AUG 2023

1. With reference to dangerous (enclosed) spaces onboard a vessel:

(a) state FOUR different examples; (4)

(b) explain why the atmosphere may be dangerous. (6)

AUG 2023

2. (a) State, with reasons, where the watch should be handed over on a vessel fitted with a UMS system, where the period of duty is 24 hours. (2)

(b) Outline the responsibility of the duty engineer with respect to EACH of the following:

(i) the Systems Status Board; (3)

(ii) the Oil Record Book; (3)

(iii) the main and auxiliary Machinery Maintenance Record Book. (2)

AUG 2023

3. With reference to MARPOL Annex V, garbage record book:

(a) state the type of vessel to which the regulation applies; (1)

(b) list the NINE categories into which garbage is grouped for the purpose of the *garbage record book.* (9)

AUG 2023

4. With reference to bunkering of marine diesel oil:

(a) state THREE possible consequences of water contamination of the fuel; (3)

(b) state THREE sources of contamination of fuel by water on board a vessel; (3)

(c) describe TWO separate tests which would indicate the presence of water in the fuel. (4)

AUG 2023

5. With reference to sewage treatment plants:

(a) describe the biological operating principle of an aerobic sewage treatment plant, explaining the dangers if a supply of oxygen is not present; (8)

(b) state how a sufficient supply of oxygen is ensured. (2)

AUG 2023

6. With reference to refrigeration plant;

(a) state THREE indications of a loss in refrigerant charge; (3)

(b) state THREE methods of detecting the location of the source of leakage; (3)

(c) describe a safe method of bringing the gas charge back to its normal working level. (4)

AUG 2023

7. (a) Describe, with the aid of a sketch, a reverse osmosis plant, from feed water inlet, to product tank, labelling ALL components and showing the position in the system of the monitoring instruments. (7)

(b) Describe the feed water pre-treatment process before the water enters the spirally wound membrane modules. (3)

AUG 2023

8. (a) Describe, with the aid of a sketch, the method of attachment of a Bilge Keel to a vessel's hull, explaining the reason for the longitudinal position of the bilge keel, relative to the hull. (7)

(b) State the advantages and disadvantages of fitting a bilge keel compared with other methods of stabilisation. (3)

AUG 2023

9. (a) State FIVE monthly checks which should be carried out on fire fighting equipment. (5)

(b) State FIVE yearly checks which should be carried out on fire fighting equipment. (5)

AUG 2023

10. (a) Explain the meaning of EACH of the following terms:

(i) camber;

(ii) sheer. (2)

(2)

(b) Describe how EACH of the terms explained in part (a) improve seaworthiness. (6)

AUG 2023

1. With reference to dangerous (enclosed) spaces onboard a vessel:

(a) state FOUR different examples; (4)

(b) explain why the atmosphere may be dangerous. (6)

# Dangerous Enclosed Spaces on a Vessel:

**(a) Four Examples:**

Enclosed spaces on a vessel can pose significant risks due to the potential for a dangerous atmosphere. Here are four common examples:

1. **Cargo Holds:** These compartments store various cargo, and the atmosphere can be dangerous due to:
   - **Oxygen Depletion:** Cargo like grain or coal can consume oxygen through respiration, leading to a deficiency that can cause suffocation.
   - **Toxic Fumes:** Certain cargo, like chemicals or pesticides, may emit hazardous fumes that can be invisible and odorless, leading to poisoning.
2. **Ballast Tanks:** These tanks hold seawater to maintain a vessel's stability. Dangers include:

- **Oxygen Depletion:** Stagnant water can become depleted of oxygen due to microbial activity, leading to suffocation.
- **Flammable or Toxic Gases:** Residual cargo residues or vapors from cleaning chemicals can linger and create an explosive or toxic atmosphere.

3. **Fuel Tanks:** These compartments store fuel oil for the ship's engine. The main dangers are:

    - **Flammable Atmosphere:** Fuel vapors can accumulate, creating a high risk of fire or explosion if ignited by sparks from electrical equipment or tools.
    - **Toxic Fumes:** Fuel oil contains harmful hydrocarbons that can be toxic if inhaled.

