MEMORIAL UNIVERSITY OF NEWFOUNDLAND

Faculty of Engineering and Applied Science

Engineering 6002 - Ship Structures

MID-TERM EXAMINATION

Solutions

Date: Mon., Oct. 17, 2022 **Professor: Dr. C. Daley**
Time: 11:00am - 12:00 noon

Answer all questions on the question paper. If you must, use the back of the page, Total 20 marks. Each question is worth marks indicated **[x].**

Name: ______________________________

Student No: ______________________________

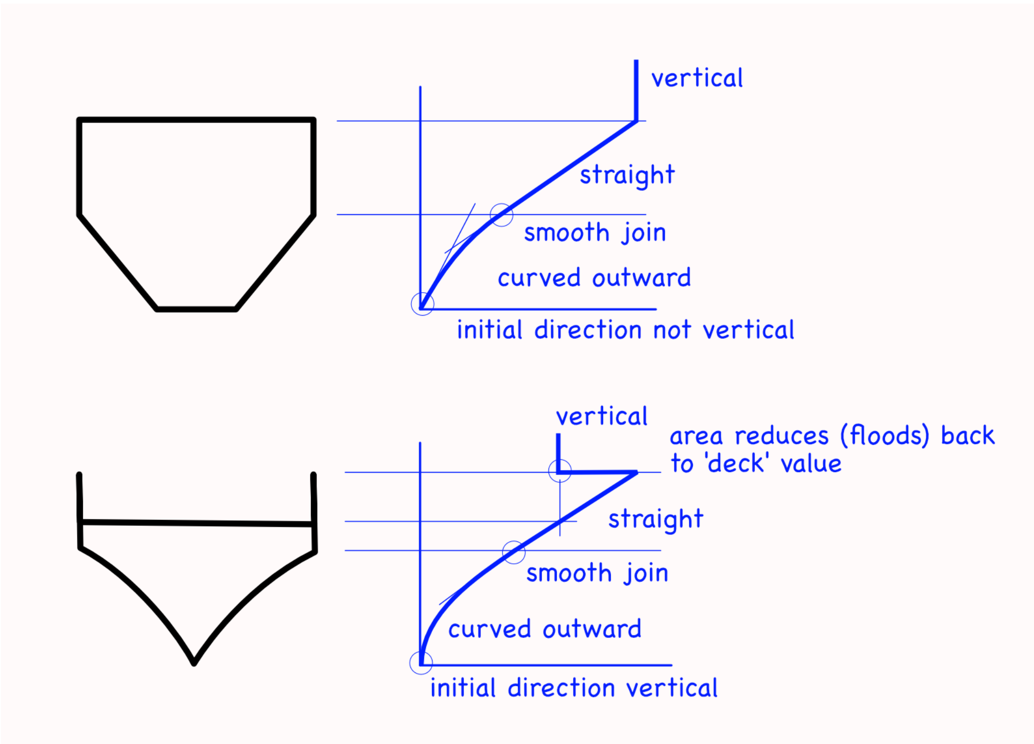
Watch your time. 60min
Think through your answers, then write and sketch clearly and concisely.

Good luck.

1. Discuss the meaning of: "ships are semi-monocoque structures". **[2]**

A monocoque structures gets all its strength from its outer shell, such as an eggshell. A semi-monocoque structure gets a lot of strength from the outer shell, but also has internal frames. Ships or of this type. The outer shell is extremely important, but its needs internal frames, decks and bulkheads to stiffen the outer shell.

2. For the two station profiles shown below, sketch the corresponding bonjean curves **[4]**



3. Consider a large 100,000 tonne cargo ship that is 240m long, 40m wide, with a block coefficient of 0.85. What can you determine using Murray's method? **[4]**

Give values and discuss.

Murray's values for $\bar{x}$;

