CERTIFICATE OF COMPETENCY EXAMINATION

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF
MARITIME AND COASTGUARD AGENCY

SMALL VESSEL CHIEF ENGINEER <3000 GT, UNLIMITED
SMALL VESSEL CHIEF ENGINEER <500 GT, UNLIMITED

059-01 - CHIEF ENGINEER STATUTORY AND OPERATIONAL REQUIREMENTS

FRIDAY, 16 February 2024

1400-1600 hrs

Examination paper inserts:

Notes for the guidance of candidates:

1. Candidates should note that 100 marks are allocated to this paper. To pass candidates must achieve 50 marks.
2. Non-programmable calculators may be used
3. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination workbook

CHIEF ENGINEER STATUTORY AND OPERATIONAL REQUIREMENTS

Attempt ALL questions
Marks for each part question are shown in brackets

1. With reference to the International Maritime Organisation (IMO):

   (a) state SEVEN of the main matters considered by the Maritime Safety Committee (MSC); (7)

   (b) list THREE other main committees of the IMO. (3)

2. Describe the procedure for using the local, emergency steering position, should the bridge control system become inoperative. (10)

3. With reference to the MARPOL Convention Annex I - Shipboard Oil Pollution Emergency Plan (SOPEP):

   (a) outline FOUR minimum requirements that should be included in the plan; (4)

   (b) describe the actions that should be taken on discovering an accidental discharge of oil during bunkering. (6)

4. (a) List SIX items of information that should be conveyed to the relieving officer, prior to taking over the engineering watch at sea. (6)

   (b) State FOUR criteria which should be taken into account when deciding on the composition of the engineering watch. (4)

5. With reference to the International Convention on Load Lines:

   (a) list SIX different trading areas that are applied to the measurement of the freeboard of a vessel; (2)

   (b) outline FOUR circumstances that would cause a vessel to infringe the Load Line regulations if it attempted to proceed to sea. (8)

6. Describe the role of EACH of the following:

   (a) the International Maritime Organisation; (4)

   (b) the Maritime and Coastguard Agency; (3)

   (c) the Marine Accident Investigation Branch. (3)

7. (a) Describe what is meant by Continuous Class Machinery Surveys. (4)

(b) State FOUR reasons why the fuel efficiency of a vessel maybe less than the build sea trials data. (4)

(c) List FOUR typical defects which may reduce the output of a centrifugal pump. (2)

8. With reference to the periodical routine dry-docking of a vessel:

(a) state FOUR reasons for dry-docking; (4)

(b) outline THREE methods of testing a hull for watertight integrity. (6)

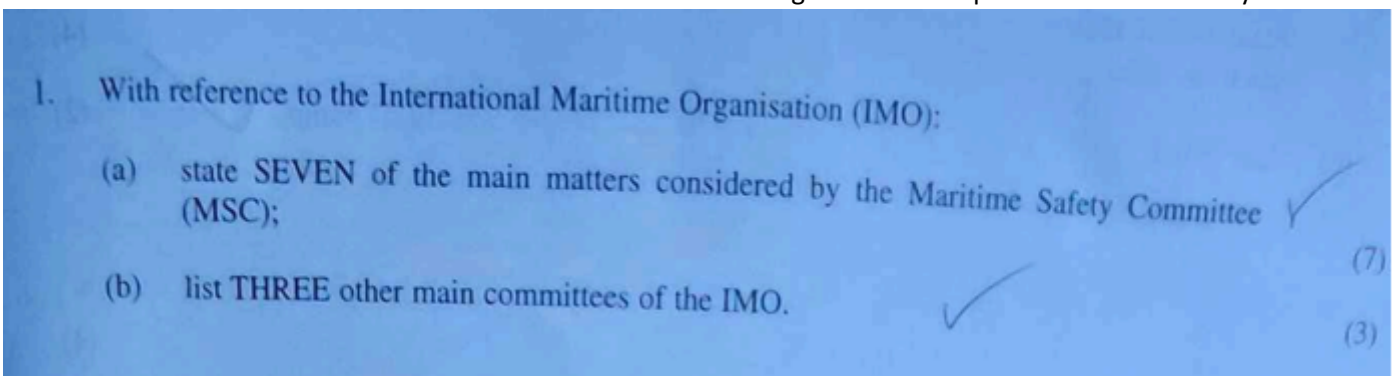
9. With reference to dry-docking:

