MEMORIAL UNIVERSITY Faculty of Engineering and Applied Science

Engineering 5003 - Ship Structures I

MID-TERM EXAMINATION

WITH SOLUTIONS

Date: Friday Feb. 16, 2017 **Professor: Dr. C. Daley**
Time: 10:00 - 10:50 am

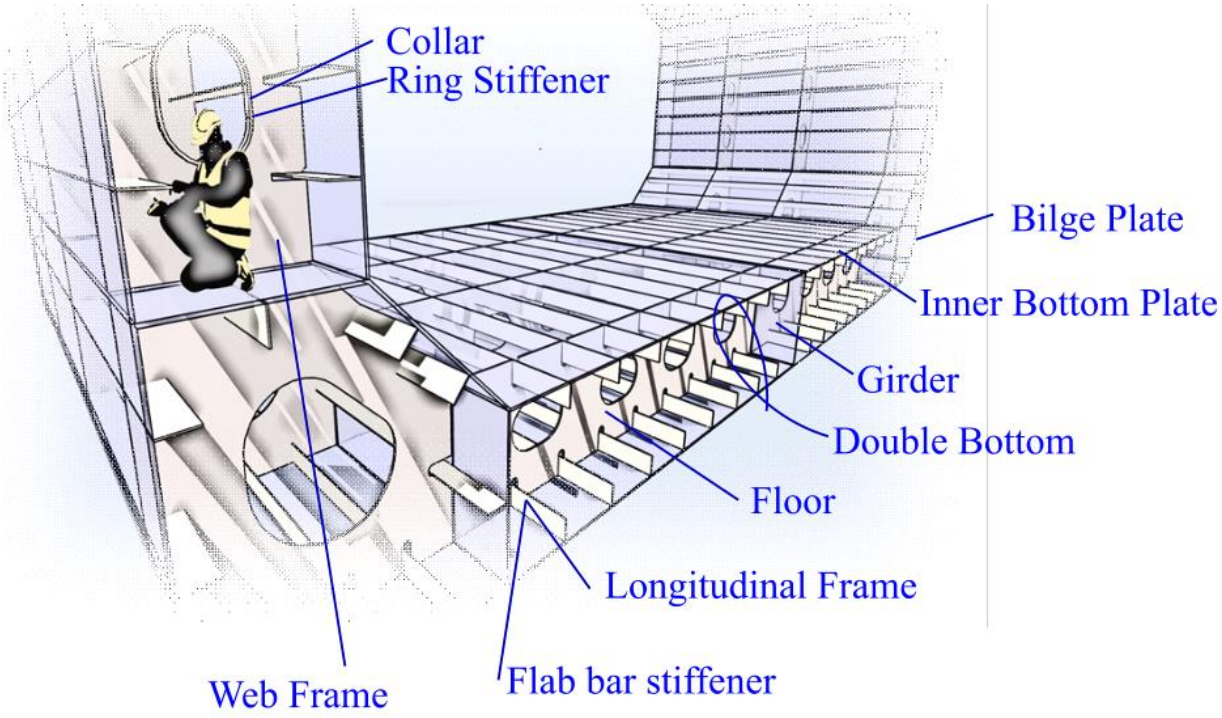
Answer all questions. Total 20 marks. Each question is worth marks indicated **[x].**
Short, clear answers are best. If you are having a problem (ie a road block) assume something, write down the assumption, and continue. Use the page backs for extra space if needed.
Good luck.

NAME: _____

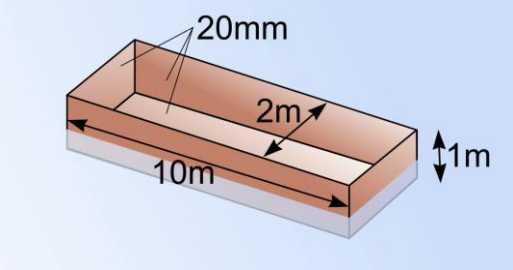
NUMBER: _____

1. Identify the following items in the figure; **[4]**

- Flab bar stiffener
- Floor
- Girder
- Inner Bottom Plate
- Web Frame
- Bilge Plate
- Double Bottom
- Collar
- Ring Stiffener
- Longitudinal Frame



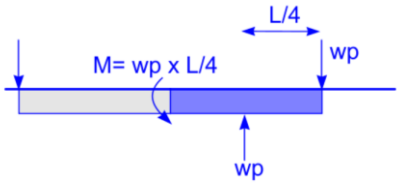
2. A simple barge is made of steel, is 10m long, 2m wide and 1m high. The sides and bottom steel is all 20mm thick. Steel has a density of 7850 kg per m3 and water has a density of 1000.



a) what is the draft of the barge? **[1]**
b) what is the midship bending moment (describe you steps and assumptions) **[2]**
c) compute the moment of inertia at midships **[2]**

(a) Total steel weight = (10x4 + 2x2) x 0.02 x7850 = 6908 kg
Total buoyancy = T x 20 x 1000 = 6908
=> T= 6908/20000 = 0.3454 m <<<<<<<<<<< ANS

(b) The steel weight of the end plate is special. All other steel is supported by a buoyancy force directly under its cg. The end plate weighs = (1x2) x 0.02 x7850 = 314 kg = 3080 N
The moment is M = 3080 x 10/4 = 7700 N-m

