D. MARINE
Study Material

MEO CLASS 2 WRITTEN: NA

(NAVAL ARCHITECTURE)

FOR INDIAN COMPETENCY EXAM

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D. MARINE
Study Material

JANUARY – 2026
SECTION-1

1. With reference to the construction of refrigerated spaces:
(a) state suitable materials that can be used for insulating refrigerated spaces.
(b) state the properties that an insulating material should possess.
(c) sketch a section through a wall of a cold storage space explaining how the insulation is attached to the ship's structure.

2026/JAN/Q1

Click Here to See the Answer

2.With reference to dry docking, define the responsibilities of the Second Engineer and instructions to Junior Engineers
a) Prior to docking
b) Whilst the vessel is in dry dock
c)Prior to flooding and leaving the dock.

2022/JAN/Q4 **2022/MAR/Q3** **2023/JUL/Q2** **2023/OCT/Q2**
2024/SEP/Q2 **2024/NOV/Q2** **2025/JAN/Q2** **2025/DEC/Q2**

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3.a) Explain what is meant by "permissible length" of compartments in passenger ships.
b) Describe how the position of bulkheads is determined.
c) Briefly describe the significance of the factor of subdivision

2026/JAN/Q3

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4. Explain how the period of roll varies with
a) The amplitude is
b) The radius of Gration
c) The initial metacentric height
d) The location of asses in the ship.

2026/JAN/Q4

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5.Describe the real an: in between frictional resistance and
a) Ship speed
b) The wetted area
c) The surface roughness
d) The length of the vessel

2022/JAN/Q2 **2022/JUL/Q1** **2022/DEC/Q5** **2023/MAR/Q4** **2023/OCT/Q5** **2024/SEP/Q5** **2024/NOV/Q5** **2025/JAN/Q5** **2025/AUG/Q2**

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6. a) How the distribution of mass within the ship affects the rolling period?
b) A ship of 14000 tons displacement is 125 m long and floats at draughts of 7.9m forward and 8.5m aft. The TPC is 19. GML 120 m and LCF 3m forward of midships. It is required to bring the vessel to an even keel draught of 8.5m. Calculate the mass which should be added and the distance of the center of the mass from midships.

2024/FEB/Q10 **2026/JAN/Q6**

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7.(a) Explain how increase of draught and of displacement influence rolling.
b) A pontoon has a constant cross-section as shown in Figure given below. The metacentric height is 2.5m. Find the height of the centre of gravity above the keel.

2026/JAN/Q7

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8.a) Describe the fundamental principle of a propeller.
b) A propeller 6m diameter has a pitch ratio of 0.9, BAR 0.48 and, when turning at 110 rev/min, has a real slip of 25% and wake fraction 0.30. If the propeller delivers a thrust of 300 kN and the propeller efficiency is 0.65, calculate:
i)Blade area.
ii)Ship speed.
iii)Thrust power
iv)Shaft power.
vi)Torque.

2022/DEC/Q8 **2023/OCT/Q8** **2024/SEP/Q8** **2024/NOV/Q8** **2025/JAN/Q8** **2026/JAN/Q8**
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9.a) Explain what is meant by:
i) Wave-making resistance
ii) Frictional resistance
iii)Eddy-making resistance.
b) When a ship is 800 nautical miles from port its speed is reduced by 20%, thereby reducing the daily fuel consumption by 42 tonne and arriving in port with 50 tonnes on board. If the fuel consumption in t/h is given by the expression (0.136+0.001 V3) where V is the speed in knots, estimate:
(i) The reduced consumption per day:
(ii) The amount of fuel on board when the speed was reduced;
(iii) The percentage decrease in consumption for the latter part of the voyage;
(iv) The percentage increases in time for this latter period.
2022/DEC/Q9 **2023/OCT/Q9** **2024/SEP/Q9** **2024/NOV/Q9** **2025/JAN/Q9** **2026/JAN/Q9**
Click Here to See the Answer

FEB-2026

Q1. a) State the reasons for the freeboard requirement. (6)
b) Explain the term condition of assignment and explain how these are maintained for a ship. (5)
c) What is the difference between a Type "A" and a Type "B" ship. (5)
2024/DEC/Q1 **2026/FEB/Q1**
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Q2. a) Sketch the cross-section of a bulk carrier with either deep or shallow double bottom showing the type of framing used. (8)
b) i) Describe the corrosion problems experienced with ballast tanks. (4)
ii) State how such tanks are protected against extensive corrosion. (4)
2021/JUL/Q2 **2022/OCT/Q1** **2023/JAN/Q1** **2024/JAN/Q1** **2024/MAR/Q5** **2024/OCT/Q4** **2024/DEC/Q2** **2025/DEC/Q1**