(a) state what is meant by the *critical period* on settling onto the dock blocks; (3)

(b) explain the reasons why this period is considered critical; (5)

(c) state how the danger is reduced. (2)

10. Describe the methods by which a high pressure water-mist fire suppression system extinguishes fire, stating why it is more effective than a low pressure sprinkler system. (10)



1. With reference to the International Maritime Organisation (IMO):

   (a) state SEVEN of the main matters considered by the Maritime Safety Committee (MSC); (7)

   (b) list THREE other main committees of the IMO. (3)

(a) Seven matters considered by the Maritime Safety Committee (MSC): (7)

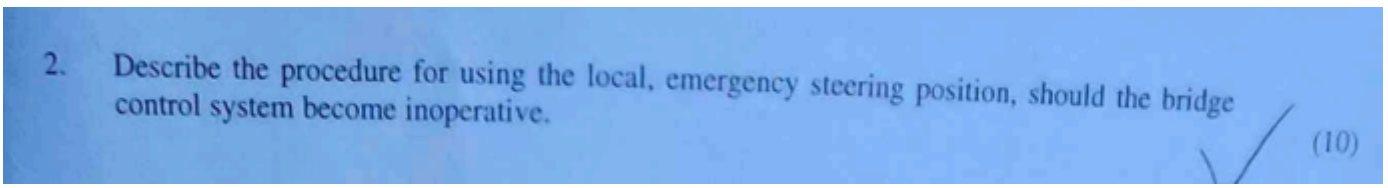
The MSC is the highest technical body of the IMO, responsible for:

1. **Safety of navigation** (charts, routeing, navigational aids, electronic navigation systems).
2. **Construction and equipment of vessels** (SOLAS compliance, fire safety, lifesaving appliances).
3. **Manning and training of seafarers** (STCW requirements).
4. **Rules for preventing collisions at sea** (COLREGs).
5. **Safety procedures for handling dangerous goods and bulk cargoes** (IMDG Code, IBC Code, IMSBC Code).
6. **Maritime security** (anti-piracy measures, ISPS Code).
7. **Search and rescue operations** (coordination, equipment, international SAR plans).

(b) Three other main committees of the IMO: (3)

1. **Marine Environment Protection Committee (MEPC)** – pollution prevention, MARPOL, emissions.
2. **Legal Committee (LEG)** – maritime law, liability, compensation issues.
3. **Technical Co-operation Committee (TCC)** – technical assistance and capacity-building in developing states.

(Also acceptable: **Facilitation Committee (FAL)** – simplification of port procedures).



2. Describe the procedure for using the local, emergency steering position, should the bridge control system become inoperative. (10)

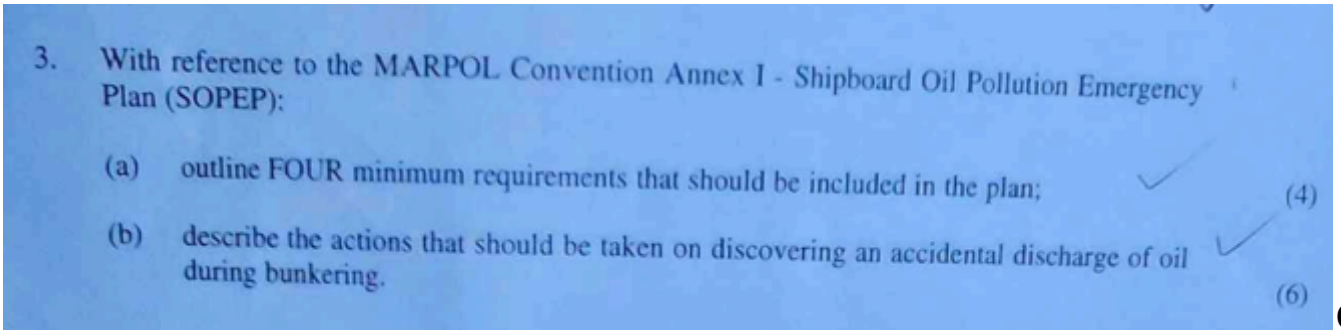
Q2. Procedure for using the local emergency steering position if bridge control fails (10 marks)

