True/False

Indicate whether the sentence or statement is true or false on your scantron.

True = A and False = B

1. Dry air is more dense than humid air.
2. The freezing point of seawater is lower than that of pure water.
3. Westerly winds and westerly currents travel in the opposite directions.
4. The deep circulation is driven by wind.
5. The trough of a tsunami always arrives first.
6. A wave behaves as a deep water wave if it is in water deeper than 1/2 its wavelength.
7. Short residence time elements are uniformly distributed in the oceans.
8. The slope of the bottom determines how a wave breaks.
9. The Sun has more effect on the tides than the moon does.
10. In the Northern Hemisphere Coriolis deflects things to the left.
11. Tsunami are shallow water waves.
12. Wave packets (sets) travel more slowly than individual waves.
13. Most of the volume of the ocean is composed of pycnocline waters.
14. Because the major ions are conservative, the ocean has the same salinity everywhere.
15. Winds from the north along the California coast would cause upwelling.
16. Ascending air gets cooler.
17. Carbon dioxide is the only Greenhouse Gas.
19. Refraction bends waves towards the slower medium.
20. Neap tides occur when the Earth, Moon, and Sun are in line with each other

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

21. How much salt is dissolved in a kilogram of typical seawater
   a) 1 gram
   b) 15 grams
   c) 35 grams
   a) 0.1 gram

22. During an ice age sea level
   a) goes up
   b) goes down
   c) stays the same
23. In sea water major ions constitute what percentage of the total?
   a) 100%
   b) 99.8%
   c) 90%
   d) 50%
   e) 10%

24. What is the approximate stirring time of the oceans?
   a) 100 years
   b) 1,000 years
   c) 36,000 years
   d) 1 million years

25. How long would it take to replace all the water in the oceans with river water?
   a) 36,000 years
   b) 8 million years
   c) 1000 years
   d) 1 million years
   e) 100 million years

26. The freezing point of seawater of salinity 35 is approximately:
   a) 0°C
   b) -2.9°C
   c) -1.9°C
   d) 4°C

27. In water the speed of sound
   a) increases with decreasing temperature
   b) increases with increasing pressure
   c) all of the above
   d) none of the above

28. If 100 units of organic matter are produced in the upper waters of the ocean on average how many units of this organic matter will fall through the water column reach the sea bed and be preserved in the sediments:
   a) less than 1
   b) 90
   c) 7 to 9
   d) 0

29. If a wind wave has a period of 8 seconds its velocity in meters per second in deep water would be approximately:
   a) 8 m/s
   b) 12 m/s
   c) 24 m/s
   d) 210 m/s

30. In a deep water wave, the _____ the wavelength, the _____ the wave energy will move through the water.
    a) longer, slower
    b) longer, faster
    c) shorter, faster
31. The period of a typical Tsunami is:
   a) 30 seconds
   b) 2 minutes
   c) 20 minutes
   d) 35 minutes

32. There are two Spring tides every
   a) day
   b) 7 days
   c) 14 days
   d) 28 days

33. Compared to the size of the atmospheric reservoir of carbon dioxide the fossil fuel reservoir is approximately:
   a) 13-times
   b) 25-times
   c) 100-times
   d) 140-times

34. The southern oscillation is:
   a) the change in direction of Coriolis force at the equator
   b) the change in pressure differential between Darwin and Tahiti
   c) the change in the thermocline depth between El Nino and La Nina
   d) A popular dance from New Zealand

35. Hydrothermal fluids do not boil at 380 °C at the bottom of the ocean because
   a) Pressure has raised the boiling point
   b) Sea water doesn’t boil
   c) There are too many chemicals dissolved in the sea water
   d) The particles prevent boiling

36. Hydrothermal fluids result from the reaction of sea water with high temperature magma below the bottom of the sea-floor. How deep can these fluids go:
   a) 10 m
   b) 1 km
   c) 5 km
   d) 100 km

37. The thermohaline circulation is
   a) the process that moves deep water from the Atlantic to the Pacific Ocean
   b) the process by which organisms remove chemicals in surface waters and remobilize them in deep water
   c) the process which brings hydrothermal fluids to the sea floor
   d) a new transport system at San Francisco airport

38. The wavelength of the radiation entering and leaving the Earth are
   a) the same
   b) incoming is short, outgoing is long
   c) incoming is long, outgoing is short
   d) none of the above
39. Western boundary currents are:
   a) faster than eastern boundary currents
   b) warmer than eastern boundary currents
   c) all of the above
   d) none of the above

40. Based on the film clip from class showing the aircraft carrier in large waves, which of the following is correct?
   a) There was 1 helicopter in the air.
   b) There were 2 helicopters in the air.
   c) There was 1 helicopter on the flight deck.
   d) There was no helicopter in the movie.