2026/FEB/Q2
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Q3. a) With the aid of a sketch describe the method of attachment for a bilge keel and hence explain what protection is made to reduce the possibility of the shell being punctured in the event of damage
to the keel. (6)
b) State why the keel does not extend for the length of the ship. (5)
c) Evaluate the effectiveness of bilge keels for large wall sided vessels. (5)
2024/DEC/Q3 **2026/FEB/Q3**
Click Here to See the Answer

Q4. a) Draw a simple line diagram of the bow of a ship to show the position of the following component parts of the ships anchoring system. Hawse pipe, Cable stopper, Windlass and Cable lifter, Spurling pipe and Chain locker. (4)
b) Describe the cable stopper and state its purpose. (4)
c) Show by means of a sketch how the anchor cable is attached to the ship. (4)
d) Describe how the chain locker is drained of water, sand and mud. (4)
2024/FEB/Q2 **2024/DEC/Q4** **2026/FEB/Q4**
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Q5. With reference to membrane tanks for the carriage of liquefied gas at very low temperatures.
a) Describe with a sketch one method of building up the insulation. (6)
b) State which alloy is used for the membrane and the reason. (5)
c) Explain why a secondary barrier is installed. (5)
2024/OCT/Q2 **2024/DEC/Q5** **2026/FEB/Q5**
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SECTION – II

Q6. A. Describe how the force on the ship's bottom and the GM vary when grounding takes place. (6)
B. A ship of 8,000 tonnes displacement takes the ground on a sand bank on a falling tide at an even keel draft of 5.2 metres. KG 4.0 metres. The predicted

depth of water over the sand bank at the following low water is 3.2 metres. Calculate the GM at this time assuming that the KM will then be 5.0 metres and that mean TPC is 15 tonne. (10)

2021/APR/Q7 **2021/OCT/Q7** **2022/FEB/Q6** **2024/JUN/Q6** **2025/JUN/Q6** **2025/OCT/Q6** **2025/NOV/Q6** **2026/FEB/Q6**

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Q7. A. Describe stability requirement for dry-docking. (6)
B. A box shaped vessel, 50 metres long × 10 metres wide, floats in salt water on an even keel at a draft of 4 metres. A centre line 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 metres long and contains cargo with permeability 30%. Calculate the list if this compartment is bilged. KG = 3 metres. (10)

2024/JUN/Q7 **2025/JUN/Q7** **2025/OCT/Q7** **2025/NOV/Q7** **2026/FEB/Q7**

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Q8. A. Define longitudinal centre of gravity (LCG) and longitudinal centre of buoyancy (LCB). (6)
B. A ship 120m long floats has draughts of 5.50m forward and 5.80m aft. MCT1 cm 80 tonne m, TPC 13, LCF 2.5m forward of midships. Calculate the new draughts when a mass of 110 tonne is added 24m aft of midships. (10)

2021/APR/Q6 **2022/FEB/Q8** **2024/JUN/Q8** **2025/JUN/Q8** **2025/OCT/Q8** **2025/NOV/Q8** **2026/FEB/Q8**

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Q9. A. What are the main components of ship resistance that a vessel encounters while moving through water. (6)
B. The speed of a ship is increased to 18% above normal for 7.5 hours and then reduced to 9% below normal for 10 hours. The speed is then reduced for the remainder of the day so that the consumption
for the day is the normal amount. Find the percentage difference between the distance travelled in that day and the normal distance travelled per day. (10)

2024/JUN/Q9 **2025/NOV/Q9** **2026/FEB/Q9**

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Q10. With reference to fixed pitch propellers:
a. Explain Propeller Slip and Propeller Thrust. (6)
b. The shaft power of a ship is 3000 kW, the ship's speed V is 13.2 knot. Propeller RPS is 1.27. Propeller pitch is 5.5 m and the speed of advance is 11 Knots. Find:
i. Real Slip
ii. Wake fraction
iii. Propeller thrust, when its efficiency, η = 70% (10)
2021/APR/Q9 **2024/JUN/Q10** **2025/JUN/Q10** **2025/OCT/Q10** **2025/NOV/Q10** **2026/FEB/Q10**
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MAR-2026

