BOX IT UP

Rubric and Sample Responses

Question 1

RUBRIC

Diagram

Score	Description
6	Student diagram demonstrates complete understanding of calculating the volume of rectangular prisms with fractional sides, drawing nets, and calculating volume and surface area. • Completely accurate and correct diagram. (3 points) • Include the scale, the actual dimensions, the volume, and the surface area. (3 point)

Explanation

Score	Description
2	Response demonstrates thorough understanding of volume, surface area, and nets. • Student thoroughly explains process used to calculate the dimensions of the rectangular prism's dimensions. (1 point) • Student thoroughly explains client requirements for this container. (1 point)
0	Response does not demonstrate understanding of volume, surface area, or nets. Response missing or completely inaccurate.

SAMPLE RESPONSE
Scenario 1

The client requested a package to contain macaroni. The package must have a volume between 400 and 410 cubic inches. I estimated that the faces had to be rectangles at least 14.25 inches by 5.5 inches, 14.25 inches by 4.5 inches, and 5.5 inches by 4.5 inches, because each of the shapes would fit on rectangles of those sizes.

Next, I calculated the volume with those measurements and found that the container had a volume of 352.6875. That was too small, so I looked for factors of 405 that were slightly larger. I found that 4.5 x 6 x 15 came out to the correct volume, and each face would be large enough to hold the six required shapes. The total surface area for this rectangular prism would be 369 square inches.

Question 2

RUBRIC

Diagram

Score	Description
4	Response demonstrates complete understanding of drawing nets, calculating surface area, and calculating scrap. • Accurate and correct diagram. (2 points) • Includes scale. (1 point) • Includes scale drawing of material (1 point)

Explanation

Score	Description
2	Response demonstrates thorough understanding of surface area and nets and includes calculation of the amount of scrap material. • Student thoroughly explains process used to place nets on the raw material (1 point) • Student thoroughly explains process used to calculate scrap (1 point)

SAMPLE RESPONSE

Scenario 1

This net can be placed on a sheet of raw material so that three packages can be created. The raw material is 42" by 42", and the net fits into a rectangle that is 24" by 21". Since 21 is half of 42, that means that two nets can be laid side by side on the 42" square sheet of raw material, and a third copy fits below them if it is turned sideways. If three nets are placed on the raw material sheet, the scrap would be 657 square inches. This figure was calculated by combining the surface areas of three nets and subtracting from the area of the raw material.

Question 3

RUBRIC

Diagram

Score	Description
6	Response demonstrates thorough understanding of calculating area of varied triangles and quadrilaterals, placement of polygons on coordinate grid, and accurate labeling of points on the grid. • Accurate and correct diagrams of all 6 faces. (3 points) • Provides correct area of each shape. (3 points)

Explanation

Score	Description
2	Response demonstrates thorough understanding of placing required shapes on coordinate grid, naming points, and justifying placement of given shapes on given faces of the rectangular prism, using references to area. • Student thoroughly explains the process used to place shapes on specific faces. (1 point) • Student thoroughly explains where shapes have been placed using coordinates and named points. (1 point)

SAMPLE RESPONSE

These diagrams use a $\frac{1}{4}$" = $\frac{1}{2}$" scale. The trapezoid and the isosceles triangle were the largest figures, with areas of 63 square inches and 40.5 square inches, so I placed them on the largest faces. Using the lower left corner of the 6" by 15" face as (0, 0) on a coordinate grid, the trapezoid will fit nicely if point A is at (5.5, 0.5), B is at (5.5, 14), C is at (0.25, 11), and D is at (0.25, 0.5). That gives it the required dimensions of base 1 = 13.5", base 2 = 10.5" and a height of 5.25". The isosceles triangle fits well on the other 6" by 15" face. Starting at (0, 0) with point E, F is at (6, 0), and G should be at (3, 13.5). This gives the triangle the correct dimensions of a 6-inch base and a height of 13.5 inches.

