Add 'em Up — *P003 scoring rubric*

Math Domain

☑ Number/Quantity	☐ Shape/Space	☐ Function
☐ Chance/Data	☐ Arrangement	

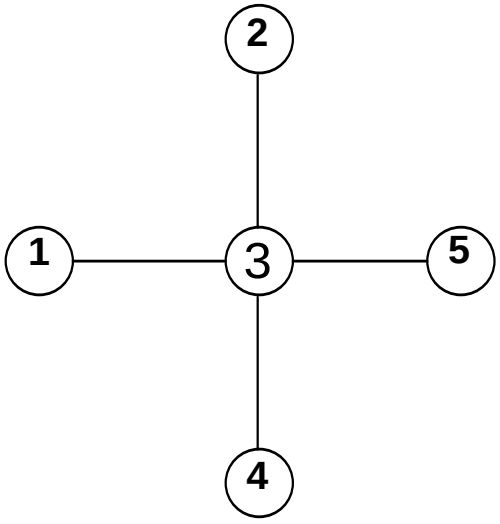
Math Actions (possible weights: 0 through 4)

0 Modeling/Formulating	3 Manipulating/Transforming
2 Inferring/Drawing Conclusions	1 Communicating

Math Big Ideas

☐ Scale	☐ Reference Frame	☐ Representation
☐ Continuity	☐ Boundedness	☐ Invariance/Symmetry
☑ Equivalence	☐ General/Particular	☐ Contradiction
☐ Use of Limits	☐ Approximation	☐ Other

1.

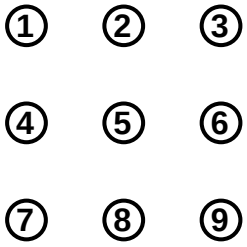


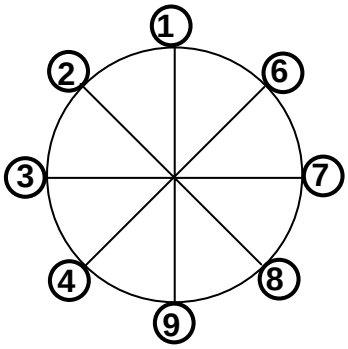
One of the rows must contain the numbers 1 and 5, the other 4 and 2. Obviously it is equally correct to interchange the position of the 2,4 and the 1,5 number pair.

2. There are several ways to solve this problem. From question 1, students should notice that the largest number should be paired with the smallest number, the second largest with the second smallest, etc. There are three solution possibilities:

- The group of smaller numbers is 1,2,3 and 4; the corresponding group of larger numbers is 8,7,6 and 5; each pair adds to 9.
- The group of smaller numbers is 1,2,3 and 4; the corresponding group of larger numbers is 9,8,7 and 6; each pair adds to 10.
- The group of smaller numbers is 2,3,4 and 5; the corresponding group of larger numbers is 9,8,7 and 6; each pair adds to 11.

For example:

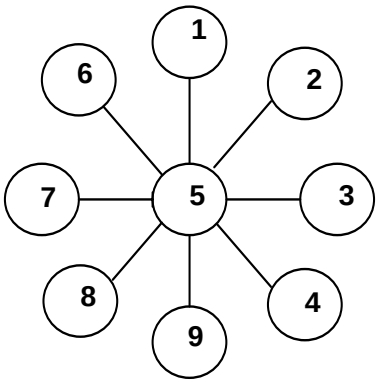


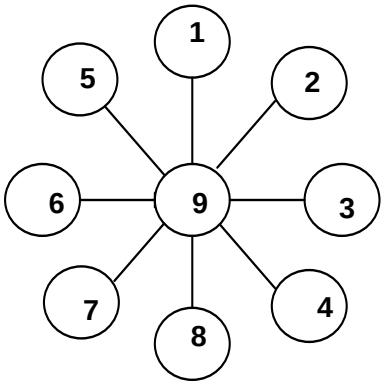


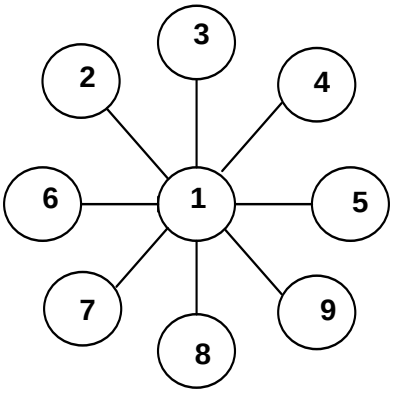
As long as the number pairs are kept intact, it does not matter how they are arranged around the circle.

3. Some students may solve this problem "from scratch"; others may notice that it is isomorphic to question 2

Here are three possible solutions for this wheel. As long as number pairs which add to 10, 9, and 11 respectively are preserved, they may be arranged in any sequence around the wheel; the corresponding sums in the wheel are 15, 18, and 12.







Extension:

4. Students should notice that the arrangement must be similar to one of the arrangements in question 3. With some trial and error, it is easy to discover that the number in the center must be 5. Then 1 and 9 cannot be in the corners—if 9 is in a corner, then 6, 7 and 8 cannot be in the any of the corners. Therefore, 1 and 9 must be in a middle row or column. The only possible row with one in the middle is 6, 1, 8; 6 and 8 are in the corners next to 1, and 4 and 2 are in the corners next to 9. This leaves only two possible positions for 3 and 7, of which only one is acceptable.

The final arrangement must be similar to

2	7	6
9	5	1
4	3	8

Again, the actual arrangement may be a rotation or a reflection of the one given above.

	partial level (1 or 2)	full level (3)
Modeling/ Formulating (weight: 0)		
Transforming/ Manipulating (weight: 3)	Student arrives at a correct result for some of the computations.	Student arrives at a correct result for all of the computations, and verifies that the sums are equal.
Inferring/ Drawing Conclusions (weight: 2)	Student develops a strategy that will lead to a successful result in one or two of the questions.	Student develops a strategy that will lead to a successful result in all of the questions, guided by the results from previous calculations.
Communicating (weight: 1)	Student places the numbers in the correct position in some of the circles for parts of the problem that have been completed.	Student places the numbers in the correct position in all of the circles.