MEMORIAL UNIVERSITY OF NEWFOUNDLAND

Faculty of Engineering and Applied Science

Engineering 6002 - Ship Structures

MID-TERM EXAMINATION

Date: Mon., Oct. 18, 2010 **Professor: Dr. C. Daley**
Time: 9:00 - 9:50 am

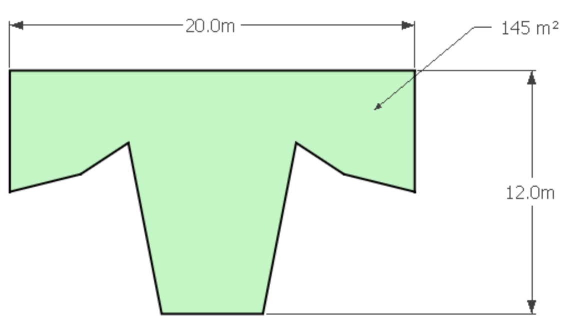
Answer all questions on this booklet (use back of pages if needed).
Total 20 marks. Each question is worth marks indicated **[x].**

NAME: ______________________________

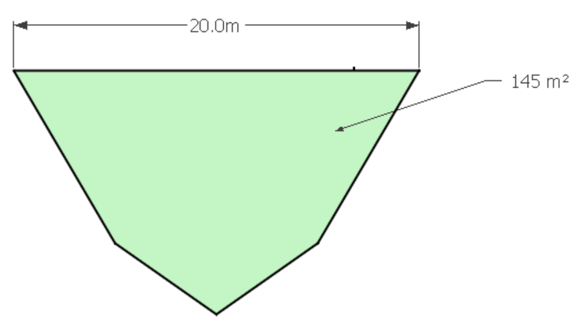
NUMBER: ______________________________

1. Longitudinal strength is a primary concern during the design of a ship.
Briefly explain the idea behind Murray's Method. **[3]**

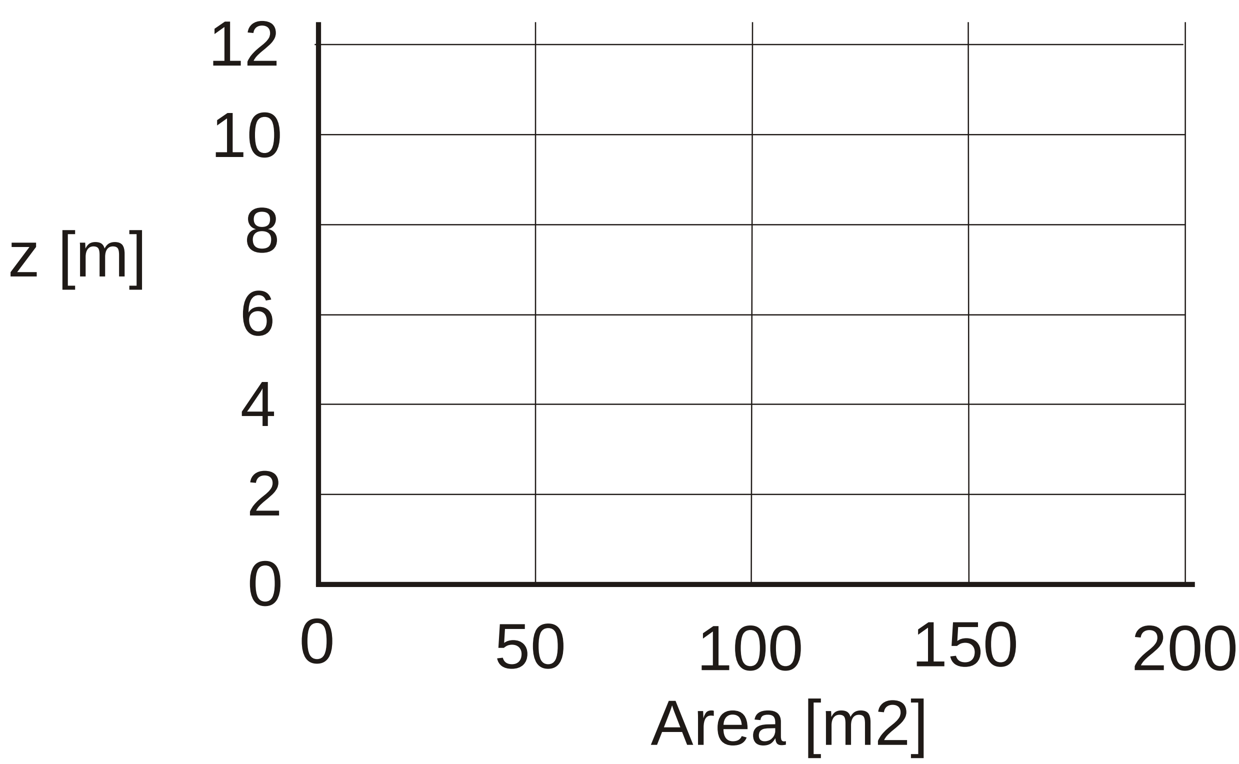
2. For the two ship stations shown below, sketch the corresponding bonjean curves on the grid below. **[4]**



