triangle ABC$ is congruent to $\triangle XYZ$.

Score 1: The student made correct construction marks, but showed no further work.
34 Triangle $XYZ$ is shown below. Using a compass and straightedge, on the line below, construct and label $\triangle ABC$, such that $\triangle ABC \cong \triangle XYZ$. [Leave all construction marks.]

Based on your construction, state the theorem that justifies why $\triangle ABC$ is congruent to $\triangle XYZ$.

$\triangle ABC \cong \triangle XYZ$ because they have the same exact arc.

Score 0: The student’s work was completely incorrect.
35 Given: Parallelogram \( \text{ANDR} \) with \( \overline{AW} \) and \( \overline{DE} \) bisecting \( \overline{NWD} \) and \( \overline{REA} \) at points \( W \) and \( E \), respectively.

Prove that \( \triangle ANW \cong \triangle DRE \).

Prove that quadrilateral \( \text{AWDE} \) is a parallelogram.

### Statements
1. Parallelogram \( \text{ANDR} \) with \( \overline{AW} \) and \( \overline{DE} \) bisecting \( \overline{NWD} \) and \( \overline{REA} \) at points \( W \) and \( E \), respectively.
2. \( \overline{AE} \cong \overline{RE} \), \( \overline{DW} \cong \overline{NW} \)
3. \( \overline{RA} \cong \overline{DN} \), \( \overline{RD} \cong \overline{NA} \)
4. \( \overline{RE} \cong \overline{NW} \)
5. \( \overline{WR} \cong \overline{EN} \)
6. \( \triangle DRE \cong \triangle ANW \)
7. \( \overline{CD} \cong \overline{WA} \)
8. \( \overline{AE} \cong \overline{DW} \)
9. Quadr. \( \text{AWDE} \) is a parallelogram.

### Reasons
1. Given
2. A segment bisector cuts a segment into two \( \cong \) parts
3. In a parallelogram, opposite sides are \( \cong \)
4. Halves of \( \cong \) segments are \( \cong \)
5. In a parallelogram, opposite angles are \( \cong \)
6. \( \text{SAS} \cong \text{SAS} \)
7. \( \text{CPCFC} \)
8. Halves of \( \cong \) segments are \( \cong \)
9. If both pairs of opposite sides are \( \cong \), the quad is a parallelogram.

**Score 6:** The student has a complete and correct proof.
35 Given: Parallelogram ANDR with $\overline{AW}$ and $\overline{DE}$ bisecting $\overline{NWD}$ and $\overline{REA}$ at points W and E, respectively

Prove that $\triangle ANW \cong \triangle DRE$.

Prove that quadrilateral AWDE is a parallelogram.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. $\square ANDR$ $\overline{AW}$ bisects $\overline{NWD}$ $\overline{DE}$ bisects $\overline{REA}$</td>
<td>1. given</td>
</tr>
<tr>
<td>2. $\overline{AN} \cong \overline{DB}$, $\overline{AE} \cong \overline{DN}$</td>
<td>2. opp. sides of a $\square$ are $\cong$</td>
</tr>
<tr>
<td>3. $\overline{AE} = \frac{1}{2}\overline{AR}$, $\overline{WO} = \frac{1}{2}\overline{DN}$</td>
<td>3. def. of bisect $+$ div. prop. of $\cong$</td>
</tr>
<tr>
<td>$\therefore \overline{AE} \cong \overline{WD}$</td>
<td>4. opp. sides of a $\square$ are $\parallel$</td>
</tr>
<tr>
<td>4. $\overline{REA} \parallel \overline{DN}$</td>
<td>5. if one pair of sides of a quad. are $\parallel$ and $\cong$, it is a $\square$</td>
</tr>
<tr>
<td>5. $\square AWDE$ is a $\square$</td>
<td>6. reason 3</td>
</tr>
<tr>
<td>6. $\overline{RE} = \frac{1}{2}\overline{AR}$, $\overline{NW} = \frac{1}{2}\overline{DN}$</td>
<td>7. reason 2</td>
</tr>
<tr>
<td>$\therefore \overline{RE} \cong \overline{NW}$</td>
<td>8. $SSS$</td>
</tr>
<tr>
<td>7. $\overline{ED} \cong \overline{AW}$</td>
<td></td>
</tr>
<tr>
<td>8. $\triangle ANW \cong \triangle DRE$</td>
<td></td>
</tr>
</tbody>
</table>

