

1. If a wave has a length of 18 meters and a height of 1 meter, check the water depths in which the wave will disturb loose sediment on the seafloor over which it passes.

[3]

(Check as many as are appropriate)

- | | | |
|-----------------|-----------------|----------------|
| _____ 60 meters | _____ 25 meters | _____ 4 meters |
| _____ 50 meters | _____ 14 meters | _____ 2 meters |
| _____ 40 meters | _____ 7 meters | _____ 1 meter |

2. A bottle is floating in the water 1200 meters from shore, where the water is 35 meters deep. Waves with a length of 25 meters are moving shoreward. How long will it be until the waves carry the bottle to the shore?

[3]

- M
- | | | |
|--|-------------------------|--------------------------|
| A. 3.5 minutes | D. 23 minutes | G. 1 hour and 42 minutes |
| B. 8.3 minutes | E. 42 minutes | H. 1 hour and 58 minutes |
| C. 12.7 minutes | F. 1 hour and 7 minutes | J. 3 hours |
| M. The waves will never carry the bottle to shore. | | |

3. Assume that, for much of a day (several hours), you observe dozens if not hundreds of waves come ashore on the east coast of the US, on a day when there is no wind and the air is calm. What is the most likely explanation of the origin of these waves?

- A
- | | |
|--|-----|
| A. They were generated by distant storms. | [3] |
| B. They were generated by small earthquakes and volcanic eruptions. | |
| C. They were generated by the gravitational effects of the moon and sun. | |

Swell What are such waves called? [2]

4. On the map shown on the screen, an undersea landslide just northwest of Slippery Island has generated a tsunami spreading in all directions. A, B, C, and D are all the same distance from Slippery Island. [4]

___ At which location will the tsunami arrive first?

___ At which location will the tsunami arrive last?

5a. If you were at Atlantic City, NJ, on the Atlantic coast of the U.S., and you knew that the most recent high tide was at 6:15 am, which one of the following would be the best guess as to the time of the next high tide there? [3]

- D
- | | | |
|----------------------|---------------------|-------------------------|
| A. 9:15 am that day | D. 6:40 pm that day | G. 6:15 am the next day |
| B. 12:25 pm that day | E. 9:15 pm that day | H. 6:35 am the next day |
| C. 3:05 pm that day | F. 9:45 pm that day | J. 6:55 am the next day |

5b. When there's a high tide in Atlantic City, the most likely place for low tide is [3]

- C
- | | | | |
|-------------------|------------|-------------|------------|
| A. South Carolina | B. Florida | C. Portugal | D. Iceland |
|-------------------|------------|-------------|------------|

6. If there's an exceptionally large tidal range in Atlantic City on March 5, the likely date of the next similarly exceptionally large range is [3]

- B
- | | | | | | |
|-------------|-------------|-------------|-------------|----------|------------|
| A. March 12 | B. March 19 | C. March 27 | D. April 15 | E. May 1 | F. June 24 |
|-------------|-------------|-------------|-------------|----------|------------|

Use the map at right to answer Questions 7 to 9.

7a. Of the coastal towns A, C, D, E, G, and J, at which would you expect the greatest tidal ranges? [2]

G

7b. Of the coastal towns A, C, D, E, G, and J, at which would you expect the smallest tidal ranges? [2]

