OCEANS AND LIFE

Class 09 - Social Science (Understanding Society)

Time Allowed: 1 hour and 27 minutes **Maximum Marks: 165**

1. What percentage of global trade is carried by sea? **[1]**

   a) Exactly 75 percent
   b) More than 80 percent
   c) Approximately 60 percent
   d) Less than 50 percent

2. What are the long, narrow, and extremely deep depressions on the ocean floor, typically associated with convergent plate boundaries? **[1]**

   a) Seamounts
   b) Rift valleys
   c) Oceanic trenches
   d) Submarine canyons

3. Which international body is primarily responsible for developing and overseeing international maritime regulations, and where is it headquartered? **[1]**

   a) International Labour Organisation (ILO), Geneva
   b) World Health Organization (WHO), Geneva
   c) International Maritime Organisation (IMO), London
   d) United Nations (UN), New York

4. Which of these marine mineral resources is primarily extracted through evaporation from seawater? **[1]**

   a) Common salt
   b) Natural gas
   c) Petroleum
   d) Manganese nodules

5. What are tropical cyclones called in China? **[1]**

   a) Depressions
   b) Typhoons
   c) Hurricanes
   d) Willy-willies

6. What is a primary reason why middlemen often control pricing for small-scale fishermen? **[1]**

   a) Fishermen possess advanced market analysis tools.
   b) Government regulations strictly dictate fixed prices for all seafood transactions.
   c) Middlemen directly participate in the fishing process, earning their share.
   d) Small-scale fishermen often have unequal market access and limited financial power.

7. Which type of buildings are recommended to enter during a tsunami if evacuation to higher ground is not immediately possible? **[1]**

   a) Kachcha houses with thatched roofs
   b) Buildings made with locally available materials

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c) Crowded buildings

d) RCC (reinforced cement concrete) buildings

8. Which international convention is often described as the 'constitution for the oceans' and defines maritime zones such as territorial seas and exclusive economic zones? **[1]**

a) UNCLOS

b) MLC 2006

c) SOLAS

d) MARPOL

9. Which type of wave is commonly caused by underwater earthquakes, volcanic eruptions, or landslides and can cause devastating destruction? **[1]**

a) Wind Waves

b) Swell Waves

c) Storm Surges

d) Tsunamis

10. Which of the following describes polymetallic nodules? **[1]**

a) Structures used to harness energy from ocean waves

b) Large marine mammals found in polar regions

c) Areas where fish farming is intensively practiced

d) Small, round mineral deposits on the deep ocean floor

11. What is the primary atmospheric condition referred to as a cyclone? **[1]**

a) A stable atmospheric condition

b) A sudden increase in temperature

c) High atmospheric pressure

d) Low atmospheric pressure formed in a zone of disturbance

12. What specifically causes tides, leading to the regular rise and fall of sea levels? **[1]**

a) Underwater earthquakes or volcanic eruptions

b) The gravitational pull of the Moon and the Sun

c) Wind blowing across the water surface

d) Differences in temperature and salinity

13. Which of the following is considered a primary marine biological resource crucial for global food security? **[1]**

a) Fisheries

b) Oceanic currents

c) Polymetallic nodules

d) Wind farms

14. Which of the following is NOT classified as a marine biological resource? **[1]**

a) Fish

b) Seaweeds

c) Petroleum

d) Plankton

15. Which of the following is a significant ecological service provided by marine ecosystems? **[1]**

a) Extraction of deep-sea minerals

b) Development of coastal real estate

c) Regulation of global climate patterns

d) Production of commercial shipping vessels

16. What type of energy harnesses the rise and fall of tides? **[1]**

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a) Tidal energy

b) Ocean Thermal Energy Conversion (OTEC)

c) Offshore wind energy

d) Wave energy

17. Identify the oceanic movement primarily responsible for transferring energy across the sea surface without significantly moving water masses from one place to another. **[1]**

a) Tides

b) Oceanic currents

c) Thermohaline circulation

d) Waves

18. If surface ocean currents in the Northern Hemisphere are observed to be consistently deflected to the right, which geophysical phenomenon is primarily responsible for this effect? **[1]**

a) Earth's rotation (Coriolis effect)

b) Continental landmasses

c) Temperature and salinity variations

d) Gravitational pull of the Moon

19. Oceanic plateaus are characterized as large elevated areas on the ocean floor, often formed by what geological process? **[1]**

a) Subduction at convergent plate boundaries

b) Extensive volcanic eruptions

c) Sediment accumulation from turbidity currents

d) Gravitational pull of the Moon and Sun

20. Which marine resource category includes crustaceans and molluscs while excluding deep-sea mineral deposits? **[1]**

a) Other ocean-based resources

b) Biological resources

c) Energy resources

d) Mineral resources

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21. Match the items in List I with those List II. **[1]**

List I	List II
(A) Seamounts	(I) Ring-shaped reefs surrounding a lagoon
(B) Guyots	(II) Flat-topped seamounts
(C) Atolls	(III) Submerged volcanic mountains
(D) Oceanic Plateaus	(IV) Broader, flatter than mid-ocean ridges

a) A-II, B-III, C-IV, D-I

b) A-IV, B-I, C-III, D-II

c) A-I, B-IV, C-II, D-III

d) A-III, B-II, C-I, D-IV

22. Match the items in List I with those in List II. **[1]**

List I	List II
(A) Marine Biological Resources	(I) Tidal, Wave, OTEC
(B) Marine Mineral Resources	(II) Fisheries, Aquaculture, Medicinal compounds
(C) Marine Energy Resources	(III) Petroleum, Manganese nodules, Common salt
(D) Other Marine Resources	(IV) Trade routes, Tourism, Climate regulation

a) A-IV, B-II, C-III, D-I
b) A-I, B-IV, C-II, D-III
c) A-II, B-III, C-I, D-IV
d) A-III, B-I, C-IV, D-II

23. Match the items in List I with those in List II. **[1]**

List I	List II
(A) Flag states	(I) Coordinate inspections
(B) Port State Control	(II) Compensation for oil incidents
(C) Paris MoU	(III) Ship registration and compliance
(D) CLC/IOPC Fund	(IV) Verify international conventions

a) A-I, B-II, C-III, D-IV
b) A-II, B-I, C-IV, D-III
c) A-III, B-IV, C-I, D-II
d) A-IV, B-III, C-II, D-I

24. Match the items in List I with those in List II. **[1]**

List I	List II
(A) Livelihood issue	(I) Regulated fishing, MPAs
(B) Environmental threat	(II) Storms, Accidents, Long hours
(C) Policy solution	(III) Overfishing, Unequal market access
(D) Occupational hazard	(IV) Plastic waste, Oil spills

a) A-III, B-IV, C-I, D-II
b) A-IV, B-III, C-II, D-I
c) A-I, B-II, C-III, D-IV
d) A-II, B-I, C-IV, D-III

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25. Match the items in List I with those in List II. **[1]**

