

1. Explain the Condorcet Winner Criterion

When a voting system always chooses the Condorcet Winner when one exists.

2. In order to choose which type of music to listen to in a student center music lounge, a Condorcet vote is held by the 15 students present. Below are the preference schedules for the students. Is there a Condorcet winner and if so, which music type?

	Number of Students		
	6	5	4
First choice	classical	rock	rock
Second choice	jazz	jazz	classical
Third choice	rock	classical	jazz

$\begin{array}{c c} C & J \\ \hline 6 & 5 \\ 4 & \end{array}$	$\begin{array}{c c} C & R \\ \hline 6 & 5 \\ 4 & \end{array}$	$\begin{array}{c c} J & R \\ \hline 6 & 5 \\ 4 & \end{array}$
(C)	(R)	(R)

Yes ; Rock

Use the preference schedule of 23 voters shown below to answer questions 3-7.

	Number of Voters			
	8	5	6	4
2 First choice	A	C	B	B
1 Second choice	C	A	C	A
0 Third choice	B	B	A	C

Total votes: 23 $\frac{23}{2} = 11.5$

$A = (25)$	$B = (20)$	$C = (24)$
$\begin{array}{c} 8 \cdot 2 \\ 5 \cdot 1 \\ 6 \cdot 0 \\ 4 \cdot 1 \end{array}$	$\begin{array}{c} 8 \cdot 0 \\ 3 \cdot 0 \\ 6 \cdot 2 \\ 4 \cdot 2 \end{array}$	$\begin{array}{c} 8 \cdot 1 \\ 5 \cdot 2 \\ 6 \cdot 1 \\ 4 \cdot 0 \end{array}$

- Which candidate, if any, wins in a majority rule election? *None*
- If a rank method is used, which candidate, if any, wins in a straight plurality election? *B*
- Who is the winner using Sequential Runoff with an Agenda of *B, C, A*?
- Who wins using the Borda Count Method *A*
- Can the four voters in the last column vote strategically to change the outcome of question 13 to one they would like better? Why or why not? *No, they can't make B win. If they place C higher then C would win and that is least desirable.*

$\begin{array}{c c} B & C \\ \hline 6 & 8 \\ 4 & 5 \end{array}$	$\begin{array}{c c} C & A \\ \hline 5 & 8 \\ 6 & 4 \end{array}$
(C)	(A)

A seventeen-member committee must elect one of four candidates: R, S, T, or W. See the preference schedule below.

	Number of Members			
	6	4	3	4
First choice	R	S	T	W
Second choice	S	R	S	T
Third choice	T	T	R	S
Fourth choice	W	W	W	R

R	S	T	W
6	4	3	4

8. R wins using the plurality method. Could those members who most prefer W vote strategically in some way to change the outcome in a way that will benefit them?

Yes, they could move S to the top. This would cause S to be new winner. Even though W would not win, R would now lose.

An 11-member committee must choose one of the four applicants, K, L, M, and N, for membership on the committee. Use this table to answer questions 9 and 10.

	Number of Members			K	L	M	N
3 First choice	6	2	3	20	19	15	12
2 Second choice	K	M	M				
1 Third choice	L	L	N				
0 Fourth choice	N	K	L	16			
	M	N	K				

9. The committee members have preferences among the applicants as given in the table. If the committee uses pairwise sequential voting with the agenda K, L, M, N, applicant K wins. Is it possible that another agenda will yield a different winner?

No, it's impossible.

10. The committee uses the Borda count method. The committee members have preferences among the applicants as given in the table. Who wins the election?

K

Consider an 11-member committee that must choose one of three alternatives, X, Y, or Z, using the Hare system. Their schedule of preferences is shown below.

	Number of Voters			X=4	X=6	X	X=4
5 First choice	5	4	2	Y=2	Z=5	(X)	Y=7
2 Second choice	Z	X	Y				
Third choice	Y	Y	X				
	X	Z	Z				Z=0

11. Who wins? Is it possible for the group of five voters to change the outcome in a way that would benefit them?

X Yes they can. Move y up to first and y will win.

Twenty-nine voters must choose from among three alternatives, A, B, and C, using the Borda count method. The voters' preference schedules are shown below.

	Number of Voters				A	B	C
2 First choice	12	8	6	3	20	33	34
1 Second choice	B	C	X B	C			
0 Third choice	C	A	B A	B	14	39	34
	A	B	C	A			

12. Who wins Borda count? Can the group of six voters change their preference list to produce an outcome they like better?

C; Yes Rank B first and then redo. Although A still doesn't win, C loses.

