National Exams December 2012
04-For-A4, Forest Management

3 hours duration

This exam addresses the following topics:

Forest dynamics.
Modelling forests and examining their change with and without intervention.
Decision-making processes used to manage change in forests.

NOTES:

1. If doubt exists as to the interpretation of any question, you are urged to submit with the answer paper, a clear statement of any assumptions made.

2. This is a CLOSED BOOK EXAM. One of two calculators is permitted any Casio or Sharp approved models.

3. Answer questions in the space provided in this exam paper.

4. Answer questions 1,2,3,6, and 7, and either of questions 4 and 5.

5. Question scoring values are:

[1]	=	16
[2]	=	16
[3]	=	16
[4]	=	16
[5]	=	16
[6]	=	20
[7]	=	16

6. Show calculations where appropriate.

[14 marks]

[1] Maintenance of biological diversity has become an increasingly important forest management objective over the past two decades.

Briefly, but clearly, define what biological diversity is and describe a basic approach used to incorporate biodiversity objectives in the design of forest management strategies.

[14 marks]

[2] Subdividing the forest into single-use zones, each targeting a specific objective or interest (e.g. a zone for timber production and a zone for forest preservation) is seen by some parties as an efficient way to meet the multiple objectives contemporary forest management must address.

Identify and briefly describe two strengths and two weaknesses of such an approach to managing a forest.

[12 marks]

[3] Two forests (A and B) of similar composition, size, and initial age structure are managed under different strategies. Both forests are composed of even-aged stands. Harvesting is conducted in each by clearcutting stands on an "oldest first basis". That is, the area to be harvested each year is chosen from the oldest existing stands. Forest A is managed using a 50 year rotation and Forest B is managed using a 100 year rotation.

In the graphs below, draw the forest age class structure that would exist 100 years hence for each forest managed as described above.

Contrast the age structures resulting under 50 and 100 harvest rotations (as graphed in the first part of this question) with those resulting from stand replacing natural fires occurring on 50 and 100 fire cycles; assume all age classes are equally likely to burn and an equal area is burned each year.

Draw in the graph for Forest A the forest age class structure representative of that resulting from fire under a 50 year fire cycle, and in the graph for Forest B that resulting under a 100 year fire cycle. Ensure the key differences between the age structures resulting under the rotation age vs fire cycle scenarios are clearly revealed.

[12 marks]

[4] A forester is considering conducting precommercial thinning in a 15 year-old, 10 hectare stand this year. The treatment will cost $750/ha. She plans to harvest the thinned stand when it is 50 years old and expects a yield of 280m^3/ha.

4A - Assuming a 5% interest rate, what minimum stumpage value ($/$m^3$) must she receive at time of harvest for the treatment to be profitable? ***[6 marks]***

4B - If she received $20/$m^3$ stumpage, what is the break-even interest rate? (*i.e.* the rate at which the net present value would equal zero) ***[6 marks]***

[12 marks]

[5] The operable growing stock (i.e. timber volume available for harvest) and maximum sustainable harvest level forecast under a particular management strategy are as shown in Figure 1.

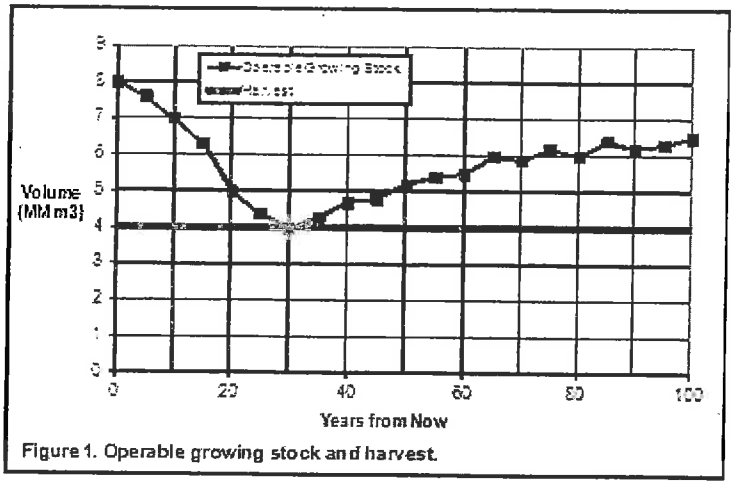

Figure 1. Operable growing stock and harvest.

You contemplate implementing six different management actions in the forest as described below. Identify which of the actions, if implemented from today forward, could result in an immediate and sustainable increase in harvest level and briefly state why.