List I	List II
(A) Structural Mitigation	(I) Coastal shelter belt plantations
(B) Non-Structural Mitigation	(II) Built on stilts or earth mounds
(C) Cyclone proof structures	(III) Hazard mapping
(D) Plant shelter belts	(IV) Wind and water resistant

a) A-IV, B-I, C-II, D-III
b) A-I, B-II, C-III, D-IV
c) A-II, B-III, C-IV, D-I
d) A-III, B-I, C-II, D-IV

26. **Statement I:** The National Hurricane Center at Miami, Florida, is responsible for monitoring earthquakes globally. **[1]**
Statement II: The Indian Meteorological Department primarily focuses on issues arising out of cold waves and snow, not cyclones.

a) Both Statement I and Statement II are false
b) Statement I is false but Statement II is true
c) Both Statement I and Statement II are true
d) Statement I is true but Statement II is false

27. **Statement I:** Climate change, including rising sea temperatures, can lead to coral bleaching and changes in fish migration routes. **[1]**
Statement II: Overfishing by large commercial trawlers has no significant impact on the livelihoods of small-scale fishermen due to market segmentation.

a) Both Statement I and Statement II are false
b) Statement I is true but Statement II is false
c) Statement I is false but Statement II is true
d) Both Statement I and Statement II are true

28. **Statement I:** Tidal energy is a marine energy resource derived from the movement of surface waves. **[1]**
Statement II: Ocean Thermal Energy Conversion (OTEC) uses the temperature difference between warm surface water and cold deep water to generate electricity.

a) Both Statement I and Statement II are false
b) Both Statement I and Statement II are true
c) Statement I is true but Statement II is false
d) Statement I is false but Statement II is true

29. **Statement I:** The gravitational pull of the Moon is the sole cause of tides, with no other celestial bodies having a significant impact. **[1]**
Statement II: Spring tides occur when the Sun, Moon, and Earth form a right angle, resulting in the smallest tidal range.

a) Statement I is true but Statement II is false
b) Both Statement I and Statement II are false
c) Statement I is false but Statement II is true
d) Both Statement I and Statement II are true

30. **Statement I:** Waves primarily transfer water from one geographic location to another, shaping coastlines through this mass movement. **[1]**
Statement II: Ocean currents, unlike waves, involve the actual movement of water masses and are crucial for global heat distribution.

a) Statement I is false but Statement II is true
b) Both Statement I and Statement II are true
c) Statement I is true but Statement II is false
d) Both Statement I and Statement II are false

31. **Assertion (A):** Tsunamis are generated by strong winds blowing across the ocean surface. **[1]**
Reason (R): Waves are the rhythmic up-and-down movements of ocean water.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

32. **Assertion (A):** Deep-sea mining technology is still developing for polymetallic nodules. **[1]**
Reason (R): These nodules represent a valuable future resource with metals like manganese and

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nickel.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

33. **Assertion (A):** Continental shelves are productive fishing grounds. **[1]**
Reason (R): Sunlight penetrates these shallow waters, supporting plankton growth.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

34. **Assertion (A):** The MLC 2006 aims to protect seafarers' welfare globally. **[1]**
Reason (R): It sets minimum standards for working conditions, accommodations, and wages for seafarers.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

35. **Assertion (A):** Ocean trenches play a crucial role in recycling oceanic crust. **[1]**
Reason (R): They are formed at divergent plate boundaries where new crust emerges.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

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36. What are the primary classifications of marine resources? **[2]**
37. Explain how climate change impacts the livelihoods of fishing communities. **[2]**
38. Name two types of marine energy resources and describe how each generates power. **[2]**
39. Which policy measures can governments implement to reduce tsunami vulnerability in coastal regions? **[2]**
40. How does tectonic plate movement contribute to the generation of tsunamis? **[2]**
41. Which public health dangers commonly arise after a severe cyclone? **[2]**
42. Explain the significance of the 'flag state' and 'port state control' mechanisms in upholding global maritime standards. **[2]**
43. What measures can be implemented to ensure the sustainable management of marine resources and address livelihood concerns? **[2]**
44. Which two non-structural mitigation measures can enhance cyclone preparedness? **[2]**
45. Discuss the significance of marine biological resources for global food security and medical research. **[2]**
46. What does 'vulnerability' mean in the context of a cyclone? **[2]**
47. What core functions are served by international maritime rules and regulations in global shipping? **[2]**
48. Discuss the primary causes and resultant characteristics of tsunamis and storm surges, highlighting their destructive potential. **[2]**
49. How do wind-driven and density-driven ocean currents differ in their formation and typical **[2]**

locations within the ocean water column?

