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?

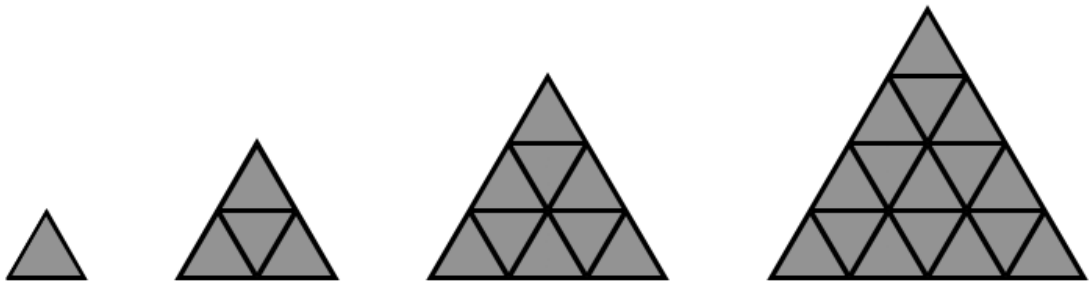
   (a) understand the problem, devise a plan, carry out the plan, look back

   (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 below is made of small triangles like the first one in the sequence. The second figure is made of 4 small triangles. How many small triangles are needed to make the 20^{th} figure in this sequence? (The idea is to find an appropriate pattern which would give you a good guess for what the answer is and to circle this good guess.)



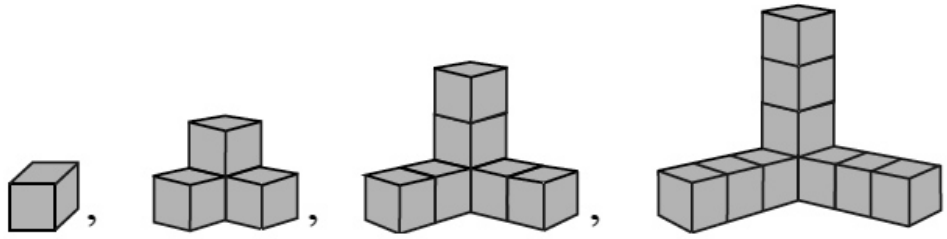
   (a) 200 (b) 20^2 (c) 20^4 (d) 2^{20}

3. How many terms are in the sequence $1, 2, 2^2, 2^3, \ldots, 2^{100}$?

   (a) 98 (b) 99 (c) 100 (d) 101

4. If the first two numbers in a geometric sequence are 3 and 12, then what is the third number in the geometric sequence?

   (a) 21 (b) 18 (c) 24 (d) 48

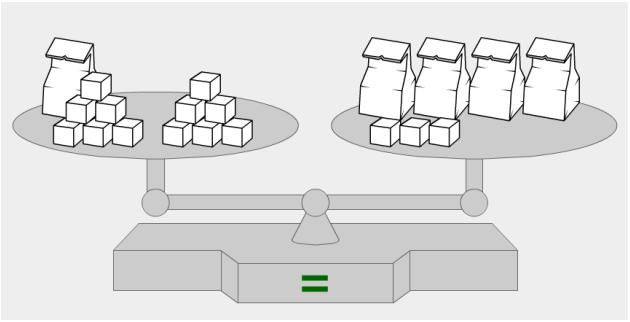
5. 

   In the sequence of figures above, there is 1 small cube in the first figure, 4 small cubes in the second figure, and 7 small cubes in the third figure. How many small cubes are in the 100^{th} figure?

   (a) 298 (b) 299 (c) 300 (d) 301

6. Each bag to the right contains the same number of heavy cubes. Each cube in a bag or outside a bag weighs the same amount. How many cubes are in each bag? (Assume that the weight of an empty bag is nothing.)

   (a) 2 (b) 3 (c) 4 (d) 5

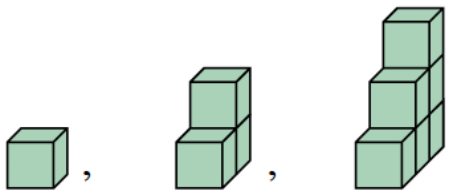


7. Each letter to the right represents a different digit. A student trying to figure out what digit each letter is, decides that the letter "T" should be the digit "5". Which one of the following might be a good second observation?

