Test 1
Math 221: Basic Concepts of Elementary Mathematics I

Name _____

Instructions: Check that your test consists of 25 problems. Put your name in the space provided above. Answer each multiple choice question below. Each problem is worth 4 points with the same scoring procedure as used on the quizzes. A blank page is provided at the end of this test for your work.

1. Which list below is the 4-step problem-solving process described in class?

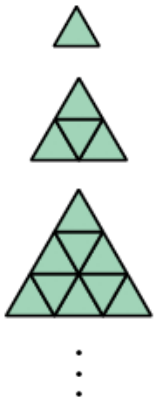
   (a) understand the problem, devise a plan, carry out the plan, look back

   (b) study hard, get a good night's sleep, eat a good breakfast, show up

   (c) study the problem, try different approaches, decide a correct approach, record your work

   (d) research the problem, locate a solution, write down the solution, turn in the solution

2. Each of the figures pictured to the right is made of small triangles like the first one in the sequence. The second figure is made up of 4 small triangles. Based on a reasonable conjecture, which of the following is most likely to be true about the 50th figure in the sequence and the exact number of small triangles that make it up.

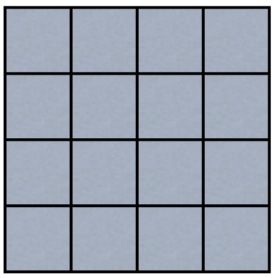
   (a) The 50th figure is made up of an odd number of small triangles.

   (b) The 50th figure is made up of 500 small triangles.

   (c) The 50th figure is made up of 50^2 small triangles.

   (d) The 50th figure is made up of > 4000 small triangles.

3. How many total squares are in the figure below? (Count all size squares using existing lines in the drawing.)

   (a) $4 + 3 + 2 + 1$

   (b) $4^2 + 3^2 + 2^2 + 1^2$

   (c) $4^4 + 3^3 + 2^2 + 1$

   (d) $5 \cdot 4 + 4 \cdot 3 + 3 \cdot 2 + 2 \cdot 1$

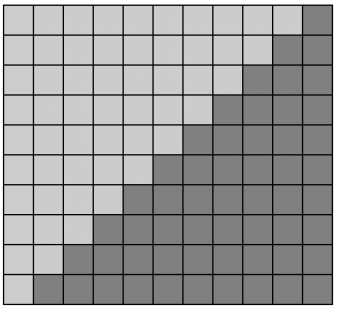
4. Each of the four sequences below, labeled (i), (ii), (iii) and (iv), is either an arithmetic sequence, a geometric sequence or neither. How *many* of them are arithmetic sequences?

(i) $2, 6, 18, 54, 162$ (ii) $1, 4, 9, 16, 25$

(iii) $3, 13, 23, 33, 43, 53$ (iv) $12, 10, 8, 6, 4$

(a) 0 (b) 1 (c) 2 (d) 3

5. The picture shown to the right illustrates why



(a) The value of $1 + 2 + 3 + \cdots + n$ is $n(n + 1)/2$.

(b) The value of $1 + 2 + 3 + \cdots + n$ is $n(n + 1)$.

(c) The value of $1 + 2 + 3 + \cdots + n$ is a square.

(d) The value of $1 + 2 + 3 + \cdots + n$ is 50.

6. We discussed the Fibonacci sequence $1, 1, 2, 3, 5, 8, 13, \ldots$ in class. Each number after the second in this sequence is the sum of the previous two numbers in the sequence. The table to the right indicates various numbers in the sequence. What is the *sum* of the first 25 numbers of the Fibonacci sequence?

Place in Sequence	Fibonacci Number
1	1
2	1
3	2
4	3
⋮	⋮
25	75025
26	121393
27	196418
28	317811

(a) 196417 (b) 317810

(c) 121392 (d) 112358

7. Each letter to the right represents a different digit. Which one of the following is a reasonable guess for the digit that is represented by "T"?

$$\begin{array}{r} \text{NEAT} \\ \text{NEAT} \\ +\ \text{NEAT} \\ \hline \text{TEST} \end{array}$$

(a) 2 (b) 5

(c) 8 (d) 9

8. Consider the problem of determining how many diagonals are on a regular polygon with 500 sides. Suppose, whether or not it is true, that you are not sure how to obtain an answer to this problem. Then which of the following might be a good approach to determine the answer?