50. Explain the primary mechanisms through which the Moon and the Sun influence oceanic water levels, detailing the resultant tidal variations. **[2]**

51. Explain how disturbances to marine ecosystems, such as coral bleaching, impact the economic security of communities reliant on marine resources. **[3]**

52. How do large bodies of water, like oceans, influence global weather patterns and the distribution of living organisms? **[3]**

53. Describe the primary geological processes that lead to the formation of tsunamis, distinguishing between the direct and indirect causes of underwater disturbances. **[3]**

54. Describe how the principles of SOLAS contribute to averting maritime casualties and safeguarding life at sea. **[3]**

55. How do large-scale marine industrial developments, such as offshore drilling or deep-sea mining, create economic disparities and social conflicts within coastal regions? **[3]**

56. Explain how the topography beneath the ocean surface can impact marine ecosystems and the availability of natural resources. **[3]**

57. Describe how the seasonal cycle influences the predictability and onset of cyclones, and what observational cues can indicate an impending event. **[3]**

58. Explain the significance of UNCLOS in defining the legal boundaries and responsibilities within ocean environments for various nations. **[3]**

59. Discuss the various mechanisms through which marine pollution affects both the environmental sustainability and socio-economic well-being of coastal populations. **[3]**

60. Identify and explain three distinct ways in which coastal communities and maritime industries are particularly vulnerable to cyclones, beyond general property damage. **[3]**

61. **Read the given source carefully and answer the questions that follow:** **[4]**

Ocean water is constantly moving through waves, tides, and currents. Waves are generated mainly by winds blowing across the sea surface and transfer energy without moving large amounts of water. As waves approach shallow coastal regions, they slow down and eventually break, shaping coastlines through erosion and deposition. Tides are the regular rise and fall of sea levels caused mainly by the gravitational pull of the Moon and, to a lesser extent, the Sun. During full moon and new moon phases, spring tides occur and produce the greatest tidal range. Ocean currents are large streams of water moving continuously in specific directions. Surface currents are driven mainly by winds, while deep-water currents result from temperature and salinity differences. Warm currents raise the temperature of nearby coastal regions, while cold currents lower it. Ocean movements influence climate, marine biodiversity, navigation, and fishing activities. They help distribute heat around the globe and support nutrient circulation in marine ecosystems. Together, waves, tides, and currents maintain the dynamic balance of ocean systems and contribute significantly to environmental stability.

Questions:

a. What causes tides? **(1)**

b. What are ocean currents? **(1)**

c. Explain the role of ocean currents in regulating climate. **(2)**

62. **Read the given source carefully and answer the questions that follow:** **[4]**

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Marine ecosystems support millions of people through fishing, tourism, aquaculture, shipping, and other ocean-based activities. However, increasing environmental and economic pressures threaten these livelihoods. Climate change has caused rising sea temperatures, coral bleaching, changing fish migration patterns, and sea-level rise. Pollution from plastics, industrial waste, and oil spills has damaged coastal ecosystems and reduced fish populations. Small-scale fishermen often struggle to compete with large commercial fishing fleets that possess advanced technology and greater financial resources. In many regions, women contribute significantly to fish processing and marketing but receive limited economic recognition. Governments and international organizations promote sustainable solutions such as regulated fishing, marine protected areas, mangrove restoration, aquaculture, eco-tourism, and skill development programmes. Community participation plays a key role in ensuring the success of these initiatives. Sustainable marine resource management not only protects biodiversity but also improves economic opportunities and strengthens the resilience of coastal communities against future environmental challenges.

Questions:

a. What is coral bleaching? **(1)**

b. Name one sustainable solution for protecting marine livelihoods. **(1)**

c. How does climate change affect marine-based livelihoods? **(2)**

63. **Read the given source carefully and answer the questions that follow:** **[4]**

Coastal regions face multiple natural hazards, including cyclones and tsunamis. Although both can cause flooding and destruction, their origins differ significantly. Cyclones are atmospheric storms formed over warm ocean waters, while tsunamis result from sudden disturbances beneath the sea floor. Effective disaster management depends on preparedness, mitigation, and community awareness. Coastal vegetation such as mangroves and shelter belts acts as a natural barrier against strong winds and waves. Building regulations encourage the construction of disaster-resistant structures in hazard-prone areas. Early warning systems provide information about approaching hazards, allowing timely evacuation. Community training programmes help people understand evacuation routes and emergency procedures. Governments also maintain disaster response teams, emergency shelters, and communication networks to improve preparedness. Experiences from major disasters have shown that regions with strong preparedness measures experience lower casualties and faster recovery. Therefore, disaster risk reduction requires cooperation between governments, scientists, local communities, and international organizations to ensure long-term safety and resilience.

Questions:

a. What is one major difference between cyclones and tsunamis? **(1)**

b. What role do mangroves play in disaster mitigation? **(1)**

c. Why is community preparedness important in coastal hazard management? **(2)**

64. **Read the given source carefully and answer the questions that follow:** **[4]**

Marine resources are among the most valuable natural assets available to humanity. Oceans provide biological resources such as fish, crustaceans, seaweeds, and plankton, which support food security and employment. Millions of people depend directly on fisheries for their livelihood. Oceans also contain important mineral resources including petroleum, natural gas,

and polymetallic nodules rich in manganese, nickel, copper, and cobalt. In addition, marine energy resources such as tidal energy, wave energy, and offshore wind power offer sustainable alternatives to fossil fuels. Oceans are equally important for international trade, with more than eighty percent of global trade transported by sea. However, marine resources face serious threats. Overfishing has reduced fish stocks in many regions, while pollution from plastics, industrial waste, and oil spills has damaged marine ecosystems. Climate change has further intensified these challenges by causing coral bleaching, sea-level rise, and changes in fish migration patterns. Sustainable management practices such as regulated fishing, marine protected areas, and pollution control are therefore essential to ensure that marine resources remain available for future generations.

Questions:

a. Name two marine biological resources. **(1)**

b. What are polymetallic nodules? **(1)**

c. Why is sustainable management of marine resources necessary? **(2)**

65. **Read the given source carefully and answer the questions that follow:** **[4]**

Cyclones are powerful atmospheric storms that develop in regions of low pressure where warm and cold air masses interact. Warm air rises while cooler air rushes inward, creating strong rotating winds. Cyclones can cause extensive destruction through high winds, heavy rainfall, flooding, and storm surges. Coastal regions are particularly vulnerable because strong winds and rising sea levels can damage homes, ports, communication networks, and agricultural land. The Indian Meteorological Department uses satellites and weather-monitoring systems to track cyclones and provide advance warnings. Early warning systems allow authorities to evacuate people from vulnerable areas and reduce loss of life. Structural mitigation measures include cyclone-resistant buildings, raised houses, cyclone shelters, embankments, and coastal shelter belts. Non-structural measures include hazard mapping, land-use planning, public awareness programmes, and efficient forecasting systems. The successful implementation of these strategies can significantly reduce disaster impacts. Experience from severe cyclones has shown that preparedness, community participation, and effective communication play vital roles in disaster risk reduction and the protection of lives and property.