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

   (a) The letter "E" is the digit "0".
   (b) The letter "E" is the digit "4".
   (c) The letter "A" is the digit "2".
   (d) The letter "N" is the digit "1".

8. Same-sized cubes are glued together to form a staircase-like sequence of solids as shown to the right. All of the unglued faces of the cubes need to be painted. How many squares will need to be painted in the 10^{th} solid in this sequence?



(a) 100 (b) 150

(c) 200 (d) 250

9. Which of the following is *not* true?

(a) $\{1\} \in \{1,2,3\}$ (b) $\{1,2\} \subset \{1,2,3\}$

(c) $\{1,2\} \subseteq \{1,2,3\}$ (d) $\{1,2,3\} \subseteq \{1,2,3\}$

10. Which of the following is *not* true?

(a) $\emptyset \not\subseteq \emptyset$ (b) $0 \notin \emptyset$

(c) $\{\,\} \not\subset \{\,\}$ (d) $\{0\} \notin \emptyset$

11. In this problem, the universe (or universal set) is the set of all humans,

$$B = \{x | x \text{ is a college basketball player}\}$$

and

$$S = \{x | x \text{ is a college student more than 200 cm tall}\}.$$

Which of the following is the set of all college basketball players that are *no* more than 200 cm tall?

(a) $B \cap S$ (b) $B \cup S$

(c) $B \cap \overline{S}$ (d) $\overline{S}$

12. If $U = \{a, b, c, d, e\}$ is the universal set and A and B are sets satisfying $\overline{A} \cup \overline{B} = \{a, c, e\}$, what is the set $A \cap B$? (Hint: Use one of De Morgan's laws.)

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

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

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

15. In a fraternity with 40 members, 20 take mathematics, 10 take both mathematics and biology, and 5 take neither mathematics nor biology. How many take biology but not mathematics?

    (a) 5 (b) 10 (c) 15 (d) 20

16. Which of the Venn Diagrams below represent the set $A - P$?

17. The figure to the right is a model for which of the following?

    (a) The commutative property of addition.
    (b) The associative property of addition.
    (c) The commutative property of multiplication.
    (d) The associative property of multiplication.

18. When dividing a whole number a by a natural number b, which of the following is *not necessarily* true?

    (a) There is only one possible value for the quotient.
    (b) There is only one possible value for the remainder.
    (c) The remainder is less than the quotient.
    (d) The remainder is less than b.

19. The figure to the right is a model for which of the following?

    (a) The commutative property of multiplication.
    (b) The associative property of multiplication.
    (c) The additive property of multiplication.
    (d) The distributive property of multiplication over addition.

20. How many of the following illustrate the Associative Property of Addition?

    (i) $(a+b)+c = a+(b+c)$
    (ii) $(a+b)+c = c+(a+b)$
    (iii) $(a+b)+c = (b+a)+c$
    (iv) $a+(b+c) = (a+b)+c$

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

21. This problem is to check if you know the proper order of performing operations. What is the value of $2+4\div 2-3\cdot(4-1)$?

    (a) 2 (b) 0 (c) 3 (d) 6

22. Which of the following is the same as $(a+b)(a+b+c)$?

(a) $a^2+ab+2ac+b^2+bc$ (b) $a^2+2ab+ac+b^2+bc$

(c) $a^2+ab+ac+b^2+bc$ (d) $a^2+ab+2ac+bc+c^2$

23.

The base 5 number represented by the blocks, flats, longs and units above is

(a) 1400_{five} (b) 2300_{five} (c) 2000_{five} (d) 2100_{five}

24. If we use blocks, flats, longs and units in base 10 to represent the number 2436, then what is the fewest total number of them that we would need to use?

(a) 12 (b) 12 (c) 15 (d) 16

25.

The expanded form of the number represented by the figure above is

(a) $2\cdot10^3+3\cdot10+6$ (b) $2\cdot10^2+3\cdot10+6$

(c) $2\cdot10^4+3\cdot10^2+6$ (d) $2\cdot10^4+3\cdot10+6$