Notation

$p \wedge q$ represents "p and q"	$A \cup B$ represents the union of sets A and B
$p \vee q$ represents "p or q"	$A \cap B$ represents the intersection of sets A and B
$p \rightarrow q$ represents "if p, then q"	$A - B$ represents the set difference of sets A and B
$p \leftrightarrow q$ represents "p if, and only if q"	$\overline{A}$ represents the compliment of set A
$\neg p$ represents "not p"	$x \in A$ represents "x is an element of set A"
$\forall x$ represents "for all x"	$A \subset B$ represents "set A is a subset of set B"
$\exists x$ represents "there exists an x"	$\emptyset$ represents the empty set

Shade the appropriate region on the answer sheet.

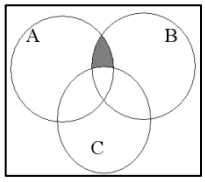
1. If p and q are true and r is false, then $(p \vee r) \rightarrow q$ is
   a) True b) False
2. If p and q are false and r is true, $r \leftrightarrow (p \wedge \neg q)$ is
   a) True b) False
3. The converse of the statement "*If the temperature drops below freezing, then it will snow tonight*" is
   a) If the temperature does not drop below freezing, then it will not snow tonight.
   b) If doesn't snow tonight, then the temperature won't drop below freezing.
   c) If it snows tonight, then the temperature will drop below freezing tonight.
   d) If the temperature does not drop below freezing, then it will snow tonight.
   e) None of these
4. The contrapositive the of statement "*If the temperature drops below freezing, then it will snow tonight*" is
   a) If the temperature does not drop below freezing, then it will not snow tonight.
   b) If doesn't snow tonight, then the temperature won't drop below freezing.
   c) If it snows tonight, then the temperature will drop below freezing tonight.
   d) If the temperature does not drop below freezing, then it will snow tonight.
   e) None of these
5. The inverse of statement "*If the temperature drops below freezing, then it will snow tonight*" is
   a) If the temperature does not drop below freezing, then it will not snow tonight.
   b) If doesn't snow tonight, then the temperature won't drop below freezing.
   c) If it snows tonight, then the temperature will drop below freezing tonight.
   d) If the temperature does not drop below freezing, then it will snow tonight.
   e) None of these

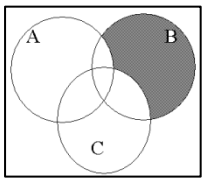
6. The negation of the statement "*If the temperature drops below freezing, then it will snow tonight*" is
   a) If the temperature does not drop below freezing, then it will not snow tonight.
   b) If doesn't snow tonight, then the temperature won't drop below freezing.
   c) If it snows tonight, then the temperature will drop below freezing tonight.
   d) If the temperature does not drop below freezing, then it will snow tonight.
   e) None of these
7. Given the universe of discourse for x and y is the set of real numbers, $\exists x \forall y(xy = 0)$ is
   a) True b) False
8. Given the universe of discourse for x and y is the set of real numbers, $\forall x \exists y(xy = 0)$ is
   a) True b) False
9. Given the universe of discourse for x and y is the set of real numbers, $\forall x \exists y(x + y = 0)$ is
   a) True b) False

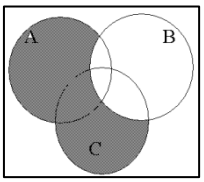
For problems 10-14, let $U = \{1,2,3,4,5,6,7,8,9,10\}$, $A = \{x \in U | x \text{ is even}\}$, and $B = \{3,6,9\}$.

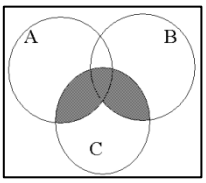
10. $\overline{A} \cup B$ is
    a) $\{2,4,6,8,10\}$ c) $\{2,4,8,10\}$ e) None of these
    b) $\{1,2,4,5,6,7,8,10\}$ d) $\emptyset$
11. $A - \overline{B}$ is
    a) $\{2,4,6,8,10\}$ c) $\{2,4,8,10\}$ e) None of these
    b) $\{1,2,4,5,6,7,8,10\}$ d) $\emptyset$
12. $\overline{B} - A$ is
    a) $\{2,4,6,8,10\}$ c) $\{2,4,8,10\}$ e) None of these
    b) $\{1,2,4,5,6,7,8,10\}$ d) $\emptyset$
13. $(A \cap \overline{B}) - A$ is
    a) $\{2,4,6,8,10\}$ c) $\{2,4,8,10\}$ e) None of these
    b) $\{1,2,4,5,6,7,8,10\}$ d) $\emptyset$
14. $(A \cup \overline{B}) \cap (A \cup B)$ is
    a) $\{2,4,6,8,10\}$ c) $\{2,4,8,10\}$ e) None of these
    b) $\{1,2,4,5,6,7,8,10\}$ d) $\emptyset$

15. Which of the following Venn diagrams represents $B - (A \cup C)$?

a) 

