ANSWERS

1. 5115
2. 594
3. It's a "black hole"
4. 190
5. 730
6. 370
7. Continuing the process will always get an answer of 370.
8. 97
9. This cannot be done.
10. 63
11. 36
12. 45
13. 18
14. 9
15. Multiples of 9

BASIC MATH

The Complete Course

Lesson Twenty Four

Number Patterns 2

KA8424

Teaching Guide & Worksheet

HOW TO USE THE VIDEO AND TEACHING GUIDE

1. The "STOP TO THINK" signal means pause to think.
2. The "STOP TO WORK" signal means work the problem(s).
3. Rewind the tape and watch the lesson again if the concept is not clear.
4. Use "Learning Strategies" section of the Teachers Guide as memory aids and topics for classroom discussion.
5. Students should complete the exercises on the worksheet to confirm their understanding of this lesson.

LEARNING STRATEGIES

PALINDROMES

A. A palindrome is a word, phrase, sentence, or number that is the same backward or forward
B. Examples of words that are palindromes:
   1. Radar
   2. Racecar
   3. Otto
   4. Anna
C. Examples of numbers that are palindromes:
   1. 1441
   2. 33
   3. 474
   4. 50705
D. Palindrome years
   1. The year 1991 is a palindrome
   2. The year 2002 is a palindrome
   3. Many people who were alive in 1991 will be alive in 2002
   4. The previous palindrome year before 1991 was 1881
   5. The next palindrome year after 2002 is 2112

THE PATTERNS OF NON-PALINDROME NUMBERS

A. Some numbers, when added to their "reverse" number, have a sum that is a palindrome
   1. 32 + 23 = 55
   2. 107 + 701 = 808
   3. 245 + 542 = 787
B. Many numbers take more than one adding cycle to become a palindrome
   1. For example, 377
      a. 377 + 773 = 1150, which is not a palindrome
      b. 1150 + 0511 = 1661, which is a palindrome
   2. Another example is 793
      a. 793 + 397 = 1190, which is not a palindrome
      b. 1190 + 0911 = 2101, which is not a palindrome
      c. 2101 + 1012 = 3223, which is a palindrome
C. The question may be asked: "Do all numbers eventually become palindromes when this process is repeated?"
D. A look at the patterns resulting from application of this process to the numbers from ten to ninety-nine
   1. Color palindromes (e.g., 44) one color
   2. Color one-step palindromes (e.g., 34 + 43 = 77) a second color
   3. Color two-step palindromes (e.g., 57 + 75 = 132, 132 + 231 = 363) a third color
   4. Color three-step palindromes (e.g., 59 + 95 = 154, 154 + 451 = 605, 605 + 506 = 1111) a fourth color
5. Numbers that are not palindromes after three steps should not be colored

BLACK HOLES AND SUBTRACTION

A. A black hole in physics is a location whose gravitational pull is so great that nothing, not even light, can escape
B. Examine the number 6174
   1. The greatest number that can be written from the four digits is 7641
   2. The least number that can be written from the four digits is 1467
   3. Subtract 1467 from 7641
   4. The answer is 6174, which is a black hole, a number from which there is no escape
C. Try other numbers to see if this process always leads to a black hole
D. Three-digit numbers, black holes, and an explanation for the pattern
   1. Start with 703
   2. 730 - 037 = 693
   3. 963 - 369 = 594
   4. 954 - 459 = 495
   5. 495 is the black hole

THE SUM OF THE CUBES OF THE DIGITS OF A NUMBER

A. List the cube of each of the ten digits (e.g., three cubed is twenty-seven
B. Examine the number 153
   1. Find the cube of each of its three digits
   2. Add up the three cubes
   3. The sum is 153
C. Examine the number 152
   1. Find the cube of each digit
   2. Add up the cubes
   3. The sum is 134
   4. Repeat the process for 134
   5. Keep repeating the process
   6. Eventually you obtain 371
   7. The sum of the cubes of the digits in 371 is 371
D. Examine this process for three-digit numbers where all the digits are the same (e.g., 111 or 999)
   1. For example, 111 ⇒ 3 ⇒ 27 ⇒ 351 ⇒ 153
   2. All three-digit numbers with the same three digits "lock" at 153
E. Examine this process for two-digit numbers where both digits are the same (e.g., 88)
   1. Multiples of three (33, 66, 99) go to 153
   2. All the others go to locks other than 153

WORKSHEET STRATEGIES

1. Start with 273. Use the “reverse and add” rule until you get a palindrome. What is that palindrome?

2. Using the digits in 593, find the difference between the largest and smallest three-digit numbers that can be written with these digits.

3. Do the same with 594 as was done with 593. What is special about the answer?

4. What is the sum of cubes of the digits in 514?

5. What is the sum of the cubes of the digits in the answer to #4?

6. What is the sum of the cubes of the digits in the answer to #5?

7. What is special about the answer to #6?

8. Find the sum of the 4th powers of the digits in 203

9. Identify a 3 digit palindrome number whose three digits are all different

The reverse of 17 is 71; 03 is the reverse of 30.

10. What is the difference between 29 and its reverse?

11. Do the same for 73

12. Do the same for 50

13. Do the same for 24

14. Do the same for 98

15. What do all these answers have in common?