Work carefully, and **SHOW ALL STEPS** in order to receive full credit. An answer without supporting work will not receive credit. Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on the back of the page.

Name and section: _____

Instructor's name: _____

1. A PTA board voted to select how to spend $20,000 they had earned in a fund-raiser. The preference rankings of the voting members appear next.

	Number of Voters								
	1	**3**	**1**	**3**	**3**	**2**	**1**	**6**	**2**
Computers	1✓	1✓	2✓	2	3	3	3	2✓	3
Library Books	2	3	1✓	1✓	1✓	2	4	3	2
Playground Equipment	4	4	3	4	4	1✓	1✓	4	4
Science Lab	3	2✓	4	3	2✓	4	2✓	1✓	1✓

(a) Which choice would win using the plurality with runoff between the top two?

(b) Which choice would win using Borda's method?

(c) If Borda's method is used, could the three members who ranked library books first, science lab second, computers third, and playground equipment last obtain a preferable result by voting strategically if the other members voted as shown in the table? Explain.

Explain your reasoning clearly. If your answer is "yes", indicate how the preferable outcome is obtained. If your answer is "no", explain why no preferable outcome is possible.

(d) Show all necessary Condorcet comparison's and then determine which choice, if any, would be a Condorcet winner?

(e) Which choice would win in an approval vote?

(f) If an approval vote is used, could the 3 voters who ranked computer first and science lab second, library books third, and playground equipment fourth obtain a preferable result by voting strategically if the other members voted as shown in the table? Explain.

Explain your reasoning clearly. If your answer is "yes", indicate how the preferable outcome is obtained. If your answer is "no", explain why no preferable outcome is possible.

2. Suppose that three candidate - Rosen, Brown, and Wheatley - are running in an election that will be decided by the plurality method with a runoff between the top two finishers if none of the candidates receives a majority of the votes. The results of the first ballot are given below.

Rosen	2246
Brown	5680
Wheatley	6126

In a runoff election between Wheatley and Brown, what percentage of Rosen supporters would need to vote for Brown in order for Brown to win the election? How about for Wheatley?

3. Suppose there are 140 votes cast in an election among five candidates- Segarra, Perez, Peters, Perry, and Milner- to be decided by plurality. After the first 100 votes are counted, the tallies are as follows:

Segarra	12
Perez	23
Peters	17
Perry	29
Milner	19

(a) At this point, is it possible for anyone to win with a majority of the votes?

(b) What is the minimum number of remaining votes Perry needs to be assured of a win?

(c) What is the minimum number of remaining votes Peters needs to be assured of a win?

4. Based on the enrollment figures from the previous year, a junior college expects the total enrollment in mathematics courses, broken down by course, to be as given in the table.

   The college employs 11 mathematics professors and they each teach 4 classes, so a total of 44 classes will be offered. The mathematics department chair decides to apportion the 44 classes among the 5 courses according to the expected enrollment.

   (a) Apportion the classes using Hamilton's method.

Course	Total of Enrollment	Natural Quota D=	Initial Allocation	Final Allocation
Algebra	315			
Trigonometry	151			
Precalculus	698			
Calculus I	590			
Calculus II	305			
Total				

   (b) Apportion the classes using Lowndes' method.

Course	Total of Enrollment	Natural Quota D=	Initial Allocation	Relative Fractional part	Final Allocation
Algebra	315				
Trigonometry	151				
Precalculus	698				
Calculus I	590				
Calculus II	305				
Total					

5. Don't-Fall-or-you-Might-Get-Trampled-Mart has 11 truck-loads of flat-screen TV's to distribute to its 4 stores. A truck-load can't be split so they want to apportion these shipments based on the number of shoppers a store gets each week. These figures are given in the following table:

Store	Boston	Mansfield	Providence	Hartford
Shoppers per week	5430	2270	3600	4100

(a) Apportion these truckloads using Webster's method:

Store	**Shoppers**	**Natural Quota D=**	**Initial Allocation**	**Modified Quota D=**	**Final Allocation**
Boston	5430				
Mansfield	2270				
Providence	3600				
Hartford	4100				
Total	15400				11

Store	**Desired Allocation**	**Threshold Divisor**
Boston		
Mansfield		
Providence		
Hartford		

(b) Apportion these truckloads using Jefferson's method:

Store	**Shoppers**	**Natural Quota D=**	**Initial Allocation**	**Modified Quota D=**	**Final Allocation**
Boston	5430				
Mansfield	2270				
Providence	3600				
Hartford	4100				
Total	15400				11

Store	**Desired Allocation**	**Threshold Divisor**
Boston		
Mansfield		
Providence		
Hartford		