

## **TEAM INSTRUCTIONS FOR THE 2015 MI-INVITATIONAL**

### **GUIDELINES FOR USE**

You May:

- Print out copies of all materials for each team participating in the Invitational
- Use for your own training purposes

The only thing I do not want you to do is to post any of these materials on the Internet, as I may allow other competitions to use it, use some of the questions in future competitions that I myself will be running, or to design training materials for next year. It takes HOURS of work for me to write a single, quality competition and almost as much time to review it and when any of my work is posted for all to see on the Internet, the value of that project is greatly diminished. Your understanding and cooperation is appreciated.

### **RUNNING THE EVENT**

The 2015 Dynamic Planet Event Rules state that the event will be run at Regional, State and National competitions in a station-to-station format. For Invitational Tournaments, you may use a workstation format in which each team is presented with a copy of all event materials.

For small tournaments or training, you can divide each of the Sections into separate stations that students can rotate into.

### **RANKING TEAMS**

The highest score wins. Time of completion is **not** to be used as a tiebreaker.

### **BREAKING TIES**

To break ties, compare scores for each of the Sections in the following order:

- Section 12: Buoyancy
- Section 13: General Oceanography Topics
- Section 4: Tectonic Plate Movements.

The team with the highest score for that Section is awarded the tie. You insert a decimal score (based on the number of teams with the same raw score) after the raw score to do this. This prevents one tie from being broken that creates another.

#### **EXAMPLE 1:**

Team A and B each receive a raw score of 42. You then find that Team A has a score of 3/3 for Section 12 and Team B has a score of 1/3 for Section 12 questions. Team A is awarded the tie with a revised score of 42.1. Team B's score remains 42.

## EXAMPLE 2:

Teams C, D and E each receive a raw score of 39. You find that Team C has a score of 3/3 for Section 12 questions; Team D also has a score of 3/3 for Section 12, while Team E has a score of 0/3 for Section 12 questions.

You then proceed to compare the Section 13 scores of Teams C and D. Team C's Section 13 scores are 5/5, while Team D's score is 2/5 for Section 13 questions.

You then assign Team C a revised score of 39.2. Team D is assigned a revised score of 39.1. Team E's score remains 39.

You assign the number of decimal places one less than the number of teams having the same score. If four teams have the same score, you would add .3, .2, .1 to the top-three teams and leave the raw score intact for the last-place team.

You can add more Sections if you need additional tiebreakers, or you can assign specific question answers if you need to. This system has served me well in my over 20 years as an Event Supervisor.

## **ADDITIONAL TRAINING RESOURCES**

You can visit my website [www.vanheckescience.com](http://www.vanheckescience.com) for training resources for this and other Earth/Space Science events.

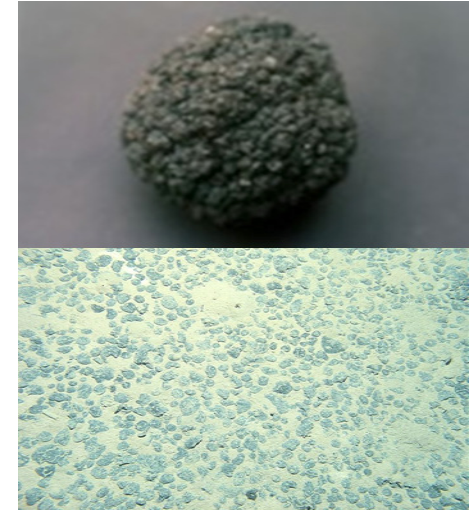
Follow this specific link to access my recommended Dynamic Planet Resource links for 2015. If you have specific questions, you may contact me at [mvanhecke@comcast.net](mailto:mvanhecke@comcast.net) anytime.

[http://www.vanheckescience.com/uploads/9/0/3/1/9031944/2015\\_dynamic\\_planet\\_resource\\_links.pdf](http://www.vanheckescience.com/uploads/9/0/3/1/9031944/2015_dynamic_planet_resource_links.pdf)

**SECTION 1: SEAWATER COMPOSITION**

**QUESTION 1**

The images to the right show a single manganese nodule and below, a large group of nodules littering the ocean floor. How were these nodules likely formed?



**CHOOSE THE BEST ANSWER**

- A. Precipitation of metals from seawater
- B. Intrusions of ore from beneath the ocean surface
- C. Remnants of asteroid collisions early in Earth's history
- D. Leeching of metals from rock extrusions

**QUESTION 2**

Which of the following statements given below is NOT supported by the comparison of fresh and ocean water graphs shown to the right?

**CHOOSE THE BEST ANSWER**

- A. River water contains higher concentrations of NaCl near ocean shores farther inland
- B. Freshwater has a higher ferrous composition than ocean water
- C. Ocean water has a lower silicate composition than freshwater
- D. Chloride is more prevalent in ocean water than in freshwater

PRINCIPAL CONSTITUENTS OF SEAWATER	
Chemical Constituent	Content (parts per thousand)
Calcium (Ca)	0.419
Magnesium (Mg)	1.304
Sodium (Na)	10.710
Potassium (K)	0.390
Bicarbonate (HCO <sub>3</sub> )	0.146
Sulfate (SO <sub>4</sub> )	2.690
Chloride (Cl)	19.350
Bromide (Br)	0.070
Total dissolved solids (salinity)	35.079

COMPARISON BETWEEN OCEAN WATER AND RIVER WATER		
Chemical Constituent	Percentage of Total Salt Content	
	Ocean Water	River Water
Silica (SiO <sub>2</sub> )	—	14.51
Iron (Fe)	—	0.74
Calcium (Ca)	1.19	16.62
Magnesium (Mg)	3.72	4.54
Sodium (Na)	30.53	6.98
Potassium (K)	1.11	2.55
Bicarbonate (HCO <sub>3</sub> )	0.42	31.90
Sulfate (SO <sub>4</sub> )	7.67	12.41
Chloride (Cl)	55.16	8.64
Nitrate (NO <sub>3</sub> )	—	1.11
Bromide (Br)	0.20	—
<b>TOTAL</b>	<b>100.00</b>	<b>100.00</b>

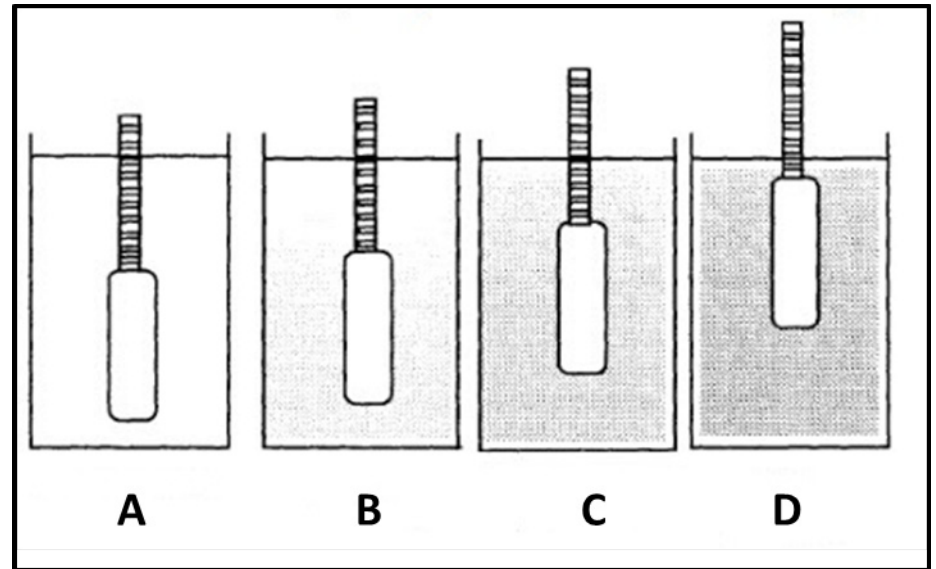
**SECTION 1: SEAWATER COMPOSITION**

**QUESTION 3:**

Which of the water samples shown in the drawing to the right would have the HIGHEST salinity?

