

National Exams May 2007

98-Civ-B10, Traffic Engineering

3 hours duration

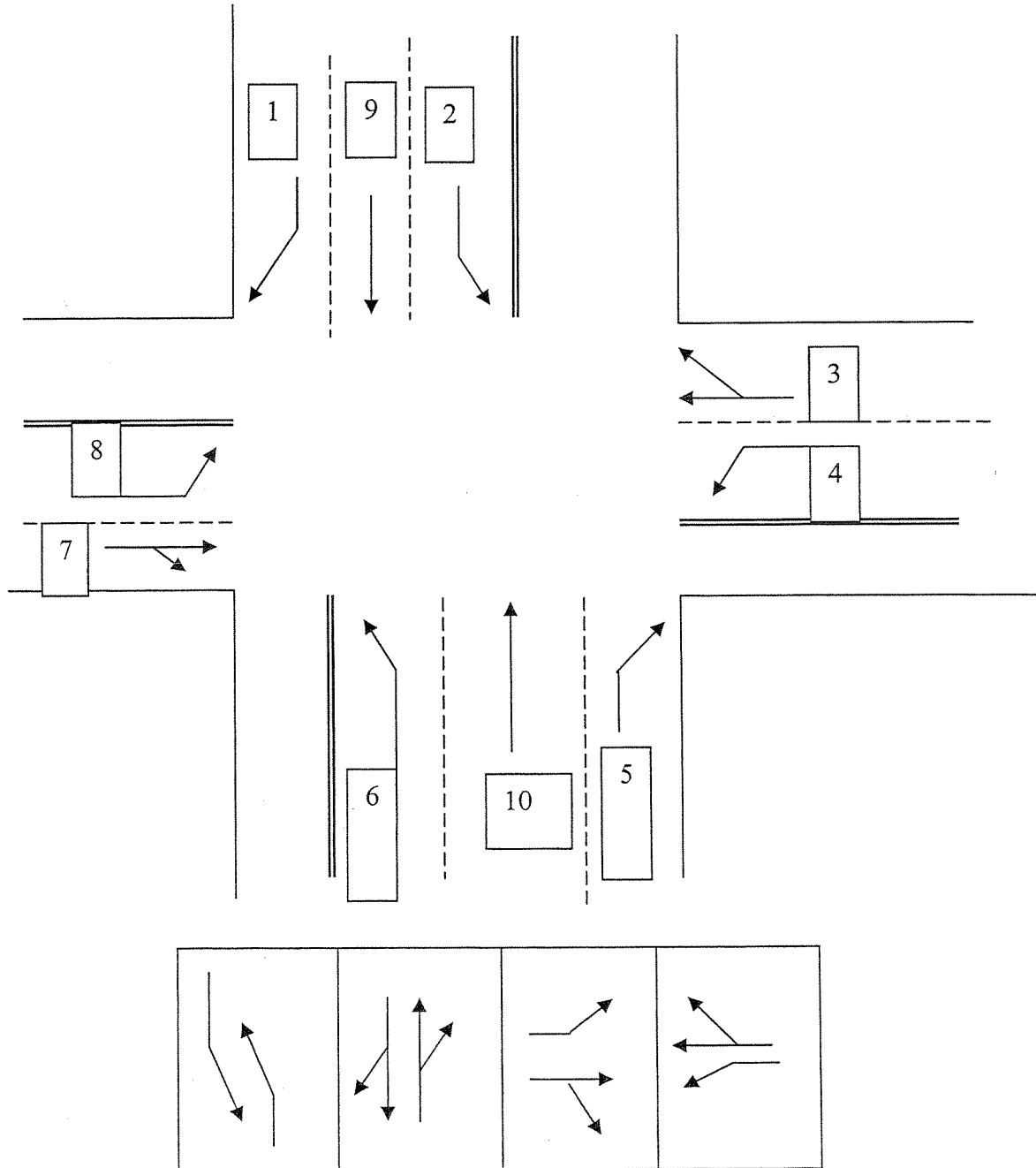
NOTES:

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. This exam has **TWO PARTS; PART A** and **PART B**. Answer any **three** questions from PART A, and any **two** questions from PART B.
4. FIVE Questions constitute a complete exam paper. The first five questions as they appear in the answer book will be marked.
5. Each question is of equal value.

PART A

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 5 seconds of inter green per phase and a maximum cycle length of 120 seconds. Ignore left turn on intergreen period and Right Turn on Red. Using a queuing diagram, calculate the total and average delay for lane 10.



Lane	1	2	3	4	5	6	7	8	9	10
Vol	225	200	275	175	175	115	225	225	450	350
Saturation Flow	1650	1500	1700	1400	1600	1450	1850	1450	1800	1800

QUESTION 1 CONT'D

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

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

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

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

An approach lane to a signalized intersection has a demand of 760 vph, a minimum headway of 2.5 seconds per vehicle, a cycle time of 100 seconds and a displayed green of 64 seconds. If the amber is 3.5 seconds, the all red is 2.5 seconds, the start loss is 2 seconds and the end gain is 3 seconds, calculate and illustrate with a queuing diagram:

- a. Effective green
- b. Effective red
- c. Capacity of approach
- d. Maximum queue size
- e. Total and average vehicle delay
- f. Delay to a vehicle that arrives 15 seconds after the light turns red
- g. Delay to a vehicle that arrives 10 seconds after the light turns green

QUESTION 3

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

$$u = 80 - .08k$$

Given that the speed is in kilometres per hour and the density is in vehicles per kilometre, determine:

- a. speed at capacity
- b. density at capacity
- c. free flow speed
- d. maximum flow
- e. Sketch u_k , u_q , and q_k relationships illustrating the key points calculated above.

QUESTION 4

A traffic stream travelling at 50 kph and a flow of 1000 vph encounter an accident that blocks their lane. This condition lasts for 20 minutes after which the accident is cleared and the traffic is allowed to discharge from the queue at rate of 1800 vph at 30 kph. If the jam density is 110 vpk, calculate;

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

PART B

QUESTION 5

The complexity of urban traffic requires the extensive use of computer tools and simulation software. Discuss and compare in detail any two of the following network simulation software tools.

- a. Transyt 7F
- b. HCS
- c. SIDRA
- d. PASSER
- e. Netsim

QUESTION 6

Discuss in detail the following:

- a. Protected versus Permitted left turn phases for signalized intersections
- b. Semi and Fully Actuated Signal Timing Control
- c. Real Time Dynamic Signal Timing Control
- d. Vehicle and Pedestrian Safety Intervals at signalized intersections
- e. Random vs. Uniform Delay at signalized intersections

QUESTION 7

Discuss in detail the following:

- a. Car following behaviour and how it impacts lane capacity
- b. Free Flow speed, Jam Density, Speed and Density at Capacity
- c. Concept of Level of Service (LOS) as it pertains to uninterrupted highway flow
- d. Real Time route guidance
- e. Relationships among speed-density-flow.

98-Civ-B10, May 2005
Traffic Engineering
Synopsis of Examination Paper

Marking Scheme

1. 20 marks
2. (a) 2 marks, (b) 2 marks, (c) 3 marks, (d) 5 marks, (e) 3 marks, (f) 2 marks, (g) 3 marks.
3. (a) 5 marks, (b) 5 marks, (c) 5 marks, (d) 5 marks.
4. (a) 5 marks, (b) 5 marks, (c) 5 marks, (d) 5 marks.
5. 10 Marks for each discussion
6. 4 marks for each.(Total 20 Marks)
7. 4 marks for each.(Total 20 Marks)