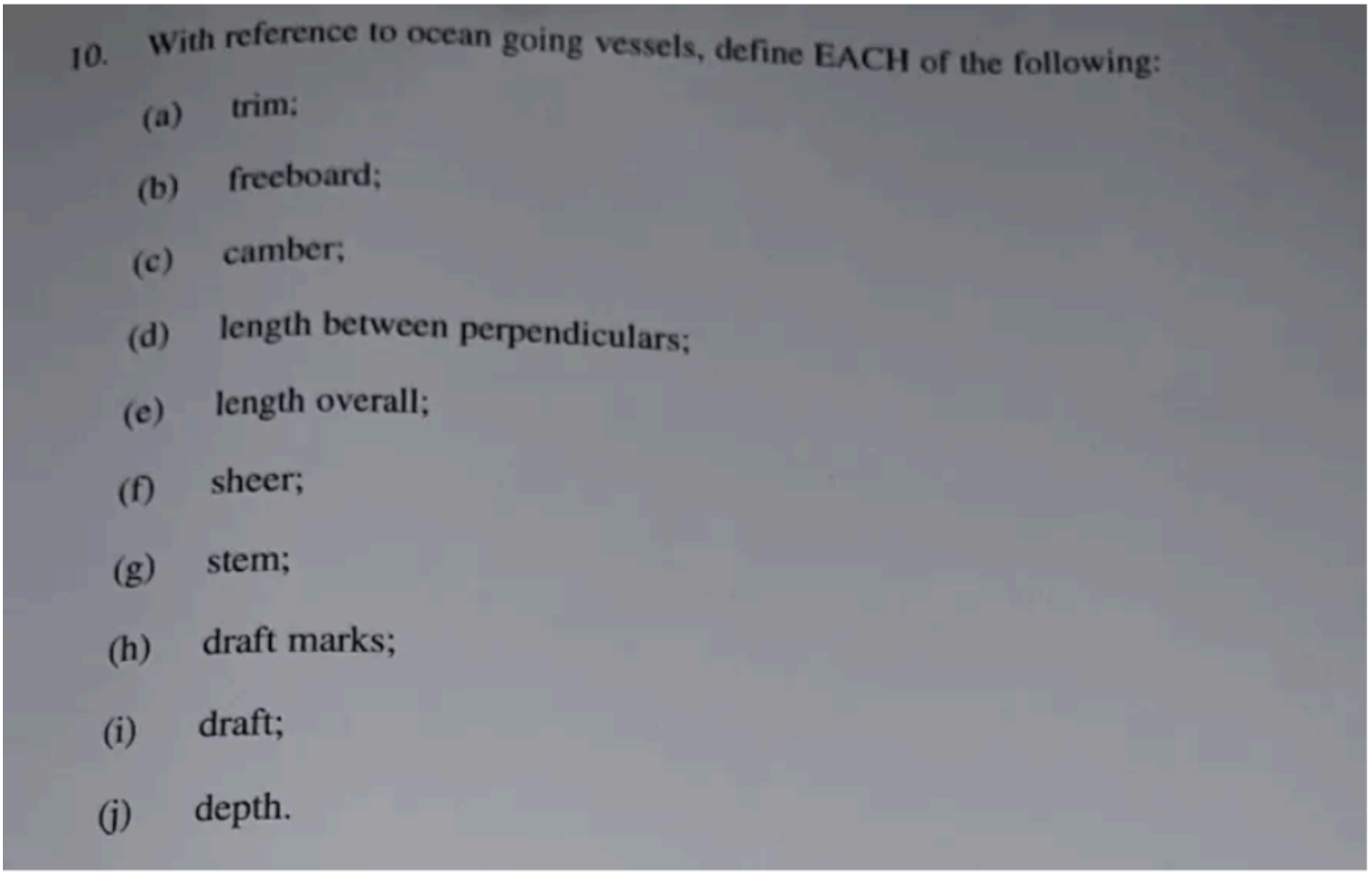
2024 January


10. With reference to ocean going vessels, define EACH of the following:

(a) trim;

(b) freeboard;

(c) camber;

(d) length between perpendiculars;

(e) length overall;

(f) sheer;

(g) stem;

(h) draft marks;

(i) draft;

(j) depth.

