CLASS 2

STABILITY

LOAD LINES

1. A ship's draft is 6.40 meter forward, and 6.60 meter aft. FWA 180 mm. Density of the dock water is 1010 kg per cu. m. If the load mean draft in salt water is 6.7 meter, find the final drafts F and A in dock water if this ship is to be loaded down to her marks and trimmed 0.15 meter by the stern. (Centre of flotation is amidships).

2. A ship arrives at the mouth of a river in water of density 1016 kg per cu. m with a freeboard of 'S' m. She then discharges 150 tonnes of cargo, and proceeds up river to a second port, consuming 14 tonnes of bunkers. When she arrives at the second port the freeboard is again `S' m., the density of the water being 1004 kg per cu. m. Find the ship's displacement on arrival at the second port.

SIMPSON'S RULE

3. A ship 75 m long has half-ordinates at the load water-plane commencing from aft as follows:

0, 1, 2, 4, 5, 5, 5, 4, 3, 2 and 0 meter respectively.

The spacing between the first three semi-ordinates and the last three semi ordinates is half of that between the other semi-ordinates. Find the position of the Centre of Flotation relative to amidships.

4. A ship is floating upright in S.W. on an even keel at 7 m draft F And A. The TPC's are as follows:

Draft (m)	1	2	3	4	5	6	7
TPC (tonnes)	60	60.3	60.5	60.5	60.5	60.5	60.5

The volume between the outer bottom and 1 m draft is 3044 cu. m, and its centre of gravity is 0.5 m above the keel. Find the ship's KB.

5. The areas of a ship's water-planes, commencing from the load draft of 24 meter, and taken at equal distances apart, are:

2000, 1950, 1800, 1400, 800, 400, and 100 sq m respectively.

The lower area is that of the ship's outer bottom. Find the displacement in salt water, the Fresh Water Allowance, and the height of the centre of buoyancy above the keel.

6. A ship 90 metres long is floating on an even keel at 6 m draft. The half-ordinates, ommencing from forward, are as follows:

0, 4.88, 6.71, 7.31, 7.01, 6.40, and 0.9 m respectively.

The half-ordinates 7.5 metres from bow and stern are 2.13 m. and 3.35 m respectively. Find the area of the water-plane and the change in draft if 153 tonnes of cargo is loaded with its centre of gravity vertically over the centre of flotation. Find also the position of the centre of flotation.

7. The areas of a ship's water-planes commencing from the load water-plane and spaced at equidistant intervals down to the inner bottom, are:

2500, 2000, 1850, 1550, 1250, 900 and 800 sq m respectively. Below the inner bottom is an appendage 1 metre deep which has a mean area of 650 sq m. The load draft is 7 metres. Find the load displacement in salt water, the Fresh Water Allowance, and the height of the centre of

buoyancy above the keel.

8. The areas of a ship's water-planes, commencing from the load water-plane and spaced 1 metre apart, are as follows:

800, 760, 700, 600, 450, and 10 sq m respectively.

Midway between the lowest two water-planes the area is 180 sq m. Find the load displacement in salt water, and the height of the centre of buoyancy above the keel.

LIST

9. A ship of 9500 tonnes displacement is listed 3.5 degrees to starboard and has KM 9.5 m and KG 9.3 m. She loads 300 tonnes of bunkers in No. 3 double-bottom tank port side (KG 0.6 m and centre of gravity 6 m from the centre line), and discharges two parcels of cargo each of 50 tonnes from the port side of No. 2 Shelter Deck (KG 11 m and centre of gravity 5 m from

the centre line). Find the final list.

10. A ship is listed 2.5 degrees to port. The displacement is 8500 tonnes KM 5.5 m, and KG 4.6 m. The ship has yet to load a locomotive of 90 tonnes mass on deck on the starboard side (centre of gravity 7.5 m from the centre line), and a tender of 40 tonnes. Find how far from the centre line the tender must be placed if the ship is to complete loading upright, and also find the final GM. (KG of the deck cargo is 7 m).