The arrow and the rectangle had the next largest areas. The rectangle's area is 53.4375 square inches. The arrow is not a regular shape, so I broke it into a triangle and a rectangle to find the area. The two shapes totaled 28.065 square inches, so I placed them on the medium-sized faces that measure 15" by 4.5". The larger rectangle can be made by putting point H at (0.25, 0.75), I at (4, 0.75), J at (4, 15), and K at (0.25, 15). The arrow can be made by placing Point L at (1.5, 0.75), and then connecting Point M at (3.5, 0.75), Point N at (3.5, 11.5), Point L' at (4.25, 11.5), Point M' at (2.5, 15), Point O' at (0.5, 11.5), Point O at (1.5, 11.5) and back to Point L.

Finally, the square and the right triangle were the smallest figures, so they should go on the smallest faces. The smallest faces of this rectangular prism are 4.5" by 6". The square, with an area of 20.25 square inches, can be drawn at points P (0, 0.5), Q (4.5, 0.5), R (4.5, 5), and S (0, 5). The right triangle, with an area of 11.8125 square inches, can be drawn by connecting points T (0, 0), U (4.5, 0), and V (0, 5.25).

Question 4

RUBRIC

Diagram

Score	Description
6	Student diagram demonstrates complete understanding of calculating the volume of rectangular prisms with fractional sides, drawing nets, and calculating volume and surface area. • Completely accurate and correct diagram. (3 points) • Includes the scale, the actual dimensions, the volume, and the surface area. (3 points)

Explanation

Score	Description
2	Response demonstrates thorough understanding of volume, surface area, and nets. • Student thoroughly explains process used to calculate the dimensions of the rectangular prism's dimensions. (1 point) • Student thoroughly explains client requirements for this container. (1 point)
0	Response does not demonstrate understanding of volume, surface area, or nets. Response missing or completely inaccurate.

SAMPLE RESPONSE

Scenario 2

The client requested a package to contain a rolling pin. The package must have a volume between 990 and 1000 cubic centimeters. I estimated that two of the faces must be 6 cm square, so the other four faces must be at least 27.75 cm by 6 cm. Each of the shapes would fit on rectangles of those sizes.

Next, I calculated the volume with those measurements and found that the container had a volume of 999 cubic inches with those dimensions. That was within the range requested by the client (990-1000). The total surface area for this shape is 738 square cm.

Question 5

RUBRIC

Diagram

Score	Description
4	Response demonstrates thorough understanding of drawing nets, calculating surface area, and calculating scrap. • Accurate and correct diagram (2 points) • Include scale (1 point) • Includes scale drawing of material. (1 point)

Explanation

Score	Description
2	Response demonstrates thorough understanding of surface area and nets and includes calculation of the amount of scrap material. • Student thoroughly explains process used to place nets on the raw material (1 point) • Student thoroughly explains process used to calculate scrap. (1 point)

SAMPLE RESPONSE

Scenario 2

This net can be placed on a sheet of raw material so that two packages can be created. The raw material is 42 cm by 51 cm, and the net fits into a rectangle that is 24 cm by 39.75 cm. The scale is $\frac{1}{4}$" represents 1.5 cm. However, if the small square faces are placed on opposite sides of the net and offset, you can place two of the nets on one sheet of plastic. If two nets are placed on the raw material sheet, the scrap would be 666 square centimeters—less than the surface area of one of the rectangular prisms, which is 738 square centimeters. This figure was calculated by combining the surface areas of two nets and subtracting that figure from the area of the sheet of raw material.