**CHOOSE THE BEST ANSWER**

- A. Sample A
- B. Sample B
- C. Sample C
- D. Sample D



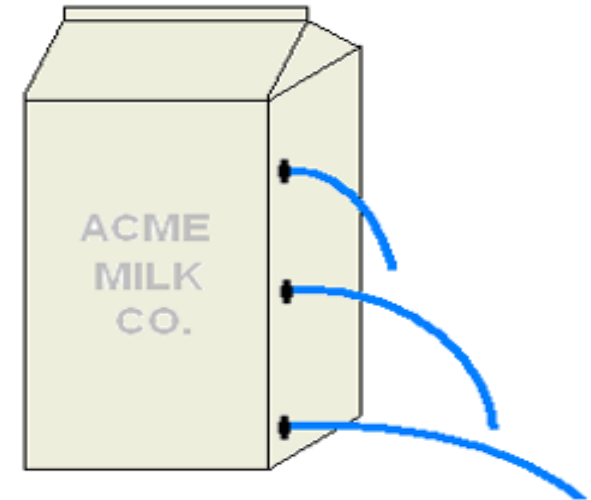
## SECTION 2: WATER METRICS

### QUESTION 4

The illustration to the right BEST illustrates what characteristic of ocean water?

#### CHOOSE THE BEST ANSWER

- A. Water Temperature
- B. Water Pressure
- C. Water Density
- D. Water Salinity

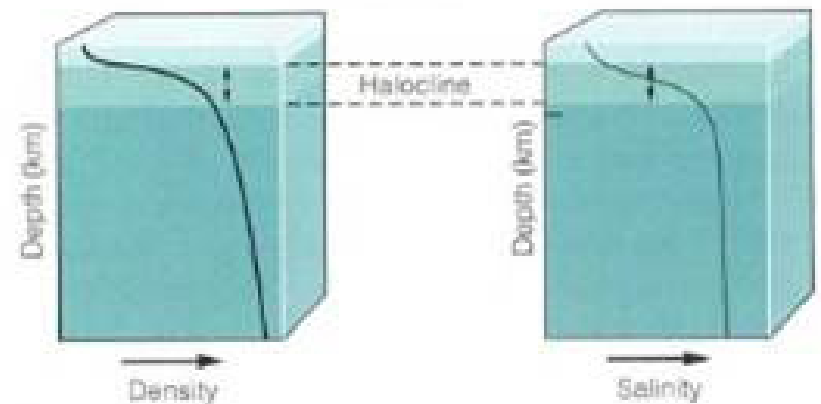


### QUESTION 5

Which of the following statements is NOT supported by the illustration shown at the right?

#### CHOOSE THE BEST ANSWER

- A. Salinity initially increases with depth, but then levels off
- B. Water density increases with depth
- C. Water temperature increases with depth
- D. The sharpest changes in density and salinity occur in the Halocline



**SECTION 2: WATER METRICS**

**QUESTION 6**

What would happen to this turtle if the pressure exerted by the ocean water was greater than that exerted by the water within its body?

**CHOOSE THE BEST ANSWER**

- A. The animal will likely be crushed by the pressure of the seawater
- B. The animal and seawater will be in homeostasis
- C. The animal will likely explode from the inside out



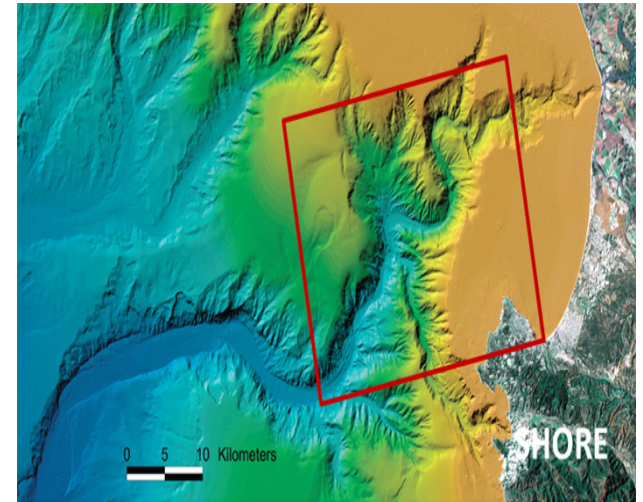
### SECTION 3: TOPOGRAPHIC FEATURES OF OCEAN BASINS

#### QUESTION 7

What undersea topographic feature is indicated by the area within the red box?

#### CHOOSE THE BEST ANSWER

- A. Submarine Canyon
- B. Continental Shelf
- C. Undersea Volcano
- D. Subduction Trench

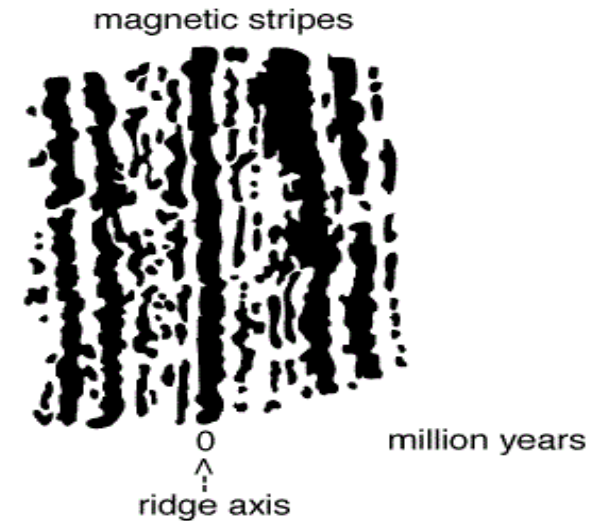


#### QUESTION 8

What do the magnetic stripes shown in this drawing indicate occurred during sea floor spreading?

#### CHOOSE THE BEST ANSWER

- A. Different layers of ocean crust
- B. Direction of tectonic plate movement
- C. Direction of sea floor spreading
- D. Changes in magnetic polarity



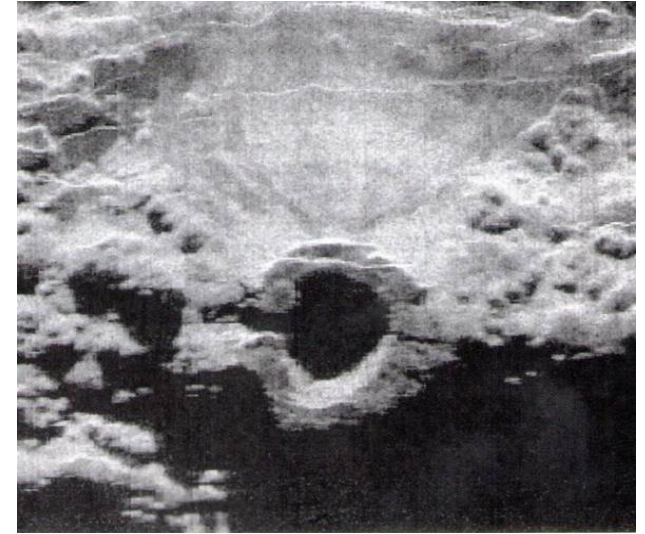
### SECTION 3: TOPOGRAPHIC FEATURES OF OCEAN BASINS

#### QUESTION 9

The image to the right indicates a flat-topped seamount in the west central Pacific ocean known as a guyot. Which of the statements below best explains the formation of guyots?