4. **Pump Rooms:** These spaces house pumps for various purposes like bilge pumping, ballast water transfer, and fuel transfer. Risks include:

    - **Oxygen Depletion:** Similar to ballast tanks, stagnant water can deplete oxygen levels.
    - **Flammable or Toxic Vapors:** Leakage from pumps or piping can introduce flammable fuel vapors or toxic fumes from bilge water contamination.

**(b) Reasons for a Dangerous Atmosphere:**

Several factors can contribute to a dangerous atmosphere in enclosed spaces onboard a vessel:

- **Oxygen Depletion:** Consumption of oxygen by organic material (cargo, stagnant water), rusting processes, or displacement by other gases can lead to oxygen deficiency, causing dizziness, unconsciousness, and even death.

- **Toxic Gases:** Fumes from cargo residues, cleaning chemicals, fuel spills, or engine exhaust can be present in enclosed spaces. These can be invisible and odorless, making them difficult to detect, and can cause respiratory problems, poisoning, or death.

- **Flammable Atmospheres:** Accumulation of flammable gases or vapors from fuels, paints, or certain cargo can create a high risk of fire or explosion if ignited by a spark source.

It's crucial to be aware of these dangers and follow strict safety procedures before entering any enclosed space onboard a vessel to minimize the risk of accidents and fatalities.

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2. (a) State, with reasons, where the watch should be handed over on a vessel fitted with a UMS system, where the period of duty is 24 hours. (2)

(b) Outline the responsibility of the duty engineer with respect to EACH of the following:

(i) the Systems Status Board; (3)

(ii) the Oil Record Book; (3)

(iii) the main and auxiliary Machinery Maintenance Record Book. (2)

# Handover and Engineer Responsibilities on a UMS Vessel:

**(a) Handover Location on a UMS Vessel (24-Hour Duty):**

On a vessel equipped with an Unattended Machinery Space (UMS) system and a 24-hour duty period, the ideal handover location **should be at the central control room**. Here's why:

- **Centralized Monitoring:** The central control room provides a centralized overview of all critical engine room parameters and alarms. This allows the oncoming duty engineer to quickly assess the current status of the machinery and identify any potential issues.
- **Information Sharing:** During handover, the outgoing engineer can efficiently communicate important information about recent events, equipment operation, and any ongoing maintenance tasks directly at the central control room. This ensures seamless continuity of watchkeeping duties.
- **Emergency Response:** Familiarity with the central control room layout and alarm systems is crucial. Handovering in this location ensures the oncoming engineer is immediately prepared to respond to any emergencies that might arise during their watch.

While the central control room is preferred, some vessels might have designated handover stations within the engine room itself. However, the key principle remains ensuring the oncoming engineer has full access to necessary information and equipment for effective watchkeeping.

**(b) Duty Engineer Responsibilities:**

The duty engineer on a UMS vessel has several key responsibilities:

**(i) Systems Status Board:**

- **Maintaining Accuracy:** The duty engineer is responsible for ensuring the Systems Status Board displays accurate and up-to-date information about the operational status of all critical machinery and auxiliary systems. This typically involves monitoring alarms, parameter readings, and equipment indications and reflecting them on the board.
- **Identifying Issues:** By monitoring the Systems Status Board, the engineer can identify any abnormal readings or developing problems that require further investigation or corrective action.

**(ii) Oil Record Book (ORB):**

- **Recording Operations:** The duty engineer is responsible for meticulously recording all oil-related operations in the ORB. This includes entries for:
    - Fuel oil bunkering (quantity, type, supplier)
    - Lubricating oil additions and changes
    - Bilge oil and waste oil discharges (with port and authorization details)
    - Any accidental oil spills or leakages
- **Maintaining Compliance:** Accurate and complete ORB records are crucial for demonstrating compliance with MARPOL (International Convention for the Prevention of Pollution from Ships) regulations concerning oil discharges and oily waste management.

**(iii) Main and Auxiliary Machinery Maintenance Record Book:**

- **Recording Maintenance:** The duty engineer is responsible for recording all maintenance activities performed on the main and auxiliary machinery in the designated record book.