1. **Notification & Communication**
    - Inform the **bridge** immediately of loss of steering control.
    - Establish **direct communication** between bridge and steering gear compartment (telephone, sound-powered phone, VHF, or messenger).
    - Emergency steering team is mustered as per the Muster List.
2. **Access & Preparation**
    - Proceed to the **steering gear compartment**.
    - Ensure **power supply** to steering gear pumps is available.
    - Identify the **emergency steering controls** (local hand levers or solenoid switches).
3. **Changeover to Local Control**
    - Isolate the **failed bridge control system**.
    - Operate the **changeover switch** (usually located on the steering gear control panel) to transfer steering control from the bridge to local manual/emergency control.
4. **Operation of Steering Gear**
    - Use the **local control levers** (or hand wheels, depending on system) to operate the solenoid valves of the hydraulic system.
    - This directs hydraulic oil to the steering rams to move the rudder port or starboard.
    - Rudder movement should be **confirmed by the rudder angle indicator** locally and relayed to the bridge.
5. **Bridge Orders Execution**
    - Helmsman/engineer at local station receives **helm orders from the bridge**.
    - Orders are repeated back for confirmation.
    - The rudder is operated manually as directed.
6. **Safety & Monitoring**
    - Monitor **oil pressure, temperature, and alarms** on the steering gear.
    - Keep **rudder movements minimal** to reduce strain on the gear and hydraulic pumps.
    - Ensure **emergency lighting** is on, as steering gear compartments are often poorly lit.
7. **Post-Restoration**

- Continue with emergency steering until **bridge control is restored**.
- Log the incident, actions taken, and report to the Master/Chief Engineer.

✅ **Marking Breakdown (10):**

- Communication (2)
- Changeover to local control (2)
- Operation of steering (2)
- Execution of bridge orders (2)
- Safety/monitoring & logging (2)



3. With reference to the MARPOL Convention Annex I - Shipboard Oil Pollution Emergency Plan (SOPEP):

(a) outline FOUR minimum requirements that should be included in the plan; (4)

(b) describe the actions that should be taken on discovering an accidental discharge of oil during bunkering. (6)

Q3.

MARPOL Convention Annex I – SOPEP

(a) Outline FOUR minimum requirements that should be included in the plan (4 marks)

The SOPEP (Shipboard Oil Pollution Emergency Plan) must include:

1. **Reporting Procedures** – contact details of coastal state authorities, flag state, and company DPA (Designated Person Ashore).
2. **List of authorities & persons to be contacted** – including port authorities, oil response centres, and company contacts.
3. **Steps to control discharge** – shipboard emergency procedures to stop or limit oil escape (e.g., shutting valves, transferring fuel, blanking overboard discharge).
4. **Equipment & resources available** – location and use of onboard spill kits, absorbents, SOPEP locker equipment, and crew duties.

(b) Actions to be taken on discovering an accidental discharge of oil during bunkering (6 marks)

1. **Stop bunkering immediately** – close manifold valves, stop transfer pumps.

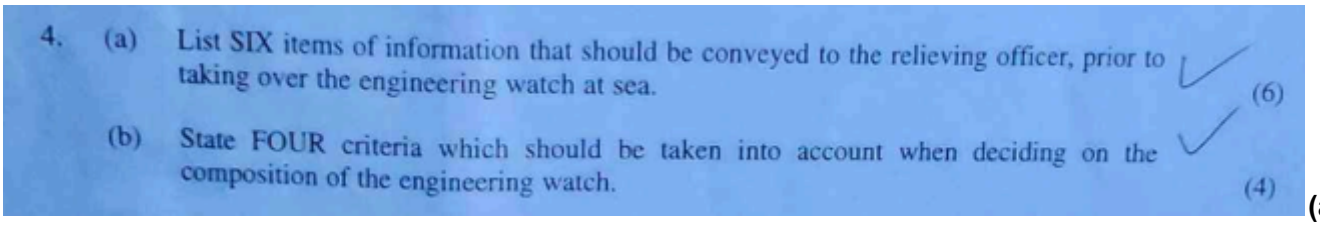
2. **Raise the alarm** – inform bridge, engine room, and officer in charge.