11. A ship of 7800 tonnes displacement has a mean draft of 6.8 m and is to be loaded to a mean draft of 7 metres. GM 0.7 m TPC 20 tonnes. The ship is at present listed 4 degrees to tarboard. How much more cargo can be shipped in the port and starboard tween deck, centres of gravity 6 m and 5 m respectively from the centre line, for the ship to complete loading and finish upright.

12. A ship of 7500 tonnes displacement has KM 8.6 m, KG 7.8 m and 20 m beam. A quantity of deck cargo is lost from the starboard side (KG 12 m,and centre of gravity 6 m in from the rail). If the resulting list is 3 degrees 20 minutes to port, find how much deck cargo was lost.

13. A ship of 12 500 tonnes displacement, KM 7 m and KG 6.4 m, has a 3 degree list to tarboard and has yet to load 500 tonnes of cargo. There is space available in the tween decks, centres of gravity 6 m each side of the centre line. Find how much cargo to load on each side if the ship is to complete loading upright.

14. A ship displacing 10 000 tonnes has a GM 1.0 m and is listed 4° to starboard. It is required to load a further 250 tonnes KG 10.0 m. Assume KM of 12.0 m is constant. Space is available 6.0 m to starboard of centre line and 4.0 m to port of centre line. How much cargo should be loaded into each if the vessel is to be upright on completion?

15. A ship of 8000 tonnes displacement has KM=7.5m and KG=7.0m. A double bottom tank is 12m long, 15m wide and 1m deep. The tank is divided longitudinally at the centre line and both sides are full of salt water. Calculate the list if one side is pumped out until it is half empty.

TRIM

16. An oil tanker 150 m long, displacement 12 500 tonnes, MCT 1 cm 200 tonnes m, leaves port with drafts 7.2 m F and 7.4 m A. There is 550 tonnes of fuel oil in the foward deep tank (centre of gravity 70 m forward of the centre of flotation) and 600 tonnes in the after deep tank (centre of gravity 60 m aft of centre of flotation). The centre of flotation is 1 m aft of amidships. During

the sea passage 450 tonnes of oil is consumed from aft. Find how much oil must be transferred from the forward tank to the after tank if the ship is to arrive on an even keel.

17. A ship is floating in salt water at drafts of 6.7 m F and 7.3 m A. MCT 1 cm 250 tonnes m. TPC 10 tonnes. Length of ship 120 metres. The centre of flotation is amidships; 220 tonnes of cargo is then discharged from a position 24 m forward of the centre of flotation. Find the weight of cargo which must now be shifted from 5 m aft of the centre of flotation to a position 20 m forward of the centre of flotation, to bring the draft aft to 7 metres. Find also the final draft forward.

18. A ship floats in salt water on an even keel displacing 6200 tonnes.KG 5.5 m, KM 6.3 m, and there is 500 tonnes of cargo yet to load.Space is available in No. 1 'tween deck (KG 7.6 m, centre of gravity 40 m forward of the centre of flotation) and in No. 4 lower hold (KG 5.5 m, centre of gravity 30 m aft of the centre of flotation). Find how much cargo to load in each space to complete loading trimmed 0.6 m by the stern, and find also the final GM. MCT 1 cm 200 tonnes m.

19. A ship, floating at drafts of 7.7 m F and 7.9 m. A sustains damage in an end-on collision and has to lift the bow to reduce the draft forward to 6.7 m.The ship is about to enter a port in which the maximum permissible draft is 8.3 m. To do this it is decided to discharge cargo from No. 1 hold (centre of gravity 75 m forward of amidships) and No. 4 hold (centre of gravity 45 m aft of amidships). MCT 1 cm 200 tonnes m, TPC 15 tonnes. Centre of flotation is amidships. Find the minimum amount of cargo to discharge from each hold.

20. A ship arrives in port with drafts 6.8 m F and 7.5 m A. The following cargo is discharged:

90 tonnes centre of gravity 30 m forward of amidships

40 tonnes centre of gravity 25 m aft of amidships

50 tonnes centre of gravity 50 m aft of amidships

The drafts are now 6.7 m F and 7.4 m A. Find the position of the centre of flotation relative to amidships.

