

How to convert *Celsius* to *Romer* [$^{\circ}\text{C}$ to $^{\circ}\text{R}\emptyset$]:

$$^{\circ}\text{R}\emptyset = ^{\circ}\text{C} \times 21/40 + 7.5$$

How many Romer in a Celsius:

If $T_{^{\circ}\text{C}} = 1$ then

$$T_{^{\circ}\text{R}\emptyset} = 8.025 ^{\circ}\text{R}\emptyset$$

How many Romer in 15 Celsius:

If $T_{^{\circ}\text{C}} = 15$ then

$$T_{^{\circ}\text{R}\emptyset} = 15.375 ^{\circ}\text{R}\emptyset$$

3. Alex is in a submarine which descends 420m. In megapascals, how much pressure is exerted on every square inch of the submarine? Round to the nearest tenth.

$$420/10 = 42 \times 0.1 \text{ MPa} = 4.2 \text{ MPa}$$

4. Only 3.5% of seawater is made up of ions. If the magnesium ion makes up 3.69% of the ions found in seawater, what percent of seawater consists of magnesium ions (to nearest 0.01%)?

$$0.035 \times 0.0369 = 0.00129 = 0.13\%$$

5. Calculate the amount of energy in Joules required to heat a 250 g sample of water from 300 K to 325 K. Show work and formula(s) used.

$Q = mc\Delta T$, where m = mass in kg, c = specific heat (4.186 for water), ΔT = change in temperature

$$= 0.25 \times 4.186 \times 25$$

$$= 26.1625 \text{ J}$$

6. You take a sample of the African plate's oceanic crust and measure it to be 2 miles from the mid-Atlantic ridge. You recall that the African plate moves at a rate of 0.85 inches per year. Calculate how old this sample of oceanic basalt is.

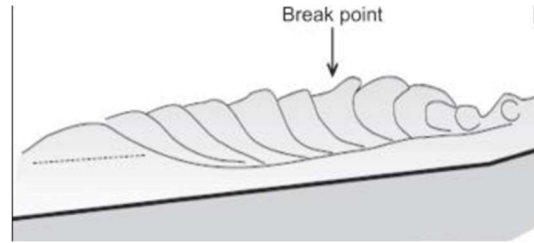
$$5280 \times 2 = 10560 / 0.85 = 12423.53 \text{ years old}$$

7. In terms of speed, what is a knot?

1 nautical mile per hour

8. What type of breaker is shown in the picture?

- a. Surging
- b. Spilling
- c. **Plunging**
- d. Barrelling



9. Calculate the celerity, in meters per second, of a propagating shallow water wave with a height of 9 meters (round to nearest hundredth).*

Celerity = \sqrt{gh} where g = acceleration due to gravity and h = depth which wave is propagating in

$$= \sqrt{9.8 * 9}$$

$$= 9.39 \text{ m/s}$$

10. Capillary waves have a wavelength of less than 1.7 centimeters.

11. Of the following phenomena, which is the most likely to generate swell waves?

- a. Trade winds
- b. **A monsoon**
- c. A waterspout
- d. Underwater landslide

12. About what percent of ocean water is contained in the “deep zone” beneath the pycnocline?

- (A) 30%
- (B) 40%
- (C) 60%
- (D) 80%**

13. The specific temperature and pressure at which water exists as all of the three main phases of matter is known as the:

- a. Universal temperature
- b. **Triple point**
- c. Curie's point
- d. Absolute zero

