

**National Exams**

**04-For-B7, Transportation of Forest Products**

**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. The examination is closed book. As a consequence, candidates are not permitted to make use of any textbooks, references or notes.
3. The use of one of two calculators is permitted, the Casio or Sharp approved models.
4. The answers to five groups of questions, three of the four question groups from Part A (1, 2, 3, 4) and all questions of the two groups from Part B, comprise a complete examination.
5. Candidates must indicate the answers that they wish to have graded on the cover of the first examination book. Otherwise the answers will be graded in the order in which they appear in the examination book(s) up to a maximum of one group of questions in Part A and all questions in Part B.
6. The total value of six questions in three question groups in Part A is the same as for the six questions in two question groups in Part B.

04-For-B7,

**Transportation of Forest Products**

**Part A**

**1. Transportation modes**

- 1.1 List and describe the forest transportation modes in Western, Eastern and Atlantic Canada.
- 1.2 Give reasons for the use of different modes in the regions.
- 1.3 Explain the pros and cons of A-, B-, and C-trains concerning vehicle stability and other important issues.

**2. Vehicle characteristics**

- 2.1 What is the function of the vehicle transmission?
- 2.2 Describe the torque and power requirements of an engine in a hauling truck on its way from landing to mill.

**3. Variable tire-inflation pressure systems (VTP)**

- 3.1 Explain the concept of VTP and technical necessities.
- 3.2 Describe advantages and disadvantages of using VTP for log hauling.

**4. Stopping sight distance**

One key element in horizontal and vertical road alignment is to allow for sufficient stopping sight distance according to the design speed of the road.

- 4.1 How is the stopping sight distance found for a certain design speed?
- 4.2 Name and explain factors influencing the stopping sight distance besides the design speed.

04-For-B7/

**Transportation of Forest Products**

**Part B**

**5. Rail transportation (please see the formulas on the next page)**

A train consists of six (6) 2500hp locomotives with 4-axes weighing 145 tons and has a cross-sectional area of 125 ft<sup>2</sup>. The train must haul 22 four-axle freight cars which each weigh 65 tons. Can this train maintain a speed of 45 mph over a section of track that is:

5.1 straight and level?

5.2 2% grade up with a 3° curve?

**6. Gradeability**

Gradeability is understood as the maximum gradient a particular vehicle can climb before wheels start to spin. In a simple model gradeability is explained by  $\tan \theta \leq f$

6.1 Draw a free body diagram of a wheel on a gradient and indicate the acting forces when the wheel is just about to spin. Give the sum of forces in x and y direction.

6.2 Explain how  $\tan \theta \leq f$  is derived from the forces in x and y direction.

6.3 Explain f and give a reasonable number for f of a forest road.

6.4 Apply your assumed f within  $\tan \theta \leq f$ . What would be the maximum allowable road gradient (in %)

04-For-B7, December 2012

**Transportation of Forest Products.**

***Required Propulsion Formulae***

**Propulsion**

$$M = 375P \eta / V$$

[...where M = propulsive force (lbs),  $\eta$  = transmission efficiency (83%), P=power (hp), V=speed (mph)]

**Inherent Resistance (locomotives)**

$$R = 1.3T + 29N + 0.03TV + CAV^2$$

[...where, R= resistance (lbs), T is weight in tons, N is number of axles, V=speed m.p.h., and C= air resistance parameter= 0.0024 for locomotive, A= cross-sectional area in ft<sup>2</sup>]

**Inherent Resistance (standard freight cars)**

$$R = 1.5 T + 72.5N + 0.015 TV + 0.055 V^2$$

**Grade Resistance**

$$R_g = (T p)/100$$

[...where  $R_g$  = resistance (lbs), T= gross weight of vehicle (lb), p = percent grade]

**Curvature Resistance**

$$R_c = \epsilon DT$$

[...where  $R_c$  = resistance (lbs),  $\epsilon$ = curvature resistance coeff. (0.81lb per ton per degree), T=weight (tons)]

**Note: assume that 1 ton = 2,000 lbs.**

**Marks**

**Part A (three out of the four question groups, 60 points)**

1.1 10 marks total

1.2 10 marks total

2.1 10 marks total

2.2 10 marks total

3.1 10 marks total

3.2 10 marks total

4.1 10 marks total

4.2 10 marks total

**Part B (60 points)**

5.1 14 marks total

5.2 14 marks total

6.1 8 marks total

6.2 8 marks total

6.3 8 marks total

6.4 8 marks total

**Maximum achievable marks: 120**