Score 6: The student has a complete and correct proof.
35 Given: Parallelogram \( \text{ANDR} \) with \( \overline{AW} \) and \( \overline{DE} \) bisecting \( \overline{NWD} \) and \( \overline{REA} \) at points \( W \) and \( E \), respectively.

Prove that \( \triangle ANW \cong \triangle DRE \).

Prove that quadrilateral \( AWDE \) is a parallelogram.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) ( \text{ANDR} ) is a ( \square ), ( \overline{AW} ) and ( \overline{DE} ) bisect ( \overline{NWD} ) and ( \overline{REA} ) at ( W ) and ( E )</td>
<td>1) given</td>
</tr>
<tr>
<td>2) ( \overline{REA} \cong \overline{NWD} )</td>
<td>2) opp sides of a ( \square ) are ( \cong )</td>
</tr>
<tr>
<td>3) ( \overline{NW} \cong \overline{WD} \cong \overline{EA} \cong \overline{ER} ) (s)</td>
<td>3) To bisect is to ( \div ) into 2 ( \cong ) parts</td>
</tr>
<tr>
<td>4) ( \overline{RD} \cong \overline{AN} )</td>
<td>4) opp. sides of a ( \square ) are ( \cong )</td>
</tr>
<tr>
<td>5) ( \angle ERO \cong \angle NAW )</td>
<td>5) opp. ( \angle )s of a ( \square ) are ( \cong )</td>
</tr>
<tr>
<td>6) ( \overline{ANW} \cong \overline{DRE} )</td>
<td>6) SAS</td>
</tr>
<tr>
<td>7) ( \overline{AW} \cong \overline{ED} )</td>
<td>7) Correspond. parts ( \cong ) ( \Delta ) is ( \cong )</td>
</tr>
<tr>
<td>8) Quadrilateral ( AWDE ) is a ( \square )</td>
<td>8) If a quadrilateral has both pairs of opp. sides ( \cong ), it is a ( \square )</td>
</tr>
</tbody>
</table>

**Score 5:** The student had one incomplete reason.
35 Given: Parallelogram ANDR with $\overline{AW}$ and $\overline{DE}$ bisecting $\overline{NWD}$ and $\overline{REA}$ at points $W$ and $E$, respectively.

Prove that $\triangle ANW \equiv \triangle DRE$.

Prove that quadrilateral AWDE is a parallelogram.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. $\overline{AW}$ and $\overline{DE}$ bisect $\overline{NWD}$ and $\overline{REA}$ at points $W$ and $E$, respectively</td>
<td>1. Given</td>
</tr>
</tbody>
</table>
| 2. $\overline{AR} \cong \overline{ND}$  
  $\overline{RD} \cong \overline{NA}$  
  $\overline{AR} \cong \overline{EN}$ | 2. EP properties            |
| 3. $E$ is the midpoint of $\overline{RN}$  
  $W$ is the midpoint of $\overline{ND}$ | 3. Definition of segment bisector  
  4. Definition of midpoint |
| 4. $\overline{AE} \cong \overline{RE}$  
  $\overline{DW} \cong \overline{NW}$ |               |
| 5. $\triangle ANW \cong \triangle DRE$ | 5. SAS                      |
| 6. $\overline{DE} \cong \overline{AW}$ | 6. CPCTC                    |
| 7. AWDE is a $\square$ | 7. In a parallelogram, both pairs of opposite sides are $\cong$ |

Score 5: The student had one missing statement and reason.
Given: Parallelogram $ANDR$ with $AW$ and $DE$ bisecting $NWD$ and $REA$ at points $W$ and $E$, respectively.