(a) Take a poll. The correct answer will be the answer most commonly picked in the poll.

(b) Guess at what the answer is and then check by counting the number of diagonals on a regular polygon with 500 sides.

(c) Work backwards. Start with the number of diagonals on a regular polygon and determine whether it has 500 sides.

(d) Consider the similar problem of obtaining the number of diagonals for regular polygons with a small number of sides and look for a pattern.

9. Which of the following makes use of the set-builder notation?

(a) $\{1, 2, 3\}$ (b) $\{1, 2\} \cup \{3, 4\}$ (c) $\{1, 2, 3, 4\} - \{3, 4\}$ (d) $\{x | x \text{ is an integer } < 6\}$

10. Recall that N is the set of natural numbers. If $\{1, 5\} \subset A$, then which one of the following can <u>not</u> be A?

(a) $\{1, 2, 3, 4, 5\}$ (b) $\{1, 5\}$ (c) $\{x \mid x \text{ is a number} < 10\}$ (d) $\{x \mid x \in N\}$

11. How many of the following are true?

(i) $\{2\} \subset \{1, 2, 3\}$
(ii) $\{2\} \subseteq \{1, 2, 3\}$
(iii) $2 \notin \{1, 2, 3\}$
(iv) $\{2\} \notin \{1, 2, 3\}$

Be sure to circle your answer below.

(a) 1 (b) 2 (c) 3 (d) 4

12. If A is a set having three elements and B is a set having two elements, what is the greatest number of elements possible in the set $A - B$?

(a) 0 (b) 1 (c) 2 (d) 3

13. How many of (i), (ii), (iii) and (iv) are true?

(i) $\emptyset \subset \{0\}$
(ii) If $A = B$, then $A \subseteq B$.
(iii) If $1 \in A$ and $3 \in A$, then $2 \in A$.
(iv) $\emptyset \subseteq \emptyset$

Be sure to circle your answer below.

(a) 1 (b) 2 (c) 3 (d) 4

14. By DeMorgan's laws, which one of the following is equal to $\overline{A \cup B}$?

(a) $\overline{A} \cup \overline{B}$ (b) $\overline{A} \cap \overline{B}$ (c) $A \cap B$ (d) $\overline{A \cap B}$

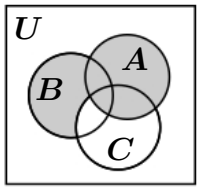
15. In a fraternity with 32 members, 20 take mathematics, 5 take both mathematics and biology, and 5 take neither mathematics nor biology. How many take biology?

(a) 10 (b) 12 (c) 15 (d) 18

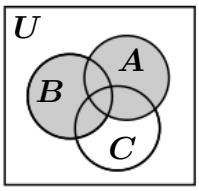
16. If $U = \{a, b, c, d\}$, $A = \{a, b, c\}$ and $B = \{b, c\}$, then what is $\overline{A \cap B}$?

(a) $\{a, d\}$ (b) $\{d\}$ (c) $\{b, c\}$ (d) $\{a, b, c, d\}$

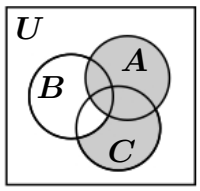
17. Which one of the following is a Venn Diagram for $A \cup (B - C)$?