3. **Contain the spill** – use SOPEP equipment (drip trays, absorbent pads, sawdust, booms) to prevent spread.

4. **Prevent oil from entering water** – plug scuppers, cover drains, deploy absorbent booms at ship's side.

5. **Report as required** – notify port authorities, flag state, and company (as per SOPEP).

6. **Record and investigate** – entry in Oil Record Book, file incident report, and take corrective action to avoid recurrence.


4. (a) List SIX items of information that should be conveyed to the relieving officer, prior to taking over the engineering watch at sea. (6)

(b) State FOUR criteria which should be taken into account when deciding on the composition of the engineering watch. (4)

(a) List SIX items of information that should be conveyed to the relieving officer prior to taking over the engineering watch (6 marks)

1. **Condition of main propulsion plant** – including speed, power output, and any abnormal readings.

2. **Status of auxiliary machinery** – generators, boilers, pumps, and steering gear.

3. **Fuel and lubricating oil status** – levels in service tanks, transfer operations in progress, purifier running status.

4. **Any defects or limitations** – machinery breakdowns, equipment under repair, or alarms isolated.

5. **Special orders from the bridge/Chief Engineer** – speed requirements, manoeuvring instructions, or navigational restrictions.

6. **Environmental conditions and safety issues** – weather, sea state, UMS alarms, bilge levels, or fire hazards.

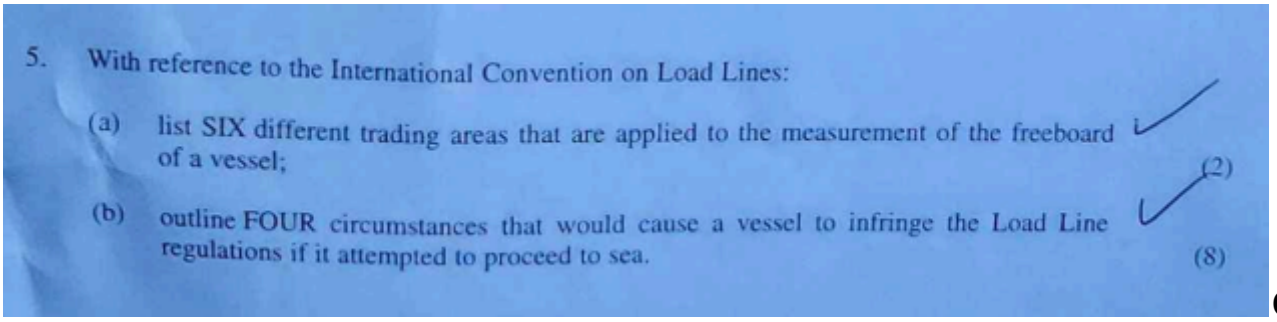
(b) State FOUR criteria which should be taken into account when deciding on the composition of the engineering watch (4 marks)

1. **Manning level and competence** – number of engineers/ratings available and their qualifications/experience.

2. **Type and condition of machinery** – level of automation (UMS or manned engine room) and reliability of equipment.

3. **Operational requirements** – voyage stage (open sea, coastal waters, manoeuvring, cargo operations).

4. **Environmental and safety conditions** – weather, traffic density, and any hazardous operations ongoing.