Questions:

a. What is a cyclone? **(1)**

b. Name one structural mitigation measure against cyclones. **(1)**

c. Why are early warning systems important in cyclone management? **(2)**

66. Explain how the vastness of oceanic resources contributes to food security, economic development, and environmental regulation globally. **[5]**

67. What is the primary mechanism by which tsunamis are generated, and what geological processes are typically involved? **[5]**

68. What are the key policy measures a nation might implement to reduce vulnerability to tsunamis, following a major disaster? **[5]**

69. Describe the fundamental difference in the movement of water between ocean waves and ocean currents, and explain how each phenomenon contributes uniquely to oceanic processes. **[5]**

70. Analyze the interplay between climate change, pollution, and large-scale marine industrial **[5]**

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activities in exacerbating livelihood challenges for coastal communities. Provide specific examples of how these factors create a synergistic negative impact.

71. Explain the concept of 'vulnerability' in the context of a cyclone disaster by providing specific examples of how different elements (natural and man-made) are affected. **[5]**

72. Evaluate how effective current methods like regulated fishing and marine protected areas are in reducing overfishing and climate change impacts on marine resources and livelihoods, and suggest additional integrated strategies to improve resilience. **[5]**

73. Explain how the gravitational forces from celestial bodies primarily influence the regular rise and fall of sea levels, particularly noting the conditions that lead to the greatest variations. **[5]**

74. Evaluate the comparative effectiveness of early warning systems for tsunamis versus cyclones, considering the nature and onset characteristics of each phenomenon. **[5]**

75. Describe the primary objectives and key provisions of the SOLAS convention in ensuring the safety of maritime operations. **[5]**

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Solution
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1.

(b) More than 80 percent
Explanation:
More than 80 percent of global trade is carried by sea because maritime transport is the most cost-effective and efficient way to move large volumes of goods across long distances. Ships can carry bulk commodities and containerized cargo at lower costs compared to air or land transport, making sea routes the backbone of international trade.

2.

(c) Oceanic trenches
Explanation:
Ocean trenches are characterized as long, narrow, and extremely deep depressions found at convergent plate boundaries where one tectonic plate subducts beneath another.

3.

(c) International Maritime Organisation (IMO), London
Explanation:
The International Maritime Organisation (IMO), a specialised agency of the United Nations headquartered in London, is the primary body responsible for developing and overseeing international maritime regulations.

4. **(a)** Common salt
Explanation:
Common salt is directly obtained from seawater through the process of evaporation in salt pans.

5.

(b) Typhoons
Explanation:
Tropical cyclones are called typhoons in China and the Northwest Pacific region. The same weather phenomenon has different names in different regions: hurricanes in the Atlantic and Northeast Pacific, and cyclones in the Indian Ocean. “Willy-willies” is used in Australia, while “depressions” refer to weaker low-pressure systems, not fully developed cyclones.

6.

(d) Small-scale fishermen often have unequal market access and limited financial power.
Explanation:
Small-scale fishermen often operate with limited resources and lack direct access to broader markets or established distribution channels. This creates a dependency on middlemen, who act as intermediaries and often leverage this position to control pricing, leaving the fishermen with minimal profit even after strenuous labor.

7.

(d) RCC (reinforced cement concrete) buildings
Explanation:
During a tsunami, if immediate evacuation to higher ground is not possible, it is safer to move into strong, multi-storey RCC buildings. These structures are designed to withstand strong water forces better than weak or temporary constructions. Kachcha houses and crowded or weak structures are unsafe and can collapse easily under tsunami impact.

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8. **(a)** UNCLOS
Explanation:
UNCLOS (United Nations Convention on the Law of the Sea) is described as the 'constitution for the oceans' and defines various maritime zones.

9. **(d)** Tsunamis
Explanation:
Tsunamis are massive waves caused by underwater earthquakes, volcanic eruptions, or landslides.

10. **(d)** Small, round mineral deposits on the deep ocean floor
Explanation:
Polymetallic nodules are described as 'small, round mineral deposits found on the deep ocean floor' that contain valuable metals.

11. **(d)** Low atmospheric pressure formed in a zone of disturbance
Explanation:
A cyclone is defined as low atmospheric pressure formed in the zone of disturbance separating masses of cold and warm air.

12. **(b)** The gravitational pull of the Moon and the Sun
Explanation:
Tides are primarily caused by the gravitational pull of the Moon and, to a lesser extent, the Sun.

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13. **(a)** Fisheries
Explanation:
Fisheries are explicitly mentioned as the most important biological resource globally, providing a primary source of protein and contributing to food security.

14. **(c)** Petroleum
Explanation:
Petroleum is a marine mineral resource, not a biological one. Biological resources include living organisms like fish and seaweeds.

15. **(c)** Regulation of global climate patterns
Explanation:
Marine ecosystems are vital in regulating global climate by absorbing carbon dioxide and assisting in heat distribution through ocean currents.

16. **(a)** Tidal energy
Explanation:
Tidal energy is explicitly defined as being generated by harnessing the rise and fall of tides.

17. **(d)** Waves
Explanation:
Waves are defined as the rhythmic up-and-down movements of ocean water that primarily transfer energy, not water, across the sea surface.

18. **(a)** Earth's rotation (Coriolis effect)
Explanation:
The Coriolis effect, a result of Earth's rotation, deflects moving objects, including ocean currents, to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

19. **(b)** Extensive volcanic eruptions
Explanation:
Oceanic plateaus are large elevated areas on the ocean floor, often formed by extensive volcanic eruptions.

20. **(b)** Biological resources
Explanation:
Crustaceans and molluscs are living organisms, thus falling under the category of marine biological resources, which excludes non-living mineral deposits.

