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.
1 A two-dimensional cross section is taken of a three-dimensional object. If this cross section is a triangle, what can *not* be the three-dimensional object?

(1) cone  (3) pyramid  
(2) cylinder  (4) rectangular prism

2 The image of $\triangle DEF$ is $\triangle D'E'F'$. Under which transformation will the triangles *not* be congruent?

(1) a reflection through the origin  
(2) a reflection over the line $y = x$  
(3) a dilation with a scale factor of 1 centered at (2,3)  
(4) a dilation with a scale factor of $\frac{3}{2}$ centered at the origin

3 The vertices of square $RSTV$ have coordinates $R(-1,5)$, $S(-3,1)$, $T(-7,3)$, and $V(-5,7)$. What is the perimeter of $RSTV$?

(1) $\sqrt{20}$  (3) $4\sqrt{20}$  
(2) $\sqrt{40}$  (4) $4\sqrt{40}$
4 In the diagram below of circle $O$, chord $\overline{CD}$ is parallel to diameter $\overline{AOB}$ and $m\overline{CD} = 130$.

What is $m\overline{AC}$?

(1) 25  (3) 65  
(2) 50  (4) 115

5 In the diagram below, $\overline{AD}$ intersects $\overline{BE}$ at $C$, and $\overline{AB} \parallel \overline{DE}$.

If $CD = 6.6$ cm, $DE = 3.4$ cm, $CE = 4.2$ cm, and $BC = 5.25$ cm, what is the length of $\overline{AC}$, to the nearest hundredth of a centimeter?

(1) 2.70  (3) 5.28  
(2) 3.34  (4) 8.25
6 As shown in the graph below, the quadrilateral is a rectangle.

Which transformation would not map the rectangle onto itself?
(1) a reflection over the x-axis
(2) a reflection over the line $x = 4$
(3) a rotation of 180° about the origin
(4) a rotation of 180° about the point (4,0)

7 In the diagram below, triangle $ACD$ has points $B$ and $E$ on sides $AC$ and $AD$, respectively, such that $BE \parallel CD$, $AB = 1$, $BC = 3.5$, and $AD = 18$.

What is the length of $AE$, to the nearest tenth?
(1) 14.0
(2) 5.1
(3) 3.3
(4) 4.0
8 In the diagram below of parallelogram ROCK, \( m\angle C \) is 70° and \( m\angle ROS \) is 65°.

![Diagram of parallelogram ROCK with angles labeled 65° and 70°](image)

What is \( m\angle KSO \)?

(1) 45°  
(2) 110°  
(3) 115°  
(4) 135°

9 In the diagram below, \( \angle GRS \cong \angle ART \), \( GR = 36 \), \( SR = 45 \), \( AR = 15 \), and \( RT = 18 \).

![Diagram of triangle GRS and triangle ART with sides labeled](image)

Which triangle similarity statement is correct?

(1) \( \triangle GRS \sim \triangle ART \) by AA.  
(2) \( \triangle GRS \sim \triangle ART \) by SAS.  
(3) \( \triangle GRS \sim \triangle ART \) by SSS.  
(4) \( \triangle GRS \) is not similar to \( \triangle ART \).

10 The line represented by the equation \( 4y = 3x + 7 \) is transformed by a dilation centered at the origin. Which linear equation could represent its image?

(1) \( 3x - 4y = 9 \)  
(2) \( 3x + 4y = 9 \)  
(3) \( 4x - 3y = 9 \)  
(4) \( 4x + 3y = 9 \)
11 Given \( \triangle ABC \) with \( m \angle B = 62^\circ \) and side \( \overline{AC} \) extended to \( D \), as shown below.

Which value of \( x \) makes \( \overline{AB} \equiv \overline{CB} \)?

(1) 59°  (3) 118°
(2) 62°  (4) 121°

12 In the diagram shown below, \( \overline{PA} \) is tangent to circle \( T \) at \( A \), and secant \( \overline{PBC} \) is drawn where point \( B \) is on circle \( T \).

If \( PB = 3 \) and \( BC = 15 \), what is the length of \( \overline{PA} \)?

(1) \( 3\sqrt{5} \)  (3) 3
(2) \( 3\sqrt{6} \)  (4) 9
13 A rectangle whose length and width are 10 and 6, respectively, is shown below. The rectangle is continuously rotated around a straight line to form an object whose volume is $150\pi$.

![Rectangle](image)

Which line could the rectangle be rotated around?

(1) a long side  
(2) a short side  
(3) the vertical line of symmetry  
(4) the horizontal line of symmetry

14 If $ABCD$ is a parallelogram, which statement would prove that $ABCD$ is a rhombus?

(1) $\angle ABC \cong \angle CDA$  
(2) $\overline{AC} \cong \overline{BD}$  
(3) $\overline{AC} \perp \overline{BD}$  
(4) $\overline{AB} \perp \overline{CD}$

15 To build a handicapped-access ramp, the building code states that for every 1 inch of vertical rise in height, the ramp must extend out 12 inches horizontally, as shown in the diagram below.

![Diagram](image)

What is the angle of inclination, $x$, of this ramp, to the nearest hundredth of a degree?

(1) 4.76  
(2) 4.78  
(3) 85.22  
(4) 85.24

Use this space for computations.
16 In the diagram below of \( \triangle ABC \), \( D \), \( E \), and \( F \) are the midpoints of \( \overline{AB} \), \( \overline{BC} \), and \( \overline{CA} \), respectively.

What is the ratio of the area of \( \triangle CFE \) to the area of \( \triangle CAB \)?

(1) 1:1  (3) 1:3
(2) 1:2  (4) 1:4

17 The coordinates of the endpoints of \( \overline{AB} \) are \( A(-8,-2) \) and \( B(16,6) \).

Point \( P \) is on \( \overline{AB} \). What are the coordinates of point \( P \), such that \( AP:PB \) is 3:5?

(1) (1,1)  (3) (9.6,3.6)
(2) (7,3)  (4) (6.4,2.8)

18 Kirstie is testing values that would make triangle \( KLM \) a right triangle when \( \overline{LN} \) is an altitude, and \( KM = 16 \), as shown below.

Which lengths would make triangle \( KLM \) a right triangle?

(1) \( LM = 13 \) and \( KN = 6 \)  (3) \( KL = 11 \) and \( KN = 7 \)
(2) \( LM = 12 \) and \( NM = 9 \)  (4) \( LN = 8 \) and \( NM = 10 \)
19 In right triangle \(ABC\), \(m\angle A = 32^\circ\), \(m\angle B = 90^\circ\), and \(AC = 6.2\) cm. What is the length of \(BC\), to the nearest tenth of a centimeter?

(1) 3.3 (3) 5.3
(2) 3.9 (4) 11.7

20 The 2010 U.S. Census populations and population densities are shown in the table below.

<table>
<thead>
<tr>
<th>State</th>
<th>Population Density (people/mi(^2))</th>
<th>Population in 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Florida</td>
<td>350.6</td>
<td>18,801,310</td>
</tr>
<tr>
<td>Illinois</td>
<td>231.1</td>
<td>12,830,632</td>
</tr>
<tr>
<td>New York</td>
<td>411.2</td>
<td>19,378,102</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>283.9</td>
<td>12,702,379</td>
</tr>
</tbody>
</table>

Based on the table above, which list has the states’ areas, in square miles, in order from largest to smallest?

(1) Illinois, Florida, New York, Pennsylvania
(2) New York, Florida, Illinois, Pennsylvania

21 In a right triangle, \(\sin (40 - x)^\circ = \cos (3x)^\circ\). What is the value of \(x\)?

(1) 10 (3) 20
(2) 15 (4) 25

22 A regular decagon is rotated \(n\) degrees about its center, carrying the decagon onto itself. The value of \(n\) could be

(1) \(10^\circ\) (3) \(225^\circ\)
(2) \(150^\circ\) (4) \(252^\circ\)
23 In a circle with a diameter of 32, the area of a sector is \( \frac{512\pi}{3} \). The measure of the angle of the sector, in radians, is

(1) \( \frac{\pi}{3} \)  
(2) \( \frac{4\pi}{3} \)  
(3) \( \frac{16\pi}{3} \)  
(4) \( \frac{64\pi}{3} \)

24 What is an equation of the perpendicular bisector of the line segment shown in the diagram below?

(1) \( y + 2x = 0 \)  
(2) \( y - 2x = 0 \)  
(3) \( 2y + x = 0 \)  
(4) \( 2y - x = 0 \)
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 Sue believes that the two cylinders shown in the diagram below have equal volumes.

[Diagrams of two cylinders with dimensions given: 11.5 m diameter, 5 m height on the left; 11.5 m diameter, 12 m height on the right.]

Is Sue correct? Explain why.
26 In the diagram of rhombus $PQRS$ below, the diagonals $PR$ and $QS$ intersect at point $T$, $PR = 16$, and $QS = 30$. Determine and state the perimeter of $PQRS$. 
27 Quadrilateral $MATH$ and its image $M''A''T''H''$ are graphed on the set of axes below.

Describe a sequence of transformations that maps quadrilateral $MATH$ onto quadrilateral $M''A''T''H''$. 
28 Using a compass and straightedge, construct a regular hexagon inscribed in circle $O$.  
[Leave all construction marks.]
The coordinates of the endpoints of $\overline{AB}$ are $A(2,3)$ and $B(5,-1)$. Determine the length of $\overline{A'B'}$, the image of $\overline{AB}$, after a dilation of $\frac{1}{2}$ centered at the origin.

[The use of the set of axes below is optional.]
30 In the diagram below of $\triangle ABC$ and $\triangle XYZ$, a sequence of rigid motions maps $\angle A$ onto $\angle X$, $\angle C$ onto $\angle Z$, and $\overline{AC}$ onto $\overline{XZ}$.

Determine and state whether $\overline{BC} \cong \overline{YZ}$. Explain why.
31 Determine and state the coordinates of the center and the length of the radius of a circle whose equation is $x^2 + y^2 - 6x = 56 - 8y$. 
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 Triangle $PQR$ has vertices $P(-3,-1)$, $Q(-1,7)$, and $R(3,3)$, and points $A$ and $B$ are midpoints of $\overline{PQ}$ and $\overline{RQ}$, respectively. Use coordinate geometry to prove that $AB$ is parallel to $\overline{PR}$ and is half the length of $\overline{PR}$.