5. With reference to the International Convention on Load Lines:

(a) list SIX different trading areas that are applied to the measurement of the freeboard of a vessel; (2)

(b) outline FOUR circumstances that would cause a vessel to infringe the Load Line regulations if it attempted to proceed to sea. (8)

Q5. Load Line Convention

(a) List SIX different trading areas that are applied to the measurement of the freeboard of a vessel (2 marks)

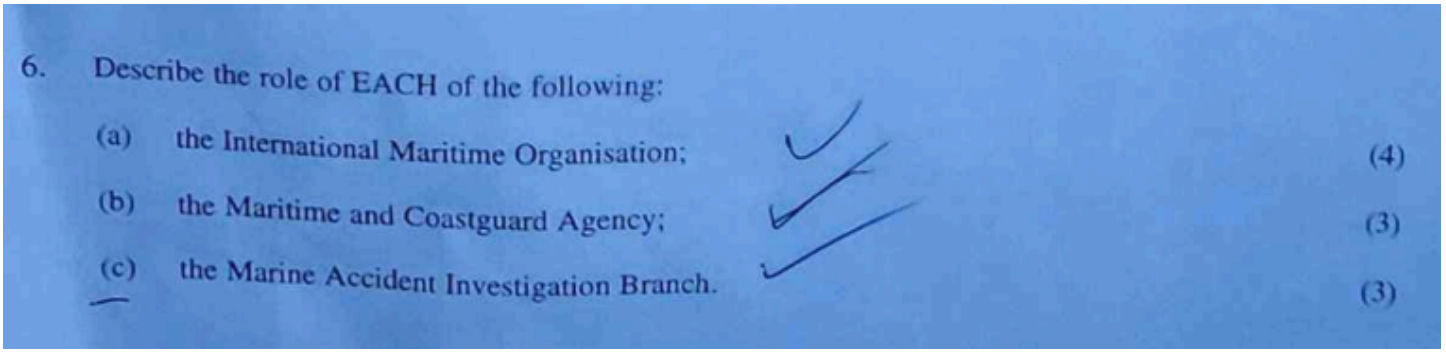
1. Tropical Fresh Water (TFW)
2. Fresh Water (F)
3. Tropical Seawater (T)
4. Summer Seawater (S)
5. Winter Seawater (W)
6. Winter North Atlantic (WNA)

(Each of these zones has different assigned freeboards due to varying sea/weather conditions.)

(b) Outline FOUR circumstances that would cause a vessel to infringe the Load Line regulations if it attempted to proceed to sea (8 marks)

1. **Overloaded condition** – vessel loaded such that the waterline is above the assigned load line mark.
2. **Incorrect zone/freeboard applied** – vessel sailing in Winter Zone but loaded to the Summer mark instead of Winter mark.
3. **Deteriorated hull condition** – corrosion, structural damage, or open hatches reducing reserve buoyancy and watertight integrity.
4. **Defective hatch covers or closing appliances** – failing to secure watertight integrity of the vessel.
5. **Excessive consumption of ballast/fuel** – reducing vessel's stability/freeboard below the assigned mark before voyage completion.
6. **Failure to maintain load line certificate** – expired or invalid statutory certification.

(Any four of these would earn full marks.)



6. Describe the role of EACH of the following:

(a) the International Maritime Organisation; (4)

(b) the Maritime and Coastguard Agency; (3)

(c) the Marine Accident Investigation Branch. (3)

Q6. Describe the role of EACH of the following:

(a) The International Maritime Organisation (IMO) (4 marks)

