

National Exam Dec 2005

98-Civ-B10, Traffic Engineering

3 hours duration

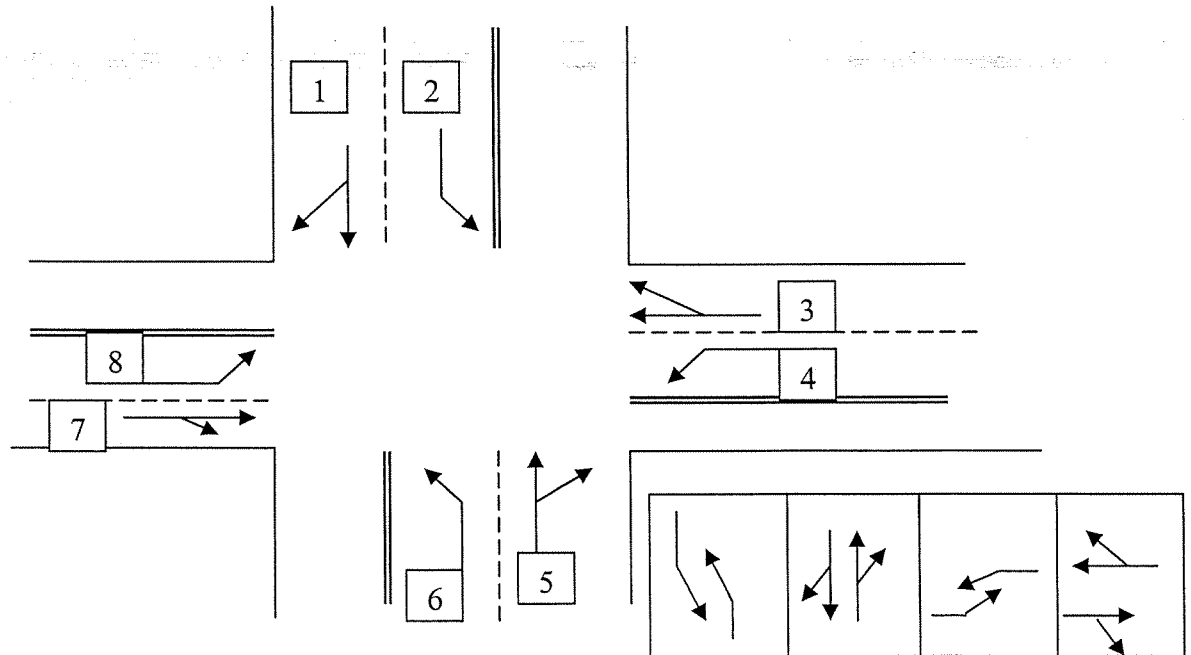
NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is a closed book exam. Only the approved Casio or Sharp calculators are permitted
3. FOUR Questions constitute a complete exam paper. The first four questions as they appear in the answer book will be marked.
4. Each question is of equal value.

QUESTION 1

For the following intersection and demand table, using Webster's Equations as shown below, determine the minimum and optimum cycle time and the green split. Assume a four phase timing plan as shown with 4 seconds of inter green per phase and a maximum cycle length of 180 seconds. Ignore sneakers and Right Turn on Red. Using a queuing diagram, calculate the total and average delay for lane 1. Sketch the discharge pattern for Lane 2 for a typical cycle.

Lane	1	2	3	4	5	6	7	8
Volume	500	200	275	55	325	115	350	60
Saturation Flow	1650	1500	1700	450	1600	1450	1850	550



$$C_{\min} = \frac{L}{1 - \sum y_{ci}}$$

$$C_{\text{opt}} = \frac{1.5L + 5}{1 - \sum y_{ci}}$$

$$g_i = \frac{y_{ci}}{\sum y_{ci}} (C - L)$$

Where:

- C_{\min} = Minimum Cycle time (s)
- C_{opt} = Optimum Cycle time (s)
- y_{ci} = Critical Flow Ratio "y" for phase "i"
- y_{ji} = Flow ratio for lane "j" in phase "i", given by ratio of Demand Volume to Saturation flow rate for lane "j" in phase "i"
- L = Total Lost time per cycle (s)
- g_i = Green time for phase "i" (s)

QUESTION 2

The density-speed relationship for a freeway lane was found to be:

$$u = 54.5 - 0.24k$$

Speed is given by u , density is given by k , and flow is given by q . Determine:

- a. speed at capacity
- b. density at capacity
- c. free flow speed
- d. maximum flow
- e. Sketch the $u-q$, $q-k$ and $u-k$ curves for this stream flow equation.

QUESTION 3

Discuss in detail the following:

- a. Actuated Signal Control
- b. Dynamic Signal Control
- c. MUTCD (Manual on Uniform Traffic Control Devices)
- d. Random versus Uniform delay at Signalised Intersections.
- e. Warrants for Signalised Traffic

QUESTION 4

A traffic stream travelling at 75 kph and a flow of 1600 vph encounter an accident that blocks their lane. This condition lasts for 5 minutes after which the accident is cleared and the traffic is allowed to discharge from the queue at rate of 2000 vph at 45 kph. If the jam density is 100 vpk, calculate;

- maximum number of vehicles in the queue,
- maximum length of the queue,
- time to dissipate the queue, and
- time until upstream conditions reach the site of the accident

Where:

$$q = ku$$

q = flow (vehicle per hour)

k = density (vehicles per kilometre)

u = speed (kilometres per hour)

Where:

$$u_{sw} = \frac{q_b - q_a}{k_b - k_a}$$

u_{sw} = Speed of shockwave

a = upstream condition

b = downstream condition

QUESTION 5

Discuss in detail the following:

- a. Methods to establish speed limits
- b. Shock waves in uninterrupted traffic flow
- c. Intelligent Transportation Systems (ITS)
- d. Vehicle Volume Studies
- e. Speed and Travel Time Studies