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

[Diagram of a coordinate plane with points labeled and axes indicated.]
33 In the diagram below of circle $O$, tangent $\overline{EC}$ is drawn to diameter $\overline{AC}$. Chord $\overline{BC}$ is parallel to secant $\overline{ADE}$, and chord $\overline{AB}$ is drawn.

Prove: \[ \frac{BC}{CA} = \frac{AB}{EC} \]
Keira has a square poster that she is framing and placing on her wall. The poster has a diagonal 58 cm long and fits exactly inside the frame. The width of the frame around the picture is 4 cm.

Determine and state the total area of the poster and frame to the nearest tenth of a square centimeter.
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 Isosceles trapezoid $ABCD$ has bases $\overline{DC}$ and $\overline{AB}$ with nonparallel legs $\overline{AD}$ and $\overline{BC}$. Segments $\overline{AE}$, $\overline{BE}$, $\overline{CE}$, and $\overline{DE}$ are drawn in trapezoid $ABCD$ such that $\angle CDE \equiv \angle DCE$, $\overline{AE} \perp \overline{DE}$, and $\overline{BE} \perp \overline{CE}$.

![Diagram of isosceles trapezoid with additional segments](image)

Prove $\triangle ADE \equiv \triangle BCE$ and prove $\triangle AEB$ is an isosceles triangle.
36 A rectangular in-ground pool is modeled by the prism below. The inside of the pool is 16 feet wide and 35 feet long. The pool has a shallow end and a deep end, with a sloped floor connecting the two ends. Without water, the shallow end is 9 feet long and 4.5 feet deep, and the deep end of the pool is 12.5 feet long.

If the sloped floor has an angle of depression of 16.5 degrees, what is the depth of the pool at the deep end, to the nearest tenth of a foot?

Find the volume of the inside of the pool to the nearest cubic foot.

Question 36 is continued on the next page.
Question 36 continued

A garden hose is used to fill the pool. Water comes out of the hose at a rate of 10.5 gallons per minute. How much time, to the nearest hour, will it take to fill the pool 6 inches from the top? [1 ft³ = 7.48 gallons]
Scrap Graph Paper — This sheet will *not* be scored.
## High School Math Reference Sheet

1 inch = 2.54 centimeters  
1 meter = 39.37 inches  
1 mile = 5280 feet  
1 mile = 1760 yards  
1 mile = 1.609 kilometers

1 kilometer = 0.62 mile  
1 pound = 16 ounces  
1 pound = 0.454 kilogram  
1 kilogram = 2.2 pounds  
1 ton = 2000 pounds

1 cup = 8 fluid ounces  
1 pint = 2 cups  
1 quart = 2 pints  
1 gallon = 4 quarts  
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
\[ S_n = \frac{a_1 - a_1 r^n}{1 - r} \text{ where } r \neq 1 \]

### Radians
1 radian = \( \frac{180}{\pi} \) degrees

### Degrees
1 degree = \( \frac{\pi}{180} \) radians

### Exponential Growth/Decay
\[ A = A_0 e^{k(t - t_0)} + B_0 \]
FOR TEACHERS ONLY

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

GEOMETRY

Thursday, August 17, 2017 — 12:30 to 3:30 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. 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 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 scored 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, August 17, 2017. 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.

<table>
<thead>
<tr>
<th>(1)</th>
<th>(9)</th>
<th>(17)</th>
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<tbody>
<tr>
<td>(2)</td>
<td>(10)</td>
<td>(18)</td>
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<td>(8)</td>
<td>(16)</td>
<td>(24)</td>
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</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. 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/](http://www.nysedregents.org/geometryre/).
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] Yes, and a correct explanation is written.

[1] Appropriate work is shown, but one computational error is made. An appropriate explanation is written.

or

[1] Appropriate work is shown, but one conceptual error is made. An appropriate explanation is written.

or

[1] Appropriate work is shown, but an incomplete explanation is written.

[0] Yes, 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.

(26)  [2] 68, 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] Correct work is shown to find 17, the length of one side of PQRS, but no further correct work is shown.

or

[1] 68, 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] A correct sequence of transformations is written.

[1] An appropriate sequence of transformations is written, but one computational error is made.

\[ \text{or} \]

[1] An appropriate sequence of transformations is written, but one conceptual error is made.

\[ \text{or} \]

[1] An appropriate sequence of transformations is written, but it is incomplete.

[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] A correct construction is drawn showing all appropriate arcs, and the hexagon is drawn.

[1] An appropriate construction is drawn showing all appropriate arcs, but the hexagon is not drawn.

[0] A drawing that is not an appropriate construction 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.

(29) [2] 2.5, and appropriate work is shown.

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

\[ \text{or} \]

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

\[ \text{or} \]

[1] Appropriate work is shown to find 5, the length of \( \overline{AB} \), but no further correct work is shown.

\[ \text{or} \]

[1] Appropriate work is shown to find \((1,1.5)\) and \((2.5,-0.5)\), but 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.
(30)  [2] $BC \equiv YZ$ is indicated, and a correct explanation is written.

[1] An appropriate answer is stated, but one conceptual error is made.

\textit{or}

[1] $BC \equiv YZ$ is indicated, but the explanation is incomplete or partially correct.

[0] $BC \equiv YZ$ is indicated, but the explanation is missing or incorrect.

\textit{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] Center $(3, -4)$ and radius 9, and correct work is shown.

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

\textit{or}

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

\textit{or}

[1] Correct work is shown to find $(x - 3)^2 + (y + 4)^2 = 81$ and/or to find the coordinates of the center or length of the radius, but no further correct work is shown.

\textit{or}

[1] Center $(3, -4)$ and radius 9, 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 that the midsegment is parallel to $PR$ and is half the length of $PR$, and concluding statements are written.**

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

**or**

**[3]** Correct work is shown to find the slopes and lengths of $PR$ and the midsegment, but one concluding statement is incomplete, incorrect, or missing.

**[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 that the midsegment is parallel to $PR$, but no further correct work is shown.

**or**

**[2]** Correct work is shown to prove that the midsegment is half the length of $PR$, but no further correct work is shown.

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

**or**

**[1]** The correct slopes and lengths are stated, 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] A complete and correct proof that includes a concluding statement is written.

[3] 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 the concluding statement is missing.

or

[3] A proof is written that shows \( \triangle ABC \sim \triangle ECA \). 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 two statements and/or reasons are missing or incorrect.

or

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

or

[2] A proof is written that shows \( \angle ABC \equiv \angle ECA \) and \( \angle BCA \equiv \angle EAC \). No further correct work is shown.

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

or

[1] A proof is written that shows \( \angle ABC \equiv \angle ECA \) or \( \angle BCA \equiv \angle EAC \). No further correct work is shown.

[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.
[4] 2402.2, and correct work is shown.

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

or

[3] A correct answer is written in radical form for the total area of the poster and frame.

[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 length of the side of the frame and/or the length of the diagonal of the frame. 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] Correct work is shown to find the length of the poster and/or the area of the poster. No further correct work is shown.

or

[1] 2402.2, 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 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 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] \( \triangle ADE \cong \triangle BCE \) and \( \overline{EA} \cong \overline{EB} \) are proven, but no further correct work is shown.

or

[5] \( \triangle ADE \cong \triangle BCE \) and \( \angle EAB \cong \angle EBA \) are 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 in proving \( \triangle ADE \cong \triangle BCE \).

or

[4] \( \triangle ADE \cong \triangle BCE \) is proven, but no further correct work is shown.

[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 method of proof, but one conceptual error is made in proving \( \triangle ADE \cong \triangle BCE \). One statement and/or reason is missing or incorrect.

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

or
\[ \angle DEA \cong \angle CEB \text{ or } \triangle DEA \text{ and } \triangle CEB \text{ are right triangles is proven, but no further correct work is shown.} \]

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

[0] The “given” and/or the “prove” statements are written, but no further correct relevant statements are written.

\textit{or}

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

(36)

\[ 8.5, 3752, 41, \text{ and correct work is shown.} \]

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

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

\textit{or}

[4] Correct work is shown to find 8.5 and 3752, but no further correct work is shown.

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

[2] Correct work is shown to find 8.5, but no further correct work is shown.

[1] \( \tan 16.5 = \frac{x}{13.5} \), or an equivalent equation is written, but no further correct work is shown.

\textit{or}

[1] 8.5, 3752, and 41, 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.
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<td>6</td>
<td>G-MG.A</td>
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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.
Sue believes that the two cylinders shown in the diagram below have equal volumes.

Is Sue correct? Explain why.

Yes, Sue is correct because when two cylinders have the same base areas and the same height, the two cylinders must have the same volume.

Score 2: The student gave a complete and correct response.
Sue believes that the two cylinders shown in the diagram below have equal volumes.

Is Sue correct? Explain why.

Sue is correct. Both cylinders' radii and heights are equal causing their volumes to be the same.

Score 2: The student gave a complete and correct response.
25 Sue believes that the two cylinders shown in the diagram below have equal volumes.

Is Sue correct? Explain why.

\[ V = \pi r^2 h \]
\[ = \pi \times 5^2 \times 11.5 \]
\[ = 287.5\pi \]

\[ V = \pi r^2 h \]
\[ = \pi \times 5^2 \times 11.5 \]
\[ \approx 287.5\pi \]

Yes Sue is correct - the 2 cylinders have the same volume.

Score 1: The student found the volumes of both cylinders, but did not write an explanation for why the volumes are the same.
25 Sue believes that the two cylinders shown in the diagram below have equal volumes.

Is Sue correct? Explain why.

Yes, because the cylinders have the same measurements. One is just tilted.

Score 0: The student did not show enough correct relevant work to receive any credit.
25 Sue believes that the two cylinders shown in the diagram below have equal volumes.

Is Sue correct? Explain why.

\[
V = \frac{1}{3} \pi \cdot 10 \cdot 11.5
\]

\[
V = \frac{1}{3} \pi \times 5.115
\]

\[
V = 19.16
\]

Sue is incorrect, their volumes are not equal.

Score 0: The student gave a completely incorrect response.
26 In the diagram of rhombus $PQRS$ below, the diagonals $PR$ and $QS$ intersect at point $T$, $PR = 16$, and $QS = 30$. Determine and state the perimeter of $PQRS$.

