



**THIS EXAMINATION PAPER MUST
NOT BE REMOVED FROM EXAM CENTRE**

University of Technology, Sydney

SURNAME: _____
FIRST NAME: _____
STUDENT NO: _____
COURSE: _____

AUTUMN SEMESTER EXAMINATION 2000

SUBJECT NUMBER 48370

TRANSPORT IN THE ENVIRONMENT

**CIVIL ENGINEERING DEGREE COURSE
CIVIL AND ENVIRONMENTAL ENGINEERING DEGREE COURSE**

WEDNESDAY 14 JUNE 2000

2.00 P.M. – 5.10 P.M.

Time Allowed: 3 hours plus 10 minutes reading time

ALL QUESTIONS ARE TO BE ATTEMPTED

**ANSWERS TO PARTS 'A', 'B' & 'C' ARE TO BE IN SEPARATE
BOOKLETS MARKED 'PART A', 'PART B' & 'PART C'**

This is a **CLOSED BOOK EXAMINATION**.

Non-programmable calculators are permitted.

Rough work can be done on the blank pages at the end of each answer booklet

PART A

QUESTION 1 (10 Marks)

An office development adjacent to the CBD of Sydney plans to have 10,000 workers in its first stage, 20,000 in its second stage (5 years after opening) and 35,000 in its final stage (planned for 10 years after opening).

It is estimated that 50% of the workers will travel by public transport if available.

Three options are to be considered:

1. Buses running on bus only lanes
2. Light rail
3. Heavy rail

Each of these options is feasible.

Which of these options would you recommend. Discuss the reasons for your choice.

QUESTION 2 (10 Marks)

a) (7 Marks)

Draw a diagram showing the concept of land use and transport interaction and explain the mechanism. Use this diagram to discuss the effect on Goulburn if a high speed rail line were constructed, linking Goulburn to Sydney and Canberra.

b) (3 Marks)

In order to increase public transport usage, the flat fare (currently \$2) on the bus system is reduced by 25%. At \$2 the daily patronage is 100,000. The elasticity of demand is - 0.3. What effect will the reduction in fares have on daily revenue?

QUESTION 3 (10 Marks)

a) (8 Marks)

A large area in the south west of Sydney is intended for residential development. Explain how you would prepare a transport plan for this area. In your answer include reference to the four step model.

b) (2 Marks)

Briefly discuss the connection between cheap transport and urban sprawl.

PART B

The following friction table and formulae are for your use as required:

Design Speed	Coefficient of Longitudinal Friction (f_l)	Coefficient of Side Friction (f)
70 km/hr	0.45	0.19
80 km/hr.	0.43	0.16
90 km/hr.	0.41	0.13
100 km/hr.	0.39	0.12

$$(1) \quad D_s = \frac{R_s V}{3.6} + \frac{V^2}{254 f_l} \quad (2) \quad e + f = \frac{V^2}{127 R} \quad (3) \quad C = 200(\sqrt{h_1} + \sqrt{h_2})^2$$

$$(4) \quad \alpha \text{ (in radians)} = \frac{D_s}{R - 1.5} \quad (5) \quad B = R - (R - 1.5) \cos \frac{1}{2} \alpha$$

$$(6) \quad L_p = \frac{L_2 E}{(E_1 - E_2)} \quad (7) \quad L = 2D_s - \frac{C}{A}$$

$$(8) \quad L = \frac{(D_s^2 \times A)}{C}$$

$$(9) \quad W = R - \sqrt{(R^2 - 69) + 2.5 + C_1 + \frac{V}{19\sqrt{R}}} - W_1$$

QUESTION 4 (10 Marks)

(a) (2 Marks)

Neatly freehand draw a typical cross section for a two (2) lane rural road showing at least eight (8) design elements that would normally be shown. Label these clearly.

(b) (2 Marks)

Place a tick in the **TRUE** or **FALSE** box in response to the statement below.

TRUE	FALSE	STATEMENT
<input type="checkbox"/>	<input type="checkbox"/>	The plan, longitudinal and cross sections should all be considered relative to each other when carrying out a design for a road.
<input type="checkbox"/>	<input type="checkbox"/>	Road intersections and junctions need to be located on crests if possible.
<input type="checkbox"/>	<input type="checkbox"/>	Vertical and horizontal curves should coincide where practicable.
<input type="checkbox"/>	<input type="checkbox"/>	When designing a road, it is desirable to fit plan transitions to all horizontal curves.
<input type="checkbox"/>	<input type="checkbox"/>	Provision of compound horizontal curves within a road alignment is always a good road design practice to follow.
<input type="checkbox"/>	<input type="checkbox"/>	Broken-back curves are a good feature within a horizontal alignment, as they offer relief from driver boredom.
<input type="checkbox"/>	<input type="checkbox"/>	There should be a minimum number of reverse curves in the horizontal alignment for any given length of road.
<input type="checkbox"/>	<input type="checkbox"/>	Headlight sight distance needs to be provided on all crest vertical curves.
<input type="checkbox"/>	<input type="checkbox"/>	Large radius horizontal curves should not be provided in low speed environments.
<input type="checkbox"/>	<input type="checkbox"/>	The geometry on a rural road needs to be “subconsciously predictable” for the driver.
<input type="checkbox"/>	<input type="checkbox"/>	On dual carriageway roads, long straights are preferable to a continuously curved alignment.
<input type="checkbox"/>	<input type="checkbox"/>	If a minimum radius must be used in the horizontal alignment, it should be located within a crest vertical curve.

(c) (2 Marks)

A two-lane two-way rural road has a base flow capacity of about 2800 vph in ideal conditions. List at least six (6) of these conditions (or requirements) that are needed to achieve this capacity.