#### CHOOSE THE BEST ANSWER

- A. Formed by the deposition of sediments from turbidity currents
- B. Subduction of one tectonic plate over another
- C. Formed near spreading centers and transported downward as the seafloor moves away
- D. Remnants of inactive volcanoes that eroded away



#### QUESTION 10

What topographic feature is identified by the area within the red circle on this image?

#### CHOOSE THE BEST ANSWER

- A. Trench
- B. Mid-Ocean Ridge
- C. Continental Shelf
- D. Submarine Canyon





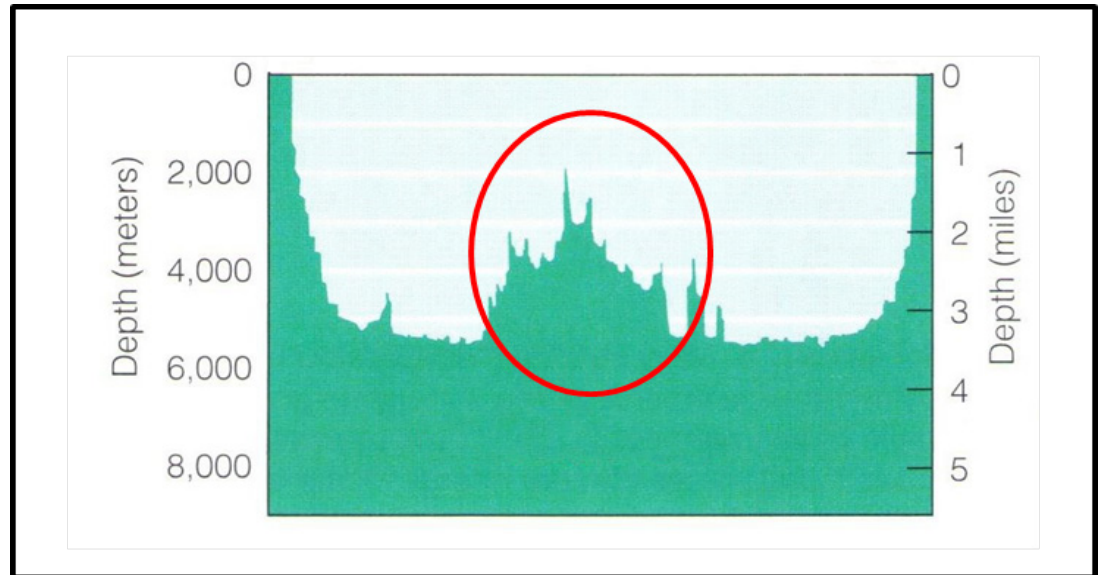
### SECTION 3: TOPOGRAPHIC FEATURES OF OCEAN BASINS

#### QUESTION 11

What topographic feature of the Atlantic Ocean is identified by the red circle within the graph shown to the right?

#### CHOOSE THE BEST ANSWER

- A. Hydrothermal Vent
- B. Continental Shelf
- C. Mid-Ocean Ridge
- D. Trench



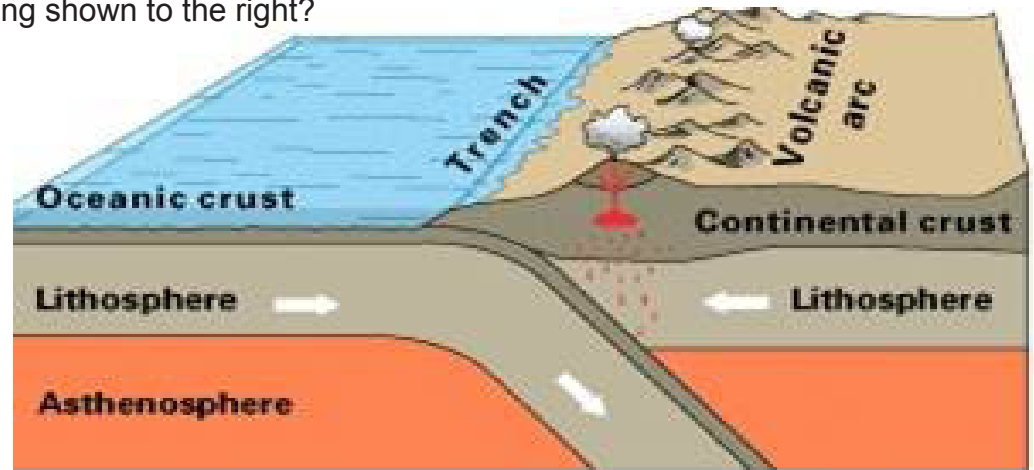
## SECTION 4: TECTONIC PLATE MOVEMENTS

### QUESTION 12

What type of tectonic plate movement is illustrated in the drawing shown to the right?

#### CHOOSE THE BEST ANSWER

- A. Ocean-Ocean Convergence
- B. Ocean-Continental Convergence
- C. Continent-Continent Convergence
- D. Sea-Floor Spreading

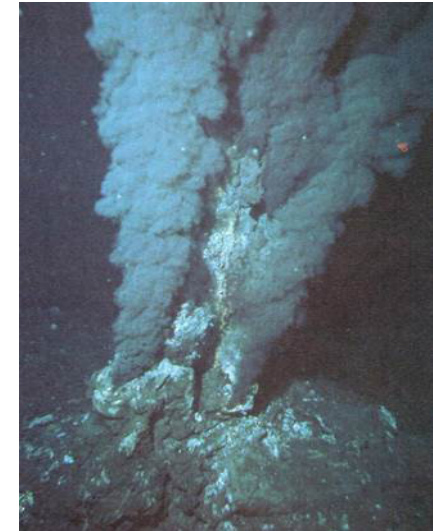


### QUESTION 13

The image to the right shows a particular kind of hydrothermal vent known as a Black Smoker. Which of the following statements related to hydrothermal vents is NOT correct?

#### CHOOSE THE BEST ANSWER

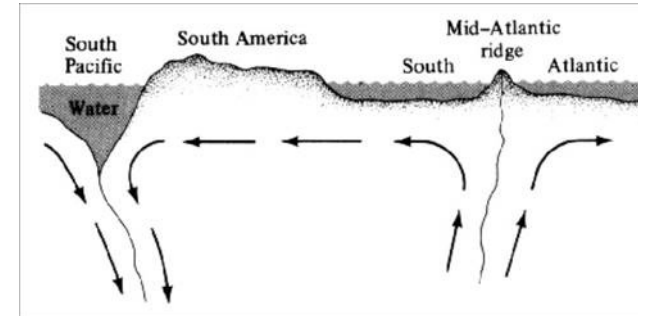
- A. May occur in cooler waters
- B. Are often found near ocean ridges
- C. Never occur in fresh water
- D. Water descends into cracks and fissures that come into contact with superheated rocks causing the water to dissolve minerals and gases



## SECTION 4: TECTONIC PLATE MOVEMENTS

### QUESTION 14

Which of the statements below BEST describes the geologic phenomenon taking place in the drawing shown to the right?