Management Action	Immediate Sustainable Harvest Increase Possible (Yes or No)	Reason Why
Establish black spruce plantations that will be first operable for harvest at age 40 years		
Apply fertilizer to mature stands which will immediately increase volume increment by 2%.		
Space 20 year-old stands to reduce their operable harvest age from 60 to 40 years		
Harvest to protect natural regeneration to increase yield when stands reach harvest operability at age 60		
Reduce merchantable top diameter and reduce stump height to increase recoverable volume per tree		
Establish Norway spruce plantations that will be first operable for harvest at age 25 years		

[20 marks]

[6] The age class structure for a 70 000 ha forest is shown in Figure 2. The forest is composed of one stand type, whose wood volume yield, carbon content, and understory shrub content development patterns are as shown in Figures 3, 4, and 5, respectively.

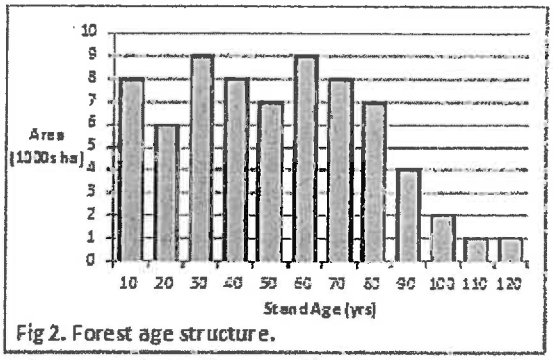

Fig 2. Forest age structure.

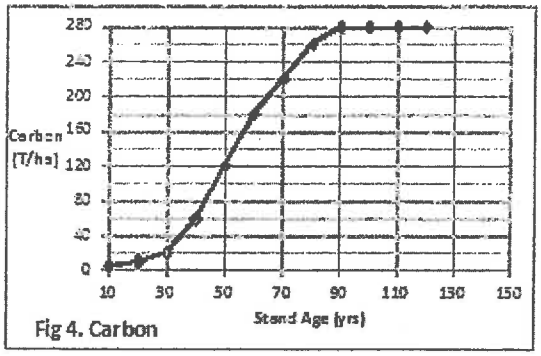

Fig 4. Carbon

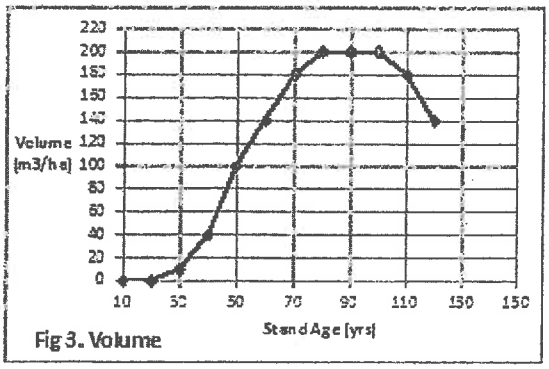

Fig 3. Volume

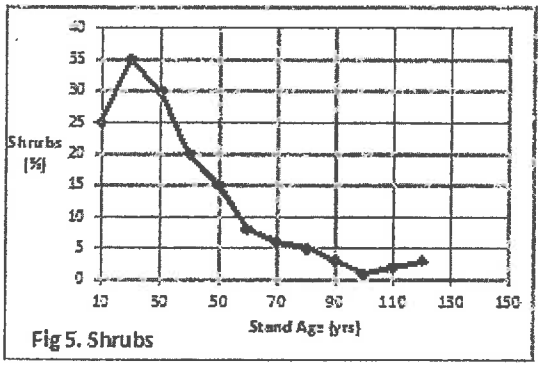

Fig 5. Shrubs

6A - What is the total carbon content of the forest today (2012)? *[5 marks]*

You decide to harvest stands in the forest using (a) even-aged management, (b) area regulation with a rotation length equal to the age of peak mean annual volume increment in stands, and (c) an oldest first harvest priority.

6B - Identify the area by age class you would harvest over with the next decade (2012-2021)under this strategy (state values for the decade as a whole, not by individual years). *[5 marks]*

6C - How much harvest volume would be generated during the next decade (2012-2022) under that harvest strategy? *[5 marks]*

Green warblers' inhabit the forest in question. Their habitat requirement are for stands containing 25% or more shrub cover.

6D - How many hectares of green warbler habitat will exist in the forest at year 2022? *[5 marks]*

[7] A forest in Canada is for sale and two potential buyers have each designed management strategies for that forest. Each party has approached a bank to finance the purchase. Both bidders:

- used the same basic forest inventory data (that is stand type maps, stand attribute lists, and ground survey plots);
- used the same stand treatments (i.e. harvest and silviculture prescriptions), timber yields, costs, and wood prices;
- employed two and only two constraints, namely,
  - maintaining least 15% of the landbase in an old growth state and
  - maintaining at least 1000ha of the landbase in an early successional state;
- maximized net present value;
- performed their work without error.

Despite these similarities, the maximum net present value calculated by the two companies differ by 18%. Bank officials are uneasy about this discrepancy and have hired you to conduct a forensic review of the bidders' analyses.

State five possible differences you might discover in the bidders' analyses that could account for their very different resulting net present value.