(d) (2 Marks)

A section of four (4) lane urban arterial road with several cross streets is located between adjacent sections of six (6) lane road, and it has now become a “bottleneck”. List six (6) strategies that may offer opportunity for the capacity to be increased.

(e) (2 Marks)

A 200 metre length vertical curve is to be provided between grades of +5% and -4% on a rural road with a design speed of 80 km/hr. Determine by calculation if this length is suitable – if it is not suitable, show the length that it needs to be. Use a stopping sight distance of 100 metres in your calculations.

QUESTION 5 (10 Marks)

A 450 metre radius horizontal curve about 300 metres long is to be designed for a speed of 90 km/hr. The road itself is two (2) lane rural, the lane width is 3.5 metres and the unsealed shoulders are each 2.5 metres in width. Calculate the following using the relevant formulae given.

(a) (2 Marks)

The stopping sight distance for the design speed. The value you get is to be rounded to 10 metres above and used in any subsequent calculations for this question.

(b) (3 marks)

The benching required that satisfies the stopping sight distance requirements. The offset is to be given from the centreline of the road. You may find it helpful to draw a sketch.

(c) (1 mark)

The super-elevation value for the curve.

(d) (1 Mark)

Assuming a super-elevation transition length of 50 metres, calculate the plan transition length, rounding to 10 metres above.

(e) (1 Mark)

The amount of widening per lane. The lateral clearance between vehicles is 0.8 metres.

(f) (2 Marks)

For this road (with a 90 km/hr. design speed), what is the minimum radius horizontal curve that would be acceptable if the super-elevation value was limited to 4%?

‘Over/...’

PART C

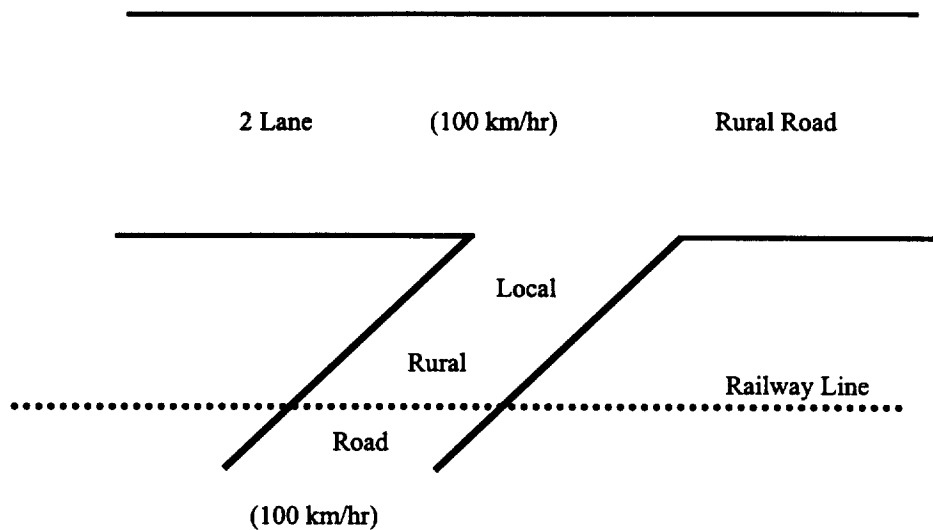
QUESTION 6 (10 Marks) (Characteristics of Motor Vehicles & Road Users)

(a) 5 marks

It is said that damage caused to road pavements is primarily caused by heavy commercial vehicles. Discuss this statement in detail outlining accepted rationale in this area of road pavement damage assessment.

(b) 5 Marks

With regard to the existing intersection layout shown below discuss the 'Traffic Safety' ramifications in terms of 'road users'. What action would you take as a road engineer to ensure a safe road environment?



'Over/...'

QUESTION 7 (10 Marks) (Freight Transportation in Australia)

(a) 5 marks

What is 'J.I.T.' in terms of Freight movement?

(b) 2 marks

What is the 'Natural Mode' of freight transport?

(c) 3 marks

A major pipe manufacturing company located in Cairns (Queensland) has won a contract to manufacture and deliver 28,500 m of 300mm ϕ 'high strength' steel pipes to a civil engineering contractor in Western Australia, for the construction of a natural gas pipeline from the source to Freemantle. Using 'freight' terminology, discuss the options available to the company.

QUESTION 8 (10 Marks) (Road Safety)

(a) 2 marks

What are the four (4) Contributing factors to serious road crashes?

(b) 3 Marks

What is a "Hazardous Location" on a road reserve?

(c) 3 marks

A Pro-active approach to crash prevention is a responsibility of the road engineer and cannot be over emphasised. Comment upon this statement.

(c) 2 Marks

What is a Road User Movement? Use a sketch to illustrate your answer.

QUESTION 9 (10 Marks) (Road Maintenance)

The symptoms of accumulated damage and evidence of current condition of road pavements are observed as Pavement Surface Deficiencies.

(a) 5 Marks

Describe in detail five (5) examples of "Deformation" related deficiencies.

(b) 5 marks

Describe in detail five (5) examples of "Cracking" related deficiencies.

QUESTION 10 (10 Marks) (Environmental Impact Assessment and Transport Projects)

The Roads and Traffic Authority have made a decision to position a By-Pass around a country town of population 23,000. The town is located within a Sub-Regional water catchment and soils in the area are generally subject to movement.

Outline the process that will need to be followed prior to adoption of a 'final' route for the new roadway. In your answer list at least 10 factors that would need to be considered in any environmental assessment that might be undertaken.