### CHOOSE THE BEST ANSWER

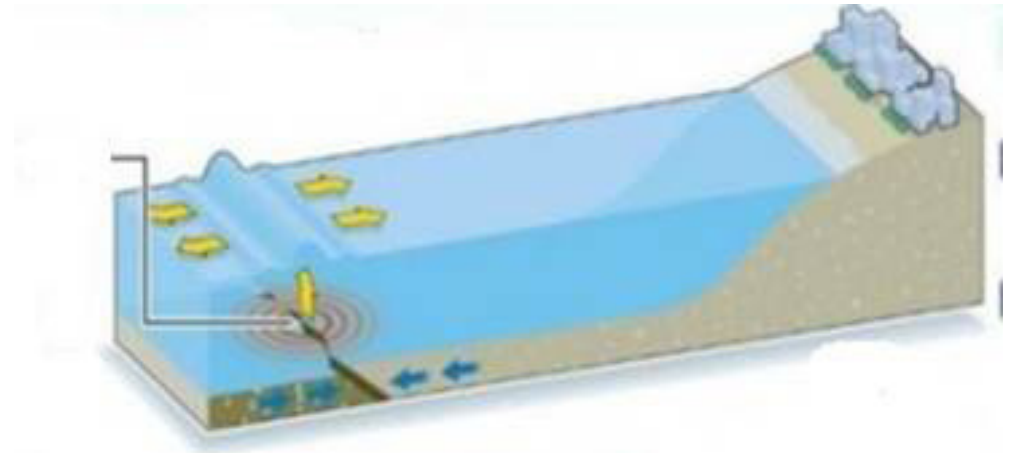
- A. Ocean-Ocean convergence taking place in the mid- South Atlantic
- B. Overriding of Pacific Plate over western South America
- C. Subduction of Pacific Plate and Western South America's continental crust
- D. Subduction of the African continental crust beneath the Atlantic ocean

### QUESTION 15

What is being illustrated by the drawing shown to the right?

### CHOOSE THE BEST ANSWER

- A. El Nino
- B. Tsunami
- C. Sea-Floor Spreading
- D. Subduction



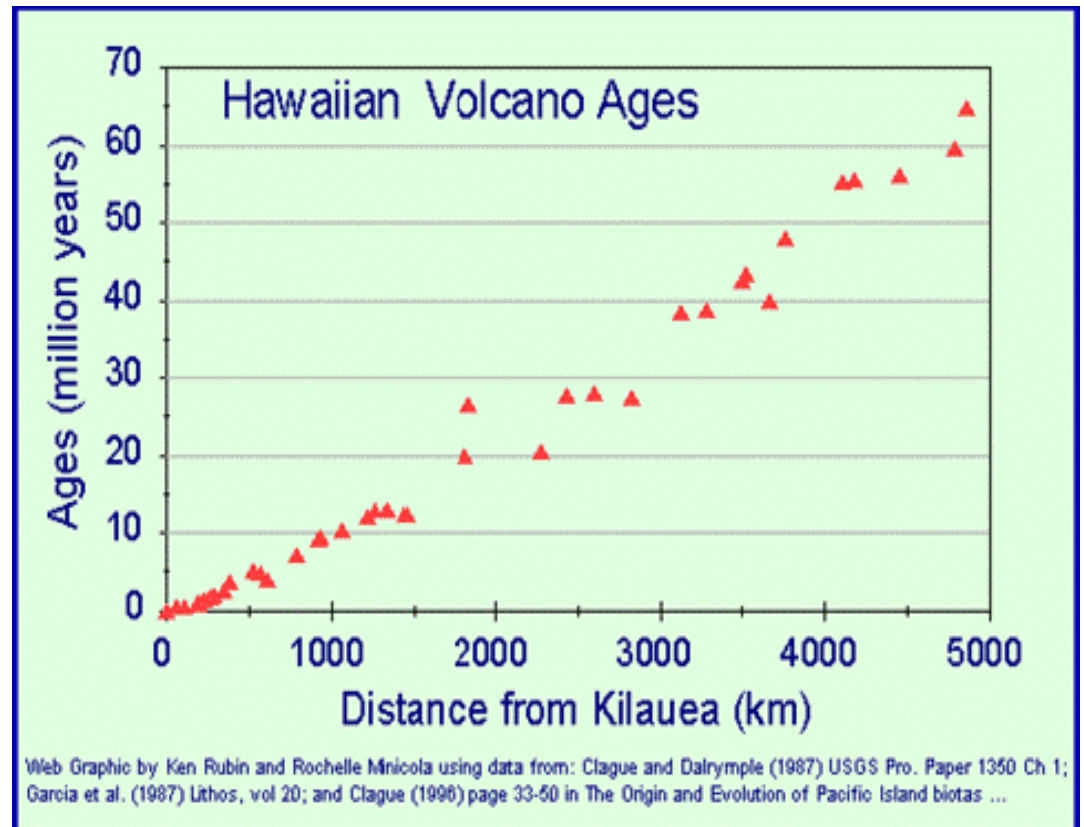
## SECTION 4: TECTONIC PLATE MOVEMENTS

### QUESTION 16

Which of the statements below BEST describes what the graph of Hawaiian volcano development shown to the right is illustrating?

#### CHOOSE THE BEST ANSWER

- A. Volcanoes indicated at the right of the graph are the youngest
- B. Volcanoes indicated at the far left of the graph are the oldest
- C. The cluster of volcanoes indicated at the bottom left of the graph indicates an oceanic hot spot
- D. Older volcanoes tend to occur in clusters



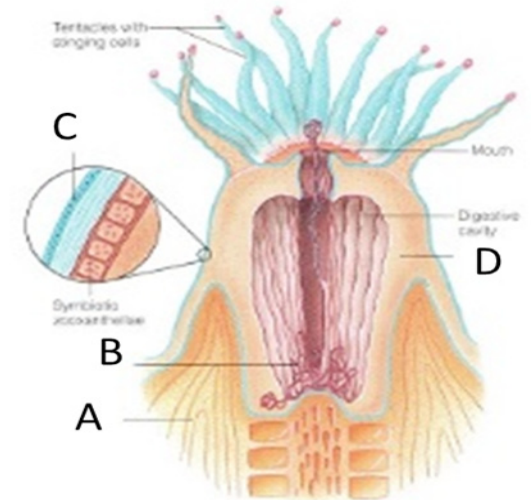
## SECTION 5: REEF FORMATION

### QUESTION 17

What anatomical feature is indicated by A in the diagram of a coral reef polyp shown to the right?

#### CHOOSE THE BEST ANSWER

- A. Cell Walls
- B. Calcium Carbonate Deposits
- C. Gullet
- D. Cnidoblasts



### QUESTION 18

What type of reef is shown in the image to the right?

#### CHOOSE THE BEST ANSWER

- A. Atoll
- B. Barrier Reef
- C. Fringing Reef
- D. Outlier Reefs



**SECTION 5: REEF FORMATION**

**QUESTION 19**

Which of the statements below BEST describes the formation of the reef shown in the image to the right?

**CHOOSE THE BEST ANSWER**

- A. Often emerge over the surface of the water as islands that include a central lagoon
- B. Project seaward directly from the shore to form borders along the shoreline
- C. Form at a greater distance from the shoreline and are separated from the greater land mass by deep lagoons
- D. Form by breaking off from larger reef structures



**QUESTION 20**

What type of reef structure is shown in the image to the right?

**CHOOSE THE BEST ANSWER**

- A. Atoll
- B. Barrier Reef
- C. Fringing Reef
- D. Outlier Reef



**SECTION 5: REEF FORMATION**

**QUESTION 21**

Which of the statements below BEST describes the growth of hermatypic corals?

