Use the following information to answer the next two questions.

Three rows of a pattern are shown below.

Row 1	$1 \times 8 + 1 = 9$
Row 2	$12 \times 8 + 2 = 98$
Row 3	$123 \times 8 + 3 = 987$

1. The fifth row of the pattern will be

    A. $1\,234 \times 8 + 4 = 9876$
    B. $1\,234 \times 8 + 5 = 9876$
    C. $12\,345 \times 8 + 4 = 9876$
    D. $12\,345 \times 8 + 5 = 98765$

2. If the number 8 in the pattern above is replaced by the number 9 as shown below, describe a pattern that could be used to calculate the value of row 7.

    Row 1 $1 \times 9 + 1 = $ _____
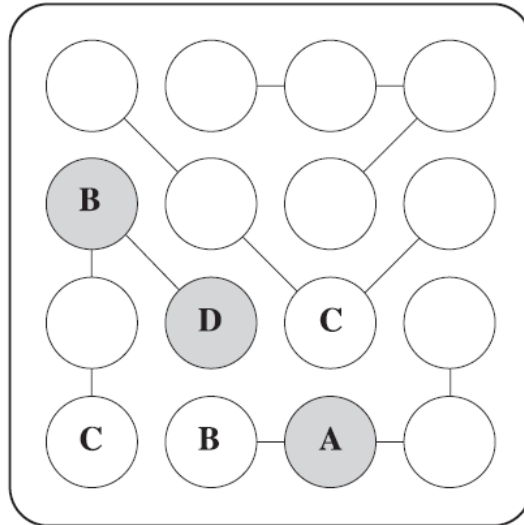   **Row 2** $12 \times 9 + 2 = $ _____
    Row 3 $123 \times 9 + 3 = $ _____

The goal of a particular puzzle is to fill the circles in a grid with the letters A, B, C, and D so that no letters are repeated in any row, column, or set of connected circles.

The three entries in the grey circles were given to start the puzzle. Jerome has already completed three entries shown in the white circles, but he has made an error.

3. a. Identify the error that Jerome made in his solution to the puzzle.

    b. Explain why this entry is incorrect.

    c. Correct the error that Jerome made and complete the puzzle.

The intention of a particular two-player game is to create a line of four adjacent squares using the same letter. To play, each player takes turns placing their first initial somewhere on a six-by-six grid. Margaret and Gerda have started playing this game, as shown on the grid below.

Column

|	1	2	3	4	5	6
1	G					
2		G				
3			G	G		
4			M	M	G	
5		M				
6	M	M	G			

Row

Numerical Response

4. It is Margaret's turn, and she determines that she can guarantee a win by placing the letter M in

row _____

column _____

A pattern of pictures is shown below. The first picture is the original. In each subsequent picture, each shaded square has stayed in the same place **or** moved to a square horizontally, vertically, or diagonally adjacent to its previous location. The shaded square undergoes the same movement in each subsequent step.
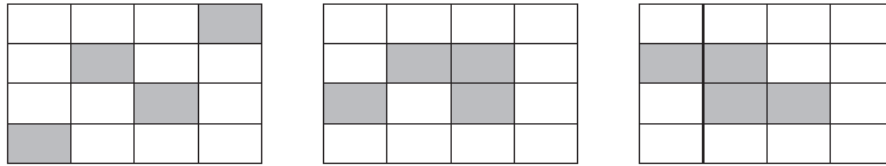
5. Which of the following pictures is next in the pattern?

A.

B.

C.

D.
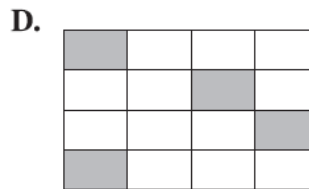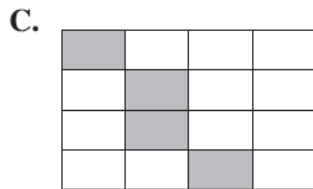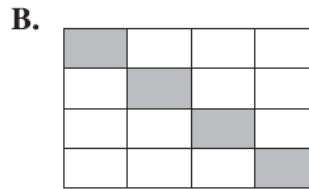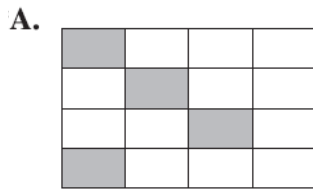
A student makes the following statement.

