

1. On each of three consecutive days the National Weather Service announces that there is a 50-50 chance of rain. Assuming that they are correct, answer the following:
 - a) draw a possibility tree for the outcomes.
 - b) in how many ways can the event "rain on exactly one day" happen?
 - c) what is the probability that it rains on exactly one of the three days?
2. Baskin-Robbins made itself famous for selling 31 flavors of ice cream. Suppose a Baskin - Robbins ice cream shop is selling those 31 flavors and you have a choice of regular cone, waffle cone or sugar cone in sizes kiddie, small, medium and large. How many different ways can you order ice cream that is in a cone at that shop?
3. In a certain state, license plates consist of two capital letters followed by either 3 or 4 digits. How many different license plates are there that have no repeated letters or digits?
4. In how many ways can a photographer at a wedding arrange six people in a row, including the bride and groom if:
 - a) there is no restriction on where the people are to be placed?
 - b) the bride must be next to the groom?
 - c) the bride is not next to the groom?
 - d) the bride is positioned somewhere to the left of the groom?
5. How many positive integers not exceeding 100 are divisible by 4 or by 6? What is the probability of randomly selecting a number that is divisible by 4 or by 6 when selecting from positive integers not exceeding 100?
6. When surveying 100 students it is found that :

33 are taking math
57 are taking biology
57 are taking chemistry
25 are taking math & biology
15 are taking math & chemistry
22 are taking biology & chemistry
10 are taking all three

Construct and label a Venn diagram where the appropriate number is indicated in the regions using A=Math, B=Biology, C=Chemistry. And answer the following questions:

- a) How many students were taking biology but not chemistry?
- b) How many students were taking only one of the three classes?
- c) How many students are taking math and biology but not chemistry?
- d) How many students are not taking math, biology or chemistry?

7. A club has seven members. Three are to be chosen to travel as a group to a national meeting.
- How many distinct groups of three can be chosen?
 - If the club contains four men and three women, how many distinct groups of three contain two men and one woman?
 - If the club contains four men and three women, how many distinct groups of three contain at most two men?
 - If the club contains four men and three women, how many distinct groups of three contain at least one woman?
 - If the club contains four men and three women, what is the probability that a distinct group of three will contain at least one woman?
 - If two members of the club refuse to travel together as part of the group (but each is willing to go if the other does not), how many distinct groups of three can be chosen?
 - If two members of the club insist on either traveling together or not going at all how many distinct groups of three can be chosen?

8. Prove algebraically that for all integers $n \geq 3$ $P(n+1,3) - P(n,3) = 3P(n,2)$.

9. Prove algebraically for all integers n, k , and r with $n \geq k \geq r$ that $\binom{n}{k} \cdot \binom{k}{r} = \binom{n}{r} \cdot \binom{n-r}{k-r}$.

10. Use the **Binomial Theorem** (you must set it up using the theorem and then simplify each term) to expand: $(x^2 - 2y)^5$.

11. What is the coefficient of $x^{20}y^{1170}$ in the expansion of $(2x^2 + y^3)^{400}$?

Questions 12- 17 refer to the graph with vertices A, B, C, D, E and edges AD, AC, BD, CC, CE, CD, DE, and DE.

12. Draw the graph.

13. Vertex A is adjacent to which vertices?

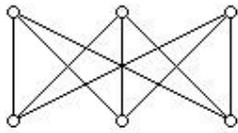
14. Find the degree of each vertex.

15. Does the graph have an Euler circuit?

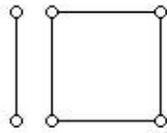
16. Does the graph have an Euler Path?

17. Which edge is a bridge of the graph? (If none, answer "none.")

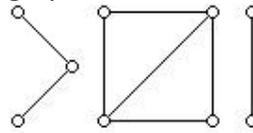
Questions 18-23 refer to the following five graphs.