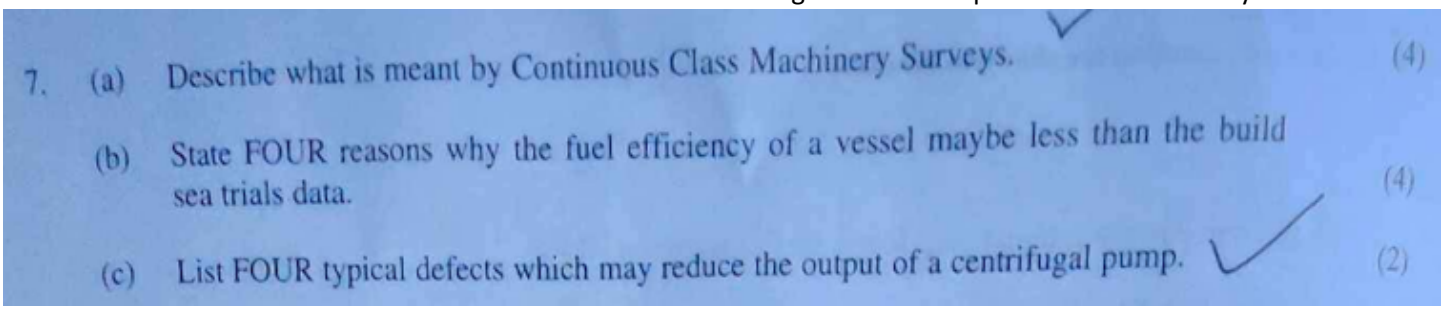
- A specialised United Nations agency responsible for maritime safety, security, and prevention of marine pollution.
- Develops and maintains international conventions, e.g. SOLAS, MARPOL, STCW, Load Lines.
- Provides a forum for cooperation among member states to adopt international shipping regulations.
- Promotes safe, secure, efficient, and environmentally sustainable shipping.

(b) The Maritime and Coastguard Agency (MCA) (3 marks)

- A UK Government agency responsible for implementing national and international maritime safety regulations.
- Ensures safety of seafarers, ships, and protection of the marine environment in UK waters.
- Operates the UK Coastguard, coordinates search and rescue (SAR), and enforces compliance with SOLAS, MARPOL, and STCW.

(c) The Marine Accident Investigation Branch (MAIB) (3 marks)

- An independent UK body that investigates marine accidents and incidents.
- Aims to improve safety at sea by identifying causes and making safety recommendations.
- Does **not** apportion blame or liability, but focuses on preventing recurrence.



7. (a) Describe what is meant by Continuous Class Machinery Surveys. (4)

(b) State FOUR reasons why the fuel efficiency of a vessel maybe less than the build sea trials data. (4)

(c) List FOUR typical defects which may reduce the output of a centrifugal pump. (2)

Q7

(a) Describe what is meant by Continuous Class Machinery Surveys. (4 marks)

- A system of machinery survey where inspections are carried out continuously at intervals during normal service instead of during a single special survey.
- Allows machinery items to be examined, overhauled, and reported on progressively throughout a 5-year cycle.
- Reduces downtime and avoids the need for complete shutdown during drydock or special survey.
- Ensures that machinery remains in class by maintaining compliance with classification society requirements.

(b) State FOUR reasons why the fuel efficiency of a vessel may be less than the build sea trials data. (4 marks)

1. **Hull fouling** (marine growth increases resistance).
2. **Propeller fouling or damage** (reduces propulsion efficiency).
3. **Engine wear or poor tuning** (reduced combustion efficiency).
4. **Adverse loading or weather conditions** (increased resistance compared to trial conditions).

(Other valid answers: poor maintenance, use of lower grade fuel, ballast condition, increased displacement, fouled heat exchangers, or degraded turbocharger performance.)

(c) List FOUR typical defects which may reduce the output of a centrifugal pump. (2 marks)

1. Worn or damaged impeller.
2. Blocked suction strainer or pipework.
3. Air leakage into suction line (loss of priming).
4. Worn mechanical seals or bearings leading to reduced performance.

8. With reference to the periodical routine dry-docking of a vessel:

(a) state FOUR reasons for dry-docking; (4)

(b) outline THREE methods of testing a hull for watertight integrity. (6)

(a) State FOUR reasons for dry-docking. (4 marks)

1. **Hull cleaning and painting** – to remove marine fouling and apply protective coatings.
2. **Survey and inspection** – classification society, flag state, and statutory inspections of hull, rudder, and underwater fittings.
3. **Repair and maintenance** – underwater parts such as sea chests, propellers, rudders, and stern glands.
4. **Hull thickness measurement and structural inspection** – to detect corrosion, cracking, or deformation.

(Other valid reasons: ballast tank inspection, cathodic protection renewal, or modification work.)