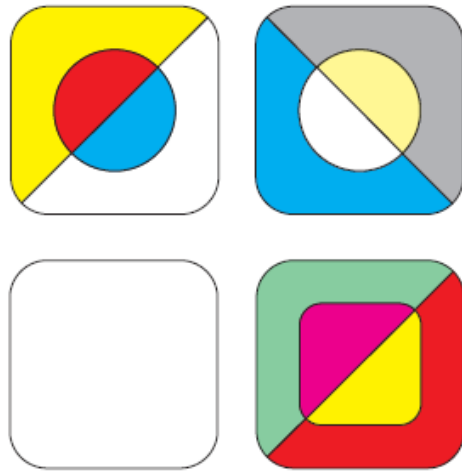"VOTE compares to VETO as the number 8570 compares to the number _____."

Numerical Response

6. The 4-digit number that completes the statement above is _____.

A geometric pattern is presented below. In this pattern, the lower left square is unknown.

7. Which of the following could be in the lower left square to complete the geometric pattern shown above?

A.

B.

C.

D.

Use the following information to answer the next four questions.

Students in a particular high school were surveyed to determine the subjects in which they were currently enrolled. The table below represents the data that was collected.

Courses Enrolled In	Number of Students
Math only	28
Art only	33
Math and Art	17
Neither course	20

8. The number of students in the universal set is

    A. 61
    B. 64
    C. 78
    D. 98

Numerical Response

9. The number of students taking Art is _____.

Numerical Response

10. The number of students **not** taking Math is _____.

11. The number of students taking Math or Art is

    A. 17
    B. 61
    C. 78
    D. 98

Use the following information to answer the next four questions.

A group of 100 students was surveyed about movies that they have seen, as shown below.

  2 people saw all three movies

12 people saw "Metal Man" and "The Princely Groom"

53 people saw "Metal Man"

10 people saw "Metal Man" and "Quick and Angry 8"

18 people saw "The Princely Groom" only

23 people saw "The Princely Groom" and "Quick and Angry 8"

  6 people did not see any of the movies

Jason started to organize the results in the Venn diagram shown below.
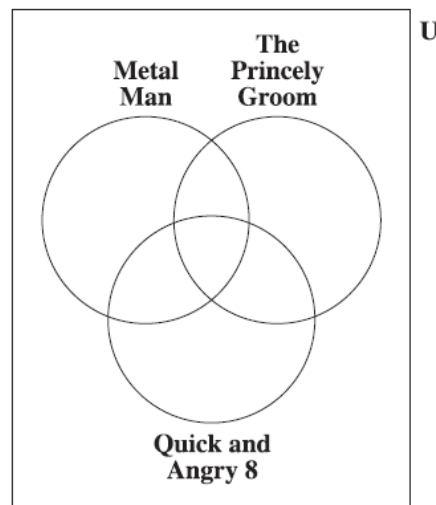
12. The number of people who saw "The Princely Groom" is

A. 18

B. 20

C. 51

D. 53

Numerical Response

13. The number of people who saw "Metal Man" and "The Princely Groom" but **not** "Quick and Angry 8" is _____.

14. The number of people who saw "Metal Man" only is

    A.   20
    B.   33
    C.   51
    D.   53

15. The number of people who saw "Metal Man" or "Quick and Angry 8" is

    A.   10
    B.   43
    C.   76
    D.   98

Use the following information to answer the next two questions.