**CHOOSE THE BEST ANSWER**

- A. Corals deposit calcium carbonate at higher rates in low latitude regions
- B. Reef corals grow best in warm, well lit waters
- C. Reef corals grow best in cool, dim waters
- D. Reef-building corals are found within zones that correspond with the 65 degree range of latitude in both hemispheres



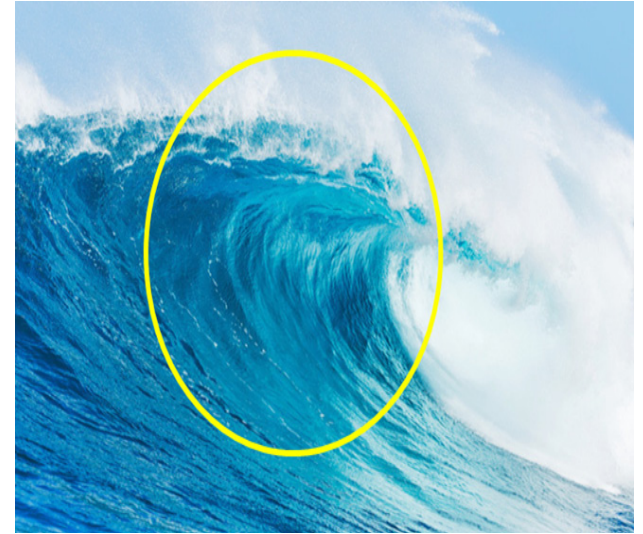
**SECTION 6: WAVES**

**QUESTION 22**

What part of the wave is indicated by the area within the yellow circle shown on the image to the right?

**CHOOSE THE BEST ANSWER**

- A. Trough
- B. Crest
- C. Curl
- D. Pipeline

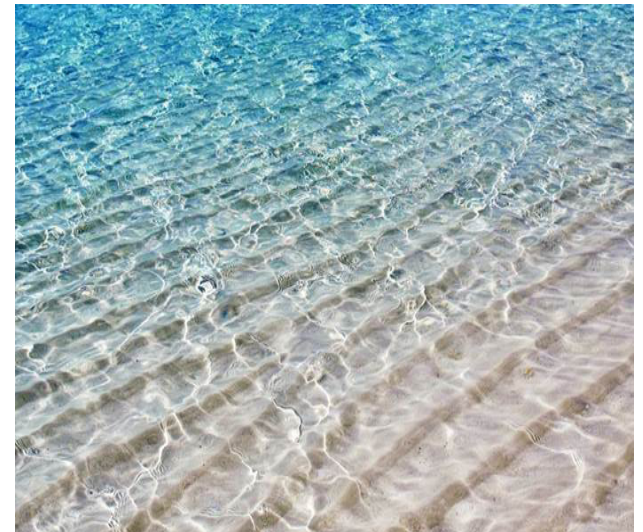


**QUESTION 23**

In what direction does the energy of a wave move?

**CHOOSE THE BEST ANSWER**

- A. Forward as well as up and down
- B. Backward as well as up and down
- C. Downwards only
- D. Forward only





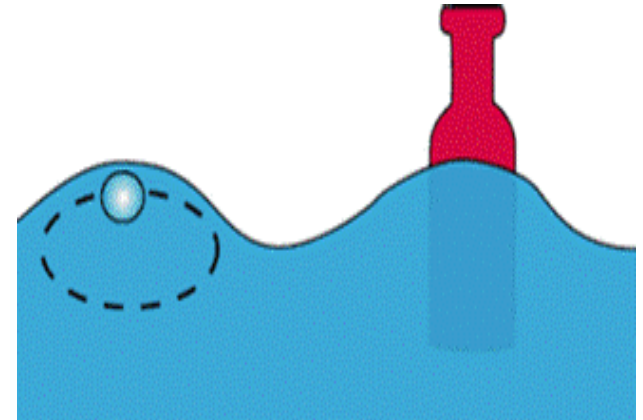
**SECTION 6: WAVES**

**QUESTION 24**

Which of the statements given below BEST describes what is illustrated in the drawing to the right?

**CHOOSE THE BEST ANSWER**

- A. Buoyancy of objects in water
- B. Direction of wave movement
- C. Water Density
- D. Molecular movement of ocean water



**QUESTION 25**

What is happening to the incoming waves as they approach the shore in the image shown to the right?

**CHOOSE THE BEST ANSWER**

- A. The waves are being reflected away from the shore
- B. The waves are being refracted by the shore
- C. The waves are being absorbed by the shoreline
- D. The waves are increasing in height as they near the shore



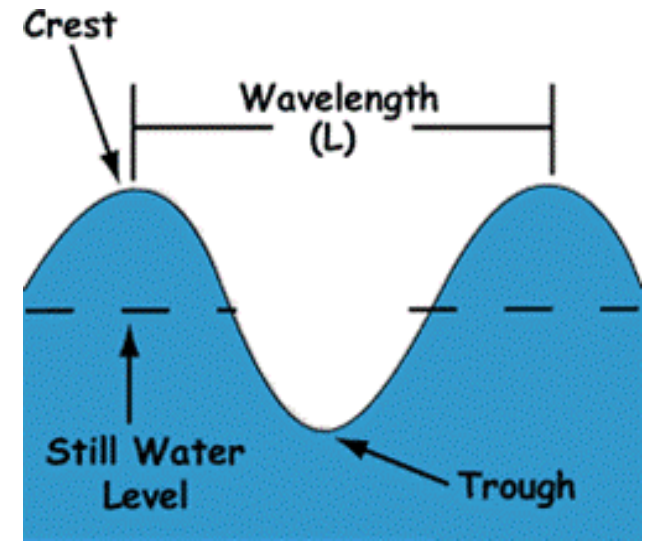
## SECTION 6: WAVES

### QUESTION 26

How is the height of a wave determined?

#### CHOOSE THE BEST ANSWER

- A. The horizontal distance from one wave crest to that of an adjacent wave
- B. The vertical distance between the trough and wave crest
- C. The vertical distance between the still water level and the crest
- D. The horizontal distance between the wave crest and the trough



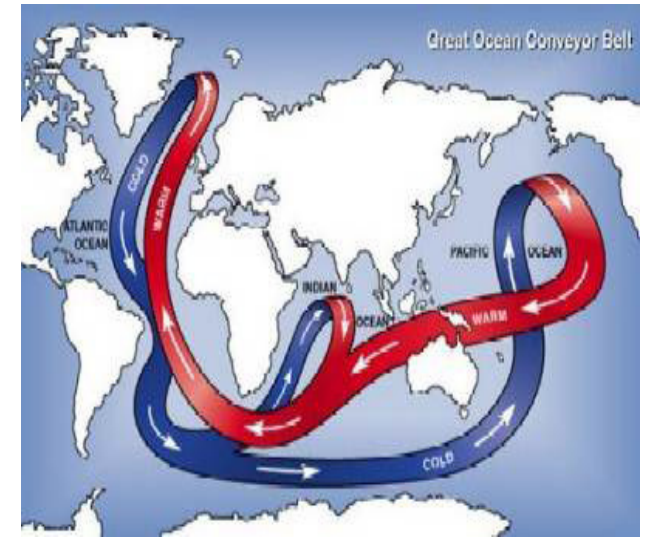
## SECTION 7: SURFACE CURRENTS

### QUESTION 27

Which of the following statements is NOT supported by the illustration of world surface currents shown to the right?

#### CHOOSE THE BEST ANSWER

- A. Thermal energy is transferred from areas of high concentration to areas of lower concentration
- B. The Coriolis Effect might explain the movement of tropical waters in an easterly direction
- C. Cold ocean waters move primarily in an easterly direction
- D. Heat is interchanged between warm and cool ocean currents in the North Atlantic



### QUESTION 28

What type of ocean current is identified by the white arrows shown on the map?

#### CHOOSE THE BEST ANSWER

- A. Coastal Currents
- B. Longshore Currents
- C. Ocean Gyres
- D. Rip Currents



## SECTION 7: SURFACE CURRENTS

### QUESTION 29

The map to the right shows what has come to be known as The Great Pacific Garbage Patch. What factor will NOT influence its movement in the Pacific Ocean?

