

Student Guide

Factor Games (SG pp. 424–427)

Questions 1–21

1. A. 4, 8
B. 12
C. 26
2. 26
3. 6, 9, 10, 12, 15, 18, 20
4. Answers will vary. Students will describe their success in the second game compared to the first.
- 5.* Good choices are numbers that are relatively large and have only a few factors. Player X's best choice for the first turn in Factor 20 is 19, since its only factor besides itself is 1. Player O's best choice for the first turn is 15 (opponent will earn $3 + 5 = 8$ points).
- 6.* Numbers with several factors or with relatively large factors are not good choices for a starting turn. For example, 12, 18, and 20 are not good choices until some of their factors have been marked off.
- 7.* Prime numbers cannot be chosen after the first move, since a number can be chosen only if it has factors on the board. The only factor of a prime number (other than itself) is 1 and that is marked off on the first move. See the Lesson for more patterns.
- 8.* 12, 18, and 20 each have six factors.
- 9.* 2, 3, 5, 7, 11, 13, 17, and 19 (the prime numbers) each has only two factors.
- 10.* 4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20
11. Answers will vary.
12. Answers will vary.
13. 19, the highest prime number possible, is the best first move for Player X. After that move, Player O can circle only the number 1. So Player X gets $19 - 1 = 18$ more points than Player O after the first turn.
14. 37 is the best first move for Player X in Factor 40. Player X gets $37 - 1 = 36$ more points than Player O after the first turn.
15. 97 is the best first move for Player X in Factor 100. Player X earns 96 points more than Player O.

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1. A. What are the factors that Jerome can mark?
B. How many points will Jerome earn for these factors?
C. How many total points does Jerome have so far?
 2. How many points does Ming have so far?
 3. Jerome can only choose a number that has at least one unmarked factor left. Which numbers are left for Jerome to choose?
- Play Factor 20 twice with a partner. As you play the game, think of strategies that will give you as many points as possible while also keeping your partner from scoring a lot of points.**
4. While playing the game a second time, think about the moves you and your partner make. Were you more successful in the second game? Describe any strategies you used or things you learned while playing the second time around.
 5. Which numbers were good choices for starting a turn? Why?
 6. Which numbers were not good choices for starting a turn? Why not?
 7. Did you notice any patterns? Which types of numbers were against the rules to choose?
 8. Which number(s) on a blank Factor 20 Game Board has the most factors? What are the factors?
 9. Which numbers (besides the number 1) have the fewest factors? What are the factors?

A **prime number** is a number with exactly two factors, one and itself. The numbers from the game board with the fewest factors that you listed for Question 6 should all be prime numbers.

A **composite number** is a number with more than 2 different factors. A composite number has factors other than one and itself.

Since the number 1 does not have 2 different factors, it is not considered prime or composite.

10. Which numbers on a Factor 20 Game Board are composite numbers?

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Now play Factor 40 twice with your partner. The rules are the same, but the game board has numbers from 1 to 40.

11. How was playing Factor 40 different from playing Factor 20?
12. What new strategies did you learn playing Factor 40?

After playing a few games of Factor 20, Jerome noticed that sometimes when he chose a number to mark, his partner actually got more points than he did on that turn. That was because the sum of the factors was greater than the number he picked. For example, in their third game, Jerome marked 20 for his first move. Ming was then able to circle 1, 2, 4, 5, and 10. Jerome got only 20 points, while Ming scored 22 before he chose his own number. He realized that a good way to score more points than his partner was to pick large numbers with only a few small factors.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20

	X	O	
Number	20	1,2,4,5,10	Factors
Factors			Number
Number			Factors
Factors			Number
Number			Factors
Factors			Number
Number			Factors
Factors			Number
Number			Factors
Factors			Number
TOTAL			TOTAL

22 total is 2 more than X's number.

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13. What is the best first move Player X can make to start a game of Factor 20? With that move, how many more points does Player X get than Player O after the turn is over? Show how you found your answer.
14. What is the best first move Player X can make to start a game of Factor 40? How many more points does Player X get than Player O after the turn is over? Show how you found your answer.
15. If a game board had the numbers from 1 to 100 on it, what would be the best first move Player X could make? How many more points would Player X get than Player O after the first turn is over? Show how you found your answer.

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*Answers and/or discussion are included in the lesson.

✓ Check-In: Questions 16-19

1	2	3	4
6	7	8	9
11	12	13	14
16	17	18	19
21	22	23	24
26	27	28	29
31	32	33	34
36	37	38	39
40			

	X	O	
Number	37	1	Factors
Factors	5, 7	35	Number
Number	39	3, 13	Factors
Factors	?	38	Number
Number			Factors
Factors			Number
Number			Factors
Factors			Number
Number			Factors
Factors			Number



Ming and Jerome are playing Factor 40. Their game board and score box are shown above.

16. Jerome, Player O, decides to choose 38 for his next turn, since it is a large number with few unmarked factors on the board.
- What are the unmarked factors of 38 on the game board?
 - How many more points does Jerome score than Ming for this turn if Ming finds all the factors?
 - It is against the rules to mark a number that does not have any available factors. What other numbers could Jerome pick on this turn instead of 38?
 - Is 38 the best number for Jerome to choose on this turn? If not, which number is the best choice? Show how you know.