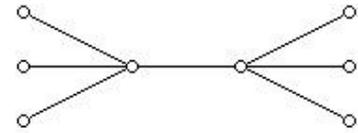
Graph 1



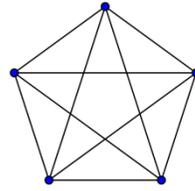
Graph 2



Graph 3



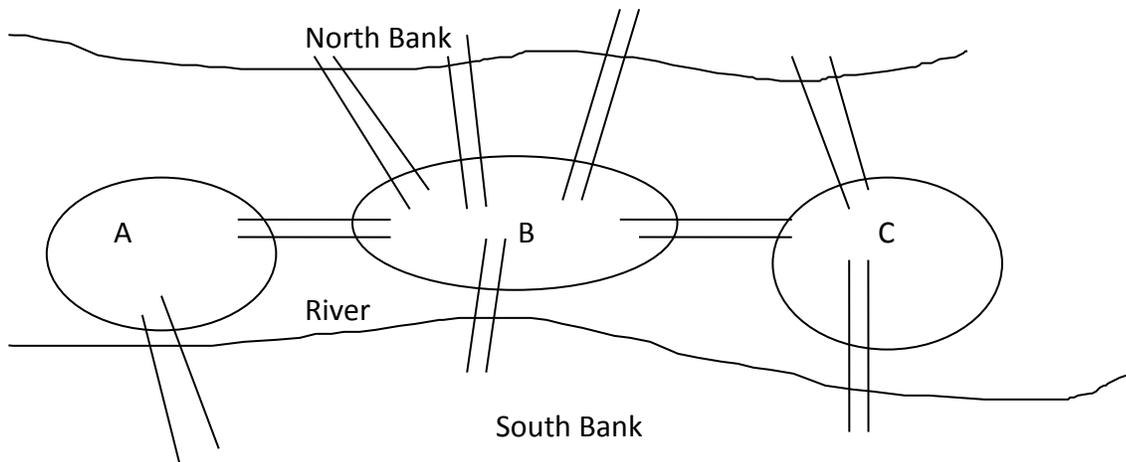
Graph 4



Graph 5

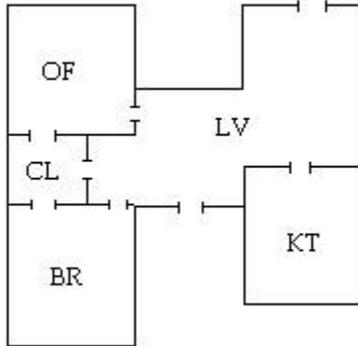
18. Which graph(s) has (have) an Euler circuit?
19. Which graph(s) has (have) a Hamilton circuit?
20. Which graphs are disconnected?
21. Which graph has no circuits?
22. In which graph is it true that every edge is bridge?
23. Are any of the graphs complete? If so which one(s)?

Questions 24-26 refer to the following situation: In a certain city there is a river running through the middle of the city. There are three islands and nine bridges as shown in the figure.

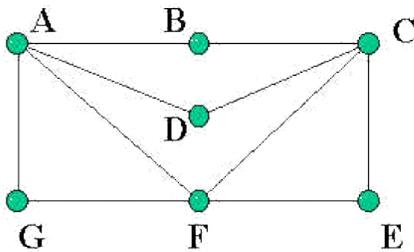


24. Draw the graph that represents this situation.
25. Does this graph have an Euler circuit? If so, state the circuit.
26. Does this graph have an Euler Path? If so, state the path.

27. Draw a graph that represents the floor plan, then determine if it is possible to start outside and walk through each doorway exactly once. If so draw the route you would take, if not explain why not.



28. What is required of a graph that has an Euler circuit?
 29. What is required of a graph that has an Euler path?
 30. Find an Euler circuit starting at A. Number the edges in the order in which you use them.



31. Draw a Graph with 5 vertices that has an Euler Path.
 32. Draw a graph with 5 vertices that does not have an Euler circuit or an Euler path.

Questions 33-35 refer to the following situation: A delivery truck must deliver packages to 5 different store locations (A, B, C, D, and E) The trip must start and end at A. The distances between the locations are as follows:

	A	B	C	D	E
A	–	10	8	20	30
B	10	–	5	7	15
C	8	5	–	3	12
D	20	7	3	–	25
E	30	15	12	25	–

33. Draw a graph to represent this situation.
 34. How many distinct Hamilton circuits would have to be checked if the Brute Force algorithm was used to find the optimal solution?

35. Use the nearest neighbor algorithm starting at A to find the best route for the delivery truck. What is the total mileage for the route?
36. Use the repetitive nearest neighbor to find the best route for the delivery truck. Write the route starting from A once you have found it and give the total mileage.
37. Use the cheapest link algorithm to find a route starting from A, what is the total mileage?
38. Suppose you must visit several family members. You live in city A and you must visit cities B, C, and D before you return home. Find the **optimal** solution. (The route with the lowest total mileage.) What is the total mileage?