#### CHOOSE THE BEST ANSWER

- A. Coriolis Effect
- B. Sea-Floor Spreading
- C. Ocean Gyres
- D. Sub-surface currents



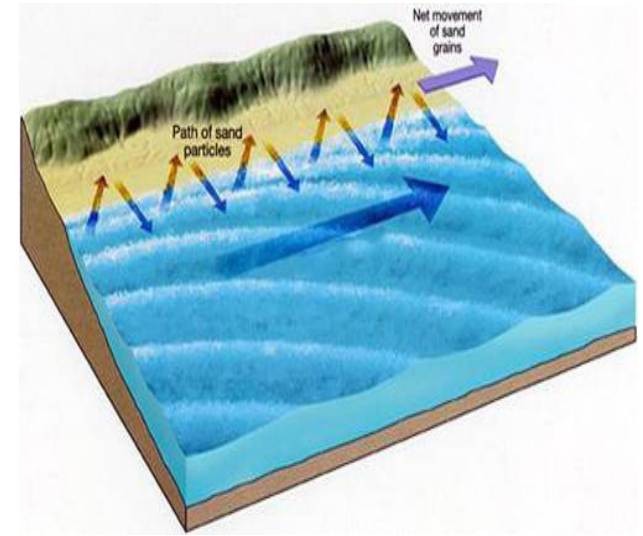
## SECTION 8: COASTAL CURRENTS

### QUESTION 30

What type of coastal current is shown in the drawing to the right?

#### CHOOSE THE BEST ANSWER

- A. Rip current
- B. Longshore Current
- C. Undertow Current
- D. Deep-Water Current

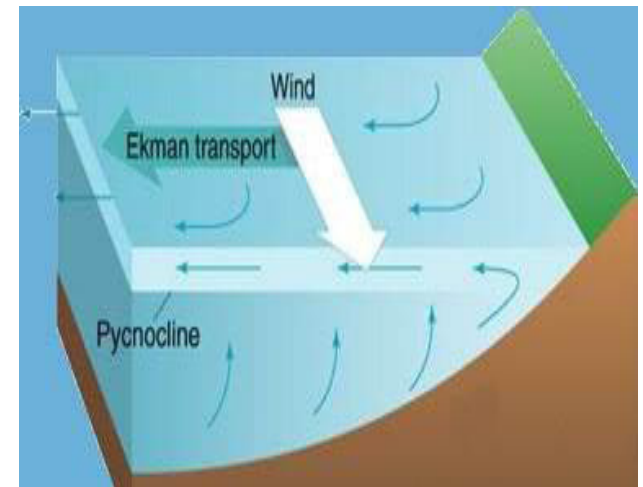


### QUESTION 31

Describe what is happening in the illustration shown to the right. Assume that the coastline is in North America.

#### CHOOSE THE BEST ANSWER

- A. The friction of the wind blowing along the surface of the water is deflected to the south by the Coriolis Effect
- B. Dissolved gases and nutrients are moved into deeper ocean waters
- C. Nutrient rich waters move towards the surface
- D. Waves are reflected away from the shoreline



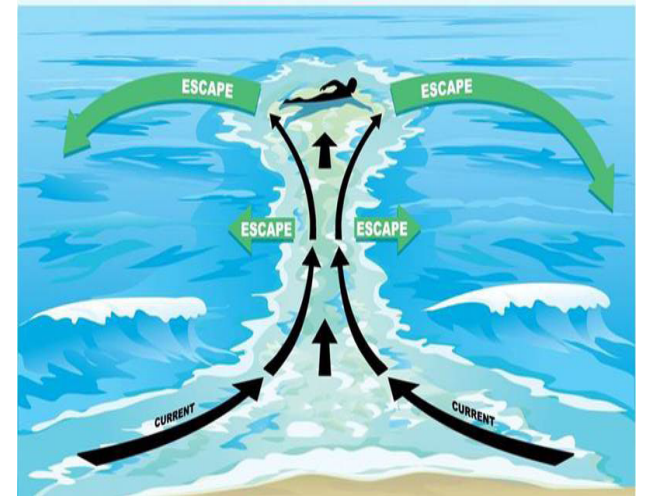
## SECTION 8: COASTAL CURRENTS

### QUESTION 32

What type of coastal current is shown in this illustration?

#### CHOOSE THE BEST ANSWER

- A. Rip Current
- B. Longshore Current
- C. Upwelling
- D. Sub-surface current



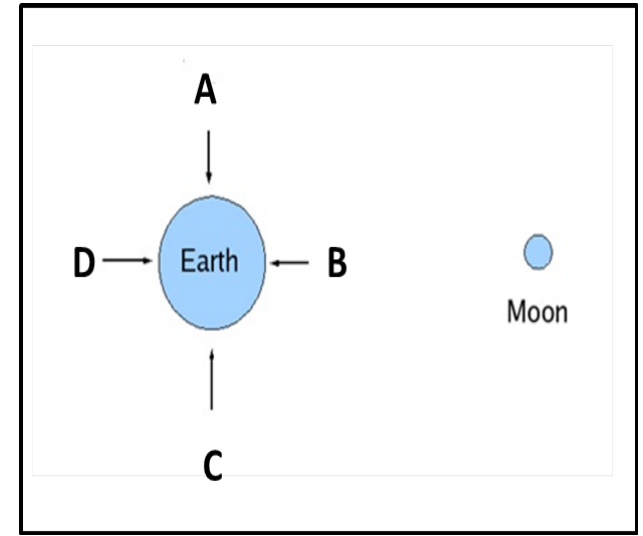
## SECTION 9: HIGH AND LOW TIDES

### QUESTION 33

Which pairs of letters on the drawing indicate areas of HIGH tide?

#### CHOOSE THE BEST ANSWER

- A. A and B
- B. B and C
- C. B and D
- D. A and C

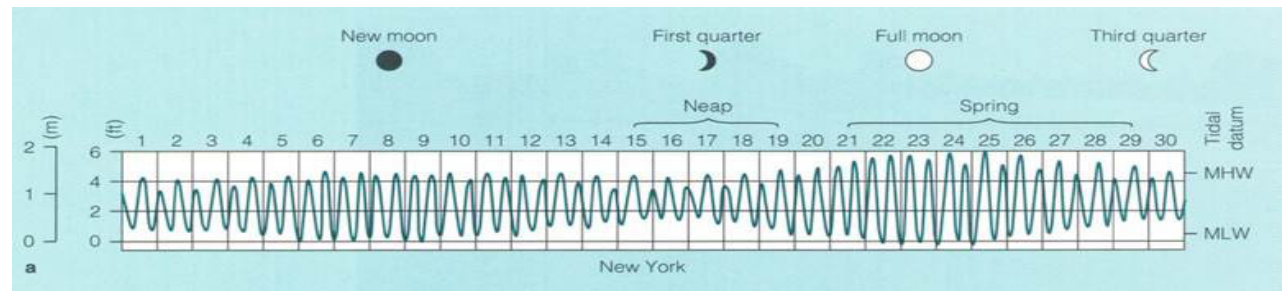


### QUESTION 34

The zero (0) indicated on the y-axis of this tidal graph of New York City shown to the right indicates:

#### CHOOSE THE BEST ANSWER

- A. Tidal Datum
- B. Tidal Bore
- C. Mean Sea Level
- D. Tidal Range



**SECTION 9: HIGH AND LOW TIDES**

**QUESTION 35**

Describe what is happening in the image shown to the right

**CHOOSE THE BEST ANSWER**

- A. Tidal waves created by a tsunami
- B. A tide caused by gravitational interactions between the Earth, Sun and Moon
- C. Waves caused by tides rushing into increasingly narrower and shallower passages
- D. A tide caused by gravitational interactions between the Earth and Jupiter





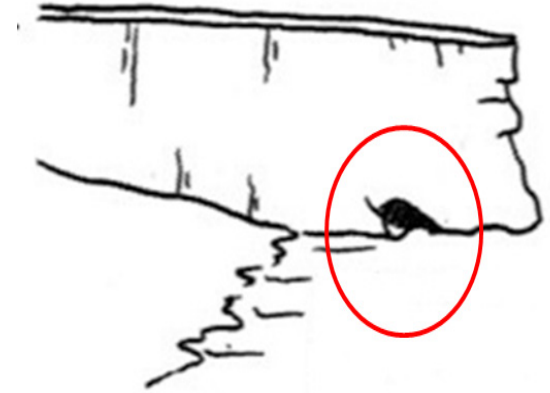
**SECTION 10: COASTAL FEATURES**

**QUESTION 36**

Identify the correct description of what is taking place in the image to the right.