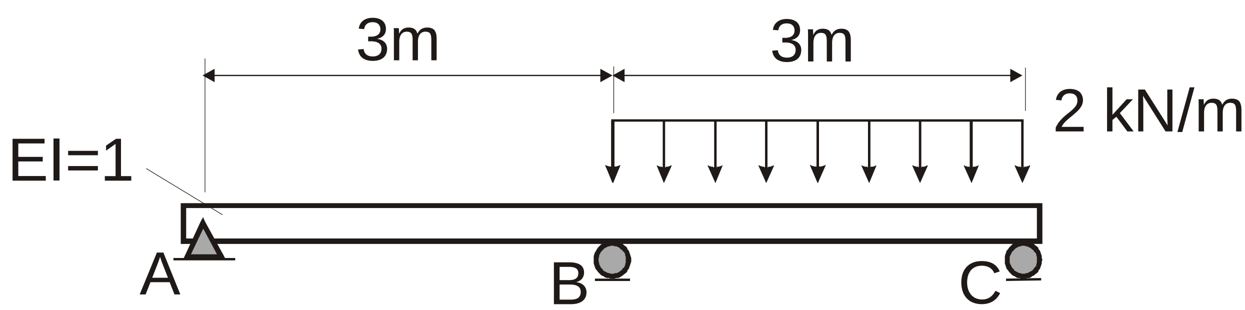
(a)



(b)



3. Force Method.



a) Sketch 3 alternative approaches to solving this indeterminate problem using the force method. For each approach, you will need two sketches of the auxiliary systems. **[3]**

b) Using one of the approaches sketched in a) , solve the system to find the reaction (in kN) ay B **[3]**

4. Consider a 100m long tanker resting on an even keel (same draft fore and aft) in sheltered waters. The CG of all weights is at midships and is 8000 tonnes.

a) Use Murray's Method and Prohaska's values to determine the still water bending moment for this vessel (i.e. get both the *weight and buoyancy BMs about midships).

[5]

Formulae

Weight of a Vessel:

$$W = \Delta = C_B \cdot L \cdot B \cdot T \cdot \gamma$$

Prohaska for parallel middle body : $\overline{W} = \dfrac{W_{hull}}{L}$ the values of a and b are ;

	$\dfrac{a}{\overline{W}}$	$\dfrac{b}{\overline{W}}$
Tankers (C_B = .85)	.75	1.125
Full Cargo Ships (C_B = .8)	.55	1.225
Fine Cargo Ships (C_B=.65)	.45	1.275
Large Passenger Ships (C_B=.55)	.30	1.35

$$\Delta lcg = \frac{x}{\overline{W}} L \frac{7}{54}$$

Murray's Method

$$BM_B = \frac{1}{2}\left(\Delta_a g_a + \Delta_f g_f\right) = \frac{1}{2}\Delta \cdot \overline{x}$$

$$\overline{x} = L(a \cdot C_B + b)$$

Where

T/L	a	b
.03	.209	.03
.04	.199	.041
.05	.189	.052
.06	.179	.063

This table for a and b can be represented adequately by the equation;

$$a = .239 - T/L$$
$$b = .1.1T/L - .003$$

Trochoidal Wave Profile

$$x = R\theta - r \sin \theta$$
$$z = r(1 - \cos \theta)$$

θ = rolling angle

Section Modulus Calculations

Ina = 1/12 a d^2

= 1/12 t b^3 $\cos^2\theta$

Family of Differential Equations Beam Bending

$v =$ deflection [m]

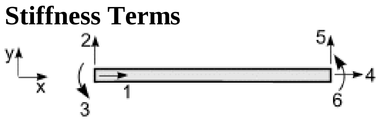
$v' = \theta =$ slope [rad]

$v''EI = M =$ bending moment [N-m]

$v'''EI = Q =$ shear force [N]

$v''''EI = P =$ line load [N/m]