Q1. a) Sketch the cross-section of a bulk carrier with either deep or shallow double bottom showing the type of framing used. (8)
b) i) Describe the corrosion problems experienced with ballast tanks. (4)
ii) State how such tanks are protected against extensive corrosion. (4)
2022/OCT/Q1 **2023/JAN/Q1** **2024/JAN/Q1** **2024/MAR/Q5** **2024/OCT/Q4** **2024/DEC/Q2** **2025/DEC/Q1** **2026/FEB/Q2** **2026/MAR/Q1**
Click Here to See the Answer

Q2. Describe the process and preparation as per the classification society requirements for in-water survey of the underwater structure of a very large vessel
2026/MAR/Q2
Click Here to See the Answer

Q3. Sketch and describe the construction of a bulbous bow. Why is such an arrangement fitted on a merchant ship?
2026/MAR/Q3
Click Here to See the Answer

Q4. With reference to the vessel hull panting and pounding
a) Explain the causes and effect of panting and pounding, indicating the affected areas.
b) Describe the constructional details designed to resist panting and pounding.
2026/MAR/Q4
Click Here to See the Answer

Q5. (a) Describe the relationship between frictional resistance and
(a) Ship's speed. (4)
(b) The wetted area. (4)
(c) The surface roughness. (4)
(d) The length of the vessel. (4)
2021/FEB/Q4 2022/JAN/Q2 2022/JUL/Q1 2022/DEC/Q5 2023/MAR/Q4 2023/OCT/Q5 2024/SEP/Q5 2024/NOV/Q5 2025/JAN/Q5 2026/JAN/Q5 2026/MAR/Q5
Click Here to See the Answer

SECTION – II

Q6. a) Describe how the distribution of mass within the ship affects the rolling period. (6) b) The righting moments of a ship at angles of heel of 0, 15°, 30°, 45°, and 60° are 0, 1690, 5430, 9360 and 9140 kN-m respectively. Calculate the dynamical stability at 60°. (10)
2023/JULY/Q6 2024/APR/Q6 2024/DEC/Q6 2025/DEC/Q6 2026/MAR/Q6
Click Here to See the Answer

Q7. a) Describe briefly the significance of the factor of subdivision. (6)
b) A ship 120m long has a light displacement of 4000 tonne and LCG in this condition 2.5m aft of midships. (10)
The following items are then added:
Cargo 10000 tonne LCG 3.0 m forward of midships
Fuel 1500 tonne LCG 2.0 m aft of midships
Water 400 tonne LCG 8.0 m aft of midships
Stores 100 tonne LCG 10.0m forward of midships

Using the following hydrostatic data, calculate the final draughts:

Draught (m)	Displacement (t)	MCT 1 cm (t m)	LCB from midships (m)	LCF from midships (m)
8.50	16650	183	1.94F	1.20 A
8.00	15350	175	2.10 F	0.60F

2023/JULY/Q7 **2024/APR/Q7** **2024/DEC/Q7** **2025/DEC/Q7** **2026/MAR/Q7**

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Q8. A) Explain how the distribution of masses affects rolling and pitching. (6) B) A ship turns in a circle of radius 100 metres at a speed of 15 knots. The GM is 2/3 metres and BG is 1 metre. If g = 981 cm/sec2 and 1 knot is equal to 1.8532 km/hour, find the heel due to turning. (10)

2023/JULY/Q8 **2024/JUL/Q8** **2024/DEC/Q8** **2025/DEC/Q8** **2026/MAR/Q8**

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Q9. A) Describe the effect of cavitations on the propeller blades. (6) B) A propeller 4.6m diameter has a pitch of 4.3m and boss diameter of 0.75 m. The real slip is 28% at 95 rev/min. Calculate the speed of advance, thrust and thrust power. (10)

2021/APR/Q7 **2021/NOV/Q7** **2023/JULY/Q9** **2024/JUL/Q9** **2024/DEC/Q9** **2025/DEC/Q9** **2026/MAR/Q9**

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Q10. A) Describe the stability requirements of a ship for dry-docking. (6) B) A ship 130m long displaces 14000 tonnes when floating at draughts of 7.5m forward and 8.10m aft. GML 125m, TPC 18, LCF 3m aft of midships. Calculate the final draughts when a mass of 180 tonne lying 40m aft of midships is removed from the ship. (10)

2023/JULY/Q10 **2024/JUL/10** **2024/DEC/Q10** **2025/DEC/Q10** **2026/MAR/Q10**

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APR – 2026

Q1. A. With reference to the underwater surface of a ship's hull
i. Describe a hull plate roughness analyzer system.
ii. State the significance of the roughness profile and compare the typical roughness values for a new ship and a ship eight years old. (8)
B. With reference to the application of self-polishing paint in dry dock –
i. Describe the preparation necessary. (8)
ii. State the defects that may occur in the paint coating if it is not correctly applied.