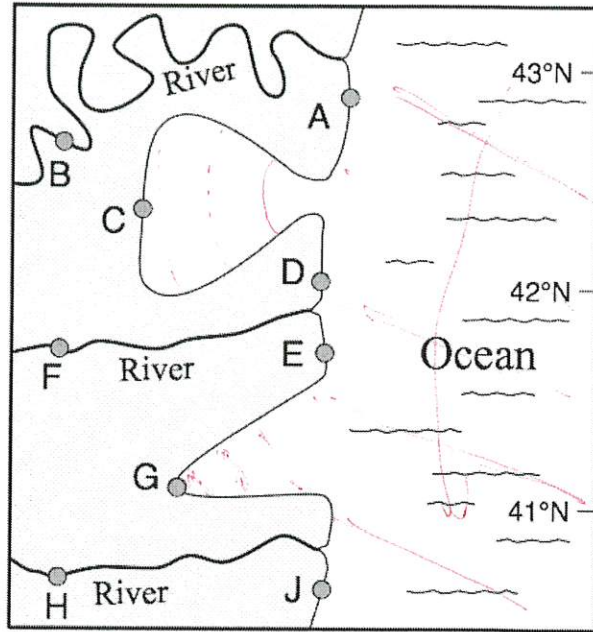
C

8. Of inland towns B, F, and H, at which would you expect the smallest tidal ranges? [2]

B

9. At which town would you expect the earliest high tide on any given day? [2]

A



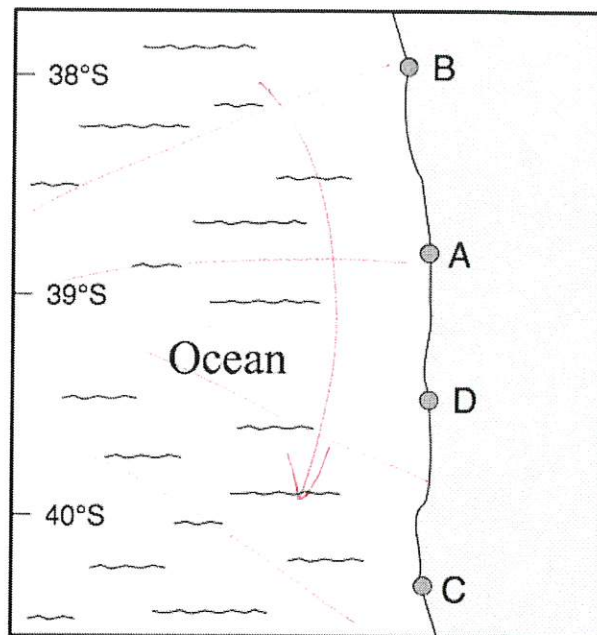
10. Use the map at right to answer the next two questions.

10a. Of towns A to D, at which town would you expect the earliest high tide on any given day? [2]

B

10b. Of towns A to D, at which town would you expect the latest high tide on any given day? [2]

C



11. What is best explanation of why primary productivity is large along the equator in the eastern Pacific Ocean? [3]

- D
- A. MOR vents supply nitrate and phosphate.
 - B. The converging California and Peru currents deliver nutrients from higher latitudes.
 - C. Warm water rises from the East Pacific Rise.
 - D. Upwelling brings nutrients to the photic zone.
 - E. Warm sunshine drives photosynthesis.
 - F. ENSO events bring warm water there.

12. Three characteristics of a swimming higher carnivore that gets its food in shallow open seawater are ...

- B D J
- A. Small tail
 - B. Long form
 - C. Spherical shape
 - D. Large tail
 - E. Microscopic size
 - F. Bullet-shape
 - G. Tear-drop shape
 - H. Immense size (largest of all organisms)
 - I. Box shape
 - J. Bullet-shape

13. Match the following planktic groups with their characteristics [8]

- | | |
|----------------------------|---|
| <u>A</u> Dinoflagellates | C. Relatively large silica-secreting photosynthesizers especially abundant at high latitudes. |
| <u>M</u> Pteropods | A. Photosynthesizers and/or heterotrophs marked by grooves and a tail or flagellum. |
| <u>O</u> Coccolithophores | H. Protozoans with flagellae that secrete tests of silica and that are common in polar oceans. |
| <u>T</u> Silicoflagellates | F. Jellies, commonly elongate in form, that have cilia in rows along their length. |
| <u>C</u> Diatoms | G. Protozoans that generate a spiny test of silica and are abundant in tropical waters. |
| <u>E</u> Foraminifera | O. Photosynthesizers that generate a test of CaCO_3 that consists of joined disks or plates |
| <u>P</u> Copepods | E. Protozoans that generate a chambered test of CaCO_3 . |
| <u>G</u> Radiolarians | P. Crustaceans with specialized appendages extending from their heads that aid in feeding. |
| <u>Y</u> Salps | M. Snail-like heterotrophs that secrete a shell of CaCO_3 in warm regions. |
| <u>F</u> Ctenophores | T. Very small photosynthesizers that generate a silica test. |
| | Y. Chordate jellies that alternate between solitary and colonial forms from generation to generation. |

14. What features help sharks avoid sinking? Check all that apply.

[3]

- Swim bladders that provide buoyancy.
 A beveled or angled chin that provides lift.
 An unevenly shaped tail that provides lift.
 Many projections to increase surface area.
 Ampullae of Lorenzini that provide buoyancy.

