

Math Domain

- | | | |
|---|--------------------------------------|--|
| <input checked="" type="checkbox"/> Number/Quantity | <input type="checkbox"/> Shape/Space | <input checked="" type="checkbox"/> Function/Pattern |
| <input type="checkbox"/> Chance/Data | <input type="checkbox"/> Arrangement | |

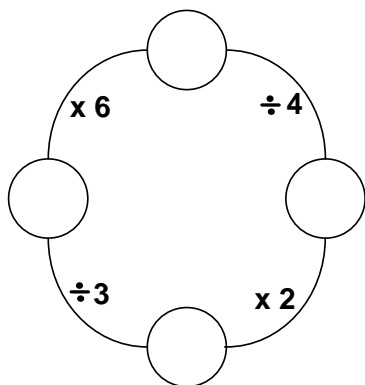
Math Actions (possible weights: 0 through 4)

- | | |
|--|--|
| <input type="checkbox"/> 2 Modeling/Formulating | <input type="checkbox"/> 2 Manipulating/Transforming |
| <input type="checkbox"/> 2 Inferring/Drawing Conclusions | <input type="checkbox"/> 2 Communicating |

Math Big Ideas

- | | | |
|---|---|---|
| <input type="checkbox"/> Scale | <input type="checkbox"/> Reference Frame | <input checked="" type="checkbox"/> Representation |
| <input type="checkbox"/> Continuity | <input type="checkbox"/> Boundedness | <input checked="" type="checkbox"/> Invariance/Symmetry |
| <input checked="" type="checkbox"/> Equivalence | <input type="checkbox"/> General/Particular | <input type="checkbox"/> Contradiction |
| <input type="checkbox"/> Use of Limits | <input type="checkbox"/> Approximation | <input type="checkbox"/> Other |

The intent of this problem is to have students demonstrate arithmetic computation skills, specifically the relation between multiplication and its inverse.



No matter what number is put into the top slot in **1** and **2**, going through the other three circles and returning to the top produces the same number.

Using a number smaller than 2 will lead to a fractional result in question **3**; students should be able to adjust to this by using a larger number.

These results are all due to the fact that the operations are balanced or counteracted by each other--the combined effect of multiplying by 6 and 2 and dividing by 4 and 3 is the same as multiplying by 12, and then dividing by 12.

	partial level	full level
Modeling/ Formulating (weight: 2)	In 5 , design a ring that may not “work” in the sense of multiplying and dividing by equivalent amounts, or that uses the same numbers as the original ring in a different order.	In 5 , design a ring that is entirely correct and uses different numbers from the original ring.
Transforming/ Manipulating (weight: 2)	Provide correct numerical results for all but one of questions 1–3 .	Consistently get correct numerical results. Be able to adapt to fractions as intermediate results.
Inferring/ Drawing Conclusions (weight: 2)	Recognize that behavior of ring is independent of starting point. Get the correct answer in 3 , but not be able to articulate the results in 4 . Design a ring in 5 that is little more than a copy of the given ring.	Articulate the conclusion with respect to the initial position in the ring and provide at least a rudimentary generalization of results in 1-3 Exhibit an understanding of the process of the ring, both through a clear verbal answer to 4 , and a ring design in 5 which uses completely different numbers and sequence of multiplication and division.
Communicating (weight: 2)	Present evidence in 1-3 by exhibiting some calculations or intervening answers without a clear verbalization of the final result. Give a partial or unclear explanation for 4 .	Give a full, clear explanation for all questions.