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

where

d/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 = 0.239 – d/L

b = 1.1 d/L – 0.003
d = draft, L= length

Murray's method is used to find the buoyancy bending moment, which together with the weight bending moment will determine the still water bending moment. For this ship we need to find the draft. The formula for displacement is;

$$\Delta = L\ B\ d\ C_B\ \rho_{sea}$$

Or

$$d = \frac{\Delta}{L\ B\ C_B\ \rho_{sea}} = \frac{100000}{240 \cdot\ 40\ \cdot 0.85 \cdot\ 1.025} = 11.956$$

so

$$\frac{\mathrm{d}}{\mathrm{L}} = \frac{11.956}{240} = .05$$

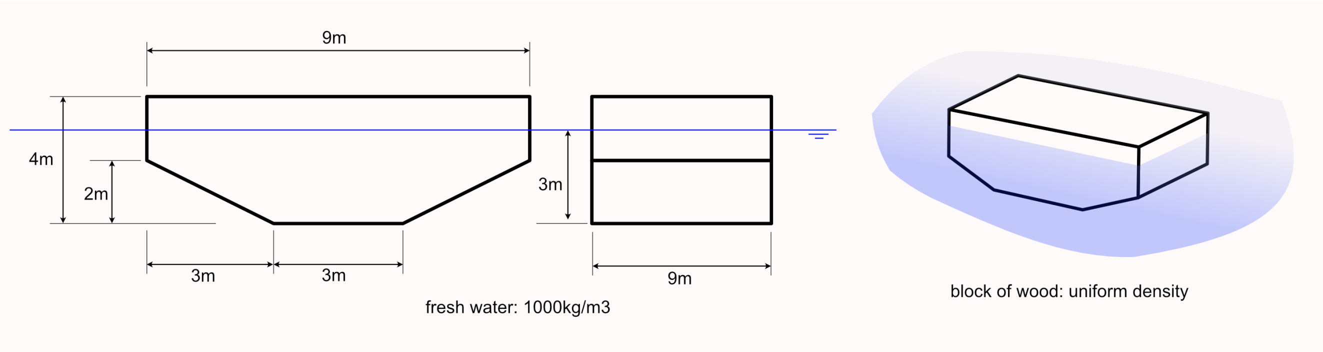
$$a = .189\ ,b = .052$$

$$\bar{x} = 240(0.189 \cdot 0.85 + 0.052) = 51.036$$

So the buoyancy bending moment is

$$M_B\ =\ \Delta/2\bar{x} =\ 2{,}551{,}800\ T - m$$

4. Still Water Forces.
a) for the floating block shown below,
i. find the mass of wooden block, **[2]**
ii. find the net load (N/m) on center 3rd of block **[4]**



Submerged area = 21 m2
Submerged volume = 189 m3
Mass of floating body is 189,000 kg <= ANS to i

Total area of body = 21 +9 = 30 m2
Total volume of body = 30 x 9 = 270 m3
Density of body = 189000/270 = 700 kg/m3

Submerged vol of middle 1/3 = 3x3x9 = 81m3
Buoyancy = 81 x 1000 x 9.8 = 793,800 N
Bouyant line load = 793800/3 =264,600 N/m

vol of middle 1/3 = 3x4x9 = 108m3
weight = 108 x 700 x 9.8 = 740,880 N
weight line load = 740,880/3 =246,960 N/m
net load (pushing up) = 17,640 N/m (up). **<= ANS to ii**

5. Beam Mechanics. For the beam sketch below:
a) what is the total force acting on the beam? **[2]**

$$F = \int_0^{10} p\,dx = \int_0^{10} x + .01x^3\,dx = 75N$$

$$= x^2/2 + x^4/400 \;\Big]_0^{10}$$

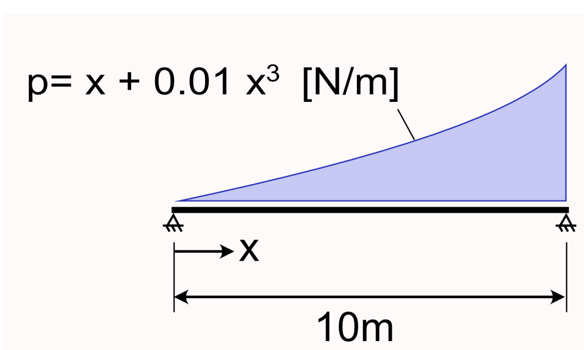
$$= 50 + 25 = 75$$

b) what is the x coordinate of the center of force? **[2]**

$$x_c = \frac{\int_0^{10} p\,x\,dx}{\int_0^{10} p\,dx}$$

$$= \frac{\int_0^{10} x^2 + .01x^4 dx}{75}$$

$$= \frac{x^3/3 + .01x^5/5 \;\Big]_0^{10}}{75} = 7.11\,m$$



bonus

c) what is the equation for the shear force Q(x) in the beam? **[4]**

reaction at right = 75 x 7.11/10 =53.33 N

reaction at left = 75 - 53.33 = 21.67 N,

$$Q = 21.67 - x^2/2 - x^4/400$$