

Indicate whether the statement is true or false.

1. Prince Henry the Navigator was a well-traveled explorer who was the captain on dozens of sea voyages.
 - a. True
 - b. False

2. Viking ships were the fastest and longest ranging ships in Europe during the Dark Ages.
 - a. True
 - b. False

3. The Hawaiian Islands were one of the last of the Pacific Islands to be colonized by the Polynesians because they are the farthest away, some 2,000 miles from other islands.
 - a. True
 - b. False

4. Latitude is a measurement that uses the prime meridian (Greenwich, England) as a reference point for determining the exact location of a specific point on Earth.
 - a. True
 - b. False

5. A chronometer is a timepiece that can be used to determine longitude.
 - a. True
 - b. False

6. The Library of Alexandria was an important gathering place for intellectuals, and a warehouse for written knowledge relating to trade, natural wonders, artistic achievements, and other items of interest to seafarers.
 - a. True
 - b. False

7. Eratosthenes was a scientist who was interested in the size of Earth and used methods of geometry to determine the circumference of our planet.
 - a. True
 - b. False

8. During the Age of European Discovery, Henry the Navigator was the first to recognize that Earth was spherical.
 - a. True
 - b. False

9. Captain Cook was the first scientist to drift in the ice pack of the Arctic.
 - a. True
 - b. False

10. Humanity did not spread to nearly all of the inhabitable areas of Earth until after the European voyages of discovery in the late 1400s and early 1500s.
 - a. True
 - b. False

Indicate the answer choice that best completes the statement or answers the question.

11. A(n) _____ is a graphic representation that depicts information about the ocean and ocean features.
- map
 - echo sounder
 - chart
 - atlas
12. Longitude can be determined with the use of a(n) _____.
- pendulum clock
 - echo sounders
 - chronometer
 - remote operated vehicle
13. Who is considered to be the father of physical oceanography?
- Jacques Cousteau
 - Ptolemy
 - Matthew Maury
 - Captain James Cook
14. Which navigator led an expedition in the early 1500s to be the first to circumnavigate the world?
- Ferdinand Magellan
 - Captain James Cook
 - Christopher Columbus
 - Prince Henry the Navigator
15. The first scientific expedition to use an echo sounder was the _____.
- Challenger* expedition
 - Meteor* expedition
 - United States *Exploring* expedition
 - voyage of *Trieste*
16. Which technology, available to modern oceanographers in the last few decades, has revolutionized our ability to study the ocean?
- remote sensing via ROVs and satellites
 - shipboard SONAR
 - leadline soundings
 - compass/chronometer
17. Edward Forbes was an Edinburgh professor who thought that _____.
- life was plentiful in the deep sea
 - there was an easy route to the orient from Europe
 - no life existed in the deep sea because of high pressure and lack of light
 - the Pacific Ocean was much smaller than it truly is
18. The word "oceanography" was first coined in association with _____.
- Cook's third voyage
 - the *Challenger* expedition
 - Columbus' fourth and final voyage
 - Captain James Cook's first voyage

19. What device bounces sound waves off the ocean bottom to study the depth and contours of the seafloor?
- echo sounder
 - satellite
 - bathyscaphe
 - submersible
20. Modern oceanography began with the efforts of _____, who trapped his ship in pack ice to explore the Arctic.
- Forbes
 - Wilkes
 - Thompson
 - Nansen
21. Who was the first European explorer to journey to Hawaii?
- Magellan
 - Forbes
 - Thompson
 - Cook
22. Which statement is true about Christopher Columbus and his explorations?
- Columbus had the primary goal of discovering new lands.
 - As with many early explorers, Columbus thought Earth was flat.
 - One of Columbus' biggest errors was in estimating Earth to be only about half of its true size.
 - Columbus was the first explorer to see the mainland of North America.
23. Which voyage was the first expedition devoted purely to marine science?
- Columbus' 1496 trip
 - the *Challenger* expedition
 - Benjamin Franklin's first voyage across the Atlantic to take up his post as American Ambassador to France
 - Captain Cook's voyage to Tahiti in the ship *Endeavour*
24. Which individual was the first to publish a reasonably accurate chart of an ocean current, specifically, the Gulf Stream?
- Edward Forbes
 - John Harrison
 - Benjamin Franklin
 - Captain James Cook
25. Which individual would be most likely to receive the title of "first marine scientist"?
- Matthew Maury
 - Captain James Cook
 - Christopher Columbus
 - Wyville Thompson (of the *Challenger* expedition)
26. The invention of the compass is attributed to the _____.
- Americans
 - Chinese
 - Spanish
 - British

