

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		10
4		15
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 level-of-service analysis for two-lane highways, the grade and heavy-vehicle factors were different for calculating percentage time spent followed, and average travel speed. Why?
2. (8) List the steps of the four-step model. Briefly (but precisely) explain the goal of each step, and how each step logically relates to the next.

Problem 2. (15 points.) OK, now that that's out of the way, the rest of the test will feature something entirely different. You will be plunged into the world of hip-hop superstardom, a fascinating milieu of bling and floss, posses and beef, intrigue and celebrity. As you may (or may not) know, after the show it's the afterparty, and after the party, it's the hotel lobby. But first it's a queuing problem.

You and your crew are leaving the afterparty and heading not to the hotel, or the motel, but the Holiday Inn, in a caravan of ten tricked-out Escalades. Even though it's the middle of the night and there's no other traffic, you still have to wait at a stoplight. On this street, the light is red for 45 seconds, and green for 45 seconds; during a green indication, vehicles can leave at a rate of 60 vehicles per minute. All ten Escalades arrive at the light within a span of thirty seconds (so assume an arrival rate of 20 veh/min for the first 30 seconds, and 0 afterwards). The light turns red just before the first Escalade arrives, but it's all good cause you're with your boo.

1. (5) What is the *least* amount of time that any of your Escalades has to wait?
2. (10) What is the total delay experienced by all of the vehicles?

Problem 3. (10 points). After the light, you decide to follow Kanye's suggestion to pump your brakes and drive slow (homey). One by one, your Escalades pass a sign reporting the speed you're driving. As each vehicle passes, the sign reads 20, 30, 20, 10, 30, 10, 30, 20, 30, and 10 miles per hour. That's pretty slow. But exactly how slow are you driving? Calculate the time-mean and space-mean speed of your Escalades.

Problem 4. (15 points). Most ballers prefer Escalades, but a growing minority prefer the Lamborghini Gallardo (repped by Akon among others). In particular, Lamborghini wants to increase its market share. This can be viewed as a mode choice problem, where the two vehicles represent different modes, and customers choose among them based on the utility they provide. Extensive marketing has revealed that the utility of these vehicles is given by the following function

$$U = 0.002P + 0.03S + 0.5H$$

where P is the price (in thousands of dollars), S is the number of seats, and H is the number of bottle holders for cristal and Henny. Currently a fully-loaded Escalade costs \$95,000, seats nine passengers, and holds eight bottles, while the Gallardo costs \$250,000, seats two, and can only hold three bottles.

1. (5) What is the current percentage of people driving each vehicle?
2. (10) Lamborghini is willing to change the price, the number of seats, and the number of bottle holders in order to increase the Gallardo's market share to 15% or more. Give values of P , S , and H that would accomplish this goal.