1. Consider the following truth table:

<table>
<thead>
<tr>
<th></th>
<th>p</th>
<th>q</th>
<th>~q</th>
<th>(p ∧ q)</th>
<th>(p ∧ q) ∨ (~ q)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The truth value for the last column should be:

A. T  B. T  C. F  D. T  E. T  F  T  T  None  T  T  T  T

2. Given the following truth table, which of the following statement should replace *?

<table>
<thead>
<tr>
<th></th>
<th>p</th>
<th>q</th>
<th>*</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>T</td>
<td></td>
<td>F</td>
</tr>
<tr>
<td>T</td>
<td>F</td>
<td></td>
<td>T</td>
</tr>
<tr>
<td>F</td>
<td>T</td>
<td></td>
<td>T</td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td></td>
<td>T</td>
</tr>
</tbody>
</table>

[A] ~ p ∧ ~ q  
[B] ~ p ∨ q  
[C] p ∨ ~ q  
[D] ~ (p ∧ q)  
[E] None of the above

3. Consider the following truth table:

<table>
<thead>
<tr>
<th></th>
<th>p</th>
<th>q</th>
<th>~p</th>
<th>~q</th>
<th>(p ∧ q)</th>
<th>(p ∧ q) ∨ (~ q)</th>
<th>~ p ∧ q</th>
<th>~ (~ p ∧ q)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The columns of (p ∧ q) ∨ (~ q) and ~ (~ p ∧ q) indicate that the two statements are:

[A] Logically Equivalent  
[B] a tautology  
[C] a Contradiction  
[D] Valid argument  
[E] None of the above
4. If it is heavy snow, then Tom's car would stay in the garage and he would have to take the bus. Tom did take the bus, therefore, it was heavy snow.

Which of the following is the correct statement:

[A] \( p \rightarrow (q \land r) \lor r \rightarrow p \)

[B] \( p \rightarrow (q \land r) \land r \rightarrow p \)

[C] \( p \rightarrow (q \land r) \lor q \rightarrow p \)

[D] \( p \rightarrow (q \land r) \land q \rightarrow p \)

[E] None of the above

5. Consider the following truth table:

<table>
<thead>
<tr>
<th>( p )</th>
<th>( q )</th>
<th>( (p \rightarrow q) )</th>
<th>( (p \rightarrow q) \land \neg p )</th>
<th>( [(p \rightarrow q) \land p] \rightarrow p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td>T</td>
<td>T</td>
<td></td>
</tr>
</tbody>
</table>

The truth value for the last column should be:

A. T  B. T  C. T  D. T  E. None

6. Consider the following truth table:

<table>
<thead>
<tr>
<th>( p )</th>
<th>( q )</th>
<th>( \neg p )</th>
<th>( (p \rightarrow q) \land \neg p )</th>
<th>( (p \rightarrow q) \leftrightarrow (\neg p \lor q) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>T</td>
<td>\neg T</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>T</td>
<td>F</td>
<td>\neg T</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>F</td>
<td>T</td>
<td>\neg T</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td>\neg T</td>
<td>T</td>
<td>T</td>
</tr>
</tbody>
</table>

The truth value for the last column should be:

A. T  B. T  C. T  D. T  E. None
Problems 7 and 8 refer to the following question: Let \( A = \{1,2,3,4,5\} \); \( B = \{1,2,3,4,5,6\} \); \( C = \{2,4,5\} \)

7. Find the number of subsets in \( A \) that contain at least one element

   [A] 5
   [B] 32
   [C] 30
   [D] 31
   [E] None of the above

8. Which of the following is not correct:

   [A] \( C \subseteq B \)
   [B] \( A \) is contained by \( B \)
   [C] \( \{2,3\} \in A \)
   [D] \( A \) is a subset of \( B \)
   [E] None of the above

Problems 9 - 11 refer to the following question:

Let \( U = \{a, b, c, d, e, f\} \); \( A = \{a, e\} \); \( B = \{b, c, d, e\} \); \( C = \{c, f\} \)

9. Find \( (A \cap B) \cup C \)

   [A] \( \{a, e, f\} \)
   [B] \( \{a, c, f\} \)
   [C] \( \{e, c, f\} \)
   [D] \( \{b, c, f\} \)
   [E] None of the above

10. Find \( A \cap (B \cup C) \)

    [A] \( \{a, e\} \)
    [B] \( \{a\} \)
    [C] \( \{e\} \)
    [D] \( \{c, f\} \)
    [E] None of the above

11. Find \( (B \cup C) \cap A' \)

    [A] \( A' \)
    [B] \( \{b, c\} \)
    [C] \( \{b, c, d\} \)
    [D] \( \{c, d, f\} \)
    [E] None of the above
Problems 12 - 14 refer to the following question: Let \( A = \{a, e\} \); \( B = \{b, d, e\} \)