27. Which is a recent technology currently used in modern marine science?
- The remotely operated vehicle
 - The chronometer
 - The pendulum clock
 - The leadline, or sounding line
28. Who was the first person to compile a picture of the large-scale wind and current systems?
- Ben Franklin
 - Matthew Maury
 - Eratosthenes of Cyrene
 - Wyville Thomson
29. The cousin of which scientist worked out the first rough chart of the Gulf Stream?
- Darwin
 - Forbes
 - Magellan
 - Benjamin Franklin
30. *Glomar Challenger* is known mainly for ____.
- being the first modern scientific survey ship to circumnavigate the globe
 - being the first nuclear powered scientific research vessel
 - being owned and operated simultaneously by four governmental agencies
 - taking the first complete cores of sea-floor sediments
31. Why did the Chinese abandon ocean exploration in 1433?
- They were too slow in developing ships that would allow them to stay at sea for long periods of time.
 - They were distracted by the turmoil of the Dark Ages.
 - They were not interested in showing the wealth or power of the Ming Dynasty to other peoples of the world.
 - They were victims of changing political winds, and the cost of the exercise was deemed too great.
32. What was one accomplishment of Captain James Cook?
- He was the first to circumnavigate the world.
 - He was the first to land on the coast of Antarctica.
 - He was the first European to explore the South Pacific.
 - He mapped the coasts of Australia and New Zealand.
33. Which statement is true with regard to latitude and longitude?
- Longitudinal lines are drawn parallel to the equator, while latitudinal lines are drawn from pole to pole.
 - Latitude and longitude comprise a system of imaginary lines dividing Earth's surface into a grid.
 - Greenwich, England was the original location of "zero longitude."
 - Zero latitude is the prime meridian and zero longitude is the equator.
34. The hybrid remotely-operated vehicle, *Nereus*, accomplished what feat in 2009?
- It circumnavigated the world.
 - It reached the bottom of the world's deepest ocean trench.
 - It collected the first manganese nodules, sparking an interest in deep sea mining.
 - It collected the longest complete core of deep sea sediments.

35. The *Challenger* expedition (1872-1876) was a unique and historic voyage. Why?
- It is the longest continuous oceanographic expedition on record.
 - Its scientists developed the first reliable navigational charts to indicate current and wind patterns.
 - It was the first expedition to use an echo sounder to study the seafloor.
 - It proved the hypothesis that life could not exist in the deep sea.
36. Contributions by early Chinese scientists and philosophers include ____.
- developing specialized steering oars held against the right side of their ships
 - designing ships that used only a single mast
 - development of the chronometer
 - designing and developing watertight compartments
37. What was the most important outcome of Matthew Maury's work?
- The discovery of the Hawaiian Islands
 - The formulation of a working hypothesis for the formation of coral reefs
 - The invention of a chronometer for the determination of longitude
 - The charting of ocean currents to significantly shorten the travel time of sailors
38. Which island group was originally colonized by the Polynesians?
- The Aleutian Islands
 - The Bahamas
 - Indonesia
 - The Hawaiian Islands
39. Which group briefly colonized the mainland of North America 500 years before the arrival of Christopher Columbus?
- The British
 - The Chinese
 - The Norwegian Vikings
 - The Polynesians
40. What type of information about the ocean are satellites most likely to provide to scientists?
- sea surface height
 - pH of the ocean in different locations
 - sea floor bathymetry
 - sea floor sedimentation rate
41. Describe the contributions made by Matthew Maury that improved our understanding of ocean science.
42. Modern technologies enable scientists to acquire information about the ocean relatively rapidly. How have satellites changed the way we perceive, navigate, and study the ocean?
43. How are clocks used to determine longitude and why does a pendulum clock fail to produce accurate estimates of longitude at sea? Why was the invention of the chronometer so important for explorers?
44. How do echo sounders work and what kind of information can they provide about the ocean floor?
45. Using specific examples, describe how advances in navigation and voyaging relate to the advent of marine science.