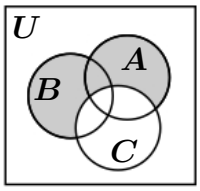
(a)



(b)

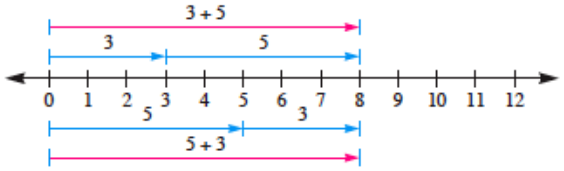


(c)



(d)

18. Which property of whole numbers is described by the picture to the right?



(a) the commutative property of addition

(b) the associative property of addition

(c) the identity property of addition

(d) the distributive property of addition

19. The equation $(2 + 3) + 4 = 2 + (3 + 4)$ is an example of which of the following properties?

(a) commutative property of addition

(b) associative property of addition

(c) distributive property of addition

(d) parenthetical property of addition

20. To make subtraction easier Abby performs some subtraction as follows: $97 - 28 = (97 + 2) - (28 + 2) = 99 - 30 = 69$. Find the value of

$$123456789 - 2999999$$

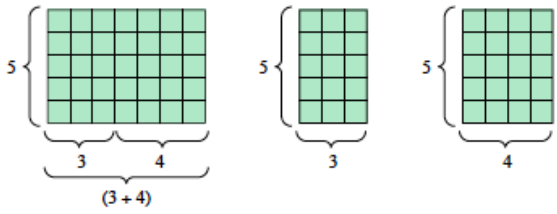
using Abby's method.

(a) 121556790 (b) 121456790 (c) 121356790 (d) 120456790

21. A whole number leaves a remainder of 2 when divided by 15. What is the remainder when the number is divided by 5?

(a) 0 (b) 1 (c) 2 (d) 3

22. Which property of whole numbers is described by the picture to the right?



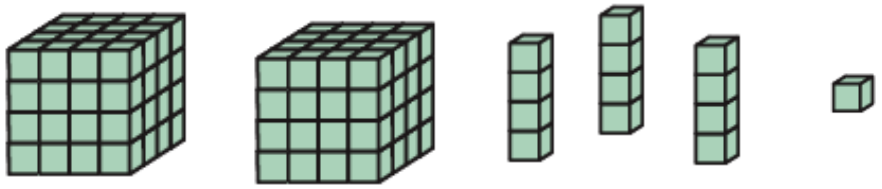
(a) the commutative property of multiplication

(b) the associative property of multiplication

(c) the identity property of multiplication

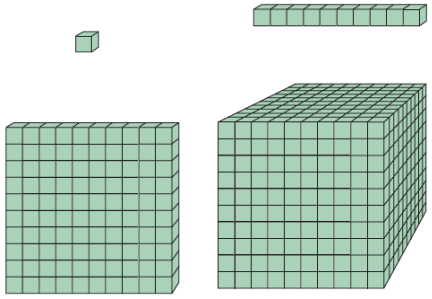
(d) the distributive property of multiplication over addition

23. What is the base-four numeral represented in the figure below?



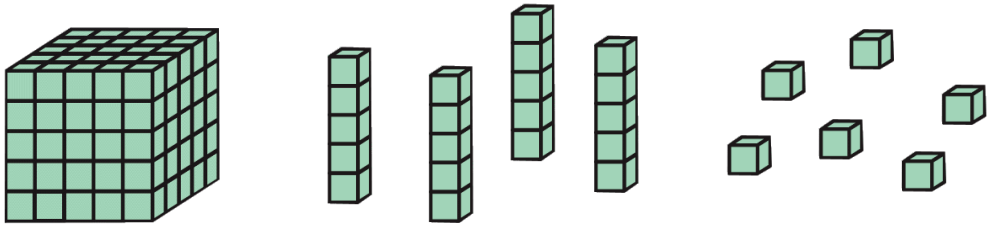
(a) 2031_{four} (b) 2301_{four} (c) 1032_{four} (d) 1302_{four}

24. Consider each unit, long, flat and block as one piece. There are four pieces shown in the figure to the right. What is the minimum number of pieces needed to represent the number 6324_{ten}?



(a) 20 (b) 14
(c) 18 (d) 15

25. After regrouping (or trading), the number represented by the figure below can be expressed in expanded form as



(a) $1 \cdot 5^3 + 1 \cdot 5^2 + 1 \cdot 5 + 1$ (b) $2 \cdot 5^3 + 1 \cdot 5 + 1$
(c) $1 \cdot 5^3 + 1 \cdot 5^2 + 1$ (d) $2 \cdot 5^3 + 1 \cdot 5^2 + 1 \cdot 5 + 1$