12. Find \( A - B \)
   [A] \( \{a, e\} \)
   [B] \( \{b, d\} \)
   [C] \( \{e\} \)
   [D] \( \{a\} \)
   [E] None of the above

13. Find \( A \times B \)
   [A] \( \{(a, b), (a, d), (a, e), (e, b), (e, d), (e, e)\} \)
   [B] \( \{(b, a), (b, e), (d, a), (d, e), (e, a), (e, e)\} \)
   [C] 5
   [D] 6
   [E] None of the above

14. Find \( n(A \times B) \)
   [A] \( \{(a, b), (a, d), (a, e), (e, b), (e, d), (e, e)\} \)
   [B] \( \{(b, a), (b, e), (d, a), (d, e), (e, a), (e, e)\} \)
   [C] 5
   [D] 6
   [E] None of the above

15. A universal set with \( n(U) = 40 \), is partitioned into three subsets \( A, B \) and \( C \). If \( n(B) = 3n(A) \) and \( n(C) = 2n(B) \); find \( n(B) \).
   [A] 4
   [B] 12
   [C] 24
   [D] 6
   [E] None of the above

16. Let \( A \) and \( B \) be subsets of a universal set \( U \), \( n(U) = 50 \), \( n(A' \cap B') = 10 \), \( n(A' \cap B) = 15 \), \( n(A \cap B') = 15 \). Find \( n(A \cap B) \).
   [A] 5
   [B] 12
   [C] 10
   [D] 15
   [E] None of the above

17. Let \( A \) and \( B \) be subsets of a universal set \( U \) with \( n(A) = 10 \), \( n(B) = 15 \), \( n(A') = 12 \), and \( n(A' \cap B') = 5 \). Find \( n(B \cap A') \).
   [A] 7
   [B] 8
   [C] 10
   [D] 2
   [E] None of the above
18. Using the Venn diagram, if $n(U) = 140$, $n(A) = 10$, $n(C) = 28$, and $n(A \cup B \cup C)' = 100$. Find the value of $y$.

[A] 1  
[B] 2  
[C] 3  
[D] 4  
[E] None of the above

19. Which of the following is a true statement: (hint, use Venn diagram)

[A] $(A \cap B)' = A' \cap B'$  
[B] $B \cap A' \subseteq A'$  
[C] $B' \cap A' \subseteq (A \cap B)'$  
[D] $B' \cup A' \subseteq (A \cup B)'$  
[E] None of the above

20. The set $A' \cup B'$ is best represented by the shaded region of graph:

[A]  
[B]  
[C]  
[D]  

![Venn Diagram](image)
21. Which of the following statement is represented by the shaded region of the Venn diagram:

[A] $B \cap (A \cup C)'$
[B] $B \cup (A \cup C)'$
[C] $B \cap (A \cap C)'$
[D] $B \cap (A' \cup C')$
[E] None of the above

22. At a survey of 75 students, it was found that:
20 took French ($F$)
40 took German ($G$)
30 took History ($H$)
6 took German and French
6 took French and History
9 took History and German
4 took none of the above

If the number of students that took all of the above is $x$, then the value of $W$ is:

[A] $8 - x$
[B] $8 + x$
[C] $10 + x$
[D] $12 + x$
[E] None of the above

23. An automobile tested by a national highway traffic safety commission was found to have 20 production defects. Of these, 11 were classified as major defects and 8 were design defects; 4 were neither major nor design defects. How many have design defects only?

[A] 8
[B] 3
[C] 5
[D] 4
[E] None of the above
24. At a survey 110 people, it was found that:
   100 listen to rock \( (R) \)
   30 listen to classic \( (C) \)
   35 listen to jazz \( (J) \)
   30 listen to rock and jazz
   30 listen to rock and classic
   20 listen to all three
   5 listen to none of the above

   How many listen to jazz only?

   [A] 0
   [B] 10
   [C] 5
   [D] 20
   [E] None of the above

25. A survey of an automobile dealership for repair produced the following data:
   36 had brake repairs
   10 had brakes and exhaust repairs
   30 had exhaust repairs
   8 had brakes and transmission repairs
   22 had transmission repairs
   12 had exhaust and transmission repair
   if two cars had all three repairs performed, how many had only exhaust repairs

   [A] 4
   [B] 6
   [C] 8
   [D] 10
   [E] None of the above

26. In a survey of 100 people, 38 were college males, 36 were college female, 18 were college male smokers,
   11 were female college smokers and 8 were neither college students nor smokers. Find the total number of
   smokers that are none college students.

   [A] 18
   [B] 11
   [C] 47
   [D] 8
   [E] None of the above