# Ocean Vessel Dimensions and Characteristics:

Here's a breakdown of the terms you requested with reference to ocean-going vessels:

(a) **Trim:** Trim refers to the longitudinal (fore-and-aft) balance of a vessel. It's the difference in the amount of water a vessel displaces at the forward (bow) and aft (stern) perpendiculars.

- **Even Trim:** The vessel floats level with equal water depths at the bow and stern.
- **By the Bow:** The vessel sits deeper in the water at the bow than the stern.
- **By the Stern:** The vessel sits deeper in the water at the stern than the bow.

Trim affects a vessel's performance, maneuverability, and stability. Proper trim is crucial for optimal efficiency and safe operation.

(b) **Freeboard:** Freeboard is the vertical distance between the waterline and a specific deck on the vessel's side, typically the uppermost continuous deck exposed to weather. It's a safety measure that ensures sufficient buoyancy and prevents excessive wave washing over the deck.

(c) **Camber:** Camber refers to the slight curvature upwards of a ship's deck from the centerline towards the sides. This curvature provides structural strength and helps to shed water overboard. Camber is most noticeable on weather decks exposed to rain and waves.

(d) **Length Between Perpendiculars (LBP):** LBP is the horizontal distance measured along the waterline between the forward perpendicular (FP) and the aft perpendicular (AP). It represents the length of the vessel's underwater hull and is a constant value for a specific ship, independent of the cargo load.

(e) **Length Overall (LOA):** LOA is the horizontal distance between the extreme forward point (usually the stem) and the extreme aft point (usually the rudder post) of the vessel. Unlike LBP, LOA can vary slightly depending on the design of the bow and stern.

(f) **Sheer:** Sheer refers to the longitudinal curvature of a vessel's deck from bow to stern. The deck is typically higher at the bow and stern compared to the midships section. This sheer helps shed water from the deck and improves seakeeping performance in rough seas.

(g) **Stem:** The stem is the forwardmost vertical structure of a vessel that cuts through the water. The shape of the stem can influence the vessel's wave-piercing ability and overall hydrodynamic efficiency.

(h) **Draft Marks:** Draft marks are permanent markings on the port and starboard sides of the vessel amidships. These markings indicate the depth of the vessel's underwater hull, with a reference line corresponding to the vessel's unloaded draft (sometimes called "light ship draft"). Additional markings may indicate different draft depths based on the vessel's load condition.

(i) **Draft:** Draft is the vertical distance between the waterline and the bottom of the vessel's keel. It represents the depth of the vessel underwater and is influenced by the vessel's weight and cargo load. A deeper draft indicates a heavier loaded vessel.

(j) **Depth:** Depth, in this context, refers to the overall vertical distance from the water surface to the seabed. It's a crucial measurement for navigation to avoid grounding the vessel on underwater obstacles. Draft should always be considered when determining safe navigation depth.

jan 2021

29 January 2021

10. (a) State the meaning of EACH of the following terms in relation to a vessel's size:

(i) gross tonnage; (2)

(ii) net tonnage; (1)

(iii) lightweight; (2)

(iv) deadweight; (2)

(v) displacement. (2)

(b) State the relationship between Lightweight, Deadweight and Displacement. (1)

aug 2020

Aug 2020

10. (a) State the meaning of EACH of the following terms in relation to a vessel's size:

(i) gross tonnage; (2)

(ii) net tonnage; (1)

(iii) lightweight; (2)

(iv) deadweight; (2)

(v) displacement. (2)

(b) State the relationship between Lightweight, Deadweight and Displacement. (1)

# Vessel Size Terminology:

(a) Here's a breakdown of the terms related to a vessel's size:

(i) **Gross Tonnage (GT):** This is a dimensionless unit that represents the total enclosed volume of a vessel. It's calculated based on a formula that considers the volume of all permanent enclosed spaces of the ship in cubic feet, divided by 100. While not a measure of weight, it provides a general indication of a vessel's overall size.