Score 2: The student gave a complete and correct response.
26 In the diagram of rhombus $PQRS$ below, the diagonals $PR$ and $QS$ intersect at point $T$, $PR = 16$, and $QS = 30$. Determine and state the perimeter of $PQRS$.

\[ P = 48 \]

**Score 2:** The student gave a complete and correct response.
Question 26

26 In the diagram of rhombus $PQRS$ below, the diagonals $PR$ and $QS$ intersect at point $T$, $PR = 16$, and $QS = 30$. Determine and state the perimeter of $PQRS$.

![Diagram of rhombus PQRS with diagonals intersecting at point T.]

\[
\begin{align*}
&\text{Diagonals bisect each other and are } \perp. \\
&\text{Opposite sides are } \equiv.
\end{align*}
\]

\[
\begin{align*}
&\sqrt{320} = PQ \\
&\sqrt{400} = PQ \\
&\sqrt{8} = PQ \\
&8 = PQ \\
&SP = PQ \\
&SP = 8\sqrt{5} \\
&QR = SP \\
&QR = 17
\end{align*}
\]

\[
\begin{align*}
&\sqrt{a^2 + b^2} = c^2 \\
&8^2 + 16^2 = PQ^2 \\
&64 + 256 = PQ^2 \\
&320 = PQ^2 \\
&\sqrt{320} = PQ \\
&17 = SP
\end{align*}
\]

\[
\begin{align*}
&\sqrt{a^2 + b^2} = c^2 \\
&8^2 + 16^2 = SP^2 \\
&64 + 256 = SP^2 \\
&320 = SP^2 \\
&\sqrt{320} = SP
\end{align*}
\]

\[
\begin{align*}
&P = PQ + QR + RS + SP \\
&= 8\sqrt{5} + 17 + 8\sqrt{5} + 17 \\
&P = 16\sqrt{5} + 34
\end{align*}
\]

Score 1: The student made an error in finding the lengths of sides $PQ$ and $RS$. 

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Question 26

In the diagram of rhombus $PQRS$ below, the diagonals $PR$ and $QS$ intersect at point $T$, $PR = 16$, and $QS = 30$. Determine and state the perimeter of $PQRS$.

\[ \sqrt{8^2 + 15^2} = C^2 \]
\[ 64 + 225 = C^2 \]
\[ 289 = C^2 \]
\[ C = 17 \]

Score 1: The student found the length of the side of the rhombus, but did not find the perimeter of the rhombus.
Question 26

26 In the diagram of rhombus $PQRS$ below, the diagonals $\overline{PR}$ and $\overline{QS}$ intersect at point $T$, $PR = 16$, and $QS = 30$. Determine and state the perimeter of $PQRS$.

Score 0: The student gave a completely incorrect response.
Question 27

27 Quadrilateral \textit{MATH} and its image \textit{M"A"T"H"} are graphed on the set of axes below.

Describe a sequence of transformations that maps quadrilateral \textit{MATH} onto quadrilateral \textit{M"A"T"H"}.

\begin{equation*}
\text{a reflection over the origin} \Rightarrow \text{a translation of } (x-1, y+1)
\end{equation*}

\textbf{Score 2:} The student gave a complete and correct response.
27 Quadrilateral $MATH$ and its image $M''AJT''H''$ are graphed on the set of axes below.

Describe a sequence of transformations that maps quadrilateral $MATH$ onto quadrilateral $M''AJT''H''$.

Score 2: The student gave a complete and correct response.
27 Quadrilateral MATH and its image M"A"T"H" are graphed on the set of axes below.

Describe a sequence of transformations that maps quadrilateral MATH onto quadrilateral M"A"T"H".

Rotate quadrilateral MATH $180^\circ$ about point $\left(-\frac{1}{2}, \frac{1}{2}\right)$.

Score 2:  The student gave a complete and correct response.
27 Quadrilateral $MATH$ and its image $M''A''T''H''$ are graphed on the set of axes below.

Describe a sequence of transformations that maps quadrilateral $MATH$ onto quadrilateral $M''A''T''H''$.

- $MATH$ was translated up one unit.
- $MATH$ was translated to the left one unit.
- $MATH$ was rotated $180^\circ$ clockwise.

Score 1: The student wrote an incomplete transformation by not stating the center of rotation.
27 Quadrilateral $MATH$ and its image $M''A''T''H''$ are graphed on the set of axes below.

Describe a sequence of transformations that maps quadrilateral $MATH$ onto quadrilateral $M''A''T''H''$.

Score 1: The student had a partially correct sequence of transformations.
27 Quadrilateral $MATH$ and its image $M''A''T''H''$ are graphed on the set of axes below.

Describe a sequence of transformations that maps quadrilateral $MATH$ onto quadrilateral $M''A''T''H''$.

Score 0: The student gave an incomplete description of the rotation (spin) and described the translation (move) incorrectly.
28 Using a compass and straightedge, construct a regular hexagon inscribed in circle $O$.
[Leave all construction marks.]

Score 2: A correct construction is drawn showing all appropriate arcs.
Question 28

28 Using a compass and straightedge, construct a regular hexagon inscribed in circle $O$.

[Leave all construction marks.]

Score 2: A correct construction is drawn showing all appropriate arcs.
28 Using a compass and straightedge, construct a regular hexagon inscribed in circle $O$.

[Leave all construction marks.]

**Score 2:** A correct construction is drawn showing all appropriate arcs.
28 Using a compass and straightedge, construct a regular hexagon inscribed in circle $O$.
[Leave all construction marks.]

Score 1: The student drew an appropriate construction, but did not draw the hexagon.
28 Using a compass and straightedge, construct a regular hexagon inscribed in circle $O$.

[Leave all construction marks.]
29 The coordinates of the endpoints of $\overline{AB}$ are $A(2, 3)$ and $B(5, -1)$. Determine the length of $\overline{A'B'}$, the image of $\overline{AB}$, after a dilation of $\frac{1}{2}$ centered at the origin.

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

Score 2: The student gave a complete and correct response.
29 The coordinates of the endpoints of $\overline{AB}$ are $A(2,3)$ and $B(5,-1)$. Determine the length of $\overline{A'B'}$, the image of $\overline{AB}$, after a dilation of $\frac{1}{2}$ centered at the origin.

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

$$d = \sqrt{(x-x')^2 + (y-y')^2}$$
$$= \sqrt{(5-2)^2 + (-1-3)^2}$$
$$= \sqrt{3^2 + 4^2} = \sqrt{9 + 16} = \sqrt{25}$$

Length of $\overline{A'B'} = 2.5$ units

Score 2: The student gave a complete and correct response.
29 The coordinates of the endpoints of $\overline{AB}$ are $A(2,3)$ and $B(5,-1)$. Determine the length of $\overline{A'B'}$, the image of $\overline{AB}$, after a dilation of $\frac{1}{2}$ centered at the origin.

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

$\overline{A'B'} = 2.5$

Score 2: The student gave a complete and correct response.
29 The coordinates of the endpoints of \( \overline{AB} \) are \( A(2,3) \) and \( B(5,-1) \). Determine the length of \( \overline{A'B'} \), the image of \( \overline{AB} \), after a dilation of \( \frac{1}{2} \) centered at the origin.

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

\[
\overline{d} = \sqrt{\left(2 + 5\right)^2 + (3 + 1)^2} \overline{\sqrt{(3)^2 + (4)^2}} \overline{\sqrt{9} + 16}
\]

\( d = 5 \)

Score 1: The student found the length of \( \overline{AB} \), but no further correct work is shown.
29 The coordinates of the endpoints of $\overline{AB}$ are $A(2,3)$ and $B(5,-1)$. Determine the length of $\overline{A'B'}$, the image of $\overline{AB}$, after a dilation of $\frac{1}{2}$ centered at the origin.

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

$\overline{A'B'}$ is shorter than $\overline{AB}$

Score 0: The student did not show enough correct relevant work to receive any credit.
In the diagram below of \( \triangle ABC \) and \( \triangle XYZ \), a sequence of rigid motions maps \( \angle A \) onto \( \angle X \), \( \angle C \) onto \( \angle Z \), and \( \overline{AC} \) onto \( \overline{XZ} \).

Determine and state whether \( \overline{BC} \cong \overline{YZ} \). Explain why.

\[
\overline{BC} \cong \overline{YZ} \text{ since the } \triangle \text{s are } \cong \text{ by ASA since } \\
\angle A \cong \angle X, \overline{AC} \cong \overline{XZ} \text{ and } \\
\angle C \cong \angle Z \text{ because they can be mapped on to each other in a series of rigid motions which preserve side length and angle measure. So since } \\
\triangle ABC \cong \triangle XYZ, \overline{BC} \cong \overline{YZ} \\
\text{ because corresponding sides of } \cong \triangle \text{s are } \cong.
\]

**Score 2:** The student gave a complete and correct response.
Question 30

30 In the diagram below of $\triangle ABC$ and $\triangle XYZ$, a sequence of rigid motions maps $\angle A$ onto $\angle X$, $\angle C$ onto $\angle Z$, and $\overline{AC}$ onto $\overline{XZ}$.

Determine and state whether $\overline{BC} \cong \overline{YZ}$. Explain why.

yes because basic rigid motions preserve segment length and angle measurement.

Score 1: The student gave an incomplete explanation by not stating the triangle congruency and not stating corresponding congruent sides.
In the diagram below of $\triangle ABC$ and $\triangle XYZ$, a sequence of rigid motions maps $\angle A$ onto $\angle X$, $\angle C$ onto $\angle Z$, and $\overline{AC}$ onto $\overline{XZ}$.

Determine and state whether $\overline{BC} \cong \overline{YZ}$. Explain why.

\[ \overline{BC} \cong \overline{YZ} \text{ because corresponding parts of congruent triangles are congruent} \]

**Score 1:** The student gave an incomplete explanation.
30 In the diagram below of $\triangle ABC$ and $\triangle XYZ$, a sequence of rigid motions maps $\angle A$ onto $\angle X$, $\angle C$ onto $\angle Z$, and $\overline{AC}$ onto $\overline{XZ}$.