(b) Outline THREE methods of testing a hull for watertight integrity. (6 marks)

1. **Hose test** – directed jet of water applied externally to joints, hatch covers, doors, etc., to check for leaks.
2. **Ultrasonic testing** – transmitter placed inside compartment; ultrasonic waves detected outside reveal leaks.
3. **Chalk or light test** – chalk applied on one side of gasket/seal (or light shone inside a compartment) and inspected from the other side for leakage paths.

(Other valid methods: vacuum box test for weld seams, pressure test for tanks/compartments.)

9. With reference to dry-docking:

(a) state what is meant by the *critical period* on settling onto the dock blocks; (3)

(b) explain the reasons why this period is considered critical; (5)

(c) state how the danger is reduced. (2)

(a) State what is meant by the *critical period* on settling onto the dock blocks. (3 marks)

The **critical period** is the interval during which the ship is settling onto the keel blocks, while the buoyancy from the water is being lost, but before full support from the blocks is achieved.

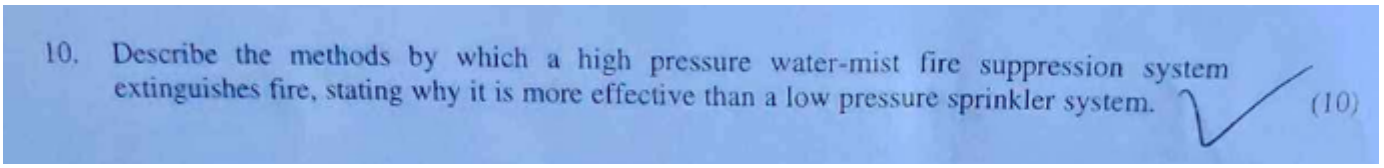
- At this time, the vessel is supported partly by the dock blocks and partly by the remaining buoyancy.
- Transverse stability is at its **minimum**, making the vessel vulnerable to heeling.

(b) Explain the reasons why this period is considered critical. (5 marks)

1. **Loss of buoyancy** – as water is pumped out, buoyant support decreases rapidly.
2. **Concentrated loads** – weight is transferred onto the keel blocks; uneven settling may stress the hull.
3. **Reduced transverse stability** – the ship may heel dangerously with small external forces (wind, movement of weights, or asymmetry).
4. **Risk of structural damage** – if the vessel is not properly aligned with the blocks, excessive stress may cause hull deformation.
5. **Risk of capsize** – if the vessel heels excessively during this unstable condition.

(c) State how the danger is reduced. (2 marks)

1. **Proper docking plan and alignment** – ensuring keel blocks match the ship's docking plan.
2. **Ballasting and trimming carefully** – keeping the ship upright and well balanced.
3. **Limiting weight shifts** – no cargo or ballast movement during the period.
4. **Close supervision** – careful monitoring of the ship's list and draft throughout pumping.


10. Describe the methods by which a high pressure water-mist fire suppression system extinguishes fire, stating why it is more effective than a low pressure sprinkler system. (10)

How Water-Mist Extinguishes Fire (High Pressure System):

1. **Cooling effect** – fine water droplets rapidly absorb heat and turn into steam, lowering the temperature below the fire point.
2. **Oxygen displacement** – as droplets vaporise, they expand (≈1700 times volume as steam), displacing oxygen and reducing concentration around the flame.
3. **Radiant heat blocking** – the mist forms a fog curtain, reducing the spread of radiant heat and preventing fire escalation.
4. **Surface wetting** – droplets deposit on surfaces, reducing the chance of re-ignition.

Why High Pressure Mist is More Effective than Low Pressure Sprinklers:

1. **Smaller droplet size (10–100 microns vs >1 mm in sprinklers):**
    - Increases total surface area for heat absorption.
    - Faster evaporation into steam.
2. **Rapid cooling and oxygen displacement:**
    - Mist suppresses flames and smouldering fires quicker.
3. **Reduced water damage:**
    - Requires **much less water** than traditional sprinklers, avoiding flooding and equipment damage.
4. **Effective in enclosed spaces:**
    - The mist disperses evenly and penetrates obstructed areas.
5. **Greater fire control efficiency:**
    - Works effectively on a variety of fires (Class A, B, and electrical fires when properly designed).