(ii) **Net Tonnage (NT):** This is another dimensionless unit derived from the gross tonnage. It represents the usable cargo space within the vessel, after accounting for areas dedicated to crew accommodation, machinery spaces, navigation, and propulsion. A larger difference between GT and NT indicates a higher proportion of space dedicated to cargo.

(iii) **Lightweight (LW):** This refers to the weight of the vessel itself, excluding cargo, fuel, passengers, crew, and any stores or provisions onboard. It includes the weight of the hull, superstructure, machinery, equipment, and permanent fixtures.

(iv) **Deadweight (DWT):** This is the weight carrying capacity of a vessel. It's calculated by subtracting the lightweight from the displacement. In simpler terms, it's the maximum weight of cargo, fuel, passengers, crew, and stores that a vessel can safely carry.

(v) **Displacement (DIS):** This refers to the total weight of water displaced by the vessel when floating at a specific trim and draft. In simpler terms, it's the weight of water the vessel pushes aside to float. Displacement is equal to the total weight of the vessel (lightweight) plus the weight of everything onboard (cargo, fuel, passengers, crew, and stores).

**(b) Relationship Between Lightweight, Deadweight, and Displacement:**

These terms are interrelated and form a critical equation for understanding a vessel's weight and carrying capacity:

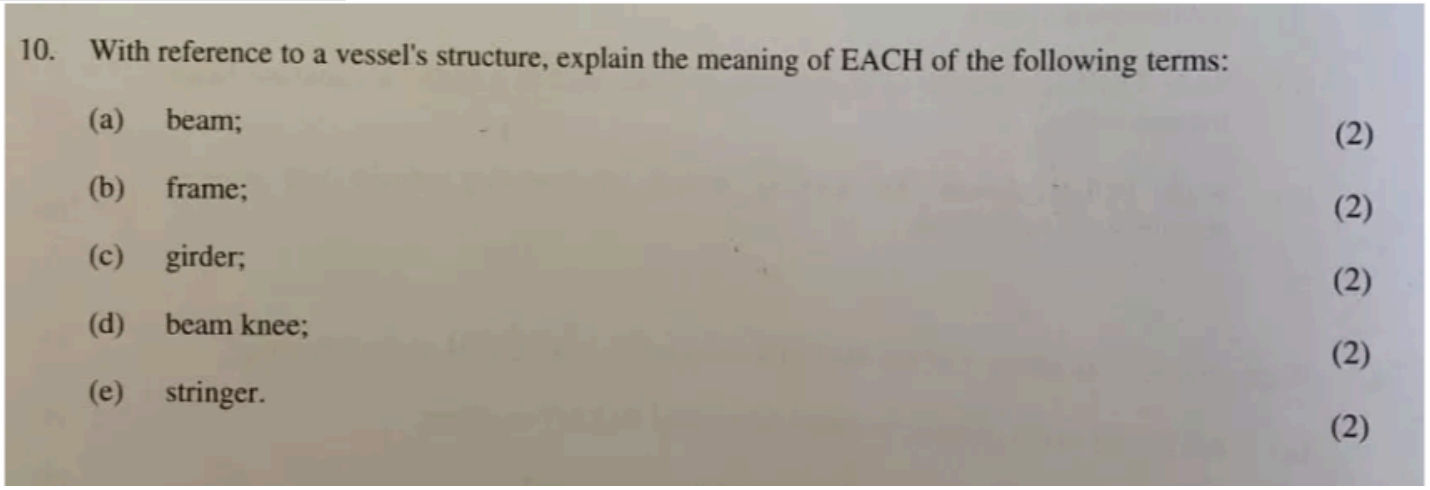
**Displacement (DIS) = Lightweight (LW) + Deadweight (DWT)**

- **Displacement:** Represents the total weight of the vessel and everything onboard.
- **Lightweight:** The weight of the empty vessel itself.
- **Deadweight:** The maximum weight the vessel can carry (cargo, fuel, etc.).