21. **(d)** A-III, B-II, C-I, D-IV
Explanation:
Seamounts are underwater volcanic mountains. Guyots are flat-topped seamounts. Atolls are ring-shaped reefs around a lagoon. Oceanic Plateaus are broader and flatter than mid-ocean ridges.

22. **(c)** A-II, B-III, C-I, D-IV
Explanation:
- **(A) Marine Biological Resources → (II)**
  Includes living resources such as **fisheries, aquaculture, medicinal compounds from marine organisms**.
- **(B) Marine Mineral Resources → (III)**
  Includes **petroleum, manganese nodules, common salt**, extracted from the sea.
- **(C) Marine Energy Resources → (I)**
  Includes **tidal energy, wave energy, OTEC (Ocean Thermal Energy Conversion)**.
- **(D) Other Marine Resources → (IV)**
  Includes non-material uses like **trade routes, tourism, climate regulation**.

23. **(c)** A-III, B-IV, C-I, D-II
Explanation:
- **(A) Flag states → (III) Ship registration and compliance**
  Flag states are responsible for **registering ships and ensuring they comply with international rules**.
- **(B) Port State Control → (IV) Verify international conventions**
  Port State Control inspects foreign ships to **ensure compliance with international maritime conventions**.
- **(C) Paris MoU → (I) Coordinate inspections**
  The Paris MoU is a **regional agreement coordinating port state inspections**.
- **(D) CLC/IOPC Fund → (II) Compensation for oil incidents**
  This system provides **compensation for oil pollution damage from tankers**.

24. **(a)** A-III, B-IV, C-I, D-II
Explanation:

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Overfishing and unequal market access are livelihood issues. Plastic waste and oil spills represent environmental threats. Policy solutions include regulated fishing and marine protected areas (MPAs). Storms, boat accidents, and long working hours are occupational hazards for fishermen.

25.

(c) A-II, B-III, C-IV, D-I

Explanation:

- **(A) Structural Mitigation → (II) Built on stilts or earth mounds:** Structural mitigation involves physical construction or engineering modifications to reduce hazard risks. Elevating buildings on stilts or mounds directly alters the structure to prevent flood or storm surge damage.
- **(B) Non-Structural Mitigation → (III) Hazard mapping:** Non-structural mitigation focuses on policies, awareness, and planning rather than physical building. **Hazard mapping** is a planning tool used to identify high-risk zones without constructing physical barriers.
- **(C) Cyclone proof structures → (IV) Wind and water resistant:** By definition, a cyclone-proof building must be engineered to withstand the extreme **winds and heavy water/flooding** associated with a tropical cyclone.
- **(D) Plant shelter belts → (I) Coastal shelter belt plantations:** Shelter belts are rows of trees or shrubs planted to act as windbreaks. In coastal regions, **shelter belt plantations** (like mangroves or casuarina trees) reduce the devastating impact of cyclones and tsunamis.

26. **(a)** Both Statement I and Statement II are false

Explanation:

Statement I is false because the National Hurricane Center monitors cyclones globally. Statement II is false because the Indian Meteorological Department is concerned with issues arising out of cyclones, among other weather conditions.

27.

(b) Statement I is true but Statement II is false

Explanation:

Statement I is true; the text explicitly states that rising sea temperatures cause coral bleaching and changes in ocean currents shift fish migration routes. Statement II is false; the text mentions that large commercial trawlers exploit marine stocks excessively, reducing fish populations and directly threatening the income and food security of small-scale fishermen.

28.

(d) Statement I is false but Statement II is true

Explanation:

Statement I is false because tidal energy is generated by harnessing the rise and fall of tides, not surface waves. Wave energy is generated by surface waves. Statement II is true as OTEC indeed uses temperature differences between warm surface water and cold deep water.

29.

(b) Both Statement I and Statement II are false

Explanation:

Statement I is false because the Sun also contributes to tides, though to a lesser extent than the Moon. Statement II is false because spring tides occur when the Sun, Moon, and Earth are aligned, resulting in the greatest tidal range. Neap tides occur when they form a right angle, resulting in the smallest tidal range.

30. **(a)** Statement I is false but Statement II is true

Explanation:

Statement I is false because waves primarily transfer energy, not large amounts of water. Statement II is true as ocean currents involve the actual movement of water masses and are vital for regulating

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global climate by distributing heat.

31. **(d)** A is false but R is true.
Explanation:
Tsunamis are caused by seismic events, not wind. Reason R accurately defines waves, but it does not make A true or provide an explanation for it.

32. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation:
    - **Assertion (A) is true:**
      Deep-sea mining technology is still in the **development and experimental stage**, especially for extracting **polymetallic nodules** from the ocean floor.
    - **Reason (R) is true:**
      Polymetallic nodules contain valuable metals like **manganese, nickel, cobalt, and copper**, making them an important **future resource**.
    - **R correctly explains A:**
      Because these nodules are valuable, there is ongoing research and technological development to extract them efficiently.

33. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation:
Continental shelves are rich in marine life because sunlight penetration supports abundant plankton, which forms the base of the food chain for fish.

34. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation:
The MLC 2006, referred to as the 'seafarers' bill of rights', indeed aims to protect seafarers' welfare globally by setting minimum standards for various working conditions, directly explaining A.

35. **(c)** A is true but R is false.
Explanation:
Trenches recycle crust via subduction, but they form at convergent, not divergent, plate boundaries.

36. Marine resources are primarily classified into biological, mineral, energy, and other resources. Biological resources include fish, seaweeds, and marine organisms. Mineral resources include petroleum, natural gas, and polymetallic nodules. Energy resources include tidal, wave, and ocean thermal energy. Other resources include transport routes, tourism, and climate regulation services provided by oceans.
37. Climate change affects fishing communities by altering ocean temperatures, shifting fish migration patterns, and reducing fish stock availability. Rising sea levels and stronger cyclones damage coastal infrastructure and homes. Ocean acidification harms marine ecosystems like coral reefs. These changes reduce catch, income stability, and increase vulnerability, forcing communities to adapt or relocate.
38. Tidal energy is generated by harnessing the periodic rise and fall of sea levels caused by the gravitational pull of the Moon and Sun, driving turbines. Wave energy converts the motion of surface waves, driven by wind, into electricity using floating or shoreline devices. Both provide renewable ocean-based power with low emissions.
39. Governments can:
    - **Join international warning networks:** Collaborating with other nations for shared early warning systems to receive and disseminate timely alerts.
    - **Strengthen building codes:** Enforcing strict construction standards in coastal areas to ensure structures can withstand tsunami impacts and promoting elevated construction.
40. Tsunamis are primarily generated by large-scale displacement of the seafloor, often caused by underwater earthquakes resulting from tectonic plate movement. When one plate suddenly slips beneath another (subduction) or moves horizontally, it displaces a massive volume of ocean water, initiating powerful tsunami waves that propagate across the ocean.