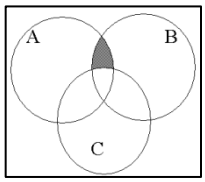
b) 

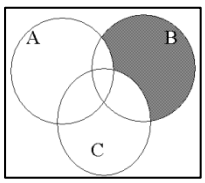
c) 

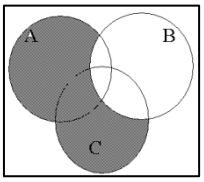
d) 

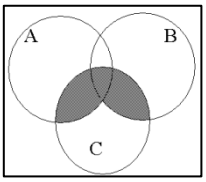
e) None of these

16. Which of the following Venn diagrams represents $B \cap (A \cup \overline{C})$

a) 

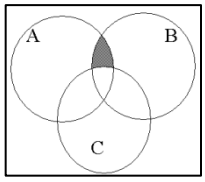
b) 

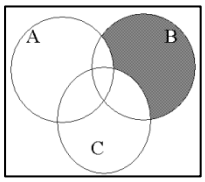
c) 

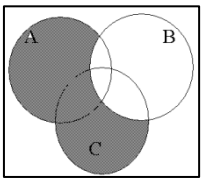
d) 

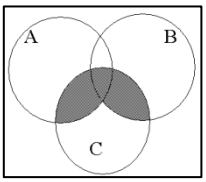
e) None of these

17. Which of the following Venn diagrams represents $(A \cap B) \cup C$

a) 

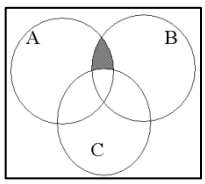
b) 

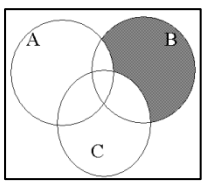
c) 

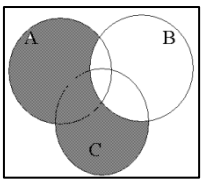
d) 

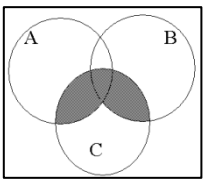
e) None of these

18. Which of the following Venn diagrams represents $(A - C) \cup B$

a) 

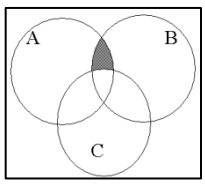
b) 

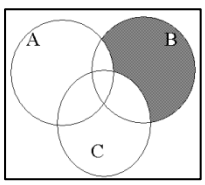
c) 

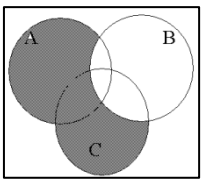
d) 

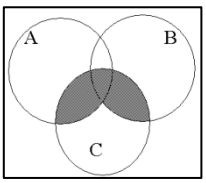
e) None of these

19. Which of the following Venn diagrams represents $(B \cap \overline{A}) - C$

a) 

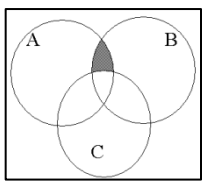
b) 

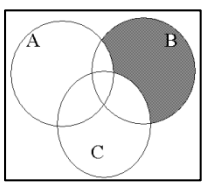
c) 

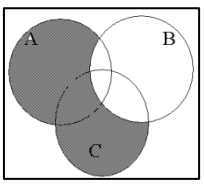
d) 

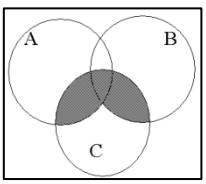
e) None of these

20. Which of the following Venn diagrams represents $(A - \overline{C}) \cup B$

a) 

b) 

c) 

d) 

e) None of these

For problems 21 through 25, consider the following situation. At a math relays contest 150 students took exams. Of these students, 60 took a geometry test, 60 took number theory, and 70 took algebraic simplifications. 30 took both number theory and algebraic simplification, 40 took geometry and algebraic simplifications, 20 took number theory and geometry, while 15 took all three.

21. How many students did not take any of these exams?

a) 15 b) 25 c) 35 d) 40 e) None of these

22. How many students took only algebraic simplification?

a) 15 b) 25 c) 35 d) 40 e) None of these

23. How many students took at most two of these exams?

a) 50 b) 70 c) 90 d) 110 e) None of these

24. How many students took number theory, algebraic simplifications, and not geometry?

a) 15 b) 25 c) 35 d) 40 e) None of these

25. How many students took number theory or geometry?

a) 30 b) 80 c) 100 d) 115 e) None of these

26. True or false, If $A \subset C$, then $(A \cup B) \subset C$.

a) True b) False

27. True or false, If $A \subset C$, then $(A \cap B) \subset C$.

a) True b) False

28. True or false, For all sets *A* and *B*, $(A \cap \overline{B}) \subset (A \cup B)$.

a) True b) False

29. True or false, For all sets *A* and *B*, $(A - \overline{B}) \subset A$.

a) True b) False

30. True or false, For all sets *A* and *B*, $(A - B) \subset B$.

a) True b) False