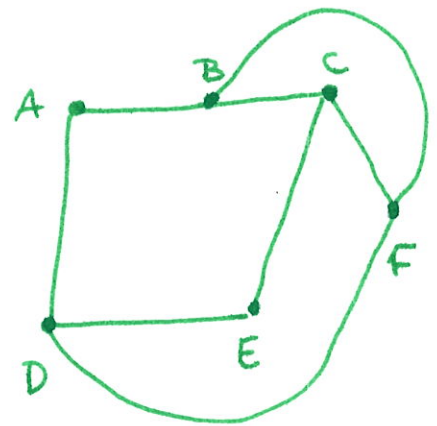
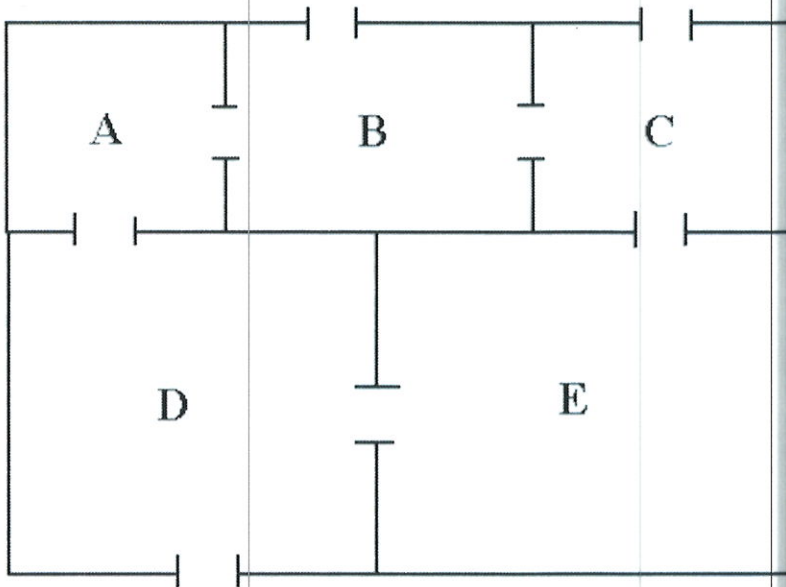
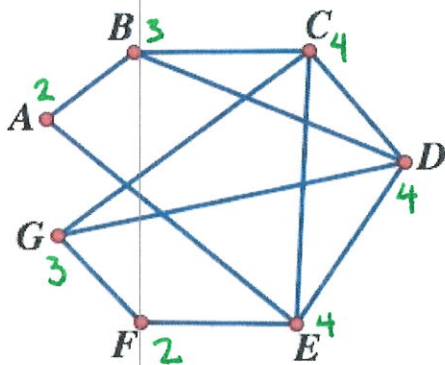


Instructions: Show all work. Use exact answers unless specifically asked to round. Be sure to complete all parts of each problem.

- For the graph below, create a graph that models how one can move from room to room. You may use the exterior region as a 6th vertex F. (12 points)

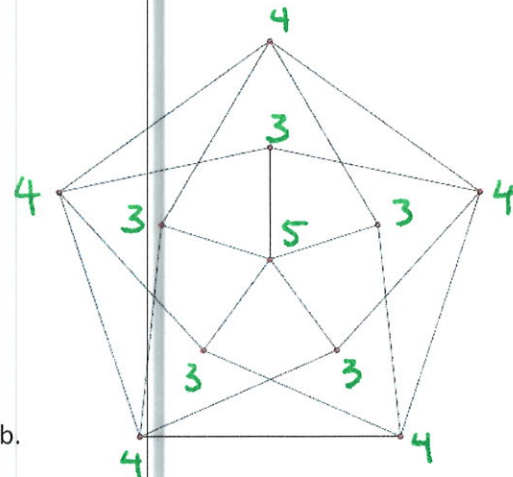


- Determine if the following graphs have Euler circuits, Euler paths or neither. Explain your reasoning. (6 points each)



a.

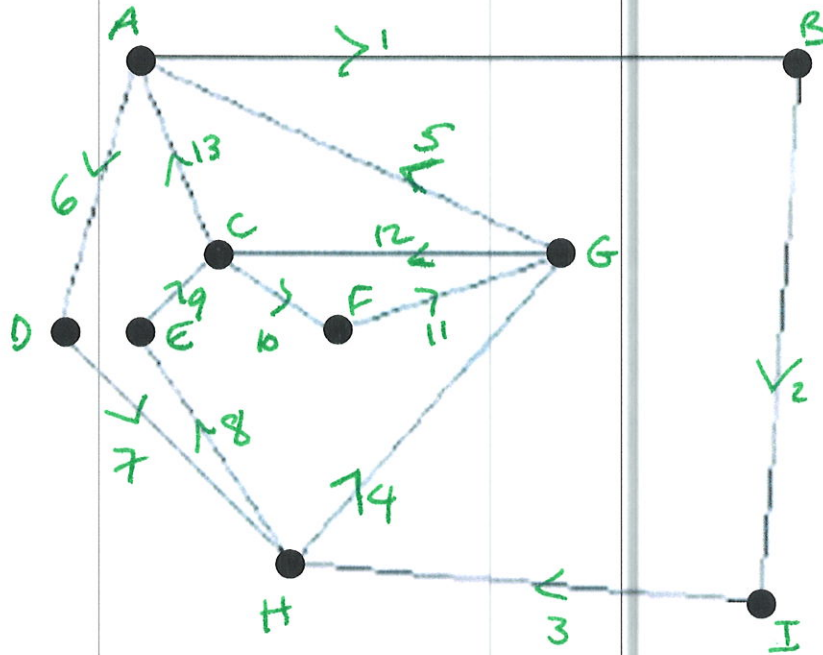
*Euler path
2 odd vertices*



b.