41. The period of a wave is:
   a) the distance between its crests
   b) the time it takes succeeding crests to pass a fixed point
   c) the number of waves that pass a fixed point each second
   d) the distance from the crest to the trough of a wave

42. Neap tides occur when:
   a) the moon is new
   b) the moon is full
   c) the sun and moon are aligned
   d) Jupiter is aligned with Mars
   e) none of the above

43. The thermocline is the part of the ocean where
   a) the density changes rapidly
   b) salinity changes rapidly
   c) the temperature changes rapidly
   d) you are most likely to find Elvis

44. The current CO$_2$ content of the atmosphere (in parts per million by volume) is about:
   a) 120
   b) 180
   c) 380
   d) 560

45. Recent atmospheric CO$_2$ levels started to increase around
   a) 1700
   b) 1850
   c) 1935
   d) 1958

46. Calm winds are found in
   a) the doldrums
   b) the horse latitudes
   c) both of the above
   d) none of the above
47. The energy in winds comes from
   a) the moon
   b) surface ocean currents
   c) the sun
   d) the tides

48. Salinity can be increased by
   a) rivers
   b) ice formation
   c) rainfall
   d) all of the above

49. Prevailing westerly winds are
   a) caused by the Hadley (tropical) cell
   b) trades
   c) caused by the Ferrel (mid-latitude) cell
   d) all of the above

50. The SOFAR layer in the ocean is a region
   a) with maximum sound speed
   b) that sound waves refract away from
   c) where submarines can hide from SONAR
   d) with minimum sound speed

51. Relative to the wind, surface currents in the northern hemisphere move
    a) 20° to the left
    b) 45° to the right
    c) 90° to the left
    d) directly ahead
    e) 15° to the right

52. The source of energy for life around hydrothermal vents is
   a) Hydrostatic pressure
   b) L&L Drive-In
   c) Radioactive decay
   d) Photosynthesis
   e) Chemosynthesis

53. The height of the tides ____ with distance from an amphidromic point.
    a) decreases
    b) remains the same
    c) increases

54. We call the ocean salty because it contains dissolved components of salts such as: NaCl, KCl, CaSO₄, and CaCO₃. When these salts dissolve they dissociate into components that are technically no longer salts, but are called ____.
    a) Atoms
    b) Elements
    c) Ions
    d) Compounds
    e) Molecules
55. Due to the combined effect of wind friction, Coriolis Effect, Ekman Transport, land mass, and the pressure gradient, ocean currents tend to _____.
   a) flow in straight lines
   b) flow along the periphery (outside) of ocean basins
   c) spiral in toward the ocean center
   d) dissipate
   e) sink downward toward the ocean bottom

56. In the Pacific Ocean, Tsunami travel at approximately:
   a) 45 mph
   b) 13 mph
   c) 450 mph
   d) 150 mph

57. What is not a result of melting polar ice?
   a) more water enters the ocean, raising sea level
   b) polar waters become fresher, so less Deep Water is formed
   c) more CO$_2$ is emitted by burning fossil fuels
   d) more sunlight is absorbed by the darker surfaces

58. Tsunamis are caused by
   a) Flooding
   b) Hurricanes
   c) Both of the above
   d) Earthquakes

59. What determines the depth to which nitrate and phosphate are completely removed from the surface waters of the ocean?
   a) light penetration
   b) pressure
   c) upwelling
   d) temperature

60. The two forces which generate the tidal bulges on opposite sides of the Earth in the equilibrium theory of tides are
   a) Coriolis and pressure gradient
   b) gravity and inertia
   c) gravity and Coriolis
   d) pressure gradient and electromagnetic

**Short answer**
*Write clearly.*

61. [3 pts] The three factors that affect wind wave development are ____________________, ____________________, and ____________________.

62. [1 pt] When ice melts exposing rock, the rock absorbs __________ sunlight than the ice had.
63. [2 pts] Why is the ocean blue?

64. [6 pts] For 2 of the 5 ocean gyres; name the gyre or basin and the corresponding western and eastern boundary currents.

   Gyre (basin) name _____________________
   Western Boundary Current __________________
   Eastern Boundary Current __________________

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65. [2 pts] Why are deep nutrient concentrations higher in the North Pacific than in the North Atlantic?