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Team Members: _____, _____

METEOROLOGY WRITTEN TEST: ANSWER KEY

Instructions:

Remember, you have **50 minutes**, so use your time wisely. If you don't know the answer to a question, you may wish to skip it and go on. An announcement will go out when 30 minutes, 15 minutes, and 5 minutes remain. If you finish early, you may wish to check over your answers.

You may use four 8.5" X 11" page of notes, front and back, along with two non-programmable, non-graphing calculators. If you have any questions, or are concerned about anything, please ask one of the event supervisors for help. Good luck and have fun!

Remember to write your names and school in the blanks provided on EACH page.

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- 1.) Which three gases make up the majority of our atmosphere? (1 point)

Nitrogen, Oxygen, and Argon

- 2.) In which layers of the atmosphere does an inversion occur? (1 point)

An inversion occurs in the stratosphere and thermosphere.

- 3.) Where on earth is the Coriolis Force the greatest? (1 point)

Near the poles; there is no Coriolis force at the equator.

- 4.) What is an isobar? (1 point)

An isobar is a line drawn on a weather map connecting points of equal pressure.

- 5.) What is the dry adiabatic lapse rate, per 100m? (1 point)

The dry adiabatic lapse rate is 1 degree Celsius per 100m.

- 6.) What does a radiosonde measure? Pressure, relative humidity, and temperature (1 point)

- 7.) Sometimes, clouds are located directly next to isolated mountain peaks. What special cloud is this?

Banner clouds (1 point)

- 8.) Name the four mechanisms that lift air so that condensation and cloud formation can occur.

a. Orographic Lifting: The forcing of air above a mountain barrier.

b. Frontal Lifting: The displacement of one air mass over another at a frontal boundary

c. Convergence: The horizontal movement of air into an area at low areas.

(Such as in a low pressure zone.)

d. Localized convective lifting due to buoyancy.

- 9.) Match the following Koppen classifications with the weather it is associated with: (2 pts each)

1. Af (E.)

A. Humid with severe, dry winter

2. BWh (C.)

B. Mild with no dry season, cool summer

3. Cfc (B.)

C. Cool deserts with a temperature lower than 18°C

4. Dwa (A.)

D. Polar tundra, no true summer

5. ET (D.)

E. Tropical wet climate, no true summer

- 10.) Fifteen minutes later you hear a very low rumble. When you look out the window you see a flash of lightning in the distance. You remember that light travels much faster than sound. Then you count 15 seconds until you hear the next rumble of thunder. This means the thunder is miles _____ away. (1 point)

a. 2

c. 15

b. 3

d. 30

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11.) Tornado: Myth or Fact? Put an 'X' in the blank next to the TRUE STATEMENTS ONLY.

(1 point for each correct "X")

_____ Tornadoes cannot hit downtown areas because the buildings deflect the airflow.

X Tornadoes can be invisible.

_____ Highway underpasses are a safe place to hide from tornadoes.

_____ A tornado watch means a tornado has been sighted.

X Wind speeds in a tornado can exceed 300 miles per hour.

12. If six tropical storms occurred in one season, would the second hurricane's name begin with B?

(1 point)

a. Yes, because hurricanes are named in alphabetical order.

b. Not necessarily because both tropical storms and hurricanes are named.