**CHOOSE THE BEST ANSWER**

- A. Sea-Floor spreading is taking place
- B. Hydraulic action created by waves opens small caves
- C. The roof of the arch has collapsed
- D. The cave is widened by hydraulic action to form an arch



**QUESTION 37**

Identify the correct description of what is taking place in the image to the right.

**CHOOSE THE BEST ANSWER**

- A. Sea-Floor spreading is taking place
- B. Hydraulic action created by waves opens small caves
- C. The roof of the arch has collapsed
- D. The cave is widened by hydraulic action to form an arch



**SECTION 10: COASTAL FEATURES**

**QUESTION 38**

Identify the correct description of what is taking place in the image to the right.

**CHOOSE THE BEST ANSWER**

- A. Sea-Floor spreading is taking place
- B. Hydraulic action created by waves opens small caves
- C. The roof of the arch has collapsed
- D. The cave is widened by hydraulic action to form an arch



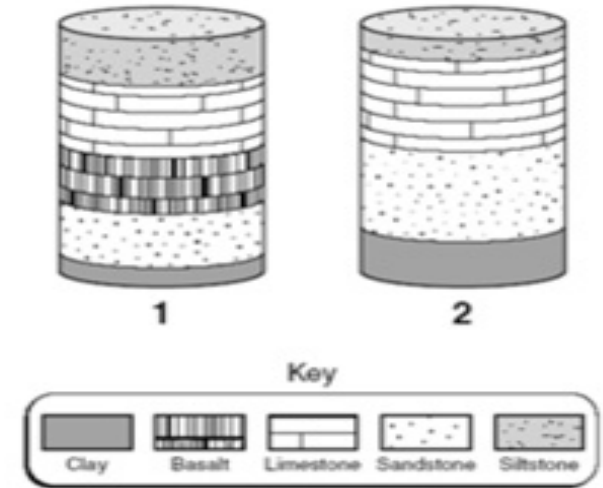
**SECTION 11: TOOLS OF OCEANOGRAPHY**

**QUESTION 39**

What tool of oceanography was used to obtain the samples indicated in the drawing to the right?

**CHOOSE THE BEST ANSWER**

- A. Box Corer
- B. Gravity Corer
- C. Grab Sampler
- D. Marine Magnetometer

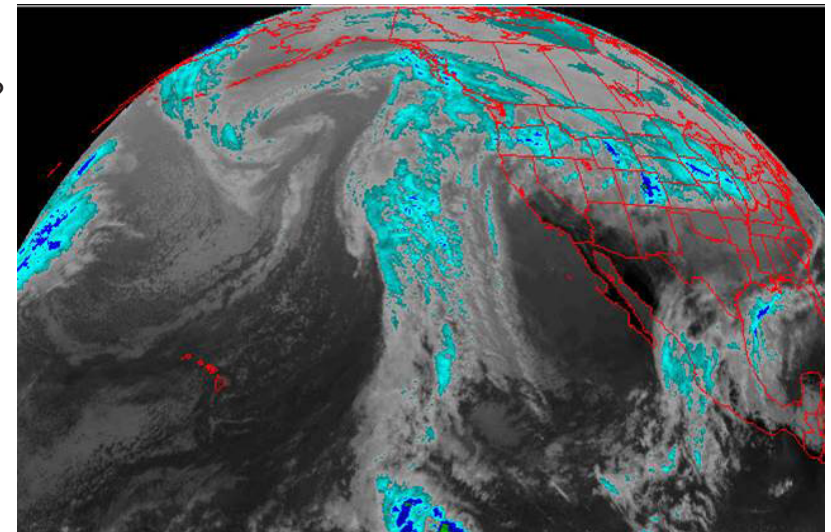


**QUESTION 40**

Which tool of oceanography was used to obtain the image shown to the right?

**CHOOSE THE BEST ANSWER**

- A. LANDSAT Satellite
- B. GOES Satellite
- C. MARINER Satellite
- D. ECHO Satellite



## SECTION 11: TOOLS OF OCEANOGRAPHY

### QUESTION 41

This tool of oceanography is used to measure energy generated by the movement of tectonic plates on the seafloor. What tool of oceanography is this?

#### CHOOSE THE BEST ANSWER

- A. Random Access Sampler
- B. CTD Sensors
- C. Bio-Mapper
- D. Ocean Bottom Seismometer



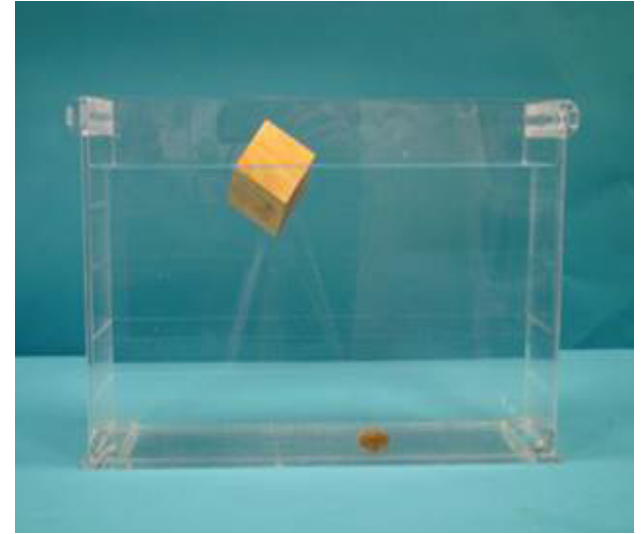
## SECTION 12: BUOYANCY

### QUESTION 42

A block of wood with a mass of 3.5Kg floats in water. What is the buoyant force on the block?

#### CHOOSE THE BEST ANSWER

- A.  $3.5\text{m}^3$  (cubic meters)
- B. 34.3N (Newtons)
- C. 9.8N
- D.  $5\text{m}^2$  (square meters)



### QUESTION 43

A floating object displaces  $0.6\text{m}^3$  of water. Calculate the buoyant force on the object and the weight of the object.

#### CHOOSE THE BEST ANSWER

- A. 9.8 N and 600Kg
- B. 5,880N (Newtons)
- C. 28 Metric Tons
- D. 2,800N



**SECTION 12: BUOYANCY**

**QUESTION 44**

A rectangular boat with a mass made out of concrete with a mass of 3000Kg floats on a freshwater lake ( $\rho = 1000\text{Kg/m}^3$ ). If the bottom area of the boat is  $6\text{m}^2$ , how much of the boat is submerged?

**CHOOSE THE BEST ANSWER**

- A. 1m (meter)
- B. 11N (Newtons)
- C. 0.5m
- D. 0.55mm (millimeters)



**SECTION 13: GENERAL OCEANOGRAPHY TOPICS**

**QUESTION 45**

What type of sediment covers about  $\frac{1}{4}$  of the sea floor and is composed primarily of lithogeneous sediment?