- **Data Recording:** Entries should include details like:
    - Date and time of maintenance

    - Equipment or system worked on
    - Specific task performed (replacement of parts, adjustments, etc.)
    - Spare parts used (if applicable)
    - Initials of the engineer performing the maintenance
- **Future Reference:** These records provide a history of maintenance performed on the machinery, which can be valuable for future reference, troubleshooting issues, and planning preventive maintenance schedules.

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3. With reference to MARPOL Annex V, garbage record book:

   (a) state the type of vessel to which the regulation applies; (1)

   (b) list the NINE categories into which garbage is grouped for the purpose of the *garbage record book.* (9)

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# MARPOL Annex V and Garbage Record Book

**(a) Applicability:**

The MARPOL Annex V regulation on garbage record keeping applies to:

- **All sea-going vessels of 400 gross tonnage and above** engaged on international voyages.
- **Every ship certified to carry 15 or more persons** engaged on international voyages.

**(b) Nine Garbage Categories:**

MARPOL Annex V categorizes garbage into nine groups for record-keeping purposes in the Garbage Record Book. These categories are:

1. **Food Wastes:**Includes all galley waste, leftovers from meals, vegetable matter, fruit peels, and other biodegradable food waste.
2. **Plastics:**Encompasses all plastics generated on board, including packaging materials, utensils, ropes, fishing gear, and plastic debris.
3. **Paper:**This category includes paper products like newspapers, cardboard boxes, paper towels, and office waste.
   **Glass:**Broken or unbroken glass waste generated on board, including bottles, tableware, and laboratory glassware.
4. **Metal:**Includes scrap metal, used metal containers, and other metallic waste generated during ship operations or maintenance activities.
5. **Vegetable Oils:**Used cooking oils, lubricating oils, and other oily residues from machinery operation or bilge cleaning.
6. **Cargo Residues:**Any solid material remaining from cargo handling operations, such as dunnage, lining materials, packing materials, or cleaning residues.
7. **Fishing Gear:**Lost or discarded fishing gear, including nets, lines, hooks, and other fishing equipment.
8. **Other Garbage:**This category includes any garbage that doesn't fall into the above categories, such as batteries, electronic waste, inert grinding materials, and harmful substances.

By maintaining a Garbage Record Book with these categorized entries, ship operators can effectively track waste generation onboard, ensuring proper waste management practices and compliance with MARPOL Annex V regulations.

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4. With reference to bunkering of marine diesel oil:

(a) state THREE possible consequences of water contamination of the fuel; (3)

(b) state THREE sources of contamination of fuel by water on board a vessel; (3)

(c) describe TWO separate tests which would indicate the presence of water in the fuel. (4)

# Bunkering and Water Contamination of Marine Diesel Oil (MDO):

**(a) Consequences of Water Contamination:**

Water contamination in MDO can have several detrimental consequences:

1. **Microbial Growth:** The presence of water creates a breeding ground for microbes (bacteria and fungi) that can grow in the fuel. These microbes can:
   - Break down fuel components, reducing its energy content and combustion efficiency, leading to increased fuel consumption and reduced engine power output.
   - Produce biofilms and slimes that can clog fuel filters, restricting fuel flow and potentially leading to engine shutdown.
   - Generate corrosive byproducts that can damage fuel tanks, pipes, and engine components.
2. **Corrosion:** Water itself can contribute to corrosion within the fuel system, especially in the presence of dissolved salts or contaminants. This can lead to leaks, equipment damage, and potential safety hazards.

3. **Fuel System Icing:** In cold weather conditions, water in the fuel can freeze and form ice crystals. These ice crystals can block fuel filters and pipelines, disrupting fuel flow and potentially causing engine failure.

**(b) Sources of Water Contamination Onboard:**

While water ingress during bunkering is a concern, there are other sources of water contamination onboard a vessel:

1. **Tank Condensation:** Temperature fluctuations can cause condensation within fuel storage tanks. This is more prevalent in humid environments or during periods of significant temperature changes.

2. **Leaking Equipment:** Leaks in piping, seals, or heat exchangers can allow seawater to enter the fuel system, introducing water contamination.