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41. Two distinct dangers to public health post-cyclone are:
    - **Spread of infectious diseases:** Violent winds can carry viral infections, and compromised sanitation systems lead to outbreaks like malaria and diarrhea.
    - **Contaminated water sources:** Flooding often contaminates drinking water supplies, increasing the risk of waterborne illnesses.
42. Flag states ensure ships registered under their jurisdiction comply with international conventions on safety, pollution control, and labor standards. Port State Control allows inspection of foreign ships in ports to verify compliance and detain non-compliant vessels. Together, they enforce global maritime regulations, improving safety, security, and environmental protection at sea.
43. Sustainable marine resource management includes enforcing regulated fishing limits, banning destructive practices, and establishing marine protected areas. Promoting sustainable aquaculture, reducing pollution, and conserving coastal ecosystems like mangroves also help. Diversifying livelihoods through tourism and skill development supports fishing communities. International cooperation and climate adaptation strategies further ensure long-term ecological balance and income security.
44. Two non-structural mitigation measures are:
    - **Hazard mapping:** Identifying and delineating areas most vulnerable to cyclones based on historical data and geographical features, aiding in targeted preparedness.
    - **Early warning systems:** Utilizing advanced technology like satellites to forecast cyclone paths and issue timely warnings, allowing for evacuation and community readiness.
45. Marine biological resources like fish, seaweeds, and plankton are vital for global food security as they provide a major source of protein for millions worldwide. They also support livelihoods in coastal regions. In medical research, marine organisms yield bioactive compounds used in antibiotics, anti-cancer drugs, and other pharmaceuticals, advancing healthcare and innovation.
46. Vulnerability refers to the susceptibility of entities to the destructive forces of a cyclone. Examples include:
    - **Coastal infrastructure:** Buildings, ports, and structures are easily damaged by wind and storm surges.
    - **Maritime activities:** Ships, fishing boats, and their crews are at great risk at sea.
    - **Populations:** People with physical infirmities or those in low-lying areas are highly vulnerable.
47. International maritime rules and regulations facilitate crucial aspects of global shipping. They ensure the safety of vessels and personnel, bolster security against threats, protect the marine environment from pollution, and enable the smooth conduct of international trade. These regulations are vital for maintaining order and consistency across the vast expanses of the world's oceans, which operate beyond the jurisdiction of individual nations, particularly given the extensive volume of global trade transported by sea.
48. Tsunamis are caused mainly by undersea earthquakes, volcanic eruptions, or landslides that displace large water volumes, producing fast-moving waves with long wavelengths and extreme coastal inundation. Storm surges result from strong winds and low pressure during cyclones, pushing seawater onto land. Both cause severe flooding, infrastructure damage, and loss of life in coastal regions.
49. Wind-driven surface currents are generated by atmospheric winds acting on the ocean’s surface and are found in the upper layers, influencing large-scale circulation patterns like gyres. Density-driven deep currents form due to variations in temperature and salinity, causing water to sink or rise. These currents circulate slowly in the deep ocean basins.
50. The Moon’s gravitational pull is the primary force creating tides by attracting ocean water, causing bulges on the side facing the Moon and the opposite side. The Sun’s gravity also influences tides but to a lesser extent. When aligned, spring tides occur with higher ranges; at right angles, neap tides result with lower tidal differences.
51. Disturbances to marine ecosystems, such as coral bleaching, reduce biodiversity and weaken fish habitats, directly lowering fish stocks and catches. This affects communities dependent on fishing for income and food security. Coral reefs also support tourism and coastal protection; their degradation reduces tourism revenue and increases coastal damage from waves and storms. As a result, livelihoods become unstable, unemployment rises, and economic vulnerability increases in coastal regions reliant on marine resources.