Question 6

RUBRIC

Diagram

Score	Description
6	Response demonstrates complete understanding of calculating area of varied triangles and quadrilaterals, placement of polygons on coordinate grid, and accurate labeling of points on the grid. • Accurate and correct diagrams of all 6 faces (3 points) • Provides correct area of each shape. (3 points)

Explanation

Score	Description
2	Response demonstrates thorough understanding of placing required shapes on coordinate grid, naming points, and justifying placement of given shapes on given faces of the rectangular prism, using references to area. • Student thoroughly explains process used to place shapes on specific faces. (1 point) • Student thoroughly explains where shapes have been placed using coordinates and names points (1 point)

SAMPLE RESPONSE

These diagrams use a $\frac{1}{4}$" represents 1 cm scale. The 5.5 cm by 6 cm rectangle and the two right triangles with base and heights of 6 cm were the smallest figures, with areas of 33 square centimeters for the square and 18 square centimeters for each triangle. I placed the small rectangle on one square face and the two triangles on the other. The triangles must have the hypotenuses on the same line, running diagonally from one corner of the face to the other. Using the lower left corner of the 6 cm by 6 cm face, the rectangle can be created by connecting points A (0, 0), B (5.5, 0), C (5.5, 6), and D (0, 6). The two triangles can be created on the other 6 cm by 6 cm piece using points E at (0, 0), F at (6, 0), and G at (0, 6) for the first triangle, and points F (6, 6), H (6, 6), and G at (0, 6) for the second triangle.

The other four faces of this rectangular prism are the same size: 6 cm by 27.75 cm. The other shapes can fit on them. One face could hold the isosceles triangle (area 81.75 square centimeters). This can be created by connecting point I (0, 0) to J (6, 0) to K at (3, 27.25), and back to I. The two squares, each with an area of 25 square centimeters, can be made by starting with point L at (0.5, 9) and connecting M (5.5, 9), N (5.5, 14), and O (0.5, 14). Start the second square at O (0.5, 14) and draw a line segment to N at (5.5, 14), Q at (5.5, 19), P at (0.5, 19), and back to O at (0.5, 14). The trapezoid has an area of 123.0625 square centimeters, and can be drawn on another of the 6 cm by 27.75 faces by starting at point R at (0, 2) and going to S at (5.5, 3), T at (5.5, 22), U at (0, 27.75), and back to R.

The final figure, the arrow, is irregular. I split it into a triangle and a rectangle to find the area. The area is 34.125 square centimeters. It can be drawn on the remaining 6 cm by 27.75 cm face. Start at point V at (2,0) and draw a line to point W at (3,0). Next, draw a line segment to points X at (3,22), Y at (5,22), Z at (2.5,27.5), A' at (0,22), B' at (2,22) and back to V to complete the arrow.

Question 7

RUBRIC

Diagram

Score	Description
6	Student diagram demonstrates complete understanding of calculating the volume of rectangular prisms with fractional sides, drawing nets, and calculating volume and surface area. • Completely accurate and correct diagram. (3 points) • Includes the scale, the actual dimensions, the volume, and the surface area. (3 point)

Explanation

Score	Description
2	Response demonstrates thorough understanding of volume, surface area, and nets. • Student thoroughly explains process used to calculate the dimensions of the rectangular prism's dimensions. (1 point) • Student thoroughly explains client requirements for this container (1 point)

SAMPLE RESPONSE

Scenario 3

The client requested a package to contain a model train starter set. The package must have a volume between 1415 and 1420 cubic inches. I estimated that the faces had to be rectangles at least 14.5 inches by 20 inches, 20 inches by 4.5 inches, and 4.5 inches by 14.5 inches, because each of the shapes would fit on rectangles of those sizes.

Next, I calculated the volume with those measurements and found that the container had a volume of 1305 cubic inches with those dimensions. That was too small, so I tried to find factors of 1420 that were slightly larger. I found that 4.5 x 15 x 21 came out to a volume of 1417.5 cubic inches, and each face would be large enough to hold the six required shapes. The total surface area for this rectangular prism would be 954 square inches.

Question 8

RUBRIC

Diagram

Score	Description
4	Response demonstrates complete understanding of drawing nets, calculating surface area, and calculating scrap. • Accurate and correct diagram (2 points) • Include scale (1 point) • Includes scale drawing of material. (1 point)

Explanation

Score	Description
2	Response demonstrates thorough understanding of using equivalent fractions to add and subtract fractions. • Student thoroughly explains process used to place nets on the raw material (1 point) • Student thoroughly explains process used to calculate scrap. (1 point)

SAMPLE RESPONSE

Scenario 3

This net can be placed on a sheet of raw material so that two packages can be created. The raw material is 57" by 43.5". The scale is $\frac{1}{4}$" represents $1\frac{1}{2}$". If one 4.5" by 21" face is placed on the right-hand side of the bottom 15" by 21" face on the net, and the other 4.5" by 21" face is positioned on the top left of the net next to the 4.5" by 15" face, you can place two of the nets on one sheet of plastic. If two nets are placed on the raw material sheet, the scrap would be 571.5 square inches. This figure was calculated by combining the surface areas of two nets and subtracting that figure from the area of the sheet of raw material.

Question 9

RUBRIC

Scoring Guides

Score	Description
6	Response demonstrates complete understanding of calculating area of varied triangles and quadrilaterals, placement of polygons on coordinate grid, and accurate labeling of points on the grid. • Accurate and correct diagrams of all 6 faces (3 points) • Provides correct area of each shape. (3 points)

Explanation

Score	Description
2	Response demonstrates thorough understanding of placing required shapes on coordinate grid, naming points, and justifying placement of given shapes on given faces of the rectangular prism, using references to area. • Student thoroughly explains process used to place shapes on specific faces. (1 point) • Student thoroughly explains where shapes have been placed using coordinates and names points (1 point)

SAMPLE RESPONSE

Scenario 3

These diagrams use a $\frac{1}{4}$" represents $\frac{1}{2}$" scale. The trapezoid with bases of 14.5" and 8.5" and height of 20" and the 20"x 14" rectangle were the largest figures, with areas of 230 and 280 square inches, so I placed them on the largest faces of the rectangular prism. If you draw point A at (0.5, 0.5) on a coordinate grid, and then connect points D at (15, 0.5), E at (10.5, 20.5), and F at (2, 20.5) and then go back to point A, the large trapezoid will fit on this face. The other large face contains a rectangle that should start at point L at (0, 0), go to points M at (14, 0), N at (14, 20), and O at (14, 0), and then go back to point L.

The 21" by 4.5" faces can contain the isosceles triangle and the arrow. . The triangle has an area of 40 square inches and the small rectangle has an area of 92.25 square inches, which fit on the long, narrow faces. The isosceles triangle should start at point P at (0.5, 0), go to points Q at (4.5, 0) and R at (2.5, 20), and then connect back to point P. The arrow is an irregular shape, so I broke it into a triangle and a rectangle to calculate its area. The area came to 34.125 square inches. If you start with Point S at (1.5, 0), then draw a line to Point T at (3,0), then Point U at (3,16), Point V at 4.5, 16), Point W at (2.25, 20.5), Point X at (0,16), Point Y at (1.5, 16) and back to Point S, the arrow will fit onto this side.

The smallest faces of this package were 15" by 4.5". The remaining shapes will fit on them. The square has an area of 16 square inches, and three were requested. This means the total area of all three squares is 48 square inches. The area of the right triangle is 29.75 square inches. The area of the smallest face is 67.5 square inches, so all of the figures fit. The three squares can go on one panel if the first square is placed at points E at (0.25, 0.5), F at (4.25, 0.5), G at (4.25, 4.5), and H at (0.25, 4.5), going 42 back to point E to complete the square. Duplicate this square starting at (0.25, 5.5), (4.25, 5.5), (4.25, 9.5), and (0.25, 9.5). Duplicate the square again starting at (0.25, 10.5), (4.25, 10.5), (4.25, 14.5), and (0.25, 14.5), and the three squares will be evenly spaced and centered. The right triangle can go on the other 15" by 4.5" face. Start with point I at (0, 0.5) and draw a line segment to J at (4.25, 0.5), and then to K at (0, 14.5).