16. A. 2, 19
 B. $38 - (2 + 19) = 17$ more points
 C. 4, 6, 8, 10, 12, 16, 18, 20, 22, 24, 26, 27, 28, 30, 32, 34, 36, 40
 D. 27 is a better choice for Jerome. Ming would earn 9 points, so Jerome would earn $27 - 9 = 18$ more points.
17. 12, 18, 20, 28, and 30 each have six factors. The factors of 12 are 1, 2, 3, 4, 6, 12; the factors of 18 are 1, 2, 3, 6, 9, 18; the factors of 20 are 1, 2, 4, 5, 10, 20; the factors of 28 are 1, 2, 4, 7, 14, 28; the factors of 30 are 1, 2, 3, 10, 15, 30.
18. 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37
19. 4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20, 21, 22, 24, 25, 26, 27, 28, 30, 32, 33, 34, 35, 36, 38, 39, 40
20. Answers will vary. Strategies include:

- The best first move for Player X is the highest prime number. Player O will earn only one point. Prime numbers cannot be chosen after the first play because their only factor, 1, has already been marked.
- When choosing a number, think about the size of the number and the sum of its factors. Try to make the difference between the two as large as possible. Sometimes a smaller number is a better choice than a large number with a lot of factors.
- It is usually better to choose a number that has small factors than one that has large factors. It is often best to be careful when choosing even numbers since even numbers have relatively large factors. (Half of an even number is a fairly large factor.) Since odd numbers are not divisible by two, the largest a factor of an odd number could be is one third of the number.

21. No written answers required.

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- Which number(s) on a blank Factor 40 Game Board has the most factors? What are the factors?
- Which numbers on a blank Factor 40 Game Board are prime numbers?
- Which numbers on a Factor 40 Game Board are composite numbers?
- Write a list of strategies you learned for playing Factor 40. For each strategy on your list, explain the following:
 - Why does the strategy work?
 - When does the strategy work? When does it not work?
- Use your list and what you have learned as you play another game of Factor 40. See if your list helps you as you choose your moves.



- Play Factor 20 and Factor 40 with a family member or friend at home. Remember to bring the game board pages from the Student Activity Book home to play the game.

Complete the following questions. You can use a calculator to help you find factors.

- Irma and Jackie are playing Factor 40 in class. Jackie is the first player. She chooses 27 as her first number.
 - What are the factors of 27 that Irma can mark?
 - How many points will Irma earn for these factors?
- Felicia and Jessie designed a Factor 100 Game Board. Factor 100 has the same rules as Factor 20 and Factor 40. It includes the numbers 1 to 100. Felicia is the first player. She chooses 40 as her first number.
 - What are the factors of 40 that Jessie can mark?
 - How many points will Jessie earn for these factors?
- Romesh and David are playing Factor 100. David is the first player. He chooses 76 as his first move.
 - What factors of 76 can Romesh mark?
 - How many points will Romesh earn for these factors?

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Homework (SG pp. 427–428)

Questions 1–9

1. No written answers required.
2. **A.** 1, 3, 9
B. 13
3. **A.** 1, 2, 4, 5, 8, 10, 20
B. 50
4. **A.** 1, 2, 4, 19, 38
B. 64
5. **A.** Factors of 84: 1, 2, 3, 4, 6, 7, 12, 14, 21, 28, 42, 84
Factors of 92: 1, 2, 4, 23, 46, 92
B. 92
C. If Nicholas chooses 92, Michael can earn $1 + 2 + 4 + 23 + 46 = 76$ points. Nicholas will earn $92 - 76 = 16$ points more than Michael. If Nicholas chooses 84, Michael can earn 140 points. Michael will earn $140 - 84 = 56$ points more than Nicholas.
6. **A.** No. Edward did not mark 4, 6, 12, 18, or 36.
B. 123
7. **A.** Factors of 31: 1, 31
B. Factors of 56: 1, 2, 4, 7, 8, 14, 28, 56
C. Factors of 63: 1, 3, 7, 9, 21, 63
D. Factors of 67: 1, 67
E. Factors of 100: 1, 2, 4, 5, 10, 20, 25, 50, 100
8. 31 and 67 are prime because they have only two factors, one and themselves.
9. 56, 63, 100 are composite. They each have more than two factors.

5. Nicholas and Michael are playing Factor 100. Nicholas is the first player. He wants to choose either 84 or 92 as his first move.
 - A.** Find all the factors of both 84 and 92.
 - B.** Which number is a better move for Nicholas?
 - C.** Explain your answer.
6. Edward and Nila are playing Factor 100. Nila is the first player. She chooses 72 as her first move. Edward marks 1, 2, 3, 8, 9, and 24. He recorded 47 points.
 - A.** Did Edward mark all the possible factors of 72? If not, what other numbers could he mark?
 - B.** If Edward marks all the possible factors, how many points will he earn?
7. List all the factors of the following numbers.
 - A.** 31
 - B.** 56
 - C.** 63
 - D.** 67
 - E.** 100
8. Which of the numbers in Question 7 are prime? How do you know?
9. Which of the numbers in Question 7 are composite? How do you know?

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