Determine and state whether $\overline{BC} \cong \overline{YZ}$. Explain why.

Yes $\overline{BC} \cong \overline{YZ}$ because of $\text{ASA} \cong \text{ASA}$.

Score 1: The student gave an incomplete explanation.
Question 30

30 In the diagram below of \( \triangle ABC \) and \( \triangle XYZ \), a sequence of rigid motions maps \( \angle A \) onto \( \angle X \), \( \angle C \) onto \( \angle Z \), and \( \overline{AC} \) onto \( \overline{XZ} \).

\[ \begin{array}{c}
A \quad B \quad C \\
\end{array} \quad \begin{array}{c}
X \quad Y \quad Z \\
\end{array} \]

Determine and state whether \( \overline{BC} \equiv \overline{YZ} \). Explain why.

\( \overline{BC} \equiv \overline{YZ} \) because the triangles look the same.

Score 0: The student wrote an incorrect explanation.
31 Determine and state the coordinates of the center and the length of the radius of a circle whose equation is \( x^2 + y^2 - 6x = 56 - 8y \).

\[
\begin{align*}
\frac{b}{2} &= 3 = a \\
\frac{b}{2} &= 3 = a \\
\frac{b}{2} &= 3 = a \\
\frac{b}{2} &= 3 = a \\
\frac{b}{2} &= 3 = a \\
\frac{b}{2} &= 3 = a \\
x^2 - 6x + y^2 + 8y &= 56 \\
x^2 - 6x + 9 + y^2 + 16 &= 56 + 9 + 16 \\
(x - 3)^2 + (y + 4)^2 &= 81 \\
\sqrt{81} &= 9 \\
\text{radius} &= 9 \\
\text{center} &= (3, -4)
\end{align*}
\]

**Score 2:** The student gave a complete and correct response.
31 Determine and state the coordinates of the center and the length of the radius of a circle whose equation is \( x^2 + y^2 - 6x = 56 - 8y \).

\[
\begin{align*}
(x^2 - 6x) + (y^2 + 8y) &= 56 \\
(x^2 - 6x + 9) + (y^2 + 8y + 16) &= 81 \\
(x - 3)^2 + (y + 4)^2 &= 81
\end{align*}
\]

center = \((-3, 4)\)

radius = 9

Score 1: The student had incorrect signs on the coordinates for the center of the circle.
31 Determine and state the coordinates of the center and the length of the radius of a circle whose equation is \( x^2 + y^2 - 6x = 56 - 8y \).

\[
\begin{align*}
\text{Given:} & \quad x^2 + y^2 - 6x = 56 - 8y \\
\text{Step 1:} & \quad x^2 - 6x + y^2 + 8y = 56 \\
\text{Step 2:} & \quad (x - 3)^2 + (y + 4)^2 = 56 \\
\text{Step 3:} & \quad (x - 3)^2 + (y + 4)^2 = 56 \\
\text{Solution:} & \quad x = -3, \quad y = -4
\end{align*}
\]

**Score 0:** The student did not show enough correct relevant work to receive any credit.
32 Triangle $PQR$ has vertices $P(-3,-1)$, $Q(-1,7)$, and $R(3,3)$, and points $A$ and $B$ are midpoints of $PQ$ and $RQ$, respectively. Use coordinate geometry to prove that $AB$ is parallel to $PR$ and is half the length of $PR$.

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

Mid of $PQ = \left( \frac{-3 + 1}{2}, \frac{-1 + 7}{2} \right) = \left( \frac{-2}{2}, \frac{6}{2} \right) = \left( -1, 3 \right)$

$A = (-1, 3)$

Slope of $AB = \frac{5 - 3}{1 - (-1)} = \frac{2}{2} = 1$

Slope of $PR = \frac{3 - (-1)}{3 - (-3)} = \frac{4}{6} = \frac{2}{3}$

Since the slopes of $AB$ and $PR$ are the same, $AB \parallel PR$.

$AB = \sqrt{(1-(-1))^2 + (5-3)^2} = \sqrt{4 + 4} = \sqrt{8}$

$PR = \sqrt{(3-(-3))^2 + (3-1)^2} = \sqrt{36 + 4} = \sqrt{40} = 2\sqrt{10}$

$AB$ is half the length of $PR$ because $\sqrt{13}$ is half of $2\sqrt{10}$.

Score 4: The student gave a complete and correct response.
Triangle $PQR$ has vertices $P(-3,-1)$, $Q(-1,7)$, and $R(3,3)$, and points $A$ and $B$ are midpoints of $PQ$ and $RQ$, respectively. Use coordinate geometry to prove that $AB$ is parallel to $PR$ and is half the length of $PR$.

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

$$\begin{align*}
|AB| &= \sqrt{2^2 + 8^2} = \sqrt{8} \\
|QR| &= \sqrt{4^2 + 2^2} = \sqrt{32} \\
\frac{1}{2}|QR| &= \frac{1}{2} \cdot \sqrt{32} = \frac{1}{2} \cdot 4\sqrt{2} = 2\sqrt{2} \\
|AB| &= \sqrt{8} = 2\sqrt{2} \\
\therefore \frac{1}{2}|QR| &= |AB|
\end{align*}$$

$:AB/QR$ since both segments have equal slopes.

Score 3: The student did correct work to show that the midsegment of a triangle is parallel and half the length to the third side of the triangle, but used the wrong midsegment.
Question 32

Triangle $PQR$ has vertices $P(-3,-1)$, $Q(-1,7)$, and $R(3,3)$, and points $A$ and $B$ are midpoints of $PQ$ and $RQ$, respectively. Use coordinate geometry to prove that $AB$ is parallel to $PR$ and is half the length of $PR$.

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

\[
\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1}
\]

\[
PR = \frac{3 - (-1)}{3 - (-3)} = \frac{3+1}{3+3} = \frac{4}{6} = \frac{2}{3}
\]

\[
AB = \frac{3 - 3}{1 - (-2)} = \frac{2}{3}
\]

$PR$ and $AB$ are || because they have the same slope.

Score 2: The student proved $AB \parallel PR$, but no further correct work is shown.
Question 32

32 Triangle $PQR$ has vertices $P(-3, -1)$, $Q(-1, 7)$, and $R(3, 3)$, and points $A$ and $B$ are midpoints of $PQ$ and $RQ$, respectively. Use coordinate geometry to prove that $\overline{AB}$ is parallel to $\overline{PR}$ and is half the length of $\overline{PR}$.

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

Score 2: The student proved $\overline{AB} \parallel \overline{PR}$, but no further correct work is shown.
32 Triangle $PQR$ has vertices $P(-3,-1)$, $Q(-1,7)$, and $R(3,3)$, and points $A$ and $B$ are midpoints of $PQ$ and $RQ$, respectively. Use coordinate geometry to prove that $\overline{AB}$ is parallel to $\overline{PR}$ and is half the length of $\overline{PR}$.

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

\[
\begin{align*}
\text{slope } \overline{AB} &= \frac{2}{3} \\
\text{slope } \overline{PR} &= \frac{4}{6} = \frac{2}{3}
\end{align*}
\]
Question 32

32 Triangle $PQR$ has vertices $P(-3,-1)$, $Q(-1,7)$, and $R(3,3)$, and points $A$ and $B$ are midpoints of $PQ$ and $RQ$, respectively. Use coordinate geometry to prove that $AB$ is parallel to $PR$ and is half the length of $PR$.

(The use of the set of axes below is optional.)

$$m = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

$$= \left(\frac{-3 + 1}{2}, \frac{1 + 7}{2}\right)$$

$$= \left(-\frac{2}{2}, \frac{8}{2}\right)$$

$$= \left(-1, 4\right)$$

$$= \left(-2, 3\right)$$

Score 0: The student did not show enough correct relevant work to receive any credit.
33 In the diagram below of circle $O$, tangent $\overline{EC}$ is drawn to diameter $\overline{AC}$. Chord $\overline{BC}$ is parallel to secant $\overline{ADE}$, and chord $\overline{AB}$ is drawn.

Prove: $\frac{BC}{CA} = \frac{AB}{EC}$

| 1. Circle of tangent $\overline{EC}$ is drawn to diameter $\overline{AC}$  | 1. Given  |
| Chord $\overline{BC}$ is parallel to secant $\overline{ADE}$ | 2. An angle inscribed in a semicircle is a right $\angle$. |
| Chord $\overline{AB}$ is drawn | 3. A radius is perpendicular to a tangent at the point of contact. |
| 2. $\angle B$ is a right $\angle$ | 4. Perpendicular lines form right angles |
| 3. $\overrightarrow{EC} \perp \overrightarrow{OC}$ | 5. All right angles are $\angle$ |
| 4. $\angle ECA$ is a right $\angle$ | 6. If 2 parallel lines are cut by a transversal, the alternate interior angles are $\angle$ |
| 5. $\angle B \cong \angle ECA$ | 7. $AA \cong AA$ |
| 6. $\angle BCA \cong \angle CAE$ | 8. Corresponding sides of similar triangles are in proportion |
| 7. $\triangle ABC \sim \triangle ECA$ | |
| 8. $\frac{BC}{CA} = \frac{AB}{EC}$ | |

**Score 4:** The student gave a complete and correct response.
Question 33

33 In the diagram below of circle O, tangent $\overline{EC}$ is drawn to diameter $\overline{AC}$. Chord $\overline{BC}$ is parallel to secant $\overline{ADE}$, and chord $\overline{AB}$ is drawn.

![Diagram of circle O with tangent EC, chord BC parallel to secant ADE, and chord AB drawn.]