14. The sun, moon, and earth are positioned as showed here. In this scenario, we experience a _____ tide.

- a. Spring
- b. **Neap**
- c. Proxigean

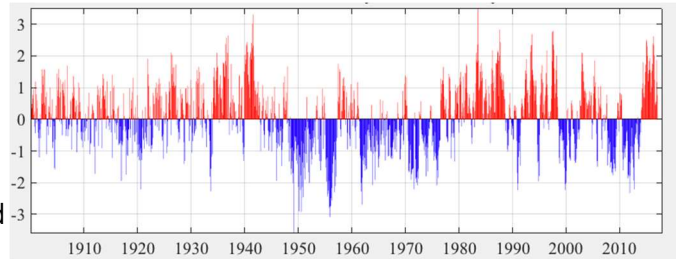
d. King

15. How long is a lunar day? A lunar month?

24 hr 50 min; 29 days 12 hr

16. This is the record of sea surface temperatures of the Pacific Ocean over the past century. This data:

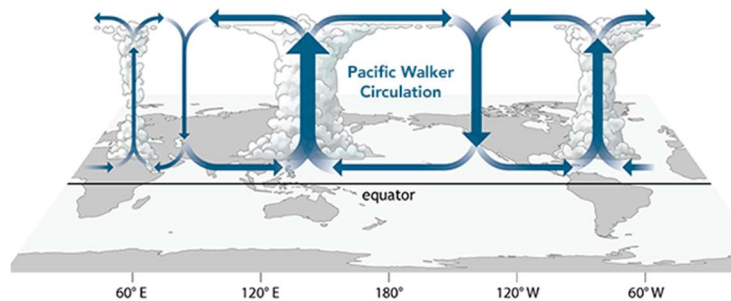
- Demonstrates alternating cycles of El Nino and La Nina
- Allows us to pinpoint when upwelling and downwelling have occurred
- Is characteristic of the Pacific Decadal Oscillation
- Is what one would normally expect when monitoring the Pacific Ocean



17. This is a diagram of the Walker circulation.

Weather patterns like this occur:

- Normally
- During El Niño
- During La Niña
- During the Pacific Decadal Oscillation



For questions 18-20, decide if the event is characteristic of El Niño or La Niña.

18. Lesser yields of fisheries along the coast of Peru

El Niño

19. Polar jet streams blow cool air towards Canada

La Niña

20. Little difference, in terms of temperature, between the Bering Sea and Central Pacific waters.

La Niña

21. At what bay are the world's highest tides found?

Bay of Fundy

22. At a _____, tidal range is almost 0.

- a. Barycenter
- b. Focal point
- c. Amphidromic point
- d. Rotary axis

23. What type of waves are observed in tidal resonance?

Standing wave/seiche

24. Which ocean surface current carries the greatest volume of water?

- (A) The Kuroshio current.
- (B) The Canary current.
- (C) South equatorial current in the Pacific.
- (D) West Wind Drift (Antarctic Circumpolar Current)

25. Sand along a beach typically moves:

- (A) perpendicular to the shoreline due to breaking waves.
- (B) parallel to the shoreline due to refracting waves.
- (C) Both A and B.
- (D) Neither A nor B.

26. This type of hard stabilization is built parallel to the shoreline along the beach/berm.

- (A) Jetty
- (B) Groin
- (C) Sea wall
- (D) Breakwater

27. This type of hard stabilization built offshore is parallel to the shoreline.

- (A) Jetty
- (B) Groin
- (C) Sea wall

(D) Breakwater

28. This type of hard stabilization is built perpendicular to the coastline.

- (A) Jetty
- (B) (B) Groin
- (C) Sea wall
- (D) Breakwater

29. This type of hard stabilization is typically built to protect harbor entrances.

- (A) Jetty
- (B) Groin
- (C) Sea wall
- (D) Breakwater

30. Which of the following statements is not true of dead zones.

- (A) They occur near the mouths of major rivers.
- (B) They are caused by large algal blooms which later die and decompose in the water column.
- (C) They are the result of eutrophication.

(D) They are often attributed to downwelling events.

31. The ___ is the distance under the sea surface at which the rate of photosynthesis equals the rate of respiration.

- (A) aphotic depth.
- (B) abyssal depth.
- (C) compensation depth.
- (D) critical depth.

32. An estuary produced by faulting or folding of rocks that creates a dropped-down section into which a river flows is called:

- (A) bar-built estuary.
- (B) fjord.
- (C) salt wedge estuary.

(D) tectonic estuary.

33. A seismograph mounted to a submarine would not be able to detect:

(A) earthquakes.

(B) P-Waves

(C) S-Waves

(D) P-Waves and S-Waves.

34. Primary production in high nutrient, low chlorophyll regions of the world oceans:

(A) is often or always iron limited.

(B) is usually phosphate limited.

(C) is always nitrogen limited during peak upwelling season.

(D) Both A and C.

35. Which of the following areas is not a high nutrient, low chlorophyll region of the world ocean?

(A) the Subarctic Atlantic Ocean

(B) the Subarctic Pacific Ocean

(C) the Southern Ocean

(D) The Equatorial Pacific Ocean

36. The label SAF is situated on the San Andreas Fault. Comparing the tectonic activity at SAF to that in the Seattle (WA) area, which of the following is true?

(A) Both areas are dominated by strike-slip faults.

(B) SAF produces mafic volcanism, whereas felsic volcanism is produced in Seattle.

(C) Both areas have deep earthquakes.

(D) Both areas have shallow earthquakes.

