

16- Nav-A1, Fundamentals of Naval Architecture

National Exams May 2017

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.

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- 1- A ship floating at level trim has a draft 21.25 ft. 120 long tons (LT) is added at 122 ft aft of amidships. Ship has the following properties .

length	529 ft
Displacement	8880 LT
TPI (tons per inch immersion)	52 LT/inch
MTI (moment to trim one inch)	1601 ft LT/inch
LCF(longitudinal center of floatation)	45 ft aft of amidships.

- Draw a diagram and show the location of the added weight, center of flotation
 - On the drawing add the parallel sinkage and initial and final waterline.
 - Give the final forward and aft draft and the mean draft.
- 2- A ship with an initial displacement equal to 9906 long tons (LT) and initial $KG = 23.19$ ft has a weight of 25 LT of equipment added 30 ft above the keel and 8 ft to starboard of the center plane of symmetry. Find
- New KG of the ship.
 - New transverse location of the center of gravity TCG .
 - If 20 LT of ballast is to be added , to bring the ship center of gravity to the original position , calculate the required transverse and vertical location the ballast for this requirement.
- 3- During an inclining experiment the following data is collected.
The weight of the mass moved for the inclining experiment is 28 LT (long tons) and the center of gravity of the mass is at 43 ft from the keel. The initial displacement of the ship is 3400 LT and $KM = 26.5$ ft.

Inclining Moment (ft.LT)	List angle (degrees)
880 (starboard)	2.3 starboard
528 (starboard)	1.2 starboard
0	0.2 port
528 (port)	1.5 port
528(port)	2.3 port

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

- 4- A barge of constant rectangular cross section is 60 m long and 10 m wide at a draft of 3m. 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, fore-end compartment measuring 8 m long is opened at sea. The permeability of the compartment could be taken as 90 percent. Water density is 1.025 tons /m³.
Hint: Calculate the changes in hydrostatic properties of the hull center of flotation, and new moment to trim one meter.

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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	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?