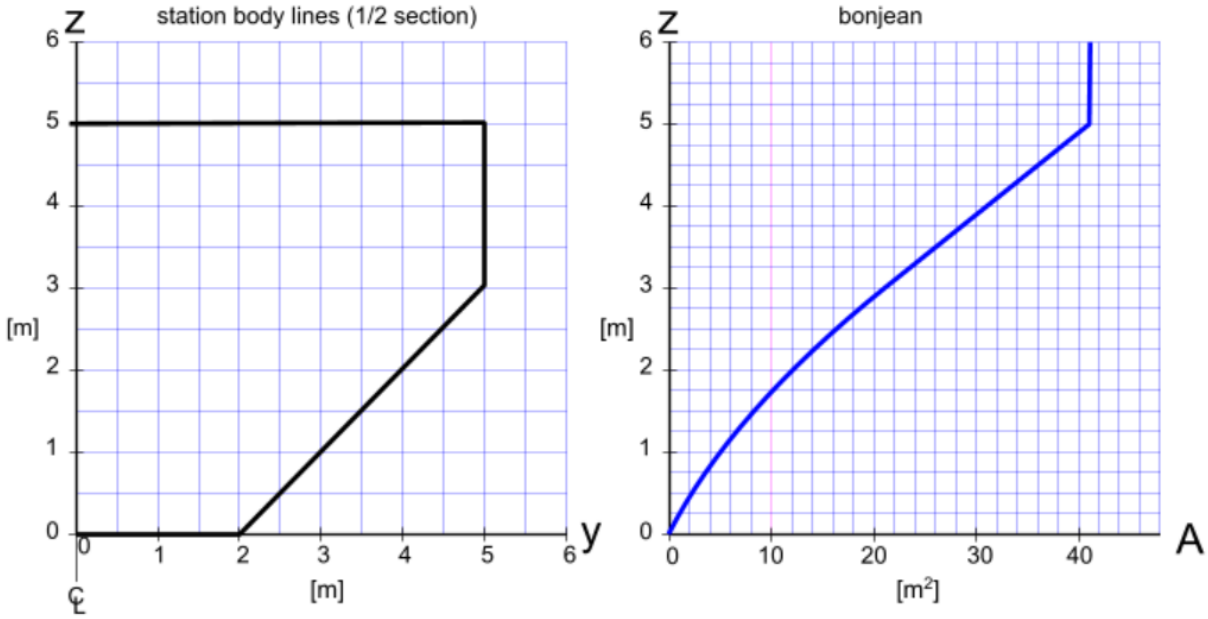


(c) Here are exact and approximate calcs (3% error).

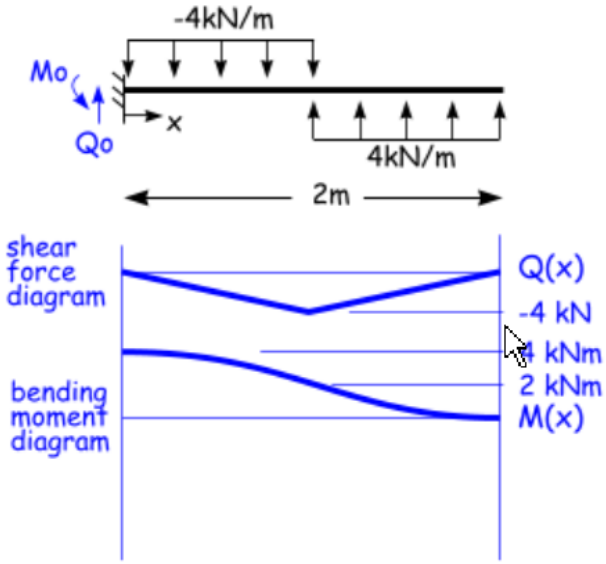
EXACT	width	height	area	dist to cent			local m.o.i.
	w	h	a	y	a y	a y^2	i
sides	0.04	1	0.04	0.5	0.02	0.01	0.00333333
bottom	1.96	0.02	0.0392	0.01	0.000392	3.92E-06	1.3067E-06
		Σ	0.0792		0.020392	0.010004	0.00333464
		centroid	c	0.257475			
			I_base	0.013339			
			I_na	0.008088	<<<<<<<<<<<< ANS		

APPROX	width	height	area	dist to cent			local m.o.i.
	w	h	a	y	a y	a y^2	i
sides	0.04	1	0.04	0.5	0.02	0.01	0.00333333
bottom	2	0.02	0.04				
		Σ	0.08		0.02	0.01	0.00333333
		centroid	c	0.25			
			I_base	0.013333			
			I_na	0.008333	<<<<<<<<<<<< ANS		

3. For the station sketched below (which only shows a half section), draw the bonjean curve (accurately and for whole section) [3]



4. For the cantilever beam sketched below, solve using direct integration to get expressions for shear and moment as functions of x. **[4]**
Plot these 2 results.



$Q_o = 0$

$M_o = 4$ kN m $(= 4 \times 1)$

$$Q(x) = Q_o + \int_0^x -4\,dx \quad (x<1) \rightarrow Q(x) = -4x \quad (x<1) \qquad Q(1) = -4 \text{ kN}$$

$$Q(x) = Q(1) + \int_1^x 4\,dx \quad (x<1)$$

$$= -4 + (4x)\Big|_1^x \rightarrow Q(x) = -8 + 4x \quad (x>1)$$

$$M(x) = M_o + \int_0^x -4x\,dx \quad (x<1) \rightarrow M(x) = 4 - 2x^2 \quad (x<1) \qquad M(1) = 2 \text{ kNm}$$

$$M(x) = M(1) + \int_1^x -8+4x\,dx \quad (x>1)$$

$$= 2 + (-8x + 2x^2)\Big|_1^x \rightarrow M(x) = 8 - 8x + 2x^2 \quad (x>1) \qquad M(2) = 0$$

5 For the four beams shown below;
Sketch the shape of the shear force, bending moment, slope and deflection diagrams. **[4]**
No numbers are required, but you should estimate the shape as correctly as you can.