Prove: $\frac{BC}{CA} = \frac{AB}{EC}$

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) In circle O, tangent $\overline{EC}$ is drawn to diameter $\overline{AC}$. Chord $\overline{BC}$ is parallel to secant $\overline{ADE}$, and chord $\overline{AB}$ is drawn.</td>
<td>1) Given,</td>
</tr>
<tr>
<td>2) $\angle ABC$ is a right angle (a)</td>
<td>2) Since $\overline{AC}$ is the diameter, it splits the circle into two congruent arcs measuring $180^\circ$ each. Therefore, $\angle ABC$ is a right angle.</td>
</tr>
<tr>
<td>3) $\angle ACE$ is a right angle.</td>
<td>3) A tangent intersecting with a diameter forms a $90^\circ$ angle.</td>
</tr>
<tr>
<td>4) $\angle ACE \cong \angle ABC$ (a)</td>
<td>4) Right angles are congruent.</td>
</tr>
<tr>
<td>5) $\angle BCA \cong \angle EA C$ (a)</td>
<td>5) Parallel lines intersected by a transversal forms congruent alternate interior angles.</td>
</tr>
<tr>
<td>6) $\overline{BC} \cong \overline{AC}$</td>
<td>6) $AA(\parallel)$.</td>
</tr>
<tr>
<td>7) $\frac{BC}{CA} = \frac{AB}{EC}$</td>
<td>7) Similar triangles have proportional relationships with corresponding sides.</td>
</tr>
</tbody>
</table>

Score 4: The student gave a complete and correct response.
In the diagram below of circle $O$, tangent $\overline{EC}$ is drawn to diameter $\overline{AC}$. Chord $\overline{BC}$ is parallel to secant $\overline{ADE}$, and chord $\overline{AB}$ is drawn.

Prove: $\frac{BC}{CA} = \frac{AB}{EC}$

<table>
<thead>
<tr>
<th>Statement</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 In Circle $O$, tangent $\overline{EC}$ is drawn to diameter $\overline{AC}$ Chord $\overline{BC}$ is parallel to secant $\overline{ADE}$</td>
<td>Given</td>
</tr>
<tr>
<td>2 $\overline{BC} \parallel \overline{DE}$</td>
<td>If 2 lines are cut by a transversal, all int $\angle$s are $\angle$s</td>
</tr>
<tr>
<td>3 $\angle B$ is a rt. $\angle$</td>
<td>An angle inscribed in a semi-circle is a rt. $\angle$</td>
</tr>
<tr>
<td>4 $\overline{AC} \parallel \overline{CE}$</td>
<td>A tangent is $\perp$ to a diameter at its point of tangency</td>
</tr>
<tr>
<td>5 $\angle ECA$ is a rt. $\angle$</td>
<td>$\perp$ lines form rt. $\angle$s</td>
</tr>
<tr>
<td>6 $\angle B \parallel \angle ECA$</td>
<td>$\angle$s are $\angle$s</td>
</tr>
<tr>
<td>7 $\triangle ABC \sim \triangle ECA$</td>
<td>$\triangle$s of similar $\angle$s are $\sim$</td>
</tr>
<tr>
<td>8 $BC \times EC = AB \times CA$</td>
<td>The product of the extremes equals the product of the means</td>
</tr>
<tr>
<td>9 $\frac{BC}{CA} = \frac{AB}{EC}$</td>
<td>The product of the means equals the product of the extremes</td>
</tr>
</tbody>
</table>

**Score 3:** The student proved $\triangle ABC \sim \triangle ECA$, but no further correct work is shown.
In the diagram below of circle $O$, tangent $EC$ is drawn to diameter $AC$. Chord $BC$ is parallel to secant $ADE$, and chord $AB$ is drawn.

Prove: $\frac{BC}{CA} = \frac{AB}{EC}$

$\angle BCA \cong \angle EAC$ because $BC \parallel AE$ cut by a transversal makes alternate interior angles

$\angle ABC$ is a right angle because its an inscribed angle that intercepts a semi-circle of circle $O$.

$AC \perp CE$ because a diameter that intersects a tangent forms a $\perp$ lines

$\angle ACE$ is a right angle because $\perp$ lines form right angles

$\angle BCA \cong \angle EAC$ because all right angles are $\cong$

$\angle AEC \cong \angle AEC$ by reflexive property

$\triangle ABC \cong \triangle ACE$ by $\triangle AAS$

$\frac{BC}{CA} = \frac{AB}{EC}$ because $CPTC$

Score 2: The student proved $\angle BCA \cong \angle EAC$ and $\angle ABC \cong \angle ACE$, but no further correct work is shown.
Question 33

33 In the diagram below of circle O, tangent $\overline{EC}$ is drawn to diameter $\overline{AC}$. Chord $\overline{BC}$ is parallel to secant $\overline{ADE}$, and chord $\overline{AB}$ is drawn.

Prove: $\frac{BC}{CA} = \frac{AB}{EC}$

<table>
<thead>
<tr>
<th>S</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) $\angle BCA \equiv \angle CAD$</td>
<td>1) Alternate interior angles of parallel lines are equal</td>
</tr>
<tr>
<td>2) $\angle ABC = 90^\circ$</td>
<td>2) Any point on a circle connected to two end points of a diameter in the circle, creating a triangle, is a right angle in which it is $90^\circ$</td>
</tr>
<tr>
<td>3) $\angle AEC = 90^\circ$</td>
<td>3) A radius to a line that passes through the circle once at a point makes two right angles.</td>
</tr>
<tr>
<td>4) $\angle ABC = \angle AEC$</td>
<td>4) Right angles are equal to right angles</td>
</tr>
<tr>
<td>5) $\triangle BCA \sim \triangle CAE$</td>
<td>5) AA theorem.</td>
</tr>
<tr>
<td>6) $\frac{BC}{CA} = \frac{AB}{EC}$</td>
<td>6) Proportions for sides lengths that apply to the same opposite congruent angles may be used in the same place of the lines</td>
</tr>
</tbody>
</table>

Score 2: The student did not include the given and had an incorrect reason in step 6.
33 In the diagram below of circle $O$, tangent $\overline{EC}$ is drawn to diameter $\overline{AC}$. Chord $\overline{BC}$ is parallel to secant $\overline{ADE}$, and chord $\overline{AB}$ is drawn.

Prove: $\frac{BC}{CA} = \frac{AB}{EC}$

1. $\overline{EC}$ is drawn to diameter $\overline{AC}$
2. $\overline{BC} \parallel \overline{ADE}$, $\overline{AB}$ is drawn
3. $\angle ABC$ is a right angle
4. $\angle ACB$ is a right angle
5. $\Delta ABC \sim \Delta ACE$
6. $BC \cdot EC = CA \cdot AB$
7. $\frac{BC}{CA} = \frac{AB}{EC}$

Score 1: The student had one correct relevant statement and reason in step 2.
33 In the diagram below of circle O, tangent EC is drawn to diameter AC. Chord BC is parallel to secant ADE, and chord AB is drawn.

Prove: \( \frac{BC}{CA} = \frac{AB}{EC} \)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) EC is tangent to circle O's diameter AC. Chord BC is parallel to secant ADE, chord AB is drawn</td>
<td>1) Given</td>
</tr>
<tr>
<td>2) ( \overline{AC} \cong \overline{AC} )</td>
<td>2) Reflexive</td>
</tr>
<tr>
<td>3) ( \overline{CD} \cong \overline{AB} )</td>
<td>3) If 2 parallel lines are cut by a cord then that cord length is congruent to any other cord that are cut to the same parallel lines</td>
</tr>
<tr>
<td>4) ( \angle BAC \cong \angle ACD )</td>
<td>4) If 2 parallel lines are cut by a transversal</td>
</tr>
</tbody>
</table>

Score 0: The student did not show enough correct relevant work to receive any credit.
Keira has a square poster that she is framing and placing on her wall. The poster has a diagonal 58 cm long and fits exactly inside the frame. The width of the frame around the picture is 4 cm.

Determine and state the total area of the poster and frame to the nearest tenth of a square centimeter.

\[
\begin{align*}
\sin \theta &= \frac{o}{h} \\
\sin \left(45^\circ\right) &= \frac{x}{58} \\
58 \sin \left(45^\circ\right) &= x \\
41.0121 &= x
\end{align*}
\]

\[
TA = (x+8)(x+8) = (41.0121+8)(41.0121+8)
\]

\[
TA = 2402.2 \text{ cm}^2
\]

Score 4: The student gave a complete and correct response.
**Question 34**

34 Keira has a square poster that she is framing and placing on her wall. The poster has a diagonal 58 cm long and fits exactly inside the frame. The width of the frame around the picture is 4 cm.

Determine and state the total area of the poster and frame to the nearest tenth of a square centimeter.

\[ A = \frac{1}{2} d^2 \]
\[ A = \frac{1}{2} (58)^2 \]
\[ A = 1682 \text{ cm}^2 \]

\[ A = (\sqrt{1682} + 8)^2 \]
\[ A = 2402.195031... \]
\[ A \approx 2402.2 \text{ cm}^2 \]

**Score 4:** The student gave a complete and correct response.
34 Keira has a square poster that she is framing and placing on her wall. The poster has a diagonal 58 cm long and fits exactly inside the frame. The width of the frame around the picture is 4 cm.

Determine and state the total area of the poster and frame to the nearest tenth of a square centimeter.

\[
\begin{align*}
A &= x^2 + x^2 \\
\frac{336}{2} &= 2x^2 \\
\sqrt{168} &= x \\
41.01219 &= x
\end{align*}
\]

\[
\begin{align*}
A &= 1682.0 \\
Frame Area &= 720.2 \\
Total Area &= 2402.2
\end{align*}
\]

Score 4: The student gave a complete and correct response.
Keira has a square poster that she is framing and placing on her wall. The poster has a diagonal 58 cm long and fits exactly inside the frame. The width of the frame around the picture is 4 cm.

Determine and state the total area of the poster and frame to the nearest tenth of a square centimeter.

\[ a^2 + b^2 = c^2 \]
\[ 2a^2 + 2b^2 = c^2 \]
\[ 841 + 841 = c^2 \]
\[ 841 = \sqrt{c^2} \]
\[ 29 = c \]

\[ A = s^2 \]
\[ A = 49^2 \]
\[ A = 2401 \text{ cm}^2 \]

Score 3: The student made a transcription error by writing $\sqrt{1681}$. 
34 Keira has a square poster that she is framing and placing on her wall. The poster has a diagonal 58 cm long and fits exactly inside the frame. The width of the frame around the picture is 4 cm.

Determine and state the total area of the poster and frame to the nearest tenth of a square centimeter.

\[
\begin{align*}
  x^2 + y^2 &= z^2 \\
  y^2 + x^2 &= 58^2 \\
  2x^2 &= 58^2 \\
  x^2 &= 29^2 \\
  x &= \sqrt{29} \approx 5.4 \\

  A &= 45.0 \cdot 45.0 \\
  A &\approx 2025.0 \text{ cm}^2
\end{align*}
\]

**Score 2:** The student made an error in rounding \(\sqrt{1682}\) early and another error by adding 4 rather than 8 to find the length of the frame.
Keira has a square poster that she is framing and placing on her wall. The poster has a diagonal 58 cm long and fits exactly inside the frame. The width of the frame around the picture is 4 cm.

