Note: You can write your answers in Chinese. For the first three problems, please write down your calculation procedures instead of answers only.

**Problem 1 (10%):** Suppose that we are solving the amber duration to prevent dilemma zones in an intersection. Assuming a comfortable deceleration (a_2^*) of 8 ft/sec^2, an intersection width (w) of 48 ft, a perception-reaction time (δ_2) of 1.5 seconds, and a vehicle length (L) of 16 ft, at what speed (v_0) does the amber duration (τ_{min}) attain a minimum? What is τ_{min}?

Problem 2 (20%): An urban highway follows the following relationship: $u = 50 - [1/(4s)]$, where u is the vehicle speed and s is the gap between two continued vehicles. (u: mile/hr, s: mile)
(a) (10%) Please find free-flow speed (u_f), congested density (k_j), capacity (q_{max}) and speed (u_m), density (k_m) at capacity.
(b) (10%) If the vehicular stream on this highway is traveling at 40 mile/hr and then interrupted by a police for 9 minutes, please estimate how many stationary vehicles are accumulated in front of the police at the end of 9 minutes.

Problem 3 (20%): Estimate the optimal cycle length and the green intervals for the intersection shown in the following figure. Assume that phase A serves the north-south traffic and phase B serves the east-west traffic. Lost time is equal to 3 seconds per phase and amber is equal to 4 seconds. The width of each lane is 11 feet and the prevailing saturation flows (vehicles/hour) are as follows:
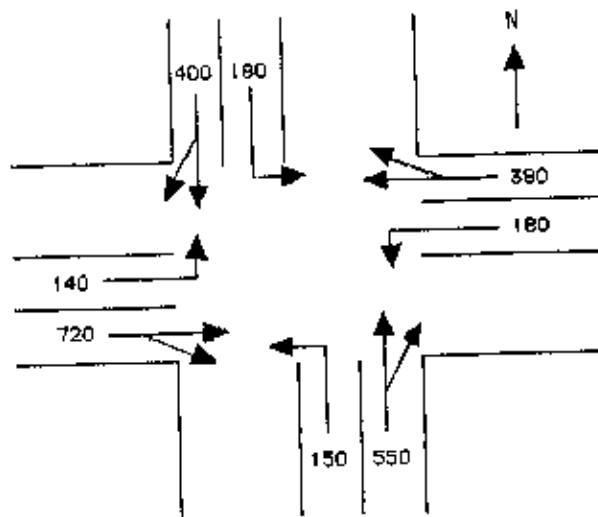
S (TH+RT) = 1800 (vehicles/hour) for through and right turn movement
S (LT) = 500 (vehicles/hour) for permitted left turn movement

Hints: Cycle length $C_0 = (1.5L+5)/(1-Y)$ (in seconds). Cycle length should be a multiple of 5 seconds. Minimum green time: $C_p = 7 + W/4 + Y'$ (in seconds).
where:
  L: total lost time during a cycle, in seconds
  Y: sum of the flow ratios of critical movements
  W: width of the crossing, in feet
  Y': total change interval time in seconds (amber plus all red, if exists)

Problem 4 (50%): Answer the following questions:
(a) (5%) What is the definition of a transportation system?
(b) (5%) Please explain what semi-actuated signals and fully actuated signals are?
(c) (5%) Please explain what "park-and-ride" and "kiss-and-ride" mean.
(d) (5%) What are the definition of transportation planning and its purpose?
(e) (10%) Please describe the relationship between transportation and land use.
(f) (10%) What are the four conventional steps in the sequential demand-forecasting process? Please show an existed model in each step?
(g) (10%) Please show five methods that can help solve urban parking problems.