21. A ship leaves port with drafts 7.6 m F and 7.9 m A; 400 tonnes of bunkers are burned from a space whose centre of gravity is 15 m forward of the centre of flotation, which is amidships. TPC 20 tonnes. MCT 1 cm 300 tonnes m. Find the minimum amount of water which must be run into the forepeak tank (centre of gravity 60 m forward of the centre of flotation) in order to bring the draft aft to the maximum of 7.7 m. Find also the final draft forward.

22. A ship 100 m long has MCT 1 cm 300 tonnes m requires 1200 tonnes of cargo to complete loading and is at present floating at drafts of 5.7 m F and 6.4 m A. She loads 600 tonnes of cargo in a space whose centre of gravity is 3 m forward of amidships. The drafts are then 6.03 m F and 6.67 m A. The remainder of the cargo is to be loaded in No. 1 hold (centre of gravity 43 m forward of amidships) and in No. 4 hold (centre of gravity 37 m aft of amidships). Find the amount which must be loaded in each hold to ensure that the draft aft will not exceed 6.8 metres. LCF is at amidships.

23. A ship 140 m long arrives off a port with drafts 5.7 m F and 6.3 m A. The centre of flotation is 3 m aft of amidships. TPC 30 tonnes. MCT 1 cm 420 tonnes m. It is required to reduce the draft aft to 6.2 m by running water into the forepeak tank (centre of gravity 67 m forward of amidships). Find the minimum amount of water to load and also give the final draft forward.

24. A vessel drawing 6.75 m forward and 7.95 m aft is to enter a channel with a maximum even keel draft of 7.4 m. The forepeak tank 60 m from the C.F. is the only empty tank and this may be filled, either from overside and/or by transferring water ballast from No. 5 D.B. tank (capacity 120 tonnes) 40 m abaft C.F. How much should be run into and/or transferred to the forepeak to obtain the correct trim at maximum draft? MCT 1 cm 150 tonnes-metres; TPC 20.

25. A vessel is floating at a draft of 7.3 m forward and 7.0 m aft. Given TPC 20 and MCT 1 cm 125 tonnes-metres, calculate how much cargo to load into No. 4. hold c.g. 45 m abaft the centre of flotation and No. 1. hold 60 m forward of the centre of flotation, to bring the vessel to an even keel at a draft of 7.5 m. Centre of flotation is at amidships.

26. A ship 200 m in length, displacement 12 200 tonnes leaves port on an even keel. She consumes 600 tonnes of fuel KG 0.75 m; 8 m forward of the C.F. and 150 tonnes of water KG 6.0 m; 96 m forward of C.F. Calculate the quantity of water to transfer from the after peak (cap. 100 t) to the fore peak a distance of 170 m and what to load, if necessary, into a D.B. tank 40 m forward of C.F. KG 0.8 m to bring the vessel back to even keel.

27. The draft marks of a vessel 120 m LBP show that the Aft draft reading is 5.15 m whilst the Forward draft reading is 4.05 m. If the Aft draft marks are 5 m for'd of the AP and the for'd draft marks are 4.00 m aft of the FP, then calculate the corresponding drafts at the AP and the FP.

28.A vessel loads the following bunkers: 1000 tonnes of oil in tank 46 metres forward of amidships 1500 tonnes of oil in tank 38 metres aft of amidships After loading, draughts were 7.58 metres forward and 8.04 metres aft. The LCF was 0.5 metres aft of amidshios and MCTC 156 tonnesmetres. If on arrival at destination the ship was on an even keel after consuming 1050 tonnes of oil, calculate how much oil is left in each tank.

29. A ship LBP 125m having lightship mass 4000 tonne, LCG 1.6m aft of amidships is loaded with the following:

8500 tonne cargo lcg 3.9m forward of amidships

1200 tonne fuel lcg 3.1m aft of amidships

200 tonne water lcg 7.6m aft of amidships.

100 tonne store lcg 30.5m fwd of amidships.

Hydrostatic particulars indicate at that 14000 tonne displacement, mean draught is 7.8m, MCTC 160 tonne-m, LCB 2.00m forward of amidships and LCF 1.5m forward of amidships. Find the final draughts at the perpendiculars.

30. The ship M.V. Penyu is floating at level keel draught of 4.50m. Cargo are loaded as follows:

500 tonnes at lcg 10m Aft of amidships

500 tonnes at lcg 10m Fwd of amidships

500 tonnes at lcg 20m Fwd of amidships

500 tonnes at lcg 15m Aft of amidships

Find its final draughts at the perpendiculars.