3. **Poor Tank Venting:** Improper venting of fuel tanks can create a vacuum, drawing in moisture from the surrounding air, especially during bunkering operations.

**(c) Tests for Water Contamination:**

1. **Visual Inspection:** During bunkering or tank inspections, a visual check for cloudiness, discoloration, or the presence of a distinct water layer at the fuel-oil interface can indicate water contamination.

2. **Spot Test:** Commercially available test kits allow for a quick on-site check for water content in the fuel. However, these kits provide a basic indication and might not be as precise as laboratory analysis.

For a more reliable assessment, fuel samples should be sent to a laboratory for detailed analysis. Laboratory tests can determine the exact water content in the fuel and identify any other potential contaminants.

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5. With reference to sewage treatment plants:

(a) describe the biological operating principle of an aerobic sewage treatment plant, explaining the dangers if a supply of oxygen is not present; (8)

(b) state how a sufficient supply of oxygen is ensured. (2)

# Aerobic Sewage Treatment Plants: Biological Process and Oxygen Supply

**(a) Biological Principle and Dangers of Oxygen Depletion:**

**Aerobic sewage treatment plants** rely on the activity of **aerobic microorganisms** to break down organic matter present in sewage. Here's a breakdown of the process:

1. **Primary Treatment:** Initially, sewage undergoes a physical separation process to remove larger solids.
2. **Biological Treatment (Aerobic Process):** The pretreated wastewater enters the aeration tank, where:
    - **Aerobic bacteria** are present in abundance.
    - **Air is continuously bubbled** through the tank to maintain a dissolved oxygen supply.
    - These bacteria feed on the organic matter in the wastewater, breaking it down into simpler compounds like carbon dioxide and water.
    - The process is similar to natural biodegradation that occurs in well-oxygenated environments.

**Dangers of Insufficient Oxygen Supply:**

If the oxygen supply to the aeration tank is insufficient, several problems can arise:

- **Inefficient Breakdown:** Aerobic bacteria become inactive or die in the absence of oxygen. This hinders the breakdown of organic matter, leading to the accumulation of pollutants in the wastewater.
- **Anaerobic Processes Take Over:** Anaerobic microorganisms, which don't require oxygen, can take over in the low-oxygen environment. However, their waste products include methane, a potent greenhouse gas, and other potentially harmful substances.
- **Increased Odors:** Anaerobic processes often generate unpleasant odors due to the production of hydrogen sulfide gas.

These issues can significantly compromise the effectiveness of the sewage treatment plant and pose environmental concerns.

**(b) Ensuring Sufficient Oxygen Supply:**

Here are some key methods to ensure a sufficient oxygen supply in the aeration tank of a sewage treatment plant:

- **Diffusers:** Fine bubble diffusers are commonly used to disperse compressed air efficiently throughout the tank volume, maximizing oxygen transfer to the wastewater.
- **Blowers:** Powerful blowers provide the compressed air necessary for the diffusers to function effectively.
- **Monitoring and Control:** Dissolved oxygen levels in the aeration tank are continuously monitored. If levels drop below a set point, alarms can trigger, and air supply can be adjusted to maintain optimal conditions.

By implementing these measures, sewage treatment plants can ensure a healthy environment for aerobic microorganisms and achieve efficient wastewater treatment.

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6. With reference to refrigeration plant;

(a) state THREE indications of a loss in refrigerant charge; (3)

(b) state THREE methods of detecting the location of the source of leakage; (3)

(c) describe a safe method of bringing the gas charge back to its normal working level. (4)

10

# Refrigeration Plant: Refrigerant Loss and Recharge

**(a) Indications of Refrigerant Loss:**

Several signs can indicate a loss of refrigerant charge in a refrigeration plant:

1. **Reduced Cooling Capacity:** One of the most noticeable signs is a decrease in the system's ability to achieve and maintain the desired cooling temperature. The chilled space may not reach the set point, or it may take longer to reach the desired temperature.

2. **Increased Compressor Workload and Run Time:** With less refrigerant circulating, the compressor has to work harder to maintain the required cooling effect. This can lead to longer compressor run times, higher energy consumption, and potential overheating of the compressor.

