UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE AND ENGINEERING

FINAL EXAMINATION, APRIL 2001, 2-1/2 HOURS

CIV 514F - CONCRETE CONSTRUCTION

Examiner - R.D. Hooton

Name: _____
PRINT **(Last)** **(First)**

Student No.: _____

Students may only use Neville's Properties of Concrete Textbook (with no significant, personally added inserts. Marked up or unauthorized texts are subject to removal) and non-programmable calculators.

Answer all questions on the exam paper.
Point form answers are sufficient.
Use the backs of sheets if necessary.

#	MARK
1	/24
2	/24
3	/20
4	/12
Total	/80

QUESTION 1. (5 parts)

The answers to the following questions can be found in the text. Provide page numbers to substantiate your answers, if applicable.

a) At a w/c less than 0.38, it is impossible to hydrate all of the portland cement. Is this, therefore, the lower limit of w/c for obtaining high strength concrete? Why?

(4 marks)

b) Based on Don Lamb's guest lecture, explain the positive and negative impacts on fresh and early-age concrete properties due to use of early types as well as more recent types of high-range water reducing (superplasticizing) admixtures.

(3 marks)

QUESTION 1. (Continued)

c) Why are sprayed-on membrane-forming curing compounds only partially effective in providing optimum conditions for curing with concretes at lower w/cm? (Assume temperature is not a concern).

(5 marks)

d) From mix design considerations to construction practices, list several steps that can be taken to promote development of a discontinuous capillary pore structure in concrete? (Use point form answers and briefly explain why each step is important).

(8 marks)

QUESTION 1. (Continued)

e) List at least 5 alternate measures that could be taken to improve the corrosion protection of reinforcement in a new bridge deck along Highway 407.

(5 marks)

QUESTION 2. (5 parts)

a) Explain how the unit water content can be controlled independently of w/cm in a concrete mixture and how each of these parameters impacts on strength and permeability.

(4 marks)

b) Providing an adequate entrained air void system (air content and spacing factor) is important for concrete that will be exposed to freezing while critically saturated. List 2 other requirements for ensuring adequate resistance to damage from freezing and thawing, and briefly explain why each is of importance.

(4 marks)

QUESTION 2. (Continued)

c) List at least 5 reasons why the measured compressive strength of a cylinder test could be lower than its potential due to improper testing.

(5 marks)

d) List 5 factors that need to be considered when interpreting raw compressive strength data from concrete cores taken from a structure?

(5 marks)

QUESTION 2. (Continued)

e) Assume that you are a site engineer during construction of a high rise tower, and want to consider the use of non-destructive testing to help you decide when it is safe to remove forms. What test(s) would you select and explain why?

(6 marks)

QUESTION 3. (4 parts)
(20 marks)

You have been retained by a large project design firm to come up with recommendations for special materials, concrete mix designs and curing specifications for concrete to be supplied for the following projects. In each case, list the design considerations, alternatives, and precautions you would take for each of the four specific environmental exposures listed.

a) A massive concrete gravity dam in the vicinity of Sudbury, Ontario. Much of the aggregate in this area is known to be alkali-silica reactive.

b) Concrete liners for a railway tunnel exposed to severe chloride soil conditions.

QUESTION 3. (Continued)

c) A residential slab-on-grade in California. The air is warm and it has a low relative humidity. The soil has a high sodium and magnesium sulphate content.

d) The water-line concrete for a dock in Toronto harbour.

QUESTION 4.