Hydrostatic Particulars of MV Penyu, LBP 50m is given below:

Drauf	Displacement tonnes	Cb	MCTC (tonne-m)	LCB (m from Midship)	LCF (m from Midship)
4.00	5000	0.75	100.00	-2.00	3.0
5.00	6000	0.76	110.00	-1.5	2.0
6.00	7000	0.77	120.00	0.0	0.0
7.00	8000	0.78	130.00	0.0	0.0

31. A ship arrives in port trimmed 25cms by stern. The centre of floatation is amidships, MCTC 100 tm. A total of 1000 tonnes is to be discharged from No1 hold (lcg 50m fwd of LCF) and No 4 Hold (lcg 45m aft of LCF). Find how much to be discharged from each hold for the ship to complete loading on even keel.

32. An oil tanker 150m long, displacement 12,500 tonnes, LCF 1m aft of amidships, MCTC 200 tonnes-m leaves port with draughts 7.2m F and 7.4m A. There are 550 tonnes of fuel oil in the forward deep tank (centre of gravity 70m forward of LCF) and 600 tonnes in the after deep tank (centre of gravity 60m aft of LCF). During the sea passage, 450 tonnes of oil is consumed from the aft tank. Find how much oil must be transferred from the forward to the aft tank if the ship is to arrive on an even keel.

33. A ship is Floating at drafts 7.25m forward and 8.45m aft and has to pass with an under keel clearance of 0.5m over a bar with a depth of 8.5 m.
The following hydrostatic particulars apply:
Length BP: 180m, LCF: 3m aft of amidships, MCTC: 200 t-m.
After peak tank: Lcg 2m aft of AP
Fore peak tank: Lcg 173m for'd of AP

Calculate EACH of the following:

(a) the amount of water ballast to transfer from the after peak to the fore peak to enable the bar to be crossed with minimum clearance;

(b) the final drafts forward and aft.

34. A ship 80 m long has a light displacement of 1050 tonne and LCG 4.64 m aft of mid-ships. The following items are then added:

Cargo 2150 tonne, Lcg 4.71 m forward of mid-ships,

Fuel 80 tonne, Lcg 32.55 m aft of mid-ships,
Water 15 tonne, Lcg 32.90 m aft of mid-ships,
Stores 5 tonne, Lcg 33.60 m forward of mid-ships.

The following hydrostatic particulars are available.

Draught m	Displacement tonne	MCT1 cm tonne m	LCB from mid-ships m	LCF from Mid-ship m
5.00	3533	43.10	1.00F	1.27A
4.50	3172	41.26	1.24F	0.84A

Calculate the final draught of the loaded vessel.

35. A ship is floating at drafts 5.5 m F and 6.0 m A. The following cargo is then loaded:
97 tonnes centre of gravity 8 m forward of amidships
20 tonnes centre of gravity 40 m aft of amidships
28 tonnes centre of gravity 20 m aft of amidships
The draft is now 5.6 metres F and 6.2 metres A. Find the position of the centre of flotation relative to amidships (given MCTC 185 t-m).

36. A ship arrives in port with drafts 6.8 m F and 7.5 m A. The following cargo is discharged:
90 tonnes centre of gravity 30 m forward of amidships
40 tonnes centre of gravity 25 m aft of amidships
50 tonnes centre of gravity 50 m aft of amidships
The drafts are now 6.7 m F and 7.5 m A. Find the position of the centre of flotation relative to amidships (given MCTC 185 t-m).

Increase in draft due to list

37. A ship has 20 m beam at the waterline and is floating upright at 6 m draft. If the rise of floor is 0.25 m, calculate the new draft if the ship is now listed 15 degrees.

38. A ship 90 m long, 15 m beam at the waterline, is floating upright at a draft of 6 m. Find the increase of draft when the ship is listed 10 degrees, allowing 0.15 m rise of floor.

Bilging and permeability

39. A box-shaped vessel 150 m 20 m 12 m is floating on an even keel at 5 metres draft. A compartment amidships is 15 metres long and contains timber of relative density 0.8, and stowage factor 1.5 cubic metres per tonne.Calculate the new draft if this compartment is now bilged.