3. **Changes in System Pressures and Temperatures:** Refrigerant loss typically results in changes to the system's pressure and temperature readings. The suction pressure (low pressure side) may be lower than usual, while the discharge pressure (high pressure side) could also be affected. Additionally, frost patterns on the evaporator coil might become erratic or uneven.

**(b) Leak Detection Methods:**

Here are three methods for detecting the location of a refrigerant leak in a refrigeration plant:

1. **Electronic Leak Detectors:** Specialized electronic leak detectors can be used to pinpoint leaks. These devices are sensitive to specific refrigerants and emit an audible or visual signal when they detect a concentration of refrigerant gas above a certain threshold.

2. **Ultrasonic Leak Detection:** This method uses ultrasonic sound waves. Leaks create turbulence in the escaping gas, which can be detected by the ultrasonic equipment. This method can be effective for pinpointing leaks in areas that may be difficult to visually inspect.

3. **Bubble Testing:** A safer method involves applying a soapy water solution to suspected leak areas. If a leak is present, bubbles will form around the leak point due to the escaping gas creating pressure against the soapy water film. This method is relatively simple but may not be effective for all types of leaks or in areas that are difficult to access.

**(c) Safe Refrigerant Recharge:**

Recharging a refrigeration system with refrigerant should only be done by a qualified technician who is properly trained and equipped to handle refrigerants safely. Here's a breakdown of a safe method for refrigerant recharge:

1. **System Leak Repair:** The first and most important step is to identify and repair the source of the leak. Leaking refrigerant poses environmental and safety risks. Recharging without fixing the leak will only lead to further refrigerant loss.

2. **System Evacuation:** A qualified technician will use a vacuum pump to evacuate the system. This removes any non-condensable gases (like air or moisture) that may have entered the system during the leak or repairs.

3. **Refrigerant Recovery (if applicable):** If any residual refrigerant remains in the system, a technician will use a recovery unit to capture and store it for proper disposal or recycling.

4. **Refrigerant Charging:** Using specialized equipment and following the manufacturer's specifications, the technician will carefully measure and introduce the correct amount and type of refrigerant into the system. Overcharging can be just as detrimental to the system as undercharging.

5. **Leak Monitoring:** After recharging, the technician will monitor the system for leaks and ensure proper system pressures and temperatures are achieved.

Following these steps ensures a safe and effective refrigerant recharge process that minimizes environmental impact and optimizes system performance.

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7. (a) Describe, with the aid of a sketch, a reverse osmosis plant, from feed water inlet, to product tank, labelling ALL components and showing the position in the system of the monitoring instruments. (7)

(b) Describe the feed water pre-treatment process before the water enters the spirally wound membrane modules. (3)

# Reverse Osmosis Plant: Feed Water to Product Tank

**(a) System Components and Monitoring:**

A reverse osmosis plant consists of several stages, each playing a crucial role in purifying the water. Here's a breakdown from feed water inlet to the product tank:

1. **Feed Water Inlet:** Raw water enters the plant, often from a well, seawater source, or municipal supply.
2. **Pre-treatment:** This stage removes impurities that could damage the RO membrane. Depending on the feed water quality, it may involve:
    - **Multimedia Filter:** Removes suspended particles like sand, silt, and debris.
    - **Activated Carbon Filter:** Absorbs chlorine, organic contaminants, and taste/odor causing substances.
    - **Antiscalant Dosing:** Chemicals are added to prevent scaling on the membrane from minerals like calcium and magnesium.
    - **Monitoring Instruments:** Pressure gauges, flow meters, and turbidity meters monitor pre-treatment performance.
3. **High-Pressure Pump:** This pump increases the pressure of the pre-treated water to overcome the osmotic pressure and drive water through the membrane.
    - **Monitoring Instruments:** Pressure gauges and flow meters monitor pump performance and feed water pressure.
4. **Spiral Wound Membrane Modules:** These house the semi-permeable membranes that allow water molecules to pass through while rejecting contaminants. The system typically uses multiple membrane modules arranged in series or parallel for increased efficiency.
    - **Monitoring Instruments:** Conductivity meters monitor permeate (product water) quality, indicating its purity. Pressure gauges monitor pressure across the membrane modules.
5. **Permeate Tank:** The filtered, low-salinity water (permeate) is collected and stored in this pressurized tank.
    - **Monitoring Instruments:** Level sensors and pressure gauges monitor the permeate water level and pressure in the tank.
6. **Brine Reject Stream:** The concentrated brine solution containing the rejected salts and impurities is discharged from the system. The discharge location depends on regulations and may involve further treatment.
    - **Monitoring Instruments:** Conductivity meters or salinity sensors monitor the concentration of the reject stream.