Knowing a vessel's displacement and lightweight allows you to calculate its deadweight capacity. This information is crucial for loading cargo safely and ensuring the vessel remains within its operational limits.

june 2021

June 2021



10. With reference to a vessel's structure, explain the meaning of EACH of the following terms:

(a) beam; (2)

(b) frame; (2)

(c) girder; (2)

(d) beam knee; (2)

(e) stringer. (2)

april 2021

April 2021

10. With reference to a vessel's structure, explain the meaning of EACH of the following terms:

(a) beam; (2)

(b) frame; (2)

(c) girder; (2)

(d) beam knee; (2)

(e) stringer. (2)

## Ship's Structural Components:

Here's a breakdown of the key structural components of a vessel:

(a) **Beam:** The beam refers to a horizontal transverse structural member that supports the decks and bulkheads. It spans across the width of the vessel, providing lateral strength and rigidity to the hull. Beams are typically made of steel and can be various shapes depending on the vessel's size and design.

(b) **Frame:** Frames are vertical members that run transversely (across the width) of the vessel, forming the ribs of the hull. They are connected to the keel and the deck beams, providing longitudinal strength and shaping the vessel's hull. Frames are typically made of steel profiles like flanged plates or angles.

(c) **Girder:** A girder is a longitudinal (fore-and-aft) structural member that provides increased strength and stiffness in areas of high stress concentration. Girders can be located at the deck level (deck girders), along the bottom of the vessel (keel girder), or vertically (bulkhead stiffeners). They are often larger and more robust than regular beams or frames.

(d) **Beam Knee:** A beam knee is a bracket-shaped reinforcement used at the connection point between a beam and a frame. It provides additional support and distributes the load more evenly between the two members. Beam knees are particularly important in areas where the beams experience high bending forces.

(e) **Stringer:** Stringers are longitudinal structural members attached to the side shell plating (the outer hull plating) of the vessel. They can be located on the inside or outside of the plating and help to reinforce it against longitudinal bending and buckling forces. Stringers can be made from various materials like steel bars, sections, or extruded profiles.

march 2021

March 21

10. Explain the meaning and purpose of EACH of the following terms:

(a) flare; (2)

(b) bulwark; (2)

(c) coaming; (2)

(d) freeing port; (2)

(e) scupper. (2)

# Ship's Features and Openings:

Here's a breakdown of the meaning and purpose of each term related to a ship's features and openings:

(a) **Flare:** Flare refers to the outward inclination of a ship's side shell plating above the waterline, particularly towards the bow. This outward angle serves several purposes:

- **Improved Buoyancy:** The flare helps to increase buoyancy at the bow, preventing excessive water ingress during head-on seas.
- **Reduced Wave Impact:** The angle deflects waves outwards, minimizing water washing over the deck and improving weather handling.
- **Stability Enhancement:** The wider beam at the waterline created by the flare improves initial stability, helping the vessel resist rolling motions.

(b) **Bulwark:** A bulwark is a vertical extension above the weather deck along the sides of the vessel. It's essentially a wall that provides safety and security for personnel onboard by preventing falls overboard. Bulwarks can be solid structures made of steel plates or railings with vertical supports.

(c) **Coaming:** A coaming is a raised edge around an opening on a deck, such as a hatchway, skylight, or ventilation opening. The purpose of the coaming is to:

- **Prevent Water Ingress:** The raised edge helps to channel water away from the opening, minimizing the risk of water ingress during rain or rough seas.
- **Provide Structural Support:** Coamings can add strength and rigidity to the deck around the opening.

(d) **Freeing Port:** A freeing port is an opening in the bulwark or side shell plating located below the level of the weather deck. These openings allow water that accumulates on deck to drain overboard and prevent the deck

from becoming flooded. Freeing ports are particularly important on working decks exposed to weather conditions.