40. A box-shaped vessel 100 metres long 20 metres wide 12 metres deep is floating in salt water on an even keel at 6 metres draft. A forward compartment is 10 metres long, 12 metres wide and extends from the outer bottom to a watertight flat, 4 metres above the keel. The compartment contains cargo of permeability 25 per cent. Find the new drafts if this Compartment is bilged.

41. A box-shaped vessel 64 m 10 m 6 m floats in salt water on an even keel at 5 m draft. A forward compartment 6 metres long and 10 metres wide,extends from the outer bottom to a height of 3.5 m, and is full of cargo of permeability 25 per cent. Find the new drafts if this compartment is now bilged.

42. A box-shaped vessel, 50 m long 10 m wide, floats in salt water on an even keel at a draft of 4 m. A centreline longitudinal watertight bulkhead extends from end to end and for the full depth of the vessel. A compartment amidships on the starboard side is 15 m long and contains cargo with permeability of 30 per cent. Calculate the list if this compartment is bilged. KG 3 m.

43. A box-shaped vessel 68 m long and 14 m wide has KG 4.7 m, and floats on an even keel in salt water at a draft of 5 m. A compartment amidships 18 m long is divided longitudinally at the centreline and contains cargo of permeability 30 per cent. Calculate the list if this compartment is bilged.

44. A box-shaped vessel, 120 m long and 24 m wide, floats on an even keel in salt water at a draft of 7 m. KG 7 m. A compartment amidships is 12 m long and is divided at the centreline by a full depth watertight bulkhead.Calculate the list if this compartment is bilged.

The inclining experiment

45. A ship has KM 6.1 m and displacement of 3150 tonnes. When a mass of 15 tonnes, already on board, is moved horizontally across the deck through a distance of 10 m it causes 0.25 m deflection in an 8 m long plumb line.Calculate the ship's KG.

46. As a result of performing the inclining experiment it was found that a ship had an initial metacentric height of 1 m. A mass of 10 tonnes, when shifted 12 m transversely, had listed the ship 3.5 degrees and produced a deflection of 0.25 m in the plumb line. Find the ship's displacement and the length of the plumb line.

47. During the course of an inclining experiment in a ship of 4000 tonnes displacement, it was found that, when a mass of 12 tonnes was moved transversely across the deck, it caused a deflection of 75 mm in a plumb line which was suspended from a point 7.5 m above the batten.

KM 10.2 m.KG 7 m. Find the distance through which the mass was moved.

Drydocking and grounding

48. A ship of 4200 tonnes displacement has GM 0.75 m and present drafts 2.7 m F and 3.7 m A. She is to enter a drydock. MCTC 120 tonnes m.The after keel block is 60 m aft of the centre of floatation. At 3.2 m mean draft KM 8 m. Find the GM on taking the blocks forward and aft.

49. A ship of 4000 tonnes displacement, 126 m long, has KM 6.7 m.KG 6.1 m. The centre of floatation is 3 m aft of amidships.MCTC 120 tonnes m. Find the maximum trim at which the ship may enter a drydock if the minimum GM at the critical instant is to be 0.3 m.

50. A box-shaped vessel 150 m long, 10 m beam, and 5 m deep, has a mean draft in salt water of 3 m and is trimmed 1 m by the stern, KG 3.5 m.State whether it is safe to drydock this vessel in this condition or not, and give reasons for your answer.

51. A vessel displacing 14000 tonnes enters dry-dock with a clearance of 0.50m over the blocks.
Given: entering 5.35m forward, 6.77m aft, M.T.C 120, T.P.C. 22 tonne, L.C.F. 4.00m aft of mid-ships, length 150m, KG 6.25m, KM 6.40m.
Assume the hydrostatic data to remain constant.
Determine:

a) The drop in water level required before the vessel takes the blocks forward and aft.
b) The GM at the instant of taking the blocks.
c) The further drop in water before the GM reduces to zero.

52. A box-shaped vessel 150 m long, 10 m beam and 5 m deep, has a mean draft in salt water of 3 m and is trimmed 1 m by the stern, KG = 3.5 m. State whether it is safe to drydock this vessel in this condition or not, and give reasons for your answer?