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52. Oceans significantly impact global weather patterns by regulating temperature and influencing climate through heat distribution. They support diverse life forms by providing habitats for countless species and supply essential resources. Ocean movements, such as currents, distribute warmth from equatorial regions towards the poles, moderating temperatures and affecting rainfall patterns. The vast biodiversity within oceans supports complex ecosystems, which are crucial for the planet's overall ecological balance. This interplay of physical and biological factors highlights their critical role in sustaining life and shaping environmental conditions globally.
53. Tsunamis are primarily generated by the sudden displacement of the seafloor, most commonly associated with underwater earthquakes or volcanic eruptions. Direct causes involve the movement of tectonic plates, where one plate slips beneath another, or disruptions in rock strata beneath the ocean, causing violent motion of the water. Indirectly, these geological events create an immense release of energy, which then transfers to the water column, generating powerful waves that propagate across the ocean as tsunamis, even from distant epicenters.
54. SOLAS establishes vital minimum standards for various aspects of ship operation and construction, directly contributing to maritime safety. It mandates specific requirements for fire protection, essential life-saving equipment, navigation systems, cargo handling procedures, and emergency protocols. These comprehensive provisions ensure that vessels are built and operated to withstand hazards, and that crews are prepared to respond effectively to emergencies. Regular inspections and certifications, enforced by flag states, verify ongoing compliance, thereby significantly reducing the risk of accidents and protecting the lives of seafarers and passengers aboard ships.
55. Large-scale marine industrial developments often marginalize local communities by displacing traditional fishing populations without adequate compensation. These projects primarily benefit multinational corporations, leaving limited direct benefits for small coastal communities. Such developments can also lead to conflicts over access to fishing zones, exacerbate economic inequality due to lack of local capacity, and fuel social unrest when governance and regulations are weak.
56. The diverse underwater landscape, characterized by features like continental shelves, abyssal plains, and mid-ocean ridges, profoundly affects marine ecosystems and resource distribution. Continental shelves, being shallow and sunlit, support rich biodiversity and are significant fishing grounds, yielding oil and natural gas. Mid-ocean ridges provide unique habitats with hydrothermal vents that sustain specialized life forms. Trenches concentrate seismic and volcanic activity, influencing the surrounding ecosystems. This varied relief determines oceanic depths, influences water circulation patterns, and dictates the presence of specific mineral and biological resources, thereby shaping marine life and resource accessibility.
57. The onset of cyclones is closely linked to the cycle of seasons, indicating a predictable pattern in their occurrence. As they are weather hazards, their formation can be anticipated by observing specific cloud patterns in the sky. This relationship between seasons and atmospheric changes allows for a certain level of foresight regarding when and where these events might begin to develop, enabling preliminary warnings based on these natural indicators.
58. UNCLOS serves as a comprehensive legal framework, effectively acting as the 'constitution for the oceans.' It precisely defines different maritime zones, such as territorial seas, contiguous zones, exclusive economic zones (EEZs), and the high seas. This convention clarifies navigational rights, allocates responsibilities for managing marine resources, and establishes mechanisms for resolving international disputes at sea. By delineating the rights and duties of both coastal and flag states, UNCLOS provides a stable and predictable legal foundation for all maritime activities, preventing conflicts and promoting orderly governance of the world's oceans.
59. Marine pollution from oil spills, plastics, and chemical waste degrades water quality, destroys habitats like coral reefs and mangroves, and disrupts marine food chains, reducing biodiversity and ecosystem resilience. It contaminates fish stocks, making seafood unsafe and reducing catches. This harms fisheries, tourism, and public health in coastal communities. Increased cleanup costs, loss of income, and livelihood insecurity further weaken socio-economic well-being, while long-term ecosystem damage reduces environmental sustainability and future resource availability.
60. Coastal communities and maritime industries face specific vulnerabilities to cyclones. Firstly, anything directly in the cyclone's path, including human life, animals, and infrastructure like houses and power

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poles, is at risk. Secondly, the sudden drop in barometric pressure generates powerful whirlwind forces, and the accompanying torrential rain and thunderstorms disproportionately endanger individuals with existing physical weaknesses. Thirdly, on the sea, vessels ranging from large ocean liners to small fishing boats and their crews are highly susceptible to the destructive forces, risking lives and livelihoods.

61. a. Tides are caused mainly by the gravitational pull of the Moon and, to a lesser extent, the Sun. Their combined gravitational forces create periodic rises and falls in sea levels known as high tides and low tides.
    b. Ocean currents are large streams of water that flow continuously in definite directions. They may be surface currents driven by winds or deep-water currents driven by differences in temperature and salinity.
    c. Ocean currents transport heat from equatorial regions towards higher latitudes and return cooler water toward the tropics. This redistribution of heat moderates coastal temperatures, influences rainfall patterns, supports marine ecosystems, and helps maintain global climatic balance.
62. a. Coral bleaching occurs when corals lose their symbiotic algae due to environmental stress, particularly rising sea temperatures. As a result, corals turn white and become more vulnerable to disease and death.
    b. Marine protected areas are an important sustainable solution. They help conserve biodiversity, restore fish populations, and support long-term livelihoods for communities dependent on marine resources.
    c. Climate change increases sea temperatures, alters fish migration routes, causes coral bleaching, and raises sea levels. These impacts reduce fish availability, damage coastal infrastructure, increase operational costs for fishermen, and threaten the economic security of marine-dependent communities.
63. a. Cyclones are atmospheric storms formed over warm oceans, whereas tsunamis are large sea waves generated by underwater earthquakes, volcanic eruptions, or submarine landslides.
    b. Mangroves act as natural protective barriers. They reduce the force of waves and storm surges, minimize coastal erosion, and help protect coastal settlements and ecosystems from damage.
    c. Community preparedness improves awareness of hazards, evacuation procedures, and emergency responses. Well-informed communities can act quickly during disasters, reducing casualties, protecting property, and supporting efficient recovery efforts after the event.
64. a. Marine biological resources include fish, crustaceans, seaweeds, plankton, and other living organisms found in oceans. These resources provide food, employment, and raw materials for various industries and communities.
    b. Polymetallic nodules are mineral deposits found on the deep ocean floor. They contain valuable metals such as manganese, nickel, copper, and cobalt, making them important potential resources for future industrial development.
    c. Sustainable management is necessary because overfishing, pollution, and climate change threaten marine ecosystems and livelihoods. Proper management helps conserve biodiversity, maintain fish stocks, protect ocean health, and ensure long-term economic and environmental benefits for future generations.
65. a. A cyclone is a powerful storm system formed in a low-pressure area where warm air rises and cooler air moves inward. It is characterized by strong rotating winds, heavy rainfall, and sometimes storm surges.
    b. Cyclone shelters are an important structural mitigation measure. They provide safe refuge to people during severe storms and help reduce casualties in vulnerable coastal regions.
    c. Early warning systems provide advance information about a cyclone's path and intensity. This allows authorities to evacuate residents, secure infrastructure, and coordinate emergency responses, thereby reducing loss of life, property damage, and disruption to essential services.
66. The vastness of oceanic resources supports global food security by providing large-scale fisheries and aquaculture that supply essential protein to billions of people. Economically, oceans enable trade routes, shipping industries, tourism, and resource extraction like oil, gas, and minerals, driving growth and employment. Environmentally, oceans regulate climate by absorbing carbon dioxide, distributing heat

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through currents, and supporting biodiversity. Together, these functions make oceans vital for sustaining human livelihoods, economic development, and ecological balance worldwide.

