CE 3500: Exam 1

Monday, March 8

10:00 – 10:50 AM

Name _____

Instructions:

- **SHOW ALL WORK** unless instructed otherwise. No shown work means no partial credit!
- If you require additional space, you may use the back of each sheet and/or staple additional pages to the end of the exam.
- If you need to make any additional assumptions, state them clearly.
- You may use one regular-sized sheet of notes; please turn in the notes with your exam. No additional resources are permitted.
- The number of points associated with each part of each problem is indicated.

Problem	Points	Possible
1		10
2		15
3		15
4		10
TOTAL		50

Problem 1. Short answer. (10 points). Answer the following questions completely, but concisely (emphasis on **short** answer). You may draw a figure if it would be helpful.

1. (2) In the functional classification system, the major purpose of freeways is mobility, and the major purpose of local streets is access. List one characteristic of freeways which enables high mobility, and one characteristic of local streets which enables high accessibility.

2. (8) Techniques or concepts used in the four-step model include the gravity model, linear regression, the principle of user equilibrium, and utility functions. Match each of these four techniques with the step where they are used, then **briefly** explain the goal of that step, and how that technique helps accomplish that goal.

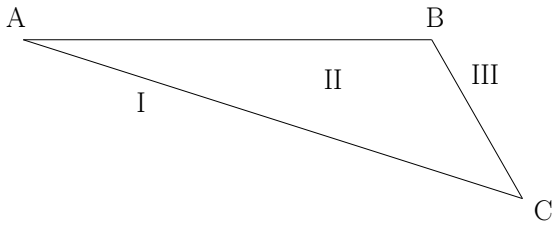
Problem 2. (15 points.) Having impressionable minds and being huge fans of the hit MTV show *Jersey Shore*, you and your friends decide to spend spring break on an epic road trip to Seaside Heights, NJ. Your trip passes through Philadelphia; and from there you have to choose among three routes to Seaside Heights. Route 1 would be to take I-95, I-195, and US-9; Route 2 is to take NJ-7 (a back road) the whole way; and Route 3 is to take NJ-42 to US-9. Being anxious to get to the beach as quickly as possible, you want to take the fastest route. Being spring break, there is likely to be some congestion.

Assume that the travel time on the three routes is given by these functions:

$$t_1 = 54 + x_1/2000$$
$$t_2 = 115 + x_2/500$$
$$t_3 = 45 + x_3/1000$$

where x_1, x_2, and x_3 are the volume on each route. There are a total of 10,000 people traveling from Philly to the Shore. Use the principle of user equilibrium to find the volume on each route. (Hint: This problem is simple enough that you don't need to consider fixed and variable flows; just apply the principle directly.)

Problem 3. (15 points). After arriving at Seaside Heights, you and your friends want to stop at the hotel for a little GTL (gym, tanning, laundry) before hitting up the clubs. As you drive by the *Jersey Shore* house, all of the rubbernecking tourists create a bottleneck, reducing the roadway capacity. The figure below shows a portion of the shockwave diagram created by this incident. In Region I, the volume is 800 vehicles per hour and the density is 25 vehicles per mile; in Region II, the volume is 500 vehicles per hour and the density is 100 vehicles per mile; and in Region III, the volume is 1100 vehicles per hour and the density is 70 vehicles per mile. Points A and B correspond to 1:00 PM and 2:00 PM, respectively.



1. (5) What is the space-mean speed in Regions I, II, and III?
2. (5) What are the speeds of shockwaves I-II and II-III?
3. (5) At what time will these shockwaves meet? (Point C on the diagram)

Problem 4. (10 points). At closing time, you (and everybody else) is trying to leave the parking lot, a total of 100 vehicles. However, vehicles have to wait for a large enough gap in traffic to turn out of the parking lot. A long night of fist-pumping to house music has made you and the other drivers more aggressive than normal; the following field data has been collected on gap acceptance after closing time at Jersey clubs (perhaps by an unforunate graduate student):

Gap length (s)	Number of accepted gaps	Number of rejected gaps
0	0	140
1	17	115
2	58	58
3	85	31
4	120	24
5	135	4
6	140	0

1. (5) What is the critical gap?
2. (5) If the volume on the cross-street is 600 veh/hr, how long do you expect it to take to clear the parking lot? (Assume that gaps are described by a Poisson process, and only one car turns on any gap.)