Water pressure

53. A lower hold bulkhead is 12 metres deep. The transverse widths of the bulkhead, commencing at the upper edge and spaced at 3 m intervals, are as follows:

15.4, 15.4, 15.4, 15.3 and 15 m respectively.

Find the depth of the centre of pressure below the water plane when the hold is flooded to a depth of 2m above the top of the bulkhead.

54. A deep tank transverse bulkhead is 30 m deep. Its width at equidistant intervals from the top to the bottom is:

20, 20.3, 20.5, 20.7, 18, 14 and 6 m respectively.

Find the depth of the centre of pressure below the top of the bulkhead when the tank is filled to a head of 4 m above the top of the tank.

55. The transverse end bulkhead of a deep tank is 18 m wide at its upper edge.

The vertical depths of the bulkhead at equidistant intervals across it are as

follows:

0, 3.3, 5, 6, 5, 3.3 and 0 m respectively.

Find the depth of the centre of pressure below the top of the bulkhead when the tank is filled with salt water to a head of 2 m above the top of the bulkhead. Find also the load on the bulkhead.

56. The half breadth of a transverse watertight bulkhead 14.2m high ,at 2.2m intervals from the top, are 10.6, 10, 9.3, 8.3, 7.1, 5.7, & 3.8m. Below the lowest semi-ordinates is a rectangular appendage 7.6m broad and 1m high. Find the KP(height of COP above the bottom) and the thrust on the bulkhead when the hold is filled with SW.

57. The half breadth of a transverse watertight bulkhead on a tanker,measured at regular vertical intervals, are 10, 9.3, 8.3, 7.1, 5.7, 4.4 & 2.9m. The common intervals between the first five semi-ordinates is 2.2m, while that between the last three semi-ordinates is 1.1m. Find the KP(height of COP above the bottom) and the thrust on the bulkhead when the tank is filled with SW to a sounding of 12.5m.

58. A collision bulkhead bounding the Fore Peak tank is 24 m in depth. Starting from the top, it has equally spaced ordinates: 34.0, 33.3, 32.5, 30.8, 26.5, 17.3 and 6.2 m. Calculate the thrust and its Centre of Pressure of above base when the tank is full of water RD of 1.016.

Effects of side winds on stability

59. With the aid of a sketch of a statical stability moment curve and a wind moment curve, show the following:

(a) Angle of steady heel.

(b) Angle of lurch.

(c) Angle of heel beyond which the vessel will capsize.

(d) Describe stability requirements.

Shear Force and Bending Moment

60. A uniform beam is 16 m long and has a mass of 10 kg per metre run. The beam is supported on two knife edges, each positioned 3 m from the end of the beam.Sketch the shearing force and bending moment diagrams and state where the bending moment is zero.

61. A box-shaped barge of uniform construction is 32 m long and displaces 352 tonnes when empty, is divided by transverse bulkheads into four equal compartments. Cargo is loaded into each compartment and level stowed as follows:

No. 1 hold N 192 tonnes No. 2 hold N 224 tonnes

No. 3 hold N 272 tonnes No. 4 hold N 176 tonnes

Construct load and shearing force diagrams, before calculating the bending moments at the bulkheads and at the position of maximum value; hence draw the bending moment diagram.

62. A uniform box-shaped barge, 40 m 12 m beam, is divided into four cargo compartments each 10 m long. The barge is loaded with 600 tonnes of iron ore, level stowed, as follows:

No. 1 hold N 135 tonnes, No. 2 hold N 165 tonnes,

No. 3 hold N 165 tonnes, No. 4 hold N 135 tonnes

The loaded barge floats in fresh water on an even keel at a draft of 1.75 m. Construct the curves of shearing force and bending moment for this condition and also find the position and value of the maximum bending moment for the still water condition.

63. A box-shaped vessel, 100 m long, floats on an even keel displacing 2000 tonnes. The mass of the vessel alone is 1000 tonnes evenly distributed and she is loaded at each end for a length of 25 m with 500 tonnes of cargo,also evenly distributed. Sketch the curve of loads, shearing force and bending moments. Also state the maximum shearing force and bending moment and state where these occur.