Prove that $\triangle ANW \cong \triangle DRE$.

Prove that quadrilateral $AWDE$ is a parallelogram.

**Score 4:** The student had a missing statement and reason and also an incomplete reason.
35 Given: Parallelogram ANDR with \( \overline{AW} \) and \( \overline{DE} \) bisecting \( \overline{NWD} \) and \( \overline{REA} \) at points \( W \) and \( E \), respectively

Prove that \( \triangle ANW \cong \triangle DRE \).

Prove that quadrilateral AWDE is a parallelogram.

---

Score 3: The student proved \( \triangle ANW \cong \triangle DRE \), but did no further work.
35 Given: Parallelogram \(\text{ANDR}\) with \(\overline{AW}\) and \(\overline{DE}\) bisecting \(\overline{NWD}\) and \(\overline{REA}\) at points \(W\) and \(E\), respectively.

Prove that \(\triangle ANW \cong \triangle DRE\).

Prove that quadrilateral \(\text{AWDE}\) is a parallelogram.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (\square \text{ANDR})</td>
<td>1. given</td>
</tr>
<tr>
<td>2. (\angle 1 \cong \angle 2)</td>
<td>2. opposite (\angle s) of (\square) are (\cong)</td>
</tr>
<tr>
<td>3. (\overline{AE} \cong \overline{ER}, \overline{NW} \cong \overline{WD})</td>
<td>3. def. bisector is to divide into 2 (\cong) parts</td>
</tr>
<tr>
<td>4. (\overline{AB} \cong \overline{ND}, \overline{BD} \cong \overline{AN})</td>
<td>4. opp. (\angle s) of (\square) are (\cong)</td>
</tr>
<tr>
<td>5. (\overline{ER} \cong \overline{NW})</td>
<td>5. halves of (\overline{EC}) (\cong) line segments</td>
</tr>
<tr>
<td>6. (\triangle ANW \cong \triangle DRE)</td>
<td>6. (\text{SAS})</td>
</tr>
</tbody>
</table>

**Score 2:** The student proved \(\triangle ANW \cong \triangle DRE\), but the given was incomplete and no further work was shown.
35 Given: Parallelogram ANDR with AW and DE bisecting NWD and REA at points W and E, respectively.

Prove that $\triangle ANW \cong \triangle DRE$.

Prove that quadrilateral AWDE is a parallelogram.

Score 2: The student had four statements and/or reasons missing or incorrect.
35 Given: Parallelogram $\text{ANDR}$ with $\overline{AW}$ and $\overline{DE}$ bisecting $\overline{NWD}$ and $\overline{REA}$ at points $W$ and $E$, respectively

Prove that $\triangle \text{ANW} \cong \triangle \text{DRE}$.

Prove that quadrilateral $\text{AWDE}$ is a parallelogram.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{P \overline{ANDR}}$</td>
<td>given</td>
</tr>
<tr>
<td>$\overline{AW}$ and $\overline{DE}$ bisecting $\overline{NWD}$ and $\overline{REA}$ at points $W$ and $E$ respectively</td>
<td>given</td>
</tr>
<tr>
<td>$\angle OF \cong \angle FN$</td>
<td>$\text{In a } \triangle \text{opp. angles are } \cong$</td>
</tr>
<tr>
<td>$\angle OE \cong \angle FA$</td>
<td>$\text{In a } \triangle \text{corr. angles are } \cong$</td>
</tr>
<tr>
<td>$\overline{RE} \cong \overline{WN}$</td>
<td>$\text{In a } \triangle \text{opp. sides are } \cong$</td>
</tr>
<tr>
<td>$\triangle \text{ANW} \cong \triangle \text{DRE}$</td>
<td>$\text{ASA} \cong \text{ASA}$</td>
</tr>
</tbody>
</table>

**Score 1:** The student had one correct statement and reason.
Given: Parallelogram $\text{ANDR}$ with $\overline{AW}$ and $\overline{DE}$ bisecting $\overline{NWD}$ and $\overline{REA}$ at points $W$ and $E$, respectively.