(12 marks)

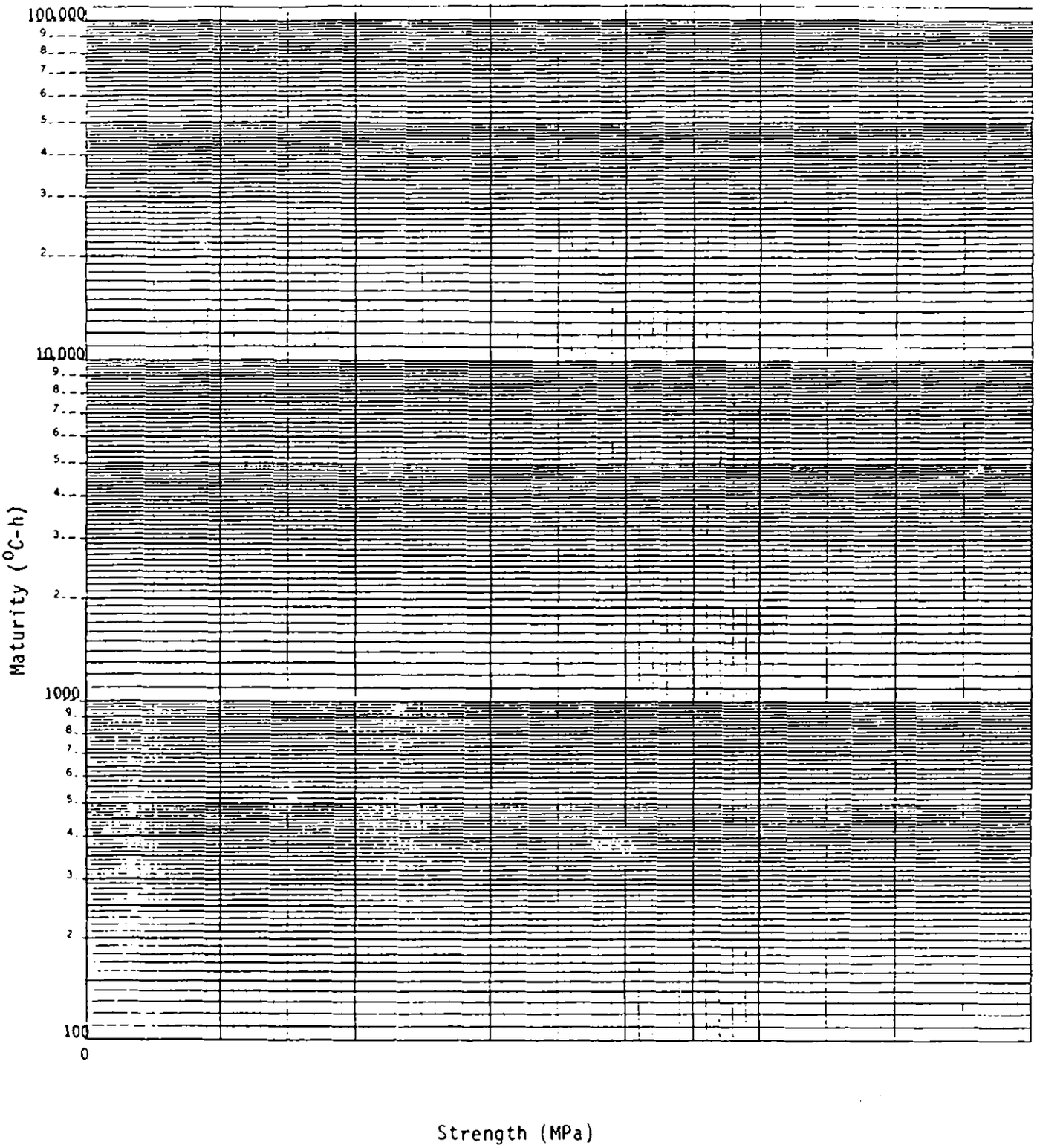
A ready-mixed concrete company normally supplies a contractor with a 30 MPa concrete which develops 6.5 MPa @ 1 day, 16.5 MPa at 3 days, and 23.7 MPa at 7 days when cured at 23 °C.

The contractor realizes that with winter approaching, the cooler weather will take the concrete longer to develop the 9 MPa strength needed to safely strip the forms.

a) How long after set will it take to reach 9 MPa at 3 °C, 13 °C and 23 °C? (Assume a datum temperature of -10 °C.)

b) Due to scheduling problems, the maximum form stripping time after set is only 22 h, what is the minimum curing temperature required.

The attached graph paper may be of use.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Maturity (°C-h)
Strength (MPa)