GZ CURVE

64. A ship with lightship displacement 1,700 tonnes, KG 3.5m is loaded with 1,800 tonnes of cargo at Kg 3.8m. KM after loading is 3.8m while KN values are as follows.

Angle of heel (°)

Displacemen t (tonnes)	10	20	30	45	60	75
3,000	0.75	1.50	2.16	2.84	3.19	3.26
4,000	0.77	1.54	2.20	2.92	3.25	3.26

Plot the GZ curve and find the area under the curve up to 30 degrees.

Does the ship pass IMO stability criteria?

65. Construct a statical stability curve in the given 'GZ vs Heel graph' for a vessel whose W=33500MT, KG=9m. Heel:GZ is 0^0:0, 15^0:0.9, 30^0:2.15, 45^0:2.55, 60^0:1.91, 75^0:0.8, 90^0:-0.5. Now, find the following from the curve: the range of stability, the angle of vanishing stability, the maximum GZ and the angle of heel at which it occurs, the initial GM, the moment of statical stability at 30^0 heel.

66. (a) Define dynamical stability.

(b) The righting levers of a vessel displacing 9500 t are as follows:

Heel:	0	10	20	30	40
GZ (m):	0	0.04	0.14	0.40	0.55

Calculate EACH of the following:

(i) the dynamical stability at 40;

(ii) the residual dynamical stability at 40 if the vessel is subjected to a steady wind moment of 380 tm.

67. The GZ values of a vessel at a certain displacement are as shown:

Heel (θ^0)	0	15	30	45	60	75
GZ (m)	0	0.27	0.73	0.95	0.61	0.06

KM: 9.00 m, KG 8.20 m

(a) Plot the GZ curve on the graph paper provided.

(b) Show that the curve satisfies the stability criteria required by the Load Line Rules 1968.

68. A ship of 10 000 tonnes displacement has the following righting levers when inclined:

Heel in degrees	0	10	20	30	40	50
GZ (m)	0.0	0.02	0.12	0.21	0.30	0.33

Calculate the dynamical stability to 50 degrees heel.

IMO GRAIN RULE

69. A vessel has loaded grain, stowage factor 1.65 m3/tonne to a displacement of 13 000 tonne. In the loaded condition the effective KG is 7.18 m.All grain spaces are full, except No. 2 tween deck, which is partially full.The tabulated transverse volumetric heeling moments are as follows:
No. 1 hold 1008 m4
No. 2 hold 1211 m4
No. 3 hold 1298 m4
No. 4 hold 1332 m4
No. 1 TD 794 m4
No. 2 TD 784 m4
No. 3 TD 532 m4

The value of the Kg used in the calculation of the vessel's effective KG were as follows:
for lower holds, the centroid of the space;
for tween decks, the actual Kg of the cargo.

Using Datasheet Q.1 Maximum Permissible Grain Heeling Moments Table,determine the vessel's ability to comply with the statutory grain regulations.

70. A vessel has loaded grain, stowage factor 1.65 m3/tonne to a displacement of 13 000 tonne. In the loaded condition the effective KG is 7.18 m. All grain spaces are full, except No. 2 tween deck, which is partially full.The tabulated transverse volumetric heeling moments are as follows:
No. 1 hold 851 m4
No. 2 hold 1022 m4
No. 3 hold 1095 m4
No. 4 hold 1124 m4
No. 1 TD 669 m4
No. 2 TD 661 m4
No. 3 TD 448 m
The value of the Kg used in the calculation of the vessel's effective KG were as follows:
for lower holds, the centroid of the space;
for tween decks, the actual Kg of the cargo.

Using Datasheet Q.1 Maximum Permissible Grain Heeling Moments Table,
determine the vessel's ability to comply with the statutory grain regulations.

71. A vessel has loaded grain, stowage factor 1.55 m3/tonne to a displacement of 13 500 tonne. In the loaded condition the effective KG is 7.12 m.All grain spaces are full, except No. 3 tween deck, which is partially full.The tabulated transverse volumetric heeling moments are as follows:
No. 1 hold 810 m4
No. 2 hold 1042 m4
No. 3 hold 1075 m4
No. 4 hold 1185 m4
No. 1 TD 723 m4
No. 2 TD 675 m4

No. 3 TD 403 m4
The value of the Kg used in the calculation of the vessel's effective KG were as follows:
for lower holds, the centroid of the space;
for tween decks, the actual Kg of the cargo.
Using Datasheet Q.1, determine the vessel's ability to comply with the statutory grain regulations.