Prove that $\triangle ANW \cong \triangle DRE$.

Prove that quadrilateral $\text{AWDE}$ is a parallelogram.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. $\overline{AW}$ and $\overline{DE}$ are $\angle$ bisectors</td>
<td>0. Given</td>
</tr>
<tr>
<td>2. $\overline{AD} \cong \overline{AW}$</td>
<td>2. Reflexive property</td>
</tr>
<tr>
<td>3. $\overline{DE} \cong \overline{ED}$</td>
<td>3. Reflexive postulate</td>
</tr>
<tr>
<td>4. $\angle ADE \cong \angle W$</td>
<td>6. $\overline{D}$ bisects $\angle$ into congruent $\angle$s</td>
</tr>
<tr>
<td>5. $\angle DAE \cong \angle D$</td>
<td>7. Same as Statement 4</td>
</tr>
<tr>
<td>6. $\triangle ANW \cong \triangle DRE$</td>
<td>8. $\text{ASA} \cong \text{ASA}$</td>
</tr>
</tbody>
</table>

**Score 0:** The student's proof was completely incorrect.
36 Cathy wants to determine the height of the flagpole shown in the diagram below. She uses a survey instrument to measure the angle of elevation to the top of the flagpole, and determines it to be 34.9°. She walks 8 meters closer and determines the new measure of the angle of elevation to be 52.8°. At each measurement, the survey instrument is 1.7 meters above the ground.

Determine and state, to the nearest tenth of a meter, the height of the flagpole.

\[
\tan 52.8 = \frac{h}{x} \quad \tan 34.9 = \frac{h}{x + 8} \\
x \tan 52.8 = \tan 34.9 + 8 \tan 34.9 \\
- \frac{x \tan 52.8 - x \tan 34.9}{x} = 8 \tan 34.9 \\
\frac{6198416839x}{6198416839} = 8 \tan 34.9 \\
x = 9.003714087 \\
\tan 52.8 = \frac{h}{9.003714087} \\
h = 9.003714087 \tan 52.8 \\
h = 11.86195525 \\
\text{height} = 13.56195525 \\
\text{height} = 13.6 \text{ m}
\]

Score 6: The student has a complete and correct response.
36 Cathy wants to determine the height of the flagpole shown in the diagram below. She uses a survey instrument to measure the angle of elevation to the top of the flagpole, and determines it to be 34.9°. She walks 8 meters closer and determines the new measure of the angle of elevation to be 52.8°. At each measurement, the survey instrument is 1.7 meters above the ground.

Determine and state, to the nearest tenth of a meter, the height of the flagpole.

\[
\frac{h}{\tan 52.8^\circ} = \frac{h - 8 \tan 34.9^\circ}{\tan 34.9^\circ} \\
h = \frac{8 \tan 34.9^\circ \tan 52.8^\circ}{\tan 34.9^\circ - \tan 52.8^\circ} \\
h = \frac{11.86195525 + 1.7}{13.56195525} \\
\text{height} = 13.6 \text{ m}
\]

Score 6:  The student has a complete and correct response.
36 Cathy wants to determine the height of the flagpole shown in the diagram below. She uses a survey instrument to measure the angle of elevation to the top of the flagpole, and determines it to be $34.9^\circ$. She walks 8 meters closer and determines the new measure of the angle of elevation to be $52.8^\circ$. At each measurement, the survey instrument is 1.7 meters above the ground.