37. The Gulf of California, is a small ocean basin where hydrothermal vents occur. Tectonically, the Gulf of California is most like the:

(A) Mediterranean Sea

(B) Puget Sound (in Washington State)

(C) Persian Gulf

(D) Red Sea

38. Comparing the sediment layer that has accumulated at locations 1 and 2 on the map, you would expect sediments at 1 to be _____ than those at 2.

(A) Finer

(B) Thicker

(C) Thinner

(D) Both A and B

39. North Atlantic Deep Water is _____ dense than Antarctic Intermediate Water.

- (A) more
- (B) less
- (C) equally as
- (D) None of the above.

40. Formation of evaporites.

- (A) Solar Radiation
- (B) Heat from radioactive decay
- (C) Heat from gravity
- (D) Hydrothermal vent heat

41. The hydrologic cycle is the movement of

- (A) water through an organism.
- (B) an organism through water.
- (C) water through various reservoirs.
- (D) hydrogenous sediment in the seafloor

42. The mass of one square inch of the atmosphere at sea level on the Earth's surface is approximately:

- (A) 1 pounds (B) 5 pounds (C) 15 pounds (D) 15 pounds

43. Each day, high tide is approximately:

- (A) 1 hour later. (B) 1 hour earlier. (C) 2 hours later. (D) around the exact same time.

The wave speed of a shallow water wave in the ocean depends on:

- (A) the coriolis effect.
- (B) wavelength.
- (C) wave period.
- (D) water depth.

44. Deep water is colder than surface water at most latitudes because:

- (A) Deep water does not receive sunlight.
- (B) Hydrothermal vents keep it cool.
- (C) it sinks to the bottom, then cools.
- (D) It cools at the surface, then sinks.

45. In the oceans, nutrients are regenerated and made available for phytoplankton by _____.

- a. Evaporation
- b. Photosynthesis
- c. Precipitation
- d. Decomposition of organic matter

46. North Atlantic Deep Water (NADW) forms

- a. At the North Pole
- b. In the North Atlantic Gyre
- c. Off the coast of Greenland

d. None of the above

47. The majority of the world's earthquakes are found along _____ plate boundaries

- a. Divergent
- b. Convergent
- c. Transform

d. All of the above

48. Which of these directly affect the density of ocean water?

- a. Temperature
- b. Salinity
- c. Pressure

d. All of the above

e. Temperature and Salinity

49. Gyres south of the equator move in what direction?

- A. Direction same as the Southern Hemisphere
- B. Clockwise
- C. To the East
- D. Counterclockwise
- E. Depends on the climate

50. The area where the water temperature drops drastically is known as what?

- A. Density difference
- B. Upwelling
- C. Thermocline
- D. Indirect sunlight
- E. Direct shade

51. Of the five ocean basins, which one has the most salinity?

- A. Arctic
- B. Indian
- C. Southern
- D. Pacific
- E. Atlantic

52. Rift valleys in oceanic ridges are connected by which of these?

A. Transform faults

- B. Plate tectonics
- C. Convergent Boundaries
- D. Divergent boundaries
- E. Assurgent boundaries

53. Which of the following is NOT a strong factor on why shoreline features vary from place to place around the Earth?

- A. Coast is sinking, stable, or rising
- B. Intensity of wave action
- C. Types of rocks at the shoreline
- D. Nature of coastal currents
- E. Type of sediment at the shore

54. Which is not true about hydrothermal vents?

- A. A form of hydrothermal venting is called diffuse venting
- B. Hydrothermal vents may support dense communities of vent animals
- C. The heat source for these vents is magma
- D. All of the above are true
- E. None of the above are true

55. Which of these is not true about why hydrothermal vents are important?

- A. Supports unique deep-sea ecosystems
- B. Affect chemistry and circulation in oceans
- C. Keeps the water warm so life can thrive
- D. Primitive life might have begun at hydrothermal vents
- E. All of the above are true

56. Light attenuation would be greatest at..

- A. Epipelagic
- B. Bathypelagic
- C. Mesopelagic
- D. Hadopelagic
- E. None of the above

57. Deep sea vents are an example of what process leading to solutes in the ocean?

- A. Degassing
- B. Bio-chemical reactions
- C. Erosion
- D. Attenuation

E. Oscillation

58. In which direction does an undertow flow?

- A. Same direction as the wave
- B. Right angles to the wave
- C. Parallel to the wave
- D. Opposite direction of the wave
- E. 45 degree angle to the wave

59. Surface currents are powered by:

- A. Wind
- B. Heat
- C. Tides
- D. Density
- E. A and B only