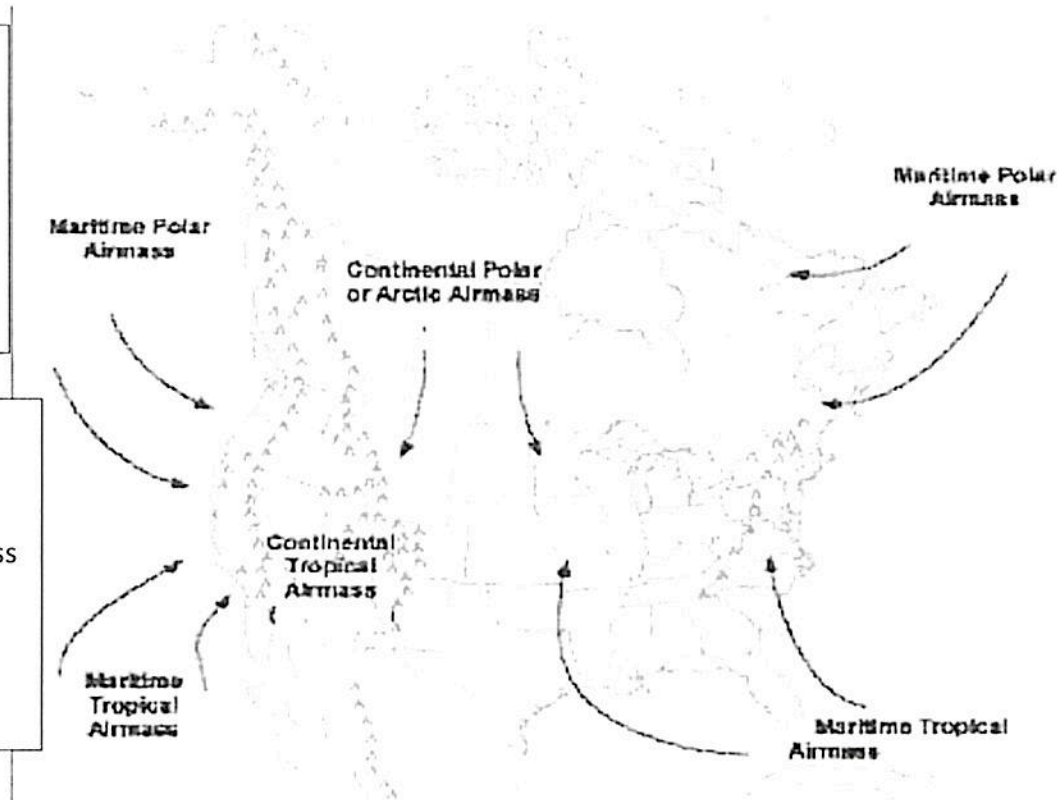
13. Meteorologists classify air masses according to the general temperature and moisture of the region where they form. The terms 'maritime' and 'continental' refer to the amount of moisture in the region while the terms 'arctic' and 'tropical' refer to the general temperature of the region. The map below shows the general location of the typical air masses we see over North America. Match the air mass name with the best description of its temperature and moisture. (4 points)

Descriptions:

- A) Cold and Dry
- B) Warm and Moist
- C) Cool and Moist
- D) Warm and Dry

Air Mass Name:

- C Maritime Polar Airmass
- A Continental Polar or Arctic Airmass
- B Maritime Tropical Airmass
- D Continental Tropical Airmass



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14. A thunderstorm just passed and you and your neighbor across the street find two big hail stones. You use a ruler to measure their size and find out that piece A was 4 centimeters and piece B was 6 centimeters. Using the equation provided, ($V = 10 \times D$ where V is the fall speed in meters per second and D is the size of hail in centimeters) you calculate that the fall speed of hailstone A is 40 meters per second and the fall speed of hailstone B is 60 meters per second.

A. Lets assume both hail stones are in the updraft of a thunderstorm with an updraft speed of 50 meters per second, which hail stone will probably stay in the updraft of the thunderstorm? (1 point)

Answer: Hailstone A

B. Assuming that the stones have not melted when you and your neighbor found them, which hail stone you think spent more time inside the thunderstorm? (1 point)

Answer: Hailstone B

15. The weather map shows the weather conditions for one day across the United States.



Based on the weather map, which city will most likely experience decreasing temperatures during the next 24 hours? (1 point)

- A) Denver, because it is raining there
- B) Minneapolis, because a cold front is approaching
- C) Atlanta, because a warm front is approaching
- D) Houston, because it is in a high-pressure area

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16. Hurricanes are rated on the Saffir-Simpson Scale (1-5). Tornadoes are rated on the Enhanced Fujita Scale (EF0-EF5). How are these ratings determined? (1 point)

- a. Saffir-Simpson is based on central pressure and Enhanced Fujita is based on wind speed.
- b. They are both based on wind speed.
- c. Saffir-Simpson is based on wind speed and Enhanced Fujita is based on damage.
- d. They are both based on damage.

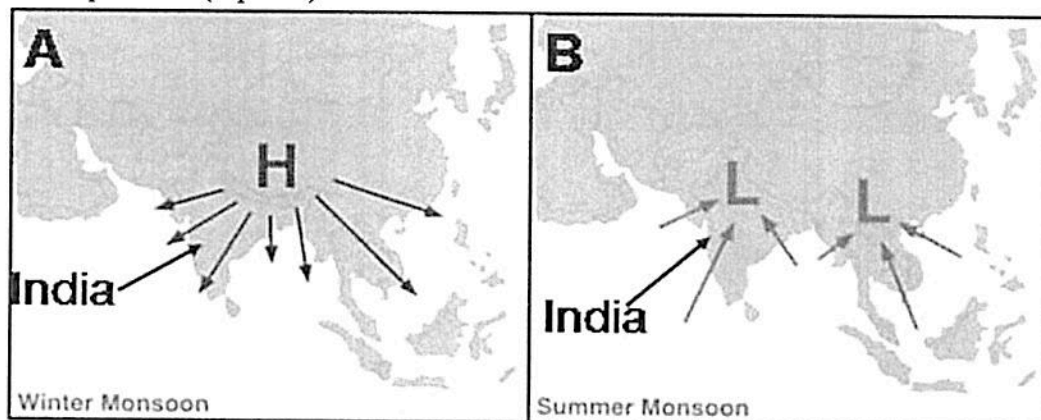
e. Saffir-Simpson is based on central pressure and Enhanced Fujita is based on damage.