Answer Key

1. False
2. True
3. True
4. False
5. True
6. True
7. True
8. False
9. False
10. False
11. c
12. c
13. c
14. a
15. b
16. a
17. c
18. b
19. a
20. d
21. d
22. c
23. b
24. c
25. b
26. b
27. a

28. b

29. d

30. d

31. d

32. d

33. b

34. b

35. a

36. d

37. d

38. d

39. c

40. a

41. Matthew Maury was, perhaps, the first person to be engaged in full-time oceanographic work, and is considered by many to be the father of physical oceanography. A U.S. naval officer, he was interested in exploiting winds and currents for commercial and naval purposes. Working in the Navy's Depot of Charts and Instruments, he was able to study ships' logs with their many regular readings of temperature and wind direction, and compile this information into coherent wind and current charts. Maury issued these charts to mariners in exchange for logs of their own new voyages, and began to assemble a picture of the worldwide pattern of surface winds and currents. These analyses allowed him to produce a set of directions for sailing great distances more efficiently.

His analyses are still applicable today, as many U.S. charts still carry the inscription, "Founded on the researches of M. F. M. while serving as a lieutenant in the U.S. Navy."

42. In 1958, the National Aeronautics and Space Administration (NASA) was organized. Its satellites have contributed greatly to our understanding of the ocean and ocean processes. The first oceanographic satellite, SEASAT, was launched in 1978 sending information about the ocean such as temperature, wave height and variation in sea surface contours. Modern satellites such as the TOPEX/Poseidon, the Jason – 3 and the AQUA are capable of sending large amount of scientific data back to Earth very quickly. The type of information that is gathered includes data about the water cycle, evaporation, temperature, phytoplankton, and dissolved organic matter at the surface of the ocean. In terms of navigation, the US Department of Defense has developed a Global Positioning System (GPS) composed of 24 satellites equipped with a computer, atomic clock and a radio transmitter. Any GPS receiver on the ground can calculate its own geographic location. Longitude and latitude are accurate with 1 meter. Overall, the use of satellites for studying the ocean has allowed scientists to see the "big picture" and watch how it changes over time - satellites can collect immense quantities of data, spanning the entire ocean, in a very short period of time. This was virtually impossible when we were limited strictly to shipboard methods. Conquering the spatial and temporal challenges of studying the ocean is one of the biggest accomplishments in oceanography to date.

43. Longitude lines are imaginary lines that run from pole to pole dividing the surface of the earth into a grid. You can find longitude using a clock by: (1) determining local noon by observing the path of a shadow of a vertical shaft which is shortest at noon. (2) Set a clock and begin to travel west. At the new location, noon on the clock will no longer correspond with the shortest shadow of the shaft. (3) Determine the time between the “clock” noon and the “shaft” noon and calculate how far west (in hours) you have traveled from the starting point. (4) Since we know that the earth rotates east making 1 rotation every 24 hours, the rotation rate is 15 degrees per hour ($360 \text{ degrees}/24 \text{ hours} = 15 \text{ degrees/hour}$). In summary, the more accurate the clock and the measurement of the shadow of the shaft will increase the accuracy of the longitude reading.

Pendulum clocks are useless on a moving ship because the motion of the sea alters the swing of the pendulum and therefore the time, rendering the clock useless. It was not until the advent of the chronometer that used spring mechanisms instead of a pendulum, that longitude could be determined with any degree of accuracy.

44. Echo sounders changed the way scientists study the ocean floor. Echo sounders bounce sound waves off the ocean floor gathering information about depth and contour. Sound waves are emitted from a ship and travel to the ocean floor and then they are reflected back to the ship. The depth is calculated by taking the velocity of the sound waves and multiplying it by the round-trip time divided by 2 ($D=V(T/2)$). Initially, this technique was very popular in measuring depths but was further applied to defining ocean floor contours and features.

45. Early exploration of the ocean was primarily for economic and political reasons. The Polynesians, Chinese and Europeans quickly discovered that the ocean was a vast expanse that was both wondrous and plentiful. Advances in navigation, such as the compass or the chronometer, allowed explorers to travel around the ocean with much greater efficiency. In the mid to late 1700's Captain James Cook was the first to use the knowledge the voyagers before him had compiled, and applied this information to the study of the ocean. Cook was both an explorer and scientist and within 100 years of his first voyage in 1768, the first fully organized, scientific expedition was launched (Challenger expedition in 1872). Economists, traders, explorers and scientists learned very early on that an understanding of the ocean could better all of their interests. Governments quickly realized there were great profits to be had from the natural resources in the ocean and started investing in oceanographic exploration.