(e) **Scupper:** A scupper is a small drainage channel located on a deck that leads to a freeing port or drainage pipe. Scuppers help to drain water that accumulates on decks, particularly from rain or washing down operations. Proper scupper placement is crucial to ensure efficient water drainage and prevent water pooling on decks.

aug 2021

# Aug 2021

10. Explain the meaning of EACH of the following terms:

(a) LOA; (2)

(b) displacement; (2)

(c) load line; (2)

(d) draught; (2)

(e) breadth. (2)

**(a) LOA (Length Overall):** This refers to the horizontal distance between the extreme forward point (usually the stem) and the extreme aft point (usually the rudder post) of the vessel. It represents the total length of the vessel.

**(b) Displacement:** Displacement refers to the total weight of water displaced by the vessel when floating at a specific trim and draft. In simpler terms, it's the weight of water the vessel pushes aside to float. Displacement is equal to the total weight of the vessel itself (lightweight) plus the weight of everything onboard (cargo, fuel, passengers, crew, and stores).

**(c) Load Line (Plimsoll Mark):** The load line is a series of markings etched on the side of a vessel amidships. These markings indicate the maximum safe draft a vessel can have under different loading conditions (e.g., freshwater, saltwater, summer, winter). Exceeding the load line draft can compromise the vessel's stability and seaworthiness.

**(d) Draught (Draft):** Draft is the vertical distance between the waterline and the bottom of the vessel's keel. It represents the depth of the vessel underwater and is influenced by the vessel's weight and cargo load. A deeper draft indicates a heavier loaded vessel.

**(e) Breadth:** Breadth, also commonly referred to as beam, refers to the horizontal transverse width of a vessel at its widest point. It represents the width of the vessel and is an important factor for stability and cargo capacity.

# Sept 2020

10. With reference to the construction of a vessel, state the meaning of EACH of the following terms:

(a) sheer; (2)

(b) freeboard; (2)

(c) moulded depth; (2)

(d) moulded draft; (2)

(e) flare. (2)

Here's a breakdown of the terms related to a vessel's construction and shape:

(a) **Sheer:** Sheer refers to the longitudinal curvature of a vessel's deck from bow to stern. The deck is typically higher at the bow and stern compared to the midships section. This curvature provides several benefits:

- **Improved Buoyancy:** The higher sheer at the bow helps to shed water and prevent excessive wave washing over the deck in rough seas.
- **Enhanced Drainage:** The slope of the sheer helps to drain water overboard more effectively.
- **Strength Considerations:** In some cases, a slight sheer can improve the longitudinal strength of the hull.

(b) **Freeboard:** Freeboard is the vertical distance between the waterline and a specific deck on the vessel's side, typically the uppermost continuous deck exposed to weather. It's a safety measure that ensures sufficient buoyancy and prevents excessive wave washing over the deck. Regulations specify minimum freeboard requirements based on factors like vessel type, size, and operating area.

(c) **Moulded Depth:** Moulded depth refers to the vertical distance between the keel (lowest point of the hull) and the uppermost deck (typically the main deck) measured at the vessel's side amidships. It's a measurement of the hull's depth excluding any external appendages like bulwarks or fenders. Moulded depth is a fixed dimension specific to a vessel design.

(d) **Moulded Draft:** Moulded draft is the vertical distance between the keel (lowest point of the hull) and the waterline measured amidships. It's a measurement of the vessel's depth underwater excluding external appendages. Unlike moulded depth, moulded draft is not fixed and changes based on the vessel's weight and cargo load (resulting in a deeper draft).

(e) **Flare:** Flare refers to the outward inclination of a ship's side shell plating above the waterline, particularly towards the bow. This outward angle serves several purposes:

- **Improved Buoyancy:** The flare helps to increase buoyancy at the bow, preventing excessive water ingress during head-on seas.
- **Reduced Wave Impact:** The angle deflects waves outwards, minimizing water washing over the deck and improving weather handling.
- **Stability Enhancement:** The wider beam at the waterline created by the flare improves initial stability, helping the vessel resist rolling motions.