Two Sets

$A = \{$prime numbers less than 20$\}$
$B = \{$factors of 20$\}$

16. The union of sets A and B is

    A. $\{2, 5\}$
    B. $\{2, 4, 5, 10\}$
    C. $\{1, 2, 3, 4, 5, 7, 10, 11, 13, 17, 19, 20\}$
    D. $\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20\}$

17. The set $C = A \cap B$ is

    A. $\{2, 5\}$
    B. $\{2, 4, 5, 10\}$
    C. $\{1, 2, 3, 4, 5, 7, 10, 11, 13, 17, 19, 20\}$
    D. $\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20\}$

18. Which of the following rows includes two groups that would be an example of disjoint sets?

Row	Group 1	Group 2
A.	People who regularly drink coffee	People who regularly drink tea
B.	People who have a home phone line	People who have a cellular phone line
C.	The set of all prime numbers	The set of all even numbers
D.	The set of all multiples of 5	The set of all factors of 24

Use the following information to answer the next question.

Vehicles with a sunroof are represented by $\{S\}$ and vehicles with a hands-free phone system are represented by $\{P\}$.

19. Which of the following illustrates $(S \cap P)'$?

    A.   A sunroof or a hands-free phone system

    B.   A sunroof and not a hands-free phone system

    C.   Not a sunroof or not a hands-free phone system

    D.   Not a sunroof and not a hands-free phone system

In a school of 120 students:

     5 students took English, Physics, and Chemistry

  15 students took Physics and English

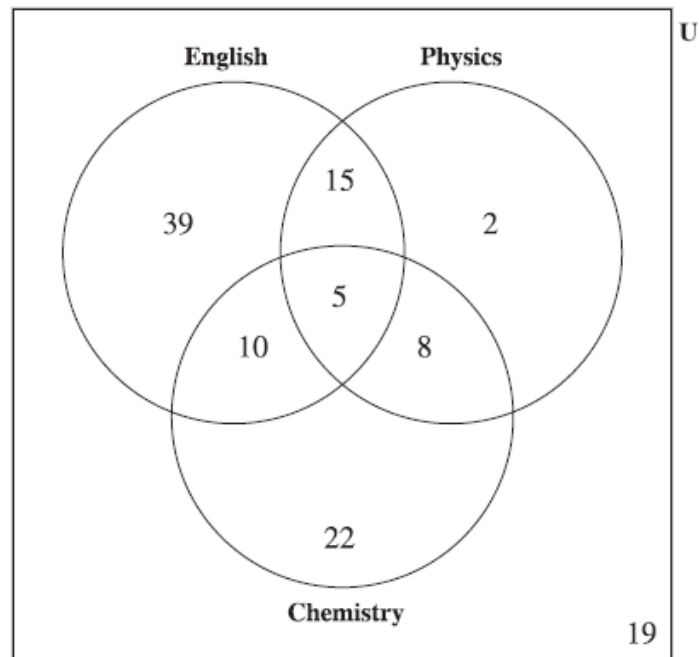   8 students took Physics and Chemistry

  10 students took English and Chemistry

  99 students took English or Chemistry

  45 students took Chemistry

  30 students took Physics

Bobby summarized the data using the Venn diagram shown below.

20. Identify the regions of Bobby's Venn diagram that have incorrect entries, and describe the errors that Bobby made. Make changes to the Venn diagram to show the correct entries.

Three Sets

$R = \{$natural numbers less than 50$\}$

$S = \{$even numbers$\}$

$T = \{10, 20, 30, 40\}$

21. Which of the following statements is true for sets R, S, and T?

   A. $R \subset S$
   B. $R \subset T$
   C. $S \subset R$
   D. $T \subset R$

22. Which of the following statements is **not** true for sets R, S, and T?

   A. $T \subset (R \cap S)$
   B. $T \subset (R \cap T)$
   C. $(R \cap S) \subset T$
   D. $(R \cap T) \subset T$

A student suggests that for any set A, $A \cup \varnothing = A$ and $A \cap \varnothing = A$.

23. Is this student correct or incorrect? Use an example or a visual representation in your explanation.

24. Which of the following phrases describes an empty set?

   A. Common factors of 3 and 7
   B. Prime numbers that are even
   C. Multiples of 5 that are less than 10
   *D. Perfect squares less than 20 that are divisible by 5