Determine and state the total area of the poster and frame to the nearest tenth of a square centimeter.

\[ x^2 + x^2 = 66^2 \]
\[ 2x^2 = 4356 \]
\[ x^2 = 2178 = \text{Area} \]

**Score 2:** The student made a conceptual error in finding the length of the diagonal.
34 Keira has a square poster that she is framing and placing on her wall. The poster has a diagonal 58 cm long and fits exactly inside the frame. The width of the frame around the picture is 4 cm.

Determine and state the total area of the poster and frame to the nearest tenth of a square centimeter.

\[ 2q^2 + 2q^2 = c^2 = \sqrt{1682} = 41.01 \text{ cm} \]

Poster area = 1682 cm²

Score 1: The student found the area of the poster, but no further correct work is shown.
34 Keira has a square poster that she is framing and placing on her wall. The poster has a diagonal 58 cm long and fits exactly inside the frame. The width of the frame around the picture is 4 cm.

Determine and state the total area of the poster and frame to the nearest tenth of a square centimeter.

\[
\begin{align*}
    a^2 + b^2 &= c^2 \\
    2a^2 + b^2 &= 58^2 \\
    841 + b^2 &= 3364 \\
    b^2 &= 2523 \\
    b &= 50.23 \\
    \text{area of poster} &= 1456.67 \\
\end{align*}
\]

Score 0: The student gave a completely incorrect response.
Isosceles trapezoid $ABCD$ has bases $DC$ and $AB$ with nonparallel legs $AD$ and $BC$. Segments $AE$, $BE$, $CE$, and $DE$ are drawn in trapezoid $ABCD$ such that $\angle CDE \equiv \angle DCE$, $AE \perp DE$, and $BE \perp CE$.

Prove $\triangle ADE \equiv \triangle BCE$ and prove $\triangle AEB$ is an isosceles triangle.

1. $ABCD$ is an isosceles trapezoid
2. $\overline{AE} \parallel \overline{DE}$
3. $\overline{AE} \perp \overline{DE}$
4. $\angle DEA$ is a right angle
5. $\angle CEB$ is a right angle
6. $\triangle ADE \equiv \triangle CBE$
7. $\angle CDE \equiv \angle DCE$
8. $\angle ADE \equiv \angle CEB$
9. $\triangle ADE \equiv \triangle CBE$
10. $\triangle AEB$ is an isosceles triangle

Score 6: The student gave a complete and correct response.
35 Isosceles trapezoid $ABCD$ has bases $DC$ and $AB$ with nonparallel legs $AD$ and $BC$. Segments $AE$, $BE$, $CE$, and $DE$ are drawn in trapezoid $ABCD$ such that $\angle CDE \equiv \angle DCE$, $AE \perp DE$, and $BE \perp CE$.

Prove $\triangle ADE \equiv \triangle BCE$ and prove $\triangle AEB$ is an isosceles triangle.

Score 6: The student gave a complete and correct response.
35 Isosceles trapezoid \(ABCD\) has bases \(\overline{DC}\) and \(\overline{AB}\) with nonparallel legs \(\overline{AD}\) and \(\overline{BC}\). Segments \(AE, BE, CE,\) and \(DE\) are drawn in trapezoid \(ABCD\) such that \(\angle CDE \equiv \angle DCE\), \(AE \perp DE\), and \(BE \perp CE\).

Prove \(\triangle ADE \equiv \triangle BCE\) and prove \(\triangle AEB\) is an isosceles triangle.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Isosceles trapezoid (ABCD) has bases (\overline{DC} ) and (\overline{AB})</td>
<td>1. given</td>
</tr>
<tr>
<td>2. (\angle CDE \equiv \angle DCE)</td>
<td>2. given</td>
</tr>
<tr>
<td>3. (AE \perp DE)</td>
<td>3. given</td>
</tr>
<tr>
<td>4. (BE \perp CE)</td>
<td>4. given</td>
</tr>
<tr>
<td>5. (\angle AED) is a right (\angle) (\angle BEC) is a right (\angle)</td>
<td>5. perpendicular lines form right (\angle)s</td>
</tr>
<tr>
<td>6. (\angle LAED \equiv \angle LBEC)</td>
<td>6. All right (\angle)'s are (\equiv)</td>
</tr>
<tr>
<td>7. (\overline{AADC} \equiv \overline{BCD})</td>
<td>7. Angles (\equiv) opposite of two (\equiv) sides are also (\equiv)</td>
</tr>
<tr>
<td>8. (\angle 1 \equiv \angle 2)</td>
<td>8. Subtraction</td>
</tr>
<tr>
<td>9. (AD \equiv BC)</td>
<td>9. legs of an isosceles trapezoid are (\equiv)</td>
</tr>
<tr>
<td>10. (\angle ADE \equiv \angle BCE)</td>
<td>10. (\triangle SSA \equiv \triangle SSA)</td>
</tr>
<tr>
<td>11. (AE \equiv BE)</td>
<td>11. CPCTC</td>
</tr>
<tr>
<td>12. (\triangle AEB) is an isosceles (\triangle)</td>
<td>12. A (\triangle) with (\angle) (\equiv) sides is isosceles</td>
</tr>
</tbody>
</table>

Score 5: The student had an incorrect reason in step 7.
Question 35

35 Isosceles trapezoid $ABCD$ has bases $\overline{DC}$ and $\overline{AB}$ with nonparallel legs $\overline{AD}$ and $\overline{BC}$. Segments $AE$, $BE$, $CE$, and $DE$ are drawn in trapezoid $ABCD$ such that $\angle CDE = \angle DCE$, $\overline{AE} \perp \overline{DE}$, and $\overline{BE} \perp \overline{CE}$.

Prove $\triangle ADE \cong \triangle BCE$ and prove $\triangle AEB$ is an isosceles triangle.

<table>
<thead>
<tr>
<th>S</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isosceles Trapezoid $ABCD$</td>
<td>Given</td>
</tr>
<tr>
<td>$\angle CDE \cong \angle DCE$</td>
<td>$\angle AED \cong \angle BCE$</td>
</tr>
<tr>
<td>$\angle ADE \cong \angle BCE$</td>
<td>Perpendicular lines form right angles</td>
</tr>
<tr>
<td>$\angle DEA \cong \angle CEB$</td>
<td>All right angles are congruent</td>
</tr>
<tr>
<td>$\overline{DE} \cong \overline{BE}$</td>
<td>If the base angles of a triangle are congruent, then the sides opposite them are congruent</td>
</tr>
<tr>
<td>$\overline{DA} \cong \overline{CB}$</td>
<td>Properties of isosceles trapezoid</td>
</tr>
<tr>
<td>$\triangle DEA \cong \triangle CEB$</td>
<td>HL(\cong)HL/High Leg Theorem</td>
</tr>
<tr>
<td>$EA \cong EB$</td>
<td>C.A.T.C.C.</td>
</tr>
<tr>
<td>$\triangle AEB$ is an isosceles triangle</td>
<td>If the base angles of a triangle are congruent, the triangle is isosceles.</td>
</tr>
</tbody>
</table>

Score 4: The student did not prove $\triangle DEA$ and $\triangle CEB$ are right triangles and wrote an incorrect last reason by referencing base angles when the student proved congruent sides.
Question 35

35 Isosceles trapezoid $ABCD$ has bases $\overline{DC}$ and $\overline{AB}$ with nonparallel legs $\overline{AD}$ and $\overline{BC}$. Segments $AE$, $BE$, $CE$, and $DE$ are drawn in trapezoid $ABCD$ such that $\angle CDE = \angle DCE$, $\overline{AE} \perp \overline{DE}$, and $\overline{BE} \perp \overline{CE}$.

Prove $\triangle ADE \equiv \triangle BCE$ and prove $\triangle AEB$ is an isosceles triangle.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Isosceles trapezoid $ABCD$</td>
<td>Q. What</td>
</tr>
<tr>
<td>$\angle CDE = \angle DCE$</td>
<td>2. An isosceles trapezoid has 2 $\perp$ legs</td>
</tr>
<tr>
<td>$\overline{AE} \perp \overline{DE}$, $\overline{BE} \perp \overline{CE}$</td>
<td>3. $\perp$ lines intersect to form 2 $\perp$ lines</td>
</tr>
<tr>
<td>$\overline{AE} \equiv \overline{BE}$, $\overline{CE} \equiv \overline{DE}$</td>
<td>4. $\perp$ lines are $\leq$.</td>
</tr>
<tr>
<td>$\triangle ADE \equiv \triangle BCE$</td>
<td>5. In a $\triangle$, sides opposite $\equiv$ are $\equiv$.</td>
</tr>
<tr>
<td>$\overline{AE} \equiv \overline{BE}$</td>
<td>6. $\text{SAS} \equiv \text{SAS}$</td>
</tr>
<tr>
<td>$\triangle AEB$ isosceles</td>
<td>7. If 2 $\triangle$s are $\equiv$, corresponding $\triangle$ points are $\equiv$.</td>
</tr>
<tr>
<td>8. An isosceles $\triangle$ with an $\triangle$</td>
<td></td>
</tr>
</tbody>
</table>

Score 4: The student made one conceptual error in proving $\triangle ADE \equiv \triangle BCE$ by SAS.
Question 35

35 Isosceles trapezoid $ABCD$ has bases $DC$ and $AB$ with nonparallel legs $AD$ and $BC$. Segments $AE$, $BE$, $CE$, and $DE$ are drawn in trapezoid $ABCD$ such that $\angle CDE = \angle DCE$, $AE \perp DE$, and $BE \perp CE$.