# 29 January 2021

8. Explain EACH of the following types of motion:

(a) roll; (2)

(b) pitch; (2)

(c) yaw; (2)

(d) surge; (2)

(e) heave. (2)

A ship experiences six main types of motion as it travels through water. Here's a breakdown of each:

(a) **Roll:** Roll is a rotational motion where the vessel tilts from side to side about its longitudinal axis. Imagine a seesaw pivoting in the center. Roll motion can be caused by wave action or uneven cargo distribution. Excessive rolling can be uncomfortable for passengers and can affect cargo stability.

(b) **Pitch:** Pitch is a rotational motion where the vessel bobs up and down about its transverse axis. Imagine a seesaw pivoting at the ends. Pitching motion is caused by encountering waves. The bow rises and falls as it encounters wave crests and troughs.

(c) **Yaw:** Yaw is a rotational motion where the vessel turns about its vertical axis. Imagine a spinning top. Yawing motion is caused by rudder movement or external forces like wind or current. It's the primary way a ship changes direction.

(d) **Surge:** Surge is a linear motion where the entire vessel moves forwards or backwards along its longitudinal axis. Imagine a car moving forward or backward in a straight line. Surge is primarily caused by the propeller thrust or external forces like wind or current.

(e) **Heave:** Heave is a linear motion where the entire vessel moves vertically up and down. Imagine a bobbing cork. Heave motion is caused by waves lifting and lowering the entire vessel. Heave can be particularly noticeable in heavy seas.

# Sept 2020

3. With reference to the use of Oily Water Bilge Separators, explain the meaning of EACH of the following terms:

(a) turbulent flow; (2)

(b) emulsion; (2)

(c) maximum flow rate; (2)

(d) coalescence; (2)

(e) interface. (2)

In the context of oily water separators (OWS) used on ships, here's a breakdown of the terminology:

(a) **Turbulent Flow:** Turbulent flow refers to a chaotic and irregular fluid motion within the separator. This can occur during the initial influx of oily bilge water and can hinder effective oil-water separation. OWS designs often incorporate features to minimize turbulence and promote laminar flow (smooth, ordered flow) for optimal separation.

(b) **Emulsion:** An emulsion is a mixture of two immiscible (non-mixing) liquids. In an OWS, the emulsion refers to the bilge water, which is a mixture of oil and water. Oil and water don't naturally form a stable solution and tend to separate. However, in bilge water, wave action and other factors can create a stable emulsion where the oil particles are dispersed throughout the water in tiny droplets. This emulsion makes separation more difficult.

(c) **Maximum Flow Rate:** The maximum flow rate of an OWS refers to the highest rate of oily bilge water that the separator can process effectively and still meet regulatory discharge limits for oil content. Exceeding the maximum flow rate can compromise the separation efficiency and result in oily water discharge exceeding regulations.

(d) **Coalescence:** Coalescence refers to the process of small oil droplets in an emulsion coming together to form larger oil droplets. This process is crucial for effective oil-water separation in OWS. OWS often employ coalescing media or plates that promote coalescence by providing surfaces for oil droplets to collide and merge. Larger oil droplets are easier to separate from the water due to the difference in density.

(e) **Interface:** The interface refers to the boundary between the two separated liquids within the OWS - the treated water (bottom layer) and the oil (top layer). OWS designs aim for a clear and distinct interface to facilitate efficient separation and removal of the oil layer. Sensors within the OWS often monitor the interface level to ensure proper operation and prevent oil carryover in the discharged water.

# Oct 2018

6. With reference to Marine Air Conditioning Systems, explain EACH of the following expressions:

(a) wet bulb temperature (2)

(b) dry bulb temperature; (2)

(c) comfort zone; (2)

(d) psychrometric chart; (2)

(e) relative humidity. (2)

In the context of Marine Air Conditioning Systems, these terms are all related to understanding air properties and creating a comfortable environment:

(a) **Wet Bulb Temperature (WBT):** This is the temperature measured by a thermometer wrapped in a wet cloth with air flowing over it. As the water evaporates, it cools the thermometer. The wet bulb temperature represents the **lowest temperature achievable by evaporative cooling** under the existing air conditions. Marine air conditioning systems often use wet bulb temperature as a reference point for dehumidification needs.