15. Put *two* letters next to each group of whales to indicate their sizes and feeding strategies.

- | | | |
|---------------------------|--|-----|
| <u>A C</u> Baleen Whales | A. The largest whales (except for sperm whales).
B. The smaller whales (except for sperm whales). | |
| <u>B E</u> Toothed Whales | C. Whales that filter-feed on plankton or other small organisms.
D. Whales that graze on kelp and benthic algae.
E. Whales that hunt primary and secondary carnivores. | [3] |

16. Match the groups of organisms with the appropriate generalizations about their form.

- | | | |
|-------------------|---|-----|
| <u>C</u> Plankton | A. Have a tear-drop or streamlined shape, and come in a great range of sizes. | [3] |
| <u>A</u> Nekton | B. Have discoid shapes and are macroscopic, and commonly generate shells of magnesium chloride. | |
| <u>D</u> Benthos | C. Are mostly microscopic and commonly have spines; may generate thin or small mineralized tests.
D. Have a variety of shapes, and may generate heavy mineralized skeletons. | |

17. At what time of year are phytoplankton most abundant in temperate regions?

[2]

- B A. Winter B. Spring C. Summer D. Fall E. All year!

Why do they become so abundant at that particular time? (There are at least two reasons.)

[3]*

Abundance of nutrients
(Increasing) Sunlight

18. The bivalved mollusk shown on the screen is a  [3]

F G. Grazer F. Filter feeder C. Hunter D. Deposit feeder S. Scavenger

19. The fish shown on the screen lives in   [3]

B A. Surface water B. Deep water C. Crevices in reefs D. River deltas E. Burrows

20. Corals are largest and most abundant in shallow, rather than deep, water because [3]

E A. They are plants that need light to photosynthesize. B. Their metabolism is pressure-limited.
C. They need the N_2 of the atmosphere. D. Coral-eating parrot fish are inhibited by light.
E. They are animals but depend on photosynthesizing organisms in their tissue.

21. For reasons that we discussed, coral tentacles are [3]

B A. Open all the time. B. Open at night C. Open during the day D. Almost never open.
E. Open only during summer F. Open only during winter G. Open only at full and new moon.

22. The organism shown on the screen is a/an [3]

? A. Arrow worm C. Copepod D. Diatom F. Foram J. Jellyfish K. Krill
? M. Meroplanktic larva P. Pteropod S. Salp T. Ctenophore Z. Zombie Worm

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24. Match the trophic system with its sustenance of the highest trophic level. [3]

B Food chain A Food web A. less efficient but more stable.
B. more efficient but more prone to failure.

25. Where is diversity greatest in the oceans? [3]

C A. Near shore in high-latitude regions
B. Far from shore in high-latitude regions
C. Near shore in low-latitude regions
D. Far from shore in low-latitude regions

26a. Why does the sea look as it does in this picture? [2]

C A. Red Algae ^{pink} C. Coral reproduction M. *Maxillioxus* bloom T. Red Tide W. Whales molting

26b. This picture is from what climatic zone? (check one) [1]

? E. equatorial/tropical T. temperate P. polar

27. Ecosystems at mid-ocean ridge hydrothermal vents are driven by [3]

O J. Food that settles from the epipelagic zone.
L. Photosynthesis by cyanobacteria. O. Chemosynthesis by bacteria using H_2S .
M. Food carried by bottom currents. S. Bacteria that harvest energy from deep-sea clays.

28. At cold seeps, the special condition allowing a localized flourishing ecosystem is [3]

B A. Hydrothermal circulation of H_2S -bearing water
B. Escape from sediments or sedimentary rocks of water bearing methane, hydrocarbons, or H_2S .
C. Release of cold water from melting ice.
D. Release of nitrate-bearing water from arctic ice sheets.

29. Using the map on the screen, enter one letter in each blank to indicate the most likely location of the seafloor ecosystem listed. [3]

H High-temperature vent community including *Riftia pachyptila* and *Alvinella pompejana*

C Cold-seep community including *Lamellibrachia luymesii*