13. Give an example of a weighted voting system that has a dummy voter but no dictator.

[15: 8, 7, 1]

14. Explain why the weighted voting system [13: 10, 6, 5, 3, 2] is not a legitimate weighted voting system. *Quota too low. $Q > \frac{1}{2}(V)$ $Q > \frac{1}{2}(16)$ $Q > 8$*

15. Given the weighted voting system [30: 20, 17, 10, 5], list all winning coalitions.

16. In a weighted voting system, is a voter with veto power the same as a dictator? Explain why or why not. *Technically yes, because the other voters need him to win*

17. Given the weighted voting system [5: 3, 2, 1, 1, 1], find which voters of the coalition {P1, P3, P4, P5} are critical. *P1, P3, P4, P5*

18. Is voter P3 a critical voter in the coalition {P1, P2, P3} of the weighted voting [15: 10, 6, 5, 3, 2]? Why or why not? *No, because P1 and P2 can win without him.*

19. Evaluate ${}_8C_3$. *56*

20. Given the weighted voting system [4: 1, 2, 3], list all winning coalitions. *$\{P_1, P_3\}$, $\{P_2, P_3\}$*

21. Which of the following describe legitimate weighted voting systems?

I [16: 13, 8, 6, 4]

II [15: 10, 8, 7, 5] *→ no*

*Quota too low $Q > \frac{1}{2}(V)$
 $Q > \frac{1}{2}(30)$
 $Q > 15$*

*$\{P_1, P_3\}$
 $\{P_1, P_3\}$
 $\{P_1, P_3, P_4\}$
 $\{P_2, P_3, P_4\}$
 $\{P_1, P_3, P_4\}$
 $\{P_1, P_2, P_4\}$
 $\{P_1, P_2, P_3, P_4\}$*

22. A weighted voting system can have dummy voters without a dictator.

- A) True
- B) False

23. Which voters in the system [38: 20, 15, 12, 5] have veto power?

- A) A only
- B) A and B
- C) A, B, and C
- D) None

24. Given the weighted voting system [38: 20, 15, 12, 5], list all winning coalitions?

*$\{P_1, P_2, P_3\}$ $\{P_1, P_2, P_4\}$
 $\{P_1, P_2, P_3, P_4\}$*

25. Given the weighted voting system [9: 6, 4, 2], which of the voters are dummy voters?

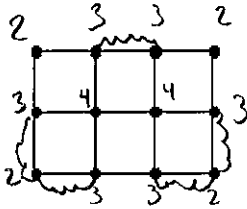
P3

26. A committee has four voters with the system [30: 20, 17, 10, 5]. Which voters are critical in the coalition {P1, P3, P4}?

P1 and P3

A blast from the past.....

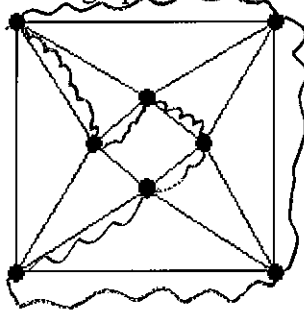
27. Add wiggly edges to find an efficient Eulerization of the following graphs.



28. In some states, license plates use a mixture of letters and numerals. How many possible plates could be constructed using three letters followed by three numerals?

$26 \cdot 26 \cdot 26 \cdot 10 \cdot 10 \cdot 10 = 26^3 \cdot 10^3 = 17576000$

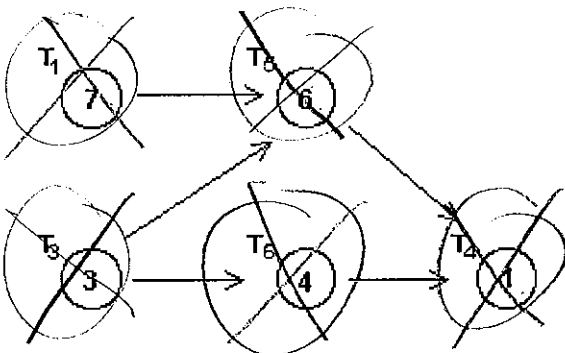
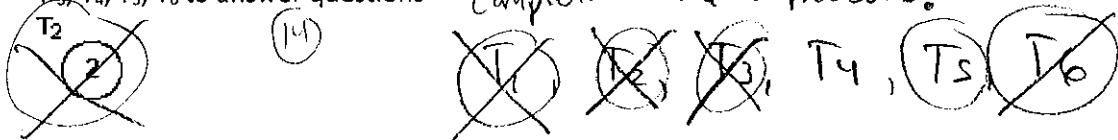
29. In the graph below, add wiggly edges to indicate a Hamiltonian circuit.



Use the first fit (FF) bin-packing algorithm to pack the following weights into bins that can hold no more than 9 lbs.

N/A Didn't give the #'s

30. Use the order-requirement digraph below (with time given in minutes) and the priority list $T_1, T_2, T_3, T_4, T_5, T_6$ to answer questions. Completion Time 2 processors.



	0	2	4	6	8	10	12	14
P ₁	T ₁		T ₅			T ₄		
P ₂	T ₂	T ₃	T ₆					