(b) **Dry Bulb Temperature (DBT):** This is the **actual air temperature** measured by a standard thermometer. It represents the sensible heat content of the air, independent of moisture content. Both dry bulb and wet bulb temperatures are used to characterize the air conditions and determine the cooling and dehumidification requirements of a marine air conditioning system.

(c) **Comfort Zone:** This is the range of **dry bulb and wet bulb temperatures considered comfortable for most people**. The specific comfort zone can vary slightly depending on individual preferences and activity levels. Marine air conditioning systems aim to maintain the cabin air within this comfort zone for optimal passenger and crew well-being.

(d) **Psychrometric Chart:** This is a graphical representation of the **relationship between dry bulb temperature, wet bulb temperature, relative humidity, and enthalpy (total heat content) of air**. Psychrometric charts are valuable tools for HVAC (Heating, Ventilation, and Air Conditioning) engineers to design and operate air conditioning systems effectively. They allow visualization of the cooling and dehumidification processes and selection of appropriate equipment settings to achieve desired comfort conditions.

(e) **Relative Humidity (RH):** This is a measure of the **amount of water vapor present in the air compared to the maximum amount the air can hold at a specific temperature**. Expressed as a percentage, relative humidity affects how comfortable people feel. High relative humidity makes the air feel muggy and can impede evaporative cooling mechanisms of the human body. Marine air conditioning systems often control dehumidification to maintain a comfortable relative humidity level within the cabin.

# May 2021

10. With reference to ocean going vessels, define EACH of the following:

(a) trim; (1)

(b) freeboard; (1)

(c) camber; (1)

(d) length between perpendiculars; (1)

(e) length overall; (1)

(f) sheer; (1)

(g) stem; (1)

(h) draft marks; (1)

(i) draft; (1)

(j) depth; (1)

(a) **Trim:** The longitudinal balance of a vessel. It refers to the difference in water depth at the bow (forward) and stern (aft) perpendiculars.

- **Even Trim:** The vessel floats level with equal water depths at bow and stern.
- **By the Bow:** The vessel sits deeper in the water at the bow than the stern.
- **By the Stern:** The vessel sits deeper in the water at the stern than the bow.

(b) **Freeboard:** The vertical distance between the waterline and a specific deck on the vessel's side, typically the uppermost continuous deck exposed to weather. It's a safety measure ensuring sufficient buoyancy and preventing excessive wave washing over the deck.

(c) **Camber:** The slight upward curvature of a ship's deck from the centerline towards the sides. This curvature provides structural strength and helps shed water overboard.

(d) **Length Between Perpendiculars (LBP):** The horizontal distance measured along the waterline between the forward perpendicular (FP) and the aft perpendicular (AP). It represents the length of the vessel's underwater hull and is a constant value for a specific ship.

(e) **Length Overall (LOA):** The horizontal distance between the extreme forward point (usually the stem) and the extreme aft point (usually the rudder post) of the vessel. Unlike LBP, LOA can vary slightly depending on the design of the bow and stern.

(f) **Sheer:** The longitudinal curvature of a vessel's deck from bow to stern. The deck is typically higher at the bow and stern compared to the midships section. This curvature helps shed water, improves seakeeping, and can offer some structural benefits.

(g) **Stem:** The forwardmost vertical structure of a vessel that cuts through the water. The shape of the stem can influence wave-piercing ability and overall hydrodynamic efficiency.

(h) **Draft Marks:** Permanent markings on the port and starboard sides of the vessel amidships. These markings indicate the depth of the vessel's underwater hull, with a reference line corresponding to the unloaded draft (sometimes called "light ship draft"). Additional markings may indicate different draft depths based on the vessel's load condition.

(i) **Draft:** The vertical distance between the waterline and the bottom of the vessel's keel. It represents the depth of the vessel underwater and is influenced by the vessel's weight and cargo load. A deeper draft indicates a heavier loaded vessel.

(j) **Depth:** In this context, refers to the overall vertical distance from the water surface to the seabed. It's a crucial measurement for navigation to avoid grounding the vessel on underwater obstacles. Draft should always be considered when determining safe navigation depth.