17. Why are maritime air masses from the north Atlantic of only limited concern for weather in the U.S.?

(1 point)

- a) they never cause severe storms
- b) prevailing winds move them away from the U.S.
- c) temperatures are usually mild over this region
- d) polar fronts block these air masses from the U.S.
- e) question is incorrect; these air masses are very important

18. Global Circulation pattern: (1 point)



India every year has a period where they receive large amounts of rain. Meteorologists have learned that these periods, called monsoons, are related to the wind patterns over India. One of the reasons that India receives so much rain is that winds can bring a lot of moisture from the ocean and move it inland.

The wind patterns for the winter monsoon are shown by the arrows in panel A and the wind patterns for the summer monsoon are shown by the arrows in panel B. Which monsoon period has the wind pattern that you think will produce the greatest amounts of rain?

Answer: panel B

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19. The approximate lifetime of a wave cyclone is- (1 point)
- a) a month
 - b) 10 - 24 hours
 - c) 1 - 2 days
 - d) a few days to a week
 - e) 10 - 14 days
20. Which of these is common to both cold and warm fronts? (1 point)
- a) light to calm winds
 - b) lifting of warm air over cold
 - c) decreasing precipitation rates
 - d) divergence of surface winds
 - e) steady barometer readings
21. What determines when a tropical depression or storm is given hurricane status? (1 point)
- a) wind speed
 - b) central pressure
 - c) diameter
 - d) water temperature
 - e) amount of rainfall
22. TRUE or FALSE: Clear skies are associated with subsidence or sinking motion. (1 point)
- Answer: True
23. TRUE or FALSE: Adiabatic temperature changes refer to parcels of air that rise or sink. (1 point)
- Answer: True
24. Deserts such as the Great Basin, Gobi, and Takla Makan are examples of: (1 point)
- a) chinook deserts
 - b) subtropical deserts
 - c) rain shadow deserts
 - d) monsoon deserts

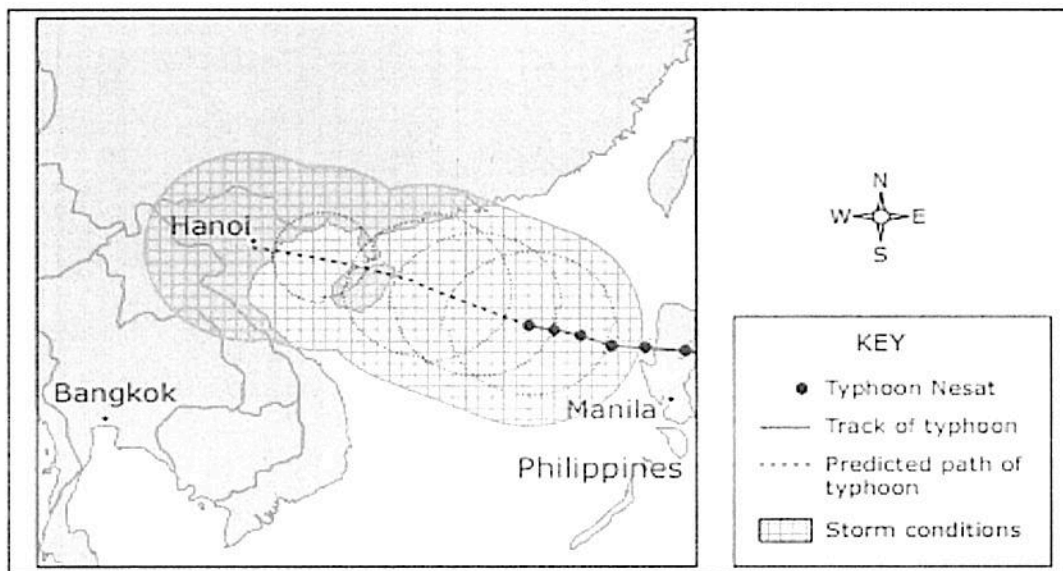
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25. In 2011, Typhoon Nesat struck the Philippines and caused widespread flooding. After hitting the Philippines, Typhoon Nesat was predicted to hit the large city of Hanoi, Vietnam.

Predicted Path of Typhoon Nesat



If Typhoon Nesat had continued along the same path, which development would most likely have reduced its strength before it hit Hanoi? (1 point)

- A) The formation of a low-pressure area south of Bangkok
- B) The formation of a high-pressure area south of Bangkok
- C) Cool water moving into the sea east of Hanoi
- D) Warm water moving into the sea east of Hanoi

26. Which of the following would not be associated with stable atmospheric conditions? (1 point)