**(b) Feed Water Pre-treatment Process:**

Pre-treatment is crucial for protecting the RO membrane and ensuring efficient operation. Here's a closer look:

1. **Multimedia Filtration:** Water passes through a series of graded layers of filter media (sand, gravel, etc.) that trap suspended particles like dirt, silt, and organic matter.
    - **Benefit:** Protects the membrane from physical damage caused by large particles.
2. **Activated Carbon Filtration:** Water flows through activated carbon, a highly adsorbent material that removes chlorine, taste/odor causing compounds, and some organic contaminants.
    - **Benefit:** Prevents chlorine from damaging the membrane and improves permeate quality.

3. **Antiscalant Dosing:** Chemicals are added to the pre-treated water to prevent scaling on the membrane from minerals like calcium and magnesium. These antiscalants bind to the minerals, keeping them in solution and preventing them from precipitating on the membrane surface.
    - **Benefit:** Extends membrane life and maintains RO system efficiency.

The specific pre-treatment steps and chemicals used will depend on the quality of the feed water entering the plant.

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8. (a) Describe, with the aid of a sketch, the method of attachment of a Bilge Keel to a vessel's hull, explaining the reason for the longitudinal position of the bilge keel, relative to the hull. (7)

(b) State the advantages and disadvantages of fitting a bilge keel compared with other methods of stabilisation. (3)

# Bilge Keels: Attachment and Benefits

**(a) Bilge Keel Attachment and Positioning:**

Bilge keels are long, narrow fins typically attached to the bilge (the lower, curved area where the hull meets the bottom) of a vessel. Here's a breakdown of their attachment and positioning:

**Attachment Method:**

- Bilge keels can be:
    - **Welded Directly:** This is a permanent attachment for new builds or major refits.
    - **Bolted On:** This method allows for easier removal or replacement, useful for repairs or vessels requiring occasional bilge keel removal.
    - **Adhesive Bonding (Less Common):** Some advanced adhesives might be used for bilge keels, but welding or bolting remains the more common method due to strength considerations.
- The attachment method ensures a secure connection that can withstand the forces exerted on the bilge keels while the vessel is underway.

**Longitudinal Position:**

Bilge keels are positioned longitudinally (running along the length of the hull) on both sides of the vessel, typically just below the bilge area. This positioning provides several benefits:

- **Maximum Leverage:** The longitudinal placement creates the greatest lever arm to counteract rolling motion. The bilge keels act like underwater fins, dampening the side-to-side rolling of the vessel in waves.
- **Minimal Draft Impact:** By positioning them near the bilge, the bilge keels have minimal impact on the vessel's draft (the depth of the hull underwater) compared to other stabilization methods like keels or outriggers.
- **Strength and Stability:** The bilge area is a naturally strong point on the hull, making it a suitable location for attaching the keels and providing structural stability.

**(b) Advantages and Disadvantages of Bilge Keels:**

**Advantages:**

- **Improved Stability:** Bilge keels effectively reduce a vessel's rolling motion, enhancing passenger comfort and safety in rough seas.
- **Minimal Draft Impact:** Compared to other methods, bilge keels have minimal impact on the vessel's draft, allowing for operation in shallower waters.
- **Relatively Simple Design:** Bilge keels are a relatively simple and cost-effective method of roll stabilization.
- **Low Maintenance:** Once installed, bilge keels require minimal maintenance.

