1. Let $A$, $B$, and $C$ be subsets of the universal set $U$. Draw Venn diagrams illustrating the following:

   (a) $(A \cap B) - C$
   (b) $(A - B) \cup C$

2. Let $A = \{1, 2, 3\}$ and $B = \{a, b\}$. How many elements are in $A \times B$? List them.

3. Let $B = \{1, 2, 3\}$, and $C = \{\{1\}, 2, 3\}$. Find $A \cap B$. For each of the following determine whether it is an element, subset or neither of $A$ and of $B$. 1, $\{1\}$, 2, $\{3\}$.

4. State one form of De Morgan’s laws for sets, and one form of the distributive law.

5. Let $U = \{1, 2, 3, 4, 5, 6\}$, and let $A = \{1, 2, 3\}$, $B = \{2, 3, 4\}$, $C = \{4, 5, 6\}$. Find
   (a) $A \cup \bar{B}$
   (b) $A - B$
   (c) The complement of $(A \cup C)$

6. Give truth tables for $p \lor q$, $p \land q$ and $p \Rightarrow q$.

7. State whether each of the following is True or False (using basic facts that you know).
   (a) This is the month of December, or it is winter.
   (b) If it is 1845, then everyone in MA 206 will get an A on the final exam.

8. Give useful negations, in words, of each of the following.
   (a) If Rommel fights Montgomery, then Montgomery will win.
   (b) Joe has packed his bags, and he is ready to go.

9. Evaluate the following: $P(n, 0)$, $P(n, 1)$, $P(6, 3)$.

10. An I. D. “number” at Buck’s Bank consists of two letters followed by 3 digits. If the I. D. number cannot have an ‘O’ (Oh) in it, and cannot end with an odd digit, then how many possible I. D. Numbers are there?

11. A production committee at the Iron Works consists of one member of management, two senior workers, and two junior workers. If there are seven managers, 10 senior workers, and six junior workers eligible to serve on the committee, then in how many ways can the committee be formed?

12. There are six fourth graders and five third graders on a field trip. In how many ways can they line up to go into a museum, if the classes are to remain together?

13. A palindrome is a number which reads the same front to back as it does back to front.
(a) How many 3 digit palindromes are there?
(b) How many 4 digit palindromes?

14. Let \( R \) be a relation on the set \( S \). Define the following:

(a) \( R \) is reflexive.
(b) \( R \) is transitive.
(c) \( R \) is an equivalence relation (list properties).

15. How does a partial order differ from an equivalence relation? (That is, what property is different and how is it different.) Give an example of a partial order that is not a total order.

16. Give examples of functions \( f, g, h, k \), such that

(a) \( f \) is 1-1 but not onto.
(b) \( g \) is onto, but not 1-1.
(c) \( h \) is not 1-1 and \( h \) is not onto.
(d) \( k \) is 1-1 and onto.

Be specific as to range and domain.

17. If \( f = \{(1, x), (2, y), (3, x)\} \) and \( g = \{(x, \alpha), (y, \beta)\} \), then find the composite function \( g \circ f \).

18. Use the Euclidean algorithm to find the G.C.D of 168 and 34. Then find \( x \) and \( y \) such that \( 168x + 34y = \gcd(168, 34) \) and \( r \) and \( s \) such that \( 168x + 34y = 10 \).

19. What is the division algorithm? Use it to find the remainder when -68 is divided by -16.

20. Give two equivalent definitions of \( a \) is congruent to \( b \) modulo \( n \). How is this denoted? Which of the following are congruent to 5, mod 7: 2, 12, -1, -1, -16, 145?

21. The relation of congruence mod 5, \( \equiv_5 \) is restricted to the subset \( A = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\} \). The equivalence classes of \( \equiv_5 \) form a partition of the set \( A \), find that partition.

22. PERT Diagram problem p9 #7 and #14. Identify critical paths and which task should be shortened to cut the total time.

23. Define a Hamiltonian circuit of a graph.

24. When does a multigraph have an Eulerian circuit? An Eulerian path? Find a circuit or path (or explain why not) 19 p177

25. Find an Eulerian circuit using the algorithm for Fig 4.34 on p 186.

26. Find the minimal distance from \( K \) to any other vertex for the graph in Prob 4, p 190.
27. Problem 8 p. 191.

28. Explain the differences between a graph and a multigraph, give an example of a multigraph that is not a graph.

29. Give two conditions that insure that a connected graph is a tree.

30. draw a tree with 6 vertices, where one vertex has degree 3 and all others have lesser degree.

31. Which of the following is not a statement?
   (a) Smoking may be hazardous to your health.
   (b) Don’t slam the door.
   (c) Some dogs are nice.
   (d) Mathematics is a required subject.
   (e) Automobiles can rust.

32. What is the negation of the following statement?
   All students work hard and some professors are entertaining.

33. What is the negation of the following:
   If you are industrious, the you will get ahead.

34. What is the inverse of
   If it is Friday, then I am taking a test

35. Which of the following is a conjunction?
   (a) The sun shines bright on my old Kentucky Home.
   (b) Dogs bark at midnight or the moon is not full.
   (c) If you are physically fit, then you can run a mile.
   (d) Donny’s stereo is too loud and he has bad manners.
   (e) I don’t know how you can eat that stuff.

36. DO SOME MORE PROBLEMS LIKE pgs 3 and 4 OF LAST TEST IF YOU don’t understand them.

37. Let $A = \begin{bmatrix} 1 & 2 & 0 \\ 3 & 8 & 1 \end{bmatrix}$, $B = \begin{bmatrix} -2 & 1 & -2 \\ 0 & 3 & 1 \end{bmatrix}$, and $C = \begin{bmatrix} 1 & -1 \\ 2 & 1 \end{bmatrix}$. Perform each of the following operations - if the operation is undefined, say why.
   (a) $2A + B$
   (b) $C(A - B)$
   (c) $AB$
   (d) $C - 3B$.  

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