Stiffness Terms



2D beam = 6 degrees of freedom

$$K = \begin{bmatrix} \frac{AE}{L} & 0 & 0 & -\frac{AE}{L} & 0 & 0 \\ 0 & \frac{12EI}{L^3} & \frac{6EI}{L^2} & 0 & -\frac{12EI}{L^3} & \frac{6EI}{L^2} \\ 0 & \frac{6EI}{L^2} & \frac{4EI}{L} & 0 & -\frac{6EI}{L^2} & \frac{2EI}{L} \\ -\frac{AE}{L} & 0 & 0 & \frac{AE}{L} & 0 & 0 \\ 0 & -\frac{12EI}{L^3} & -\frac{6EI}{L^2} & 0 & \frac{12EI}{L^3} & -\frac{6EI}{L^2} \\ 0 & \frac{6EI}{L^2} & \frac{2EI}{L} & 0 & -\frac{6EI}{L^2} & \frac{4EI}{L} \end{bmatrix}$$

Fixed End Reactions

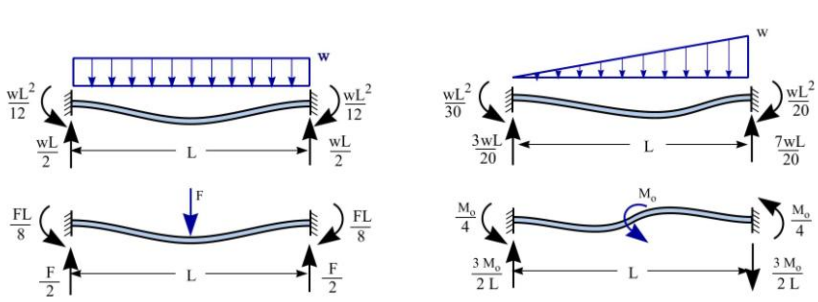
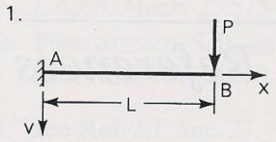
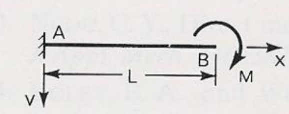
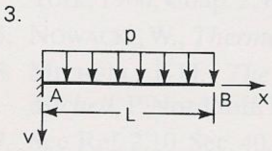
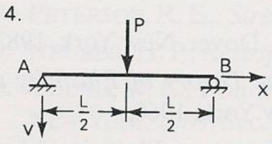
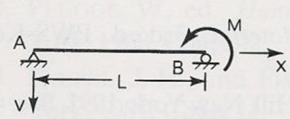
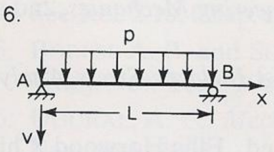
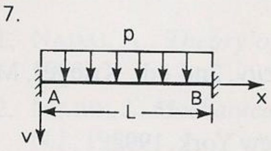


TABLE 1 *Deflections and Slopes of Beams*

Loading	*Deflection*	*Slope at*
1. 	$v = \frac{Px^2}{6EI}(3L - x)$ $v_{max} = v_B = \frac{PL^3}{3EI}$	$\theta_B = \frac{PL^2}{2EI}$
2. 	$v = \frac{Mx^3}{2EI}$ $v_{max} = v_B = \frac{ML^2}{2EI}$	$\theta_B = \frac{ML}{EI}$
3. 	$v = \frac{px^2}{24EI}(6L^2 - 4Lx + x^2)$ $v_{max} = v_B = \frac{pL^4}{8EI}$	$\theta_B = \frac{pL^3}{6EI}$
4. 	For $x \le L/2$ $v = \frac{Px}{48EI}(3L^2 - 4x^2)$ $v_{max} = v\left(\frac{L}{2}\right) = \frac{PL^3}{48EI}$	$\theta_A = -\theta_B = \frac{PL^2}{16EI}$
5. 	$v = \frac{Mx}{6EIL}(L^2 - x^2)$ $v_{max} = v\left(\frac{L}{\sqrt{3}}\right) = -\frac{ML^2}{9\sqrt{3EI}}$	$\theta_A = \frac{ML}{8EI}$ $\theta_B = -\frac{ML}{3EI}$
6. 	$v = \frac{px}{24EI}(L^3 - 2Lx^2 + x^3)$ $v_{max} = v\left(\frac{L}{2}\right) = \frac{5pL^4}{384EI}$	$\theta_A = -\theta_B = \frac{pL^3}{24EI}$
7. 	$v = \frac{px^2}{24EI}(L - x)^2$ $v_{max} = v\left(\frac{L}{2}\right) = \frac{pL^4}{384EI}$	$\theta_A = \theta_B = 0$