Prove $\triangle ADE \cong \triangle BCE$ and prove $\triangle AEB$ is an isosceles triangle.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Trapezoid $ABCD$</td>
<td>1. Given</td>
</tr>
<tr>
<td>$\angle CDE \cong \angle DCE$</td>
<td>2. Def of trapezoid</td>
</tr>
<tr>
<td>$AE \perp DE$</td>
<td>3. Has 2 congruent sides</td>
</tr>
<tr>
<td>$BE \perp CE$</td>
<td>4. Have right $\angle$s</td>
</tr>
<tr>
<td>2. $DA \equiv CB$</td>
<td>5. $HL \cong HL$</td>
</tr>
<tr>
<td>3. $\triangle DAE$ is an isosceles $\triangle$</td>
<td>6. $CPC\ TC$</td>
</tr>
<tr>
<td>4. $\triangle ADE$ and $\triangle BCE$ are right $\triangle$</td>
<td>7. Has 2 congruent sides</td>
</tr>
<tr>
<td>5. $\triangle ADE \cong \triangle BCE$</td>
<td></td>
</tr>
<tr>
<td>6. $AE \equiv BE$</td>
<td></td>
</tr>
<tr>
<td>7. $\triangle AEB$ is an isosceles $\triangle$</td>
<td></td>
</tr>
</tbody>
</table>

Score 3: The student did not prove $DE \cong CE$ and that $\angle DEA$ and $\angle CEB$ are right angles. The student also had an incorrect reason in step 2.
Question 35

35 Isosceles trapezoid $ABCD$ has bases $DC$ and $AB$ with nonparallel legs $AD$ and $BC$. Segments $AE$, $BE$, $CE$, and $DE$ are drawn in trapezoid $ABCD$ such that $\angle CDE \equiv \angle DCE$, $AE \perp DE$, and $BE \perp CE$.

Prove $\triangle ADE \equiv \triangle BCE$ and prove $\triangle AEB$ is an isosceles triangle.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Isosceles trapezoid $ABCD$ has bases $DC$ and $AB$, $AE \perp DE$, and $BE \perp CE$</td>
<td>Given</td>
</tr>
<tr>
<td>2. $BC \parallel AB$</td>
<td></td>
</tr>
<tr>
<td>3. $\angle CAE \equiv \angle CBE$ are r.t.s</td>
<td></td>
</tr>
<tr>
<td>4. $\angle CAE \equiv \angle CBE$</td>
<td></td>
</tr>
<tr>
<td>5. $\angle CEB$ and $\angle CBE$, $\angle EDA$ and $\angle ADE$ are corresponding $\angle s$.</td>
<td></td>
</tr>
<tr>
<td>6. $\triangle ADE \equiv \triangle BCE$</td>
<td>$S.A.S$</td>
</tr>
<tr>
<td>7. $\triangle AEB$ is an isosceles $\triangle$</td>
<td>$\equiv$ base $\angle s$ create an isosceles $\triangle$</td>
</tr>
</tbody>
</table>

Score 2: The student proved $\angle AED \equiv \angle BEC$, but no further correct relevant work is shown.
35 Isosceles trapezoid $ABCD$ has bases $\overline{DC}$ and $\overline{AB}$ with nonparallel legs $\overline{AD}$ and $\overline{BC}$. Segments $AE, BE, CE,$ and $DE$ are drawn in trapezoid $ABCD$ such that $\angle CDE \equiv \angle DCE$, $\overline{AE} \perp \overline{DE}$, and $\overline{BE} \perp \overline{CE}$.

Prove $\triangle ADE \cong \triangle BCE$ and prove $\triangle AEB$ is an isosceles triangle.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Proofs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isosceles trapezoid $ABCD$</td>
<td>Given</td>
</tr>
<tr>
<td>bases $\overline{DC}, \overline{AB}$</td>
<td></td>
</tr>
<tr>
<td>$\angle CDE \equiv \angle DCE$</td>
<td></td>
</tr>
<tr>
<td>$\overline{AE} \perp \overline{DE}$</td>
<td>2) perpendicular bisector form right angles</td>
</tr>
<tr>
<td>$\overline{BE} \perp \overline{CE}$</td>
<td></td>
</tr>
<tr>
<td>$\angle DCE$ and $\angle LCEB$ are right $\angle$s</td>
<td></td>
</tr>
<tr>
<td>$\angle DCE \equiv \angle LCEB$</td>
<td>3) right angles are always congruent</td>
</tr>
<tr>
<td>$\triangle ADE \equiv \triangle BCE$</td>
<td>4) Given</td>
</tr>
<tr>
<td>$\overline{DA} \equiv \overline{CB}$</td>
<td>5) Isosceles triangles have 2 congruent angles</td>
</tr>
<tr>
<td>$\triangle DEC$ is an isosceles $\triangle$</td>
<td>6) Isosceles triangles are triangles with 2 sides with equal length</td>
</tr>
<tr>
<td>$\overline{DE} \equiv \overline{EC}$</td>
<td>7) SAS $\equiv$ SAS</td>
</tr>
<tr>
<td>$\overline{AE} \equiv \overline{BE}$</td>
<td>8) corresponding parts of congruent triangles are congruent</td>
</tr>
<tr>
<td>$\triangle AEB$ is an isosceles triangle</td>
<td>9) If two sides are congruent, then the angles opposite of the sides in the triangle are congruent</td>
</tr>
</tbody>
</table>

**Score 2:** Some correct relevant statements about the proof are made in steps 3, 6, and 8, but four or more statements and/or reasons are missing or incorrect.
Question 35

Isosceles trapezoid $ABCD$ has bases $\overline{DC}$ and $\overline{AB}$ with nonparallel legs $\overline{AD}$ and $\overline{BC}$. Segments $AE$, $BE$, $CE$, and $DE$ are drawn in trapezoid $ABCD$ such that $\angle CDE = \angle DCE$, $\overline{AE} \perp \overline{DE}$, and $\overline{BE} \perp \overline{CE}$.

Prove $\triangle ADE \cong \triangle BCE$ and prove $\triangle AEB$ is an isosceles triangle.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. $\angle CDE \equiv \angle DCE$</td>
<td>1. Given</td>
</tr>
<tr>
<td>2. $\overline{DE} \equiv \overline{EC}$</td>
<td>2. In a triangle, $\equiv$ line by opposite $\equiv$ sides</td>
</tr>
<tr>
<td>3. $\overline{AE} \perp \overline{DE}$; $\overline{BE} \perp \overline{CE}$</td>
<td>3. Given</td>
</tr>
<tr>
<td>4. $\angle DAE$ and $\angle CEB$ are right angles</td>
<td>4. $\perp$ lines intersect to form right angles</td>
</tr>
<tr>
<td>5.</td>
<td></td>
</tr>
</tbody>
</table>

Score 1: The student had one correct statement and reason in step 4.
Isosceles trapezoid $ABCD$ has bases $DC$ and $AB$ with nonparallel legs $AD$ and $BC$. Segments $AE$, $BE$, $CE$, and $DE$ are drawn in trapezoid $ABCD$ such that $\angle CDE \equiv \angle DCE$, $AE \perp DE$, and $BE \perp CE$.

Prove $\triangle ADE \equiv \triangle BCE$ and prove $\triangle AEB$ is an isosceles triangle.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Isosceles trap $ABCD$ has bases $DC$ and $AB$ with non parallel legs $AD$ and $BC$</td>
<td>0. given</td>
</tr>
<tr>
<td>2. $\angle CDE \equiv \angle DCE$</td>
<td>1. given</td>
</tr>
<tr>
<td>3. $AE \perp DE &amp; BE \perp CE$</td>
<td>2. given</td>
</tr>
<tr>
<td>4. $\angle 1 \equiv \angle 2$</td>
<td>3. verticle angles are congruent</td>
</tr>
<tr>
<td>5. $\triangle ADE \equiv \triangle BCE$</td>
<td>4. Opp. sides of a trap.</td>
</tr>
<tr>
<td>6. $\triangle AEB$ is an isosceles $\triangle$</td>
<td>5. Substitution</td>
</tr>
<tr>
<td>7. $\triangle AEB$ is an isosceles $\triangle$</td>
<td>6. ASA</td>
</tr>
<tr>
<td>8. $\triangle CPCTC$</td>
<td>7. CPCTC</td>
</tr>
</tbody>
</table>

**Score 0:** The student gave a completely incorrect response.
A rectangular in-ground pool is modeled by the prism below. The inside of the pool is 16 feet wide and 35 feet long. The pool has a shallow end and a deep end, with a sloped floor connecting the two ends. Without water, the shallow end is 9 feet long and 4.5 feet deep, and the deep end of the pool is 12.5 feet long.

If the sloped floor has an angle of depression of 16.5 degrees, what is the depth of the pool at the deep end, to the nearest tenth of a foot?

\[
\tan(16.5) = \frac{x}{13.5} \\
13.5 \tan(16.5) = x \\
x = 3.98882182 \\
x = 3.99 \text{ ft}
\]

Find the volume of the inside of the pool to the nearest cubic foot.

\[
V_1 = 9.5 \times 16 \times 9 = 1449 \\
V_2 = 12.5 \times 16 \times 8.5 = 2000 \\
V_3 = 13.5 \times 4.5 \times 16 = 972 \\
V_1 + V_2 + V_3 + V_T = 3752.1
\]

Question 36 is continued on the next page.
A garden hose is used to fill the pool. Water comes out of the hose at a rate of 10.5 gallons per minute. How much time, to the nearest hour, will it take to fill the pool 6 inches from the top? \([1 \text{ ft}^3 = 7.48 \text{ gallons}]\)

\[
\begin{align*}
\text{Volume} &= 16.38 \times 15 = 245.7 \text{ ft}^3 \\
375 \times 2.780 &= 3472 \\
3472 \times 7.48 &= 25970.56 \text{ gallons} \\
25970.56 \div 10.5 &= 2473.38667 \text{ minutes} \\
2473.38667 \div 60 &= 41.2231111 \\
&= 41 \text{ hours}
\end{align*}
\]

**Score 6:** The student gave a complete and correct response.
36 A rectangular in-ground pool is modeled by the prism below. The inside of the pool is 16 feet wide and 35 feet long. The pool has a shallow end and a deep end, with a sloped floor connecting the two ends. Without water, the shallow end is 9 feet long and 4.5 feet deep, and the deep end of the pool is 12.5 feet long.