2020/FEB/Q3 **2021/NOV/Q3** **2023/JUNE/Q2** **2024/APR/Q1** **2026/APR/Q1**

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Q2. With reference to membrane tanks for the carriage of liquefied gas at very low temperatures.
A. Describe with the aid of a sketch, ONE method of building up the insulation. (6)
B. State with reasons the alloy, which is used for the membrane. (4)
C. Describe with the aid of a sketch, how the tanks are located and supported. (6)
i) Longitudinally
ii) Transversely

2022/DEC/Q1 **2023/FEB/Q1** **2023/APR/Q4** **2023/OCT/Q1** **2024/APR/Q2** **2024/SEP/Q1** **2024/NOV/Q1** **2025/JAN/Q1** **2026/APR/Q2**

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Q3. State FOUR terms used to describe the conditions that relate to the distortion of a ship's hull under waves, stating in EACH case the type of stresses involved and where the stresses occur. (16)

2026/APR/Q3

Click Here to See the Answer

Q4. With respect to trim and stability, describe the following – (4*4)
A. Effects on center of gravity of slack tanks.
B. Effect on stability of ice formation on superstructure.
C. Effects of wind and waves on ship's stability.
D. Effect of water absorption by deck cargo and retention of water on deck.
2023/JAN/Q2 **2024/APR/Q4** **2026/APR/Q4**
Click Here to See the Answer

Q5. With reference to the prevention of hull corrosion discuss:
A. Surface preparation and painting of new ship plates. (6)
B. Design of the ships structure and its maintenance. (5)
C. Cathodic protection by sacrificial anodes, of the internal and external areas of the ship. (5)
2020/FEB/Q5 **2022/JUL/Q4** **2022/AUG/Q5** **2023/FEB/Q2**
2024/APR/Q5 **2026/APR/Q5**
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SECTION – II

Q6. a) Describe how the distribution of mass within the ship affects the rolling period. (6)
b) The righting moments of a ship at angles of heel of 0, 15°, 30°, 45°, and 60° are 0, 1690, 5430, 9360 and 140 kN-m respectively. Calculate the dynamical stability at 60°. (10)
2023/JULY/Q6 **2024/APR/Q6** **2024/DEC/Q6** **2025/DEC/Q6**
2026/MAR/Q6 **2026/APR/Q6**
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Q7. a) Describe briefly the significance of the factor of subdivision. (6)
b) A ship 120m has a light displacement of 4000 tonne and LCG in this condition 2.5m aft of midships. (10)
midships. (10)
The following items are then added:

Cargo	10000 tonne	LCG 3.0 m	forward of midships
Fuel	1500 tonne	LCG 2.0 m	aft of midships
Water	400 tonne	LCG 8.0 m	aft of midships

Stores 100 tonne LCG 10.0 m forward of midships
Using the following hydrostatic data, calculate the final draughts:

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8.00	15350	175	2.10 F	0.60F

2023/JULY/Q7 **2024/APR/Q7** **2024/DEC/Q7** **2025/DEC/Q7** **2026/MAR/Q7** **2026/APR/Q7**
Click Here to See the Answer

Q8. A. Explain the effect of trim on tank soundings. (6)
B. A ship of 6000 tonne displacement has KG 3.6m and KM 4.3m. A mass of 50 tonne is now lifted from the quay by one of the ship's derricks whose head is 18 m above the keel. The ship heels to a maximum of 9.5° while the mass is being transferred. Calculate the outreach of the derrick from the ship's centreline. (10)
2024/APR/Q8 **2026/APR/Q8**
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Q9. A. Explain the effect on GM during the filling of a double – bottom tank
B. A ship of 8,000 tonnes displacement has KM 7.5 m, and KG 7.0 m. A double-bottom tank is 12 meters long 15 meters wide and 1 meter deep. The tank is divided longitudinally at the centre line and both sides are half full. Calculate the list if one side is pumped out until it is half empty. (10)
2024/APR/Q9 **2026/APR/Q9**
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Q10. A ship of 9,900 tonnes displacement has KM 7.3m, and KG 6.4m. She has yet to load two 50 tonne lifts from own gear and the first lift is to be placed on deck on the inshore side (KG = 9 m and center of gravity = 6m, out from center line). When the derrick plumbs the quay, its head is 15m above the keel and 12m out from center line. Calculate the maximum list during the operation. (16)
2020/FEB/Q9 **2021/APR/Q9(M)** **2024/APR/Q10** **2026/APR/Q10**
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