67. Tsunamis are primarily generated by the sudden displacement of a large volume of seawater. This most commonly occurs due to undersea earthquakes at convergent plate boundaries, where one tectonic plate subducts beneath another. The abrupt vertical movement of the seabed pushes the overlying water column, creating long-wavelength waves that travel rapidly across oceans. Other contributing geological processes include volcanic eruptions, submarine landslides, and, in rare cases, meteor impacts. In deep oceans, tsunami waves are low in height but move at very high speeds. As they approach shallow coastal waters, their speed decreases and wave height increases dramatically, leading to powerful and destructive coastal inundation.
68. Following a major tsunami, a nation can reduce vulnerability through a combination of structural and non-structural policy measures. These include establishing early warning systems using seismic sensors and ocean buoys, and ensuring rapid dissemination of alerts to coastal communities. Strict enforcement of coastal zoning laws can prevent settlements in high-risk zones. Building codes should mandate tsunami-resistant infrastructure, such as reinforced concrete structures and elevated shelters. Governments can promote afforestation of mangroves and coastal vegetation as natural buffers. Regular community awareness programs, evacuation drills, and disaster education improve preparedness. Investment in disaster response coordination and international cooperation further strengthens resilience and minimizes future loss of life and property.
69. Ocean waves primarily represent a transfer of energy through water, with minimal horizontal displacement of the water itself. They are characterized by rhythmic up-and-down movements, driven mainly by wind. Waves are crucial for shaping coastlines through erosion and deposition, and for mixing surface waters. Ocean currents, however, involve the actual horizontal movement of large masses of water in definite directions, much like rivers within the ocean. Driven by factors such as wind, Earth's rotation, and density differences, currents play a vital role in global heat distribution, influencing climate patterns and supporting marine ecosystems through nutrient transport.
70. Climate change, pollution, and large-scale marine industries collectively intensify livelihood challenges for coastal communities. Rising sea temperatures from climate change cause coral bleaching, destroying critical fish habitats and nursery grounds. Simultaneously, marine pollution from plastic waste, oil spills, and industrial discharge directly contaminates coastal waters, reducing fish populations and damaging marine ecosystems, which are already stressed by rising temperatures. The cumulative effect means less resilient ecosystems are more susceptible to pollution. Furthermore, extensive offshore oil drilling or deep-sea mining, while generating national revenue, can displace traditional fishing communities and introduce further local pollution. This creates a synergistic negative impact: climate change weakens marine ecosystems, rendering them more vulnerable to pollution, while industrial activities further deplete resources and degrade environments, directly impacting the food security, income, and cultural identity of dependent communities. For instance, a community reliant on fishing might face reduced catches due to coral destruction from warming waters, further compounded by fish deaths from an oil spill, and then be displaced by a new port development.
71. Vulnerability in a cyclone refers to the degree to which people, infrastructure, and ecosystems are susceptible to damage from high winds, heavy rainfall, and storm surges. Natural elements like coastal vegetation, mangroves, and coral reefs may be destroyed, reducing natural coastal protection and increasing erosion. Man-made elements such as weak housing, poorly constructed roads, and electrical infrastructure are highly vulnerable, leading to building collapse, power outages, and communication breakdowns. For example, kachcha houses are easily destroyed, while RCC buildings perform better. Vulnerability is higher in densely populated coastal settlements with poor drainage and inadequate disaster preparedness, leading to greater loss of life, property, and livelihoods during cyclones.
72. Regulated fishing, seasonal bans, and marine protected areas primarily address overexploitation by managing fish stocks and safeguarding vulnerable habitats, showing moderate effectiveness in restoring depleted populations within their boundaries. However, their effectiveness in mitigating combined threats with climate change is limited. Climate change-driven shifts in fish migration, ocean acidification, and coral bleaching can undermine static protected areas and fishing regulations, as species move or habitats degrade irrespective of restrictions. For example, a marine protected area designed to protect a

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specific coral reef ecosystem may still succumb to temperature-induced bleaching. To improve resilience, additional integrated strategies are crucial. Firstly, enhancing adaptive capacity through climate-resilient aquaculture (e.g., cultivation of species tolerant to changing conditions) and diversification of coastal livelihoods away from sole reliance on fisheries, such as eco-tourism based on less climate-sensitive aspects. Secondly, robust international cooperation is needed to manage transboundary fish stocks and address global emissions. Thirdly, investing in early warning systems for extreme weather and climate-induced ecosystem changes. Finally, empowering local communities with science-based management tools and microfinance to adapt their practices and secure alternative income streams when traditional resources are threatened is vital. This holistic approach would account for the dynamic, interconnected nature of these threats more effectively.

73. The regular rise and fall of sea levels, known as tides, are primarily caused by the gravitational pull of the Moon and, to a lesser extent, the Sun. The Moon's gravity creates a bulge of water on the side of the Earth facing it, and a corresponding bulge on the opposite side due to centrifugal force. The greatest tidal variations occur during spring tides, which happen when the Sun, Moon, and Earth are aligned during a full or new moon. In this configuration, their combined gravitational forces amplify the tidal bulges, leading to exceptionally high high tides and very low low tides, hence the largest tidal range.
74. Early warning systems for cyclones are generally more effective than for tsunamis because cyclones develop gradually over hours to days and can be tracked using satellites, radar, and weather models, allowing timely evacuation and preparedness. In contrast, tsunamis are triggered suddenly by undersea earthquakes or landslides, leaving very little reaction time, often minutes to a few hours at most. While cyclone warnings enable large-scale coordination and repeated alerts, tsunami systems rely on seismic sensors and ocean buoys, which provide limited but rapid warnings. Thus, cyclone warning systems are more predictive, whereas tsunami systems are more immediate but constrained by sudden onset and shorter response windows.
75. The SOLAS (Safety of Life at Sea) Convention is the most important international treaty aimed at ensuring maritime safety. Its primary objective is to protect human life at sea by setting minimum safety standards for ship construction, equipment, and operational procedures. Key provisions include requirements for life-saving appliances such as lifeboats and life jackets, fire safety measures, navigation safety systems, and radio communication equipment for distress signaling. It also mandates regular inspections, certification, and compliance checks for vessels. SOLAS further addresses ship stability, emergency preparedness, and voyage safety management. By enforcing uniform global standards, it significantly reduces maritime accidents and enhances the overall safety of international shipping operations.

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