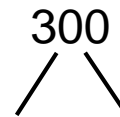


**J**acque's *Locks, Latches and Packages* is an assembly facility that makes unique packages to ship customers' products. Most of their customers are small businesses, but today the *Master Billiard Company* has placed a very large order which will keep Jacque's employees busy for months. The customer has ordered the design of a package to ship 300 billiard chucks, each of which has already been packaged in a cardboard cube measuring one inch on each side. Each of the thousands of packages will feature a shiny red and blue foil exterior emblazoned with the *Master* logo in silver foil. Since the foil exterior is somewhat expensive, Jacque's employees are tasked with finding the ideal package size which will hold the 300 cubes (volume) while using the smallest amount of foil (surface area).



Find the prime factorization of 300, the number of cubes to be transported. Prime factorizations are commonly called factor trees.



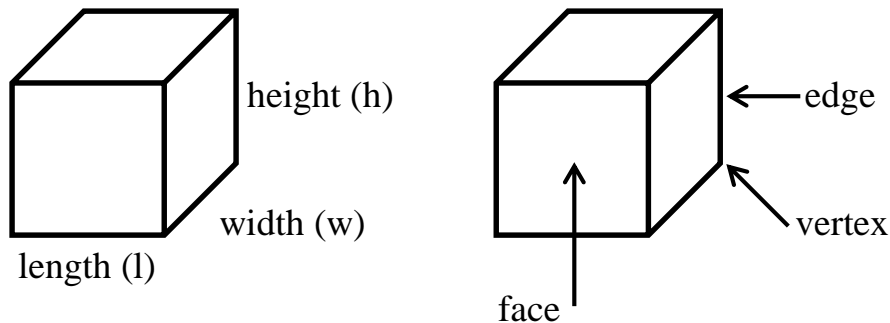
$$300 = \underline{\quad} \times \underline{\quad} \times \underline{\quad} \times \underline{\quad} \times \underline{\quad}$$

Multiply these together in various combinations to list all the factors of 300. There are a total of 18.

- \_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_,
- \_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_

Practice at <http://illuminations.nctm.org/ActivityDetail.aspx?ID=6>

Rectangular Prisms look like boxes. They have faces, edges, and vertices.



The opposite faces of a rectangular prism are parallel to each other. If all six sides are the same size, like with dice, the rectangular prism is called a Cube.

The plural of vertex is vertices. How many does a rectangular prism have? \_\_\_\_\_

How many edges does a rectangular prism have? \_\_\_\_\_

How many faces does a rectangular prism have? \_\_\_\_\_

The sizes associated with a rectangular prism come in three dimensions. The edges of a rectangular prism are typically called the length, width and height. Each of these might be represented in inches (in), feet (ft) or meters (m).

The faces of a rectangular prism are measured in area. Faces may be measured in square inches (in<sup>2</sup>), square centimeters (cm<sup>2</sup>) or square yards (yd<sup>2</sup>).

The amount of “stuff” a rectangular prism can hold is called its volume. Since the volume is the amount of cubes a container can hold, it is measured in cubic inches (in<sup>3</sup>), cubic centimeters (cm<sup>3</sup>) or cubic feet (ft<sup>3</sup>).

Sometimes it matters when it says, “This end up” or “This end down,” but no matter how you turn the box (rectangular prism), it doesn’t change size (volume or surface area).





Scoring Rubric for *Jacque's Locks, Latches and Packages*

0 points No Prime Factorization	3 points Draw a proper factor tree or list the prime factors	6 points Draw a proper factor tree and list the prime factors
0 points List fewer than 10 factors of 300	3 points List 10 to 17 factors of 300 (or 18 out of order)	6 points Correctly list all 18 factors of 300 in order
0 points Answer 0 or 1 question(s) about vertices, edges and faces correctly	4 points Answer 2 questions about vertices, edges and faces correctly	8 points Answer 3 questions about vertices, edges and faces correctly
0 points Incorrectly determine formulas to find the surface area of the left, right, front, back, top and bottom of a rectangular prism and use them to complete the second line of the table		6 points Correctly determine formulas to find the surface area of the left, right, front, back, top and bottom of a rectangular prism and use them to complete the second line of the table
0 points Correctly fill in the first three categories (l,w,h) with less than 10 combinations of factors that multiply to 300	15 points Correctly fill in the first three categories (l,w,h) with 10 to 19 combinations of factors that multiply to 300	20 points Correctly fill in the first three categories (l,w,h) with all 20 combinations of factors that multiply to 300
0 points Correctly calculate the surface area of fewer than 60 faces	15 points Correctly calculate the surface area of 60 to 100 faces	20 points Correctly calculate the surface area of 101 to 120 faces
1 point each (up to 20) ...for correctly calculating the total surface of each rectangular prism		
0 points Recommending a box size that is less efficient than the previous box	4 points Recommending a box size that is more efficient than the previously box	7 points Recommending the most efficient box size to pack 300 one-inch cubes
0 points No cost savings calculations	4 points Calculating savings for a box that saves money	7 points Calculating the correct savings for the most efficient box that the company can make for the customer

Answers:

Prime Factors

$$300 = 2 \times 2 \times 3 \times 5 \times 5$$

Factors of 300

1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 25, 30, 50, 60, 75, 100, 150, 300

8 vertices, 12 edges, 6 faces

Length ( <i>l</i> )	Width ( <i>w</i> )	Height ( <i>h</i> )	Left <i>wh</i>	Right <i>Wh</i>	Front <i>lh</i>	Back <i>Lh</i>	Top <i>lw</i>	Bottom <i>Lw</i>	Total <i>in</i> <sup>2</sup>
1	1	300	300	300	300	300	1	1	1,202
1	2	150	300	300	150	150	2	2	904
1	3	100	300	300	100	100	3	3	806
1	4	75	300	300	75	75	4	4	758
1	5	60	300	300	60	60	5	5	730
1	6	50	300	300	50	50	6	6	712
1	10	30	300	300	30	30	10	10	680
1	12	25	300	300	25	25	12	12	674
1	15	20	300	300	20	20	15	15	670
2	2	75	150	150	150	150	4	4	608
2	3	50	150	150	100	100	6	6	512
2	5	30	150	150	60	60	10	10	440
2	6	25	150	150	50	50	12	12	424
2	10	15	150	150	30	30	20	20	400
3	4	25	100	100	75	75	12	12	374
3	5	20	100	100	60	60	15	15	350
3	10	10	100	100	30	30	30	30	320
4	5	15	75	75	60	60	20	20	310
5	5	12	60	60	60	60	25	25	290
5	6	10	60	60	50	50	30	30	280

Old Package: 320 square inches

New Package: 280 square inches

Savings: 40 square inches x .05 cents x 2,000 packages = \$4,000.00