**Disadvantages:**

- **Increased Drag:** Bilge keels can create some additional drag on the vessel, potentially reducing speed and fuel efficiency.
- **Performance Impact:** In some cases, bilge keels might affect maneuverability, especially at slower speeds.
- **Grounding Risk:** Bilge keels extending further outwards increase the risk of grounding in shallow waters.
- **Aesthetics:** Some boat owners might find the appearance of bilge keels less aesthetically pleasing.

**Bilge keels vs. Other Stabilization Methods:**

- **Fin Stabilizers:** These retractable fins deploy electronically to counter rolling. They offer greater stabilization but are more complex, expensive, and require maintenance.
- **Active Stabilization Systems:** These use gyroscopes and actuators to actively counteract rolling motion. They offer excellent stabilization but are the most expensive and complex option.
- **Outriggers:** These are additional hulls mounted on either side of the main hull, providing excellent stability but significantly increasing draft and potentially affecting performance.

The choice of stabilization method depends on the vessel's size, intended use, sea conditions typically encountered, and budget considerations. Bilge keels offer a good balance of effectiveness, simplicity, and cost for many recreational and small commercial vessels.

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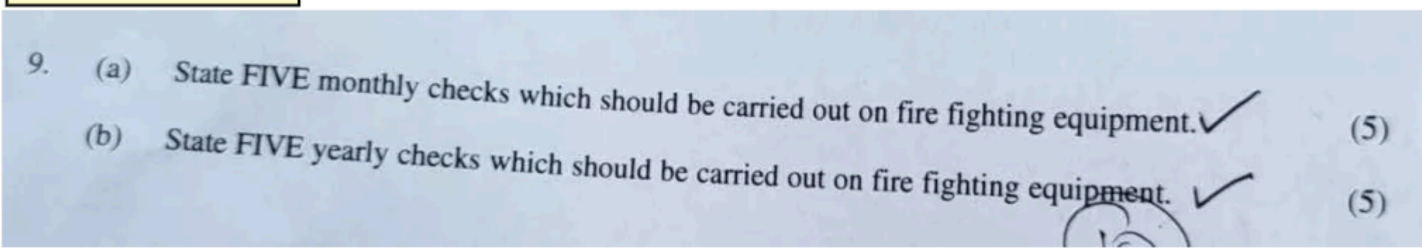
9. (a) State FIVE monthly checks which should be carried out on fire fighting equipment. (5)

(b) State FIVE yearly checks which should be carried out on fire fighting equipment. (5)

# Firefighting Equipment Checks on Marine Vessels

Here's a breakdown of important monthly and yearly checks for firefighting equipment on marine applications:

**(a) Monthly Checks (Five Examples):**

1. **Visual Inspection:** Perform a thorough visual inspection of all firefighting equipment for any signs of damage, corrosion, leaks, or missing parts. This includes:
   - Fire hoses: Check for cracks, cuts, bulges, or loose couplings.
   - Portable fire extinguishers: Verify tamper seals are intact, pressure gauges are in the green zone, and safety pins are secure.
   - Fire hydrants and valves: Ensure they are accessible, not blocked by debris, and operate smoothly.
   - Breathing apparatus: Inspect masks, hoses, and cylinders for damage or leaks.
   - Firefighting clothing: Check for tears, burns, or any deterioration that might affect protection.
2. **Operational Checks:** Where possible, conduct basic operational checks on some equipment:
   - **Fire hoses:** Unroll and connect hoses to hydrants to ensure proper water flow and pressure.
   - **Portable fire extinguishers: Visually** confirm the lifting handle and discharge lever are functional (**Do not** discharge extinguishers during monthly checks).
3. **Crew Familiarization:** Organize short training sessions or reminders for crew members to ensure familiarity with the location and operation of firefighting equipment in their assigned areas.
4. **Record Keeping:** Document the monthly checks in a designated logbook, recording the date, equipment inspected, any findings, and corrective actions taken (if necessary).
5. **Pressure Gauges:** While a detailed pressure gauge check might be done yearly, a monthly glance at the pressure gauges on fire hydrants and portable extinguishers can provide a quick indication of potential issues.