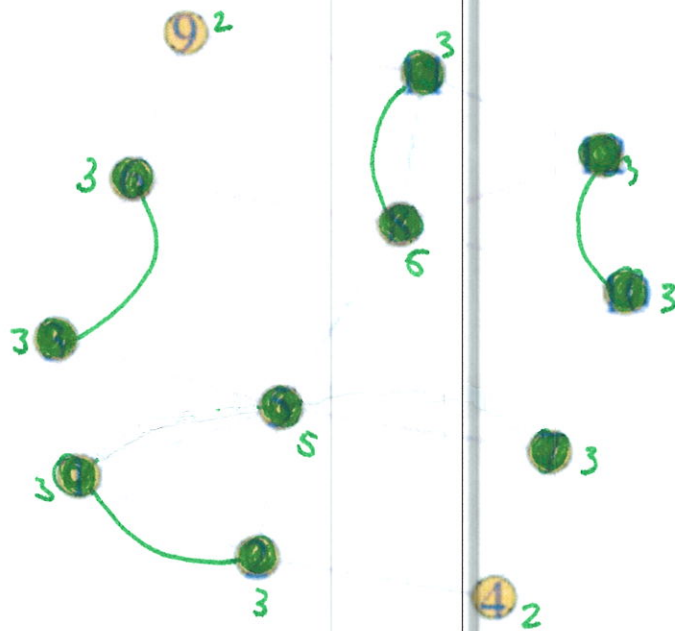
*neither
6 odd vertices*

3. The graph below contains an Euler circuit. Find the circuit using Fleury's Algorithm or another method. Number the edges consecutively as you use them. (12 points)



Answers will vary

4. Semi-eulerize the graph below. Label all the odd vertices clearly. (8 points)



5. The preference table below is for the election of a homeowners' association. Find the winner of the election using the indicated voting method.

Number of voters	8	9	11	7	7	5
1st choice	B	A	D	A	B	C
2nd choice	C	D	B	B	A	D
3rd choice	A	C	C	D	C	A
4th choice	D	B	A	C	D	B

- a. Plurality Method (8 points)

$$B = 8 + 7 = 15$$

$$A = 9 + 7 = 16 \leftarrow \text{A wins}$$

$$C = 5$$

$$D = 11$$

- b. Borda Count Method (12 points)

$$A = 8 \times 2 + 9 \times 4 + 11 \times 1 + 7 \times 4 + 7 \times 3 + 5 \times 2 = 122$$

$$B = 8 \times 4 + 9 \times 1 + 11 \times 3 + 7 \times 3 + 7 \times 4 + 5 \times 1 = 128 \leftarrow \text{B wins}$$

$$C = 8 \times 3 + 9 \times 2 + 11 \times 2 + 7 \times 1 + 7 \times 2 + 5 \times 4 = 105$$

$$D = 8 \times 1 + 9 \times 3 + 11 \times 4 + 7 \times 2 + 7 \times 1 + 5 \times 3 = 115$$

- c. Plurality with Elimination/Instant Run-off Voting (10 points)

Round 1 $A = 16$

$$B = 15$$

~~$$C = 5$$~~

$$D = 11$$

Round 2

$$A = 16$$

~~$$B = 15$$~~

$$D = 16$$

Round 3

$$A = 23 + 8 = 31 \leftarrow \text{A wins}$$

$$D = 16$$

- d. Method of Pairwise Comparisons (12 points)

$$A \checkmark B$$

$$B \checkmark C$$

$$A \checkmark C$$

$$B \checkmark D$$

$$A \checkmark D$$

$$C \checkmark D$$

A	B	C	D
1	11	1	11

B & D tie (wins)

e. Are any fairness criteria violated? Why or why not? Which ones? (10 points)

no majority criterion violated (no majority)
 there is a Condorcet violation - B & D in pairwise comparison but A won plurality & plurality of elimination
 no apparent independence of irrelevant alternatives (or monotonicity) w/o recounts needed

6. Use the extended Borda Count method on the preference table below. At Founding of the US republic, the second place candidate became vice president. Who is second place in this election? (14 points)

# voters	14	10	8	4	1
1 st	A	C	D	B	C
2 nd	B	B	C	D	D
3 rd	C	D	B	C	B
4 th	D	A	A	A	A

$$A = 14 \times 4 + 10 \times 1 + 8 \times 1 + 4 \times 1 + 1 \times 1 = 79$$

$$B = 14 \times 3 + 10 \times 3 + 8 \times 2 + 4 \times 4 + 1 \times 2 = 106$$

$$C = 14 \times 2 + 10 \times 4 + 8 \times 3 + 4 \times 2 + 1 \times 4 = 104$$

$$D = 14 \times 1 + 10 \times 2 + 8 \times 4 + 4 \times 3 + 1 \times 3 = 81$$

B is 1st, C is 2nd, D 3rd, A is 4th

7. The city of Raleigh has 9500 registered voters. There are two candidates for city council in an upcoming election: Brown and Feliz. The day before the election, a telephone poll of 350 randomly selected registered voters was conducted. 112 said they'd vote for Brown, 207 said they'd vote for Feliz, and 31 were undecided.

a. What is the population of this survey? (4 points)

voters in city of Raleigh

b. What is the size of the population? (4 points)

9500

c. What is the size of the sample? (4 points)

350

d. Give the sample statistic for the proportion of voters surveyed who said they'd vote for Brown. (4 points)

$$\frac{112}{350} = .32 \text{ or } 32\%$$