**CHOOSE THE BEST ANSWER**

- A. Pelagic
- B. Neritic
- C. Biogenous
- D. Cosmogenous

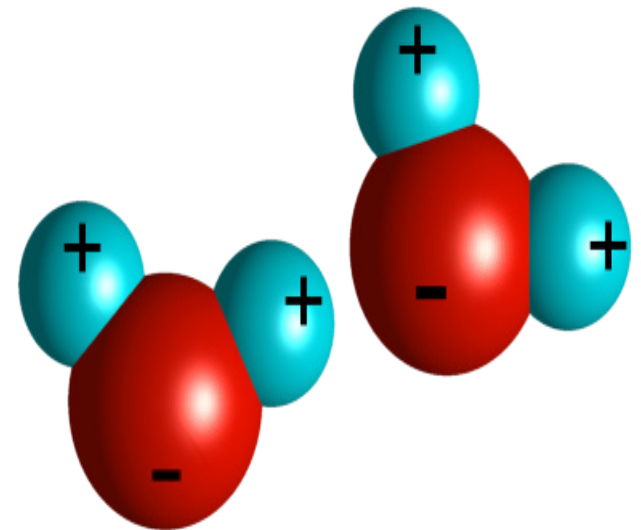


**QUESTION 46**

Single water molecules are held together by \_\_\_ bonds and multiple water molecules are held together by \_\_\_ bonds.

**CHOOSE THE BEST ANSWER**

- A. Polar Covalent
- B. Hydrogen Polar
- C. Nonpolar Polar
- D. Covalent Hydrogen



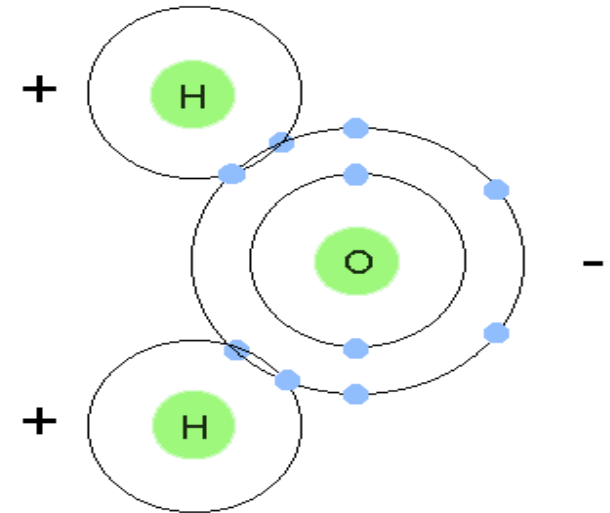
**SECTION 13: GENERAL OCEANOGRAPHY TOPICS**

**QUESTION 47**

The kind of bond where atoms are sharing electrons. All electron shells become full. In H<sub>2</sub>O, negative O has a negative charge and needs to steal electrons, so it bonds with a positive H. What type of bond is this?

**CHOOSE THE BEST ANSWER**

- A. Hydrogen
- B. Covalent
- C. Polar
- D. Non-Polar

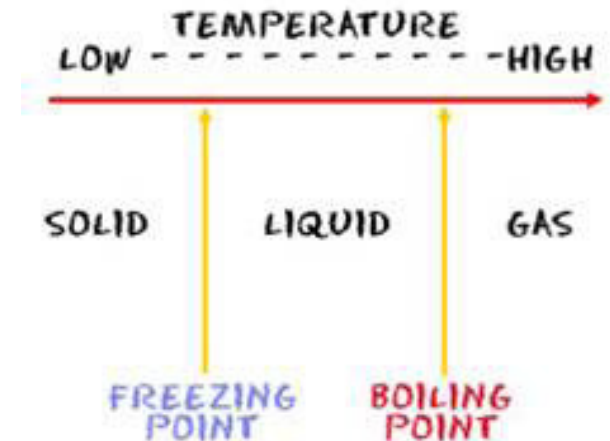


**QUESTION 48**

Heat is being released into the air. Gas is turning into a liquid and hydrogen bonds are formed. In this process, heat and energy are released. Name this process.

**CHOOSE THE BEST ANSWER**

- A. Evaporation
- B. Sublimation
- C. Precipitation
- D. Hydrothermal Vent Warming





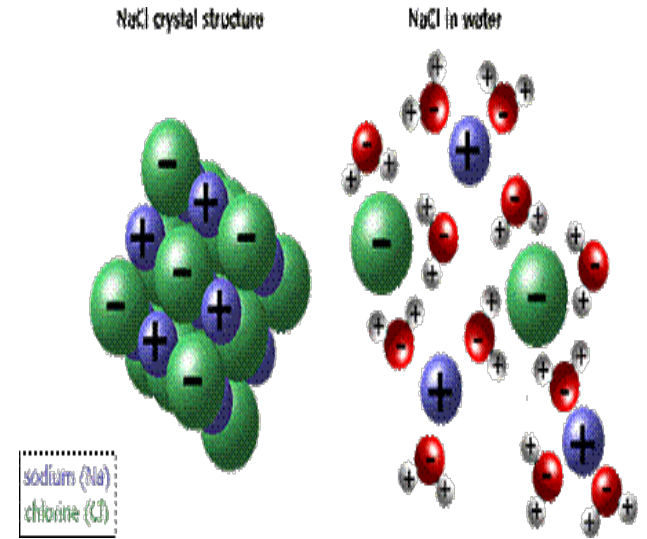
**SECTION 13: GENERAL OCEANOGRAPHY TOPICS**

**QUESTION 49**

When NaCl bonds with H<sub>2</sub>O, what is bonding with what?

**CHOOSE THE BEST ANSWER**

- A. Cl<sup>-</sup> bonds with O<sup>-</sup> while Na<sup>+</sup> bonds with H<sup>+</sup>
- B. O<sup>-</sup> bonds with Na<sup>+</sup> while Cl<sup>-</sup> bonds with H<sup>+</sup>
- C. O<sup>+</sup> bonds with Cl<sup>-</sup>
- D. O<sup>+</sup> bonds with Cl<sup>-</sup> while Na<sup>-</sup> bonds with H<sup>-</sup>



2015 DYNAMIC PLANET  
MI-INVITATIONAL COMPETITION ANSWER KEY

**SECTION 1: SEAWATER COMPOSITION**

1 **A**

2 **A**

3 **D**

**SECTION 2: WATER METRICS**

4 **B**

5 **C**

6 **A**

**SECTION 3: TOPO FEATURES**

7 **A**

8 **D**

9 **D**

10 **C**

11 **C**

**SECTION 4: TECTONIC PLATES**

12 **B**

13 **C**

14 **C**

15 **B**

16 **C**

**SECTION 5: REEF FORMATION**

17 **B**

18 **A**

19 **C**

20 **C**

21 **B**

**SECTION 6: WAVES**

22 **B**

23 **A**

24 **D**

25 **B**

26 **B**

**SECTION 7: SURFACE CURRENTS**

27 **B**

28 **C**

29 **B**

**SECTION 8: COASTAL CURRENTS**

30 **B**

31 **C**

32 **A**

2015 DYNAMIC PLANET  
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**SECTION 9: HIGH AND LOW TIDES**

33    **C**

34    **A**

35    **C**

**SECTION 10: COASTAL FEATURES**

36    **B**

37    **D**

38    **D**

**SECTION 11: TOOLS OF OCEANOGRAPHY**

39    **B**

40    **B**

41    **D**

**SECTION 12: BUOYANCY**

42    **B**

43    **B**

44    **C**

**SECTION 13: GENERAL OCEANOGRAPHY TOPICS**

45    **B**

46    **D**

47    **B**

48    **C**

49    **B**

2015 DYNAMIC PLANET  
MI-INVITATIONAL COMPETITION

TEAM \_\_\_\_\_

TEAM# \_\_\_\_\_

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2015 DYNAMIC PLANET  
MI-INVITATIONAL COMPETITION

**SECTION 9: HIGH AND LOW TIDES**

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