**(b) Yearly Checks (Five Examples):**

1. **Detailed Functional Testing:** Perform a more comprehensive functional test on firefighting equipment:
   - **Fire hoses:** Conduct a pressure test to ensure they meet the required pressure rating.
   - **Portable fire extinguishers:** These require a thorough internal and external inspection by a certified technician. This includes a hydrostatic pressure test to ensure the extinguisher can safely handle the pressure of the extinguishing agent. Discharging a small amount of the agent might also be required to verify proper functionality.
   - **Fire hydrants and valves:** Conduct a flow test to verify adequate water pressure and flow rate. Operate the valves to ensure smooth opening and closing.
2. **Breathing Apparatus (BA) Inspection:** A qualified technician should perform a detailed inspection of breathing apparatus sets, including:
   - Checking the integrity of the masks, hoses, and cylinders.
   - Testing alarms and low-air pressure warnings.
   - Verifying the serviceability of breathing gas and refilling cylinders if necessary.
3. **Firefighting Clothing Inspection:** A qualified person should inspect firefighting clothing for any damage, tears, or signs of wear and tear that might compromise their protective capabilities. Replace any unsuitable clothing.
4. **Spare Parts Inventory:** Review the stock of spare parts for firefighting equipment and ensure critical replacement parts are readily available in case of repairs.
5. **Record Keeping:** Document the yearly checks in a designated logbook, recording the date, equipment serviced, any findings or repairs done, and the name of the certified technician (if applicable).

These are just some examples, and the specific requirements for checks and maintenance might vary depending on the type of vessel, national regulations, and classification society guidelines. Always refer to the manufacturer's instructions and relevant regulations for detailed procedures and service intervals.

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10. (a) Explain the meaning of EACH of the following terms:

(i) camber;

(ii) sheer. (2)

(b) Describe how EACH of the terms explained in part (a) improve seaworthiness. (2)

(6)

## Camber and Sheer: Definitions and Impact on Seaworthiness

**(i) Camber:**

- **Definition:** Camber refers to the transverse curvature of a deck or other surface. In the context of ships, it describes the way a deck is not perfectly flat but curves slightly from the centerline outwards towards the sides. The deck is higher in the middle and slopes down towards the edges. This curvature can be symmetrical (same on both sides) or asymmetrical.

- **Impact on Seaworthiness:** Camber offers several benefits for seaworthiness:

  - **Drainage:** The sloping deck allows water (from rain, waves, or deck cleaning) to drain efficiently towards the scuppers (drainage holes) located on the sides of the ship. This helps prevent water from accumulating on deck, which can be hazardous and create weight imbalances.
  - **Strength:** A cambered deck provides additional structural strength, especially against sagging under heavy loads or wave impact. The curved shape distributes stress more evenly across the deck compared to a perfectly flat surface.
  - **Cargo Handling:** For some vessels, a cambered deck can assist with cargo handling by creating a natural rolling motion towards the center, aiding in maneuvering cargo on deck.

**(ii) Sheer:**

- **Definition:** Sheer refers to the longitudinal curvature of the main deck of a ship, viewed from the side. The deck is not perfectly horizontal but rises slightly towards the bow (front) and stern (rear) of the vessel. This upward curvature can be in a straight line or a gentle parabolic curve.

- **Impact on Seaworthiness:** Sheer offers several advantages for a ship's performance at sea:

  - **Reserve Buoyancy:** The raised bow and stern sections create increased reserve buoyancy in these areas. This helps prevent the bow from diving deeply into oncoming waves and the stern from burying excessively when pitching (the up-and-down motion of the bow and stern). This improves buoyancy distribution and reduces slamming forces on the hull.
  - **Wave Maneuverability:** The raised bow allows the ship to cut through waves more effectively, improving handling and reducing the risk of bow submersion in rough seas.

   - **Aesthetics:** A moderate sheer can also contribute to a ship's aesthetics, creating a more visually pleasing profile.

**In summary,** both camber and sheer are subtle yet crucial design elements that contribute to a ship's seaworthiness. They improve drainage, enhance structural strength, promote efficient cargo handling (for camber), and enhance wave handling and buoyancy distribution (for sheer). These features work together to ensure a safer and more efficient operation at sea.