National Exams May 2019

16-Nav-A1, Fundamentals of Naval Architecture

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. This is an OPEN BOOK EXAM.

   Any non-communicating calculator is permitted.

3. FIVE (5) questions constitute a complete exam paper.
   The first five questions as they appear in the answer book will be marked.

4. Each question is of equal value.

5. Most questions require a numerical answer . Clarity, organization and presentation of the answer are important. All operations must be clearly provided.

1- A wall sided triangular barge measures 80m in length and 16 m in maximum beam at the stern. The depth of the barge is 6 m. Minimum summer freeboard is 1.2 m.

Calculate the maximum deck load this barge may carry in summer and the location of the corresponding center of gravity (KG load) of the load. Assume that at the initial light ship condition KG is 3.10 m. and the light ship draft is 2.1 m.

For the design draft of 4 m. Calculate
a - tons per meter immersion
b- location of the Center of floatation
Geometric properties of triangles are given at the end of this booklet.

2- For the same barge in question 1 at the light ship conditions. A load of 80 tons located at amidships is shifted 25 m towards the bow. Calculate the expected trim angle if the barge is at even keel condition initially.

3- During an inclining experiment the following data are collected.

The weight of the mass moved horizontally for the inclining experiment is 35 LT (long tons) and the center of gravity of that mass is at 39 ft above the keel. The initial displacement of the ship is 3900 LT and KM= 24.5 ft.

Inclining Moment (ft.LT)	List angle (degrees)
910 (starboard)	2.7 starboard
575 (starboard)	1.4 starboard
0	0.2 port
541 (port)	1.8 port
882(port)	2.5 port

Plot the results and calculate the KG of the ship at this condition. Remember to correct your calculations for the addition of the inclining gear.

4- For the barge in question 1 at the design draft of 4m. KG of the barge is measured to be 2.5 m .

Calculate the new for and aft drafts for this ship if an empty , full width, stern-end compartment measuring 5 m long is opened at sea. The permeability of the compartment could be taken as 85 percent. Water density is 1.035 tons /m3.
Hint :, Calculate the changes in hydrostatic properties of the hull,(new draft, new center of flotation , and new moment to trim one meter). Identify your method of calculation (lost buoyancy or added weight).

5- The righting arm ,GZ, for a ship with assumed center of gravity KG=6.5 m is given below for the correct displacement as :

Inclination (degree)	0	15	30	45	60	75	90
GZ(m)	- 0.055	0.11	0.36	0.58	0.12	-0.05	-0.63

If the ship has the following weight distribution before leaving the harbour :

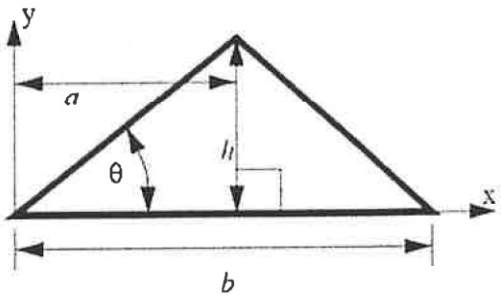
Item	Mass (tonnes)	KG(m)
Light ship	4200	6.0
Cargo	9100	7.0
Fuel	1500	1.1
Stores	200	7.5

Plot the static stability curve for this condition and correct the GZ curve for this load distribution and show GM on this curve and identify the vanishing stability and maximum stability angles. What is the maximum righting moment for this ship?

Triangle:

$$A = \frac{bh}{2}$$

$$P =$$



Centroid:

$$\bar{x} = \frac{a+b}{3}$$

$$\bar{y} = \frac{h}{3}$$

Moment of Inertia (about centroid axes):

$$\bar{I}_x = \frac{bh^3}{36}$$

$$\bar{I}_y = \frac{bh}{36}(a^2 + b^2 - ab)$$

$$\bar{I}_{xy} = \frac{bh^2}{72}(2a - b)$$

Moment of Inertia (about origin axes):

$$I_x = \frac{bh^3}{12}$$

$$I_y = \frac{bh}{12}(a^2 + b^2 - ab)$$

$$I_{xy} = \frac{bh^2}{24}(2a - b)$$