Determine and state, to the nearest tenth of a meter, the height of the flagpole.

\[
\tan 34.9 = \frac{y}{x+8} \quad \tan 52.8 = \frac{y}{x}
\]

\[
x \tan 34.9 + 8 \tan 34.9 = x \tan 52.8
\]

\[
-x \tan 34.9
\]

\[
\frac{8 \tan 34.9}{0.6198} = 0.6198x
\]

\[
x = 9.0037
\]

\[
9.0037(\tan 52.8) = y
\]

\[
y = 11.862
\]

**Score 5:** The student only found the vertical distance between the top of the flagpole to the top of the survey instrument.
36 Cathy wants to determine the height of the flagpole shown in the diagram below. She uses a survey instrument to measure the angle of elevation to the top of the flagpole, and determines it to be $34.9^\circ$. She walks 8 meters closer and determines the new measure of the angle of elevation to be $52.8^\circ$. At each measurement, the survey instrument is 1.7 meters above the ground.

Determine and state, to the nearest tenth of a meter, the height of the flagpole.

\[
\tan 34.9 = \frac{y}{x+8} \quad \tan 52.8 = \frac{1.7}{x}
\]

\[
x\tan 34.9 + 8\tan 34.9 = x\tan 52.8
\]

\[
x\tan 34.9 - x\tan 34.9 = 8\tan 34.9
\]

\[
\frac{8\tan 34.9}{0.6198} = 0.6198x
\]

\[
x = 9.0037
\]

\[
\boxed{x = 9.0}
\]

**Score 4:** The student only found the distance between the second measurement and the flagpole.
36 Cathy wants to determine the height of the flagpole shown in the diagram below. She uses a survey instrument to measure the angle of elevation to the top of the flagpole, and determines it to be 34.9°. She walks 8 meters closer and determines the new measure of the angle of elevation to be 52.8°. At each measurement, the survey instrument is 1.7 meters above the ground.

Determine and state, to the nearest tenth of a meter, the height of the flagpole.

\[
\tan 34.9 = \frac{x}{y} \quad \tan 52.8 = \frac{x}{y-8}
\]

\[
\frac{y \tan 34.9}{y - 8} = x
\]

Score 3: The student wrote both trigonometric equations correctly and substituted correctly.
36 Cathy wants to determine the height of the flagpole shown in the diagram below. She uses a survey instrument to measure the angle of elevation to the top of the flagpole, and determines it to be 34.9°. She walks 8 meters closer and determines the new measure of the angle of elevation to be 52.8°. At each measurement, the survey instrument is 1.7 meters above the ground.

\[ \tan 52.8^\circ = \frac{y}{x} \quad \tan 34.9^\circ = \frac{y}{x + 8} \]

Determine and state, to the nearest tenth of a meter, the height of the flagpole.

Score 2: The student wrote a correct system of trigonometric equations to find the height of the flagpole.
Cathy wants to determine the height of the flagpole shown in the diagram below. She uses a survey instrument to measure the angle of elevation to the top of the flagpole, and determines it to be 34.9°. She walks 8 meters closer and determines the new measure of the angle of elevation to be 52.8°. At each measurement, the survey instrument is 1.7 meters above the ground.

\[
\tan(34.9°) = \frac{x}{16}
\]

\[
16 \cdot \tan(34.9°) = 16 \cdot 0.69760 = \frac{x}{16} \cdot 16 = 11.1617546
\]

The height of the flagpole is approximately 12.9 m.

**Score 1:** The student made a critical error by assuming the distance between the survey instrument and the flagpole is 16 meters. This significantly reduced the level of difficulty of the question.
36 Cathy wants to determine the height of the flagpole shown in the diagram below. She uses a survey instrument to measure the angle of elevation to the top of the flagpole, and determines it to be 34.9°. She walks 8 meters closer and determines the new measure of the angle of elevation to be 52.8°. At each measurement, the survey instrument is 1.7 meters above the ground.

Determine and state, to the nearest tenth of a meter, the height of the flagpole.

\[ 8 \times 1.7 = 13.6 \]

**Score 0:** The student found the correct answer by an obviously incorrect procedure.
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 (Common Core).