Datasheet Q.1,

TABLE OF MAXIMUM PERMISSIBLE GRAIN HEELING MOMENTS (tm)										
	FLUID KG (metres)									
Displacement tonne	6.50	6.60	6.70	6.80	6.90	7.00	7.10	7.20	7.30	7.40
14 500	6141	5820	5499	5179	4858	4537	4217	3896	3575	3255
14 000	5957	5647	5338	5028	4719	4409	4099	3790	3480	3171
13 500	5924	5625	5327	5028	4730	4431	4132	3834	3535	3237
13 000	5934	5647	5359	5072	4784	4497	4209	3922	3634	3347
12 500	5891	5614	5338	5062	4785	4509	4232	3956	3679	3403
12 000	5857	5591	5326	5061	4795	4630	4265	3999	3734	3468
11 500	5893	5639	5385	5130	4876	4622	4368	4113	3859	3605
11 000	5944	5701	5457	5214	4971	4728	4484	4241	3998	3755
10 500	5948	5716	5484	5251	5019	4787	4555	4323	4090	3858
10 000	5940	5719	5498	5276	5055	4834	4613	4392	4171	3950
9500	5961	5751	5541	5331	5121	4911	4701	4491	4281	4071
9000	6027	5828	5629	5430	5231	5032	4833	4634	4435	4236
8500	6127	5939	5751	5563	5375	5187	4999	4811	4623	4435
8000	6210	6033	5856	5679	5502	5325	5148	4971	4795	4618
7500	6252	6087	5921	5755	5589	5423	5257	5091	4926	4760
7000	6343	6189	6034	5879	5724	5569	5415	5260	5105	4950
6500	6550	6406	6262	6118	5975	5831	5687	5543	5400	5256
6000	6832	6699	6566	6434	6301	6168	6035	5903	5770	5637
5500	7120	6998	6877	6755	6633	6512	6390	6268	6147	6025
5000	7320	7209	7099	6988	6877	6767	6656	6546	6435	6325

THEORY QUESTIONS:

72. What is Simplified stability information & Describe the use of Simplified stability information on board the ship.
73. Describe the precautions to be taken by the SHIP's OFFICER before and during the inclining experiment.
74. Explain why the values of trim and metacentric height in the freely afloat conditions are important when considering the suitability of a vessel for drydocking.
75. Describe the methods of improving the initial stability if the GM at the critical instant is found to be inadequate.
76. State the hydrostatic and stability data already pre-programmed into the loadicator.
77. Describe the information to be entered into the loadicator by the ship's officer.Also state the out put information.

78. Explain why a vessel laden to the same draught on different voyages may have different natural rolling period.
79. Explain the term Synchronous rolling and describe the dangers, if any associated with it.
80. Define Parametric rolling and the explain measures to avoid the same.
81. Describe the damage stability criteria as required by **Type A, B-100, B-60 vessel.**
82. Explains the difference between list and loll and methods of correction.
83. What is angle of Loll ? Why it is so dangerous? How will you correct it?
84. Explains with a suitable diagram the consequences and dangers of a free surface effect on board.
85. Describes the effects of variations in beam and freeboard on the curve of righting levers (GZ).
86. Outlines the conditions for a vessel to be in the stiff or tender condition and describes the effects on the curve of righting levers (GZ).
87. Explains the effects of an angle of list on the curve of righting levers (GZ).
88. Explains the effects of an angle of loll on the curve of righting levers (GZ).
89. Describes with suitable diagram the minimum stability requirements taking into account wind heeling moments as specified in current Load Line.
90. A ship is upright and is loaded with a full cargo of timber with timber on deck. During the voyage the ship develops a list, even though stores, fresh water and bunkers have been consumed evenly from each side of the centre line. Discuss the probable cause of the list and the method which should be used to bring the ship to the upright?