If the sloped floor has an angle of depression of 16.5 degrees, what is the depth of the pool at the deep end, to the nearest tenth of a foot?

\[
\tan(16.5°) = \frac{x}{13.5} = 3.99 = 4
\]

\[4 + 4.5 = 8.5\]

Find the volume of the inside of the pool to the nearest cubic foot.

\[(16)(4.5)(9) = 648\]
\[(12.5)(8.5)(16) = 1700\]
\[(13.5)(4.5)(16) = 972\]
\[\frac{1}{2}(4)(13.5)(16) = 432\]

Volume \[8752\]
A garden hose is used to fill the pool. Water comes out of the hose at a rate of 10.5 gallons per minute. How much time, to the nearest hour, will it take to fill the pool 6 inches from the top? [1 ft$^3$ = 7.48 gallons]

\[
\begin{align*}
\text{volume of pool} & = 3752 \\
\text{volume of air} & = (0.5)(16)(35) = 280 \\
\text{water volume} & = 3752 - 280 = 3472 \cdot 7.48 \\
\text{time} & = \frac{25970.5}{(10.5)(60)} = 41.223 \\
\end{align*}
\]

\[\text{41.2 hours}\]

**Score 5:** The student made a rounding error when finding the time.
A rectangular in-ground pool is modeled by the prism below. The inside of the pool is 16 feet wide and 35 feet long. The pool has a shallow end and a deep end, with a sloped floor connecting the two ends. Without water, the shallow end is 9 feet long and 4.5 feet deep, and the deep end of the pool is 12.5 feet long.

If the sloped floor has an angle of depression of 16.5 degrees, what is the depth of the pool at the deep end, to the nearest tenth of a foot?

\[
\tan(16.5) \times 13.5 = 3.985718199 + 4.5
\]

The depth is \(8.5\) ft.

Find the volume of the inside of the pool to the nearest cubic foot.

\[
12.5 \times 16 = 200 \times 9 = 5400
\]

\[
13.5 \times 16 = 216 - 4 = 504
\]

\[
2520 + 5400 + 532 = 9752\, \text{ft}^3
\]

Question 36 is continued on the next page.
Question 36 continued

A garden hose is used to fill the pool. Water comes out of the hose at a rate of 10.5 gallons per minute. How much time, to the nearest hour, will it take to fill the pool 6 inches from the top? 

\[
\frac{3752}{2.48} = \frac{501.604278078}{10.5} \text{ hours}
\]

\[
47.7\text{ hours}
\]

Score 4: The student found 8.5 and 3752, but no further correct work is shown.
A rectangular in-ground pool is modeled by the prism below. The inside of the pool is 16 feet wide and 35 feet long. The pool has a shallow end and a deep end, with a sloped floor connecting the two ends. Without water, the shallow end is 9 feet long and 4.5 feet deep, and the deep end of the pool is 12.5 feet long.

If the sloped floor has an angle of depression of 16.5 degrees, what is the depth of the pool at the deep end, to the nearest tenth of a foot?

\[ 4.5 + 3.9988821 = 8.5 \text{ ft} \]

Find the volume of the inside of the pool to the nearest cubic foot.

\[ \text{Volume} = 4.5 \times 9 \times 16 + 16 \times 26 \times 8.5 \]
\[ = 648 + 3536 = 4184 \text{ cubic ft} \]

Question 36 is continued on the next page.
Question 36 continued

A garden hose is used to fill the pool. Water comes out of the hose at a rate of 10.5 gallons per minute. How much time, to the nearest hour, will it take to fill the pool 6 inches from the top? [1 ft³ = 7.48 gallons]

Score 4:  The student did not find the time.
A rectangular in-ground pool is modeled by the prism below. The inside of the pool is 16 feet wide and 35 feet long. The pool has a shallow end and a deep end, with a sloped floor connecting the two ends. Without water, the shallow end is 9 feet long and 4.5 feet deep, and the deep end of the pool is 12.5 feet long.

If the sloped floor has an angle of depression of 16.5 degrees, what is the depth of the pool at the deep end, to the nearest tenth of a foot?

\[
\tan(16.5^\circ) = \frac{4}{13.5} \\
13.5 \tan(16.5^\circ) = 4 \\
0 = 4 \text{ ft}
\]

Find the volume of the inside of the pool to the nearest cubic foot.

\[
V = Bh \\
V = (16)(4.5)(35) \\
V = 2520 \\
V = 800 + 432 \\
\boxed{V = 3752 \text{ ft}^3}
\]
A garden hose is used to fill the pool. Water comes out of the hose at a rate of 10.5 gallons per minute. How much time, to the nearest hour, will it take to fill the pool 6 inches from the top? [1 ft³ = 7.48 gallons]

\[
\frac{10.5}{7.48} = 1.4188 \approx 10.5
\]

Score 3: The student correctly found the volume of the pool, but did not add 4.5 when finding the depth, and did not find the time correctly.
A rectangular in-ground pool is modeled by the prism below. The inside of the pool is 16 feet wide and 35 feet long. The pool has a shallow end and a deep end, with a sloped floor connecting the two ends. Without water, the shallow end is 9 feet long and 4.5 feet deep, and the deep end of the pool is 12.5 feet long.

If the sloped floor has an angle of depression of 16.5 degrees, what is the depth of the pool at the deep end, to the nearest tenth of a foot?

\[
35 - (4 + 12.5) = 13.5 \quad (\tan 16.5 = \frac{x}{13.5}) 13.5
\]
\[
13.5 \tan 16.5 = x \\
3.0 \left(1 = x \right) \\
4.0 + 4.5 = 8.5 \text{ ft}
\]

Find the volume of the inside of the pool to the nearest cubic foot.

\[
V = \frac{1}{2} bh \\
V = \frac{1}{2} (13.5 \cdot 4) \\
V = \frac{1}{2} (54) \\
V = 27 \text{ ft}^3
\]
Question 36 continued

A garden hose is used to fill the pool. Water comes out of the hose at a rate of 10.5 gallons per minute. How much time, to the nearest hour, will it take to fill the pool 6 inches from the top? [1 ft³ = 7.48 gallons]

\[3347 \cdot 7.48 = 25,035.56 \text{ gallons}\]

\[10.5 \cdot 25,035 = 262,873.38 \text{ gallons}\]

\[262,873 \text{ minutes}\]

**Score 3:** The student did not multiply by 16 when finding the volume of the triangular prism and did not find the time correctly.
36 A rectangular in-ground pool is modeled by the prism below. The inside of the pool is 16 feet wide and 35 feet long. The pool has a shallow end and a deep end, with a sloped floor connecting the two ends. Without water, the shallow end is 9 feet long and 4.5 feet deep, and the deep end of the pool is 12.5 feet long.

If the sloped floor has an angle of depression of 16.5 degrees, what is the depth of the pool at the deep end, to the nearest tenth of a foot?

\[
\sin 16.5^\circ = \frac{r}{4.5}
\]

\[
r = \frac{4.5 \cdot \sin 16.5^\circ}{2.08347207169}
\]

\[
r \approx 0.32
\]

The depth of the pool at the deep end is approximately 8.3 feet.

Find the volume of the inside of the pool to the nearest cubic foot.

\[
\begin{align*}
V &= l \times w \times h \\
V &= 4.5 \times 12.5 \times 35 \\
V &\approx 2520
\end{align*}
\]

The volume of the pool is approximately 2520 cubic feet.
A garden hose is used to fill the pool. Water comes out of the hose at a rate of 10.5 gallons per minute. How much time, to the nearest hour, will it take to fill the pool 6 inches from the top? [1 ft³ = 7.48 gallons]

Score 2: The student made an error when labeling 13.5 in the diagram, made an error when finding the volume of the triangular prism, and did not find the time.
36 A rectangular in-ground pool is modeled by the prism below. The inside of the pool is 16 feet wide and 35 feet long. The pool has a shallow end and a deep end, with a sloped floor connecting the two ends. Without water, the shallow end is 9 feet long and 4.5 feet deep, and the deep end of the pool is 12.5 feet long.

If the sloped floor has an angle of depression of 16.5 degrees, what is the depth of the pool at the deep end, to the nearest tenth of a foot?

\[
\tan 16.5^\circ = \frac{x}{13.5} \quad \Rightarrow \quad x = 18.2396 \quad \Rightarrow \quad x \approx 18.2 \text{ ft}
\]

Find the volume of the inside of the pool to the nearest cubic foot.

\[
\frac{1}{2} \cdot 16 \cdot 4.5 = 36 \text{ ft}^2 \quad \Rightarrow \quad A = 4.5 \times 9 \times 16 = 648 \text{ ft}^3 \quad \Rightarrow \quad A = 4540 \text{ ft}^3
\]

Question 36 is continued on the next page.
Question 36 continued

A garden hose is used to fill the pool. Water comes out of the hose at a rate of 10.5 gallons per minute. How much time, to the nearest hour, will it take to fill the pool 6 inches from the top? [1 ft³ = 7.48 gallons]

\[
\frac{10.5 \text{ g}}{1 \text{ min}} \times \frac{x}{60 \text{ min}} = x = 630 \text{ gallons in an hour}
\]

Score 1: The student wrote a correct trigonometric equation to find the depth of the pool. The student did not show enough correct work to find the total volume of the pool. The student did not find the time to fill the pool.
36 A rectangular in-ground pool is modeled by the prism below. The inside of the pool is 16 feet wide and 35 feet long. The pool has a shallow end and a deep end, with a sloped floor connecting the two ends. Without water, the shallow end is 9 feet long and 4.5 feet deep, and the deep end of the pool is 12.5 feet long.

If the sloped floor has an angle of depression of 16.5 degrees, what is the depth of the pool at the deep end, to the nearest tenth of a foot?

\[ \text{Find the volume of the inside of the pool to the nearest cubic foot.} \]

\[ V = l \cdot w \cdot h \]
\[ = 9 \cdot 16.5 \cdot 3 \]
\[ = 504 \text{ ft}^3 \]
\[ \frac{5040}{10} = 480 \]

\[ \text{Ans} \ 480 \text{ hrs} \]

Question 36 is continued on the next page.
Question 36 continued

A garden hose is used to fill the pool. Water comes out of the hose at a rate of 10.5 gallons per minute. How much time, to the nearest hour, will it take to fill the pool 6 inches from the top? [1 ft$^3 = 7.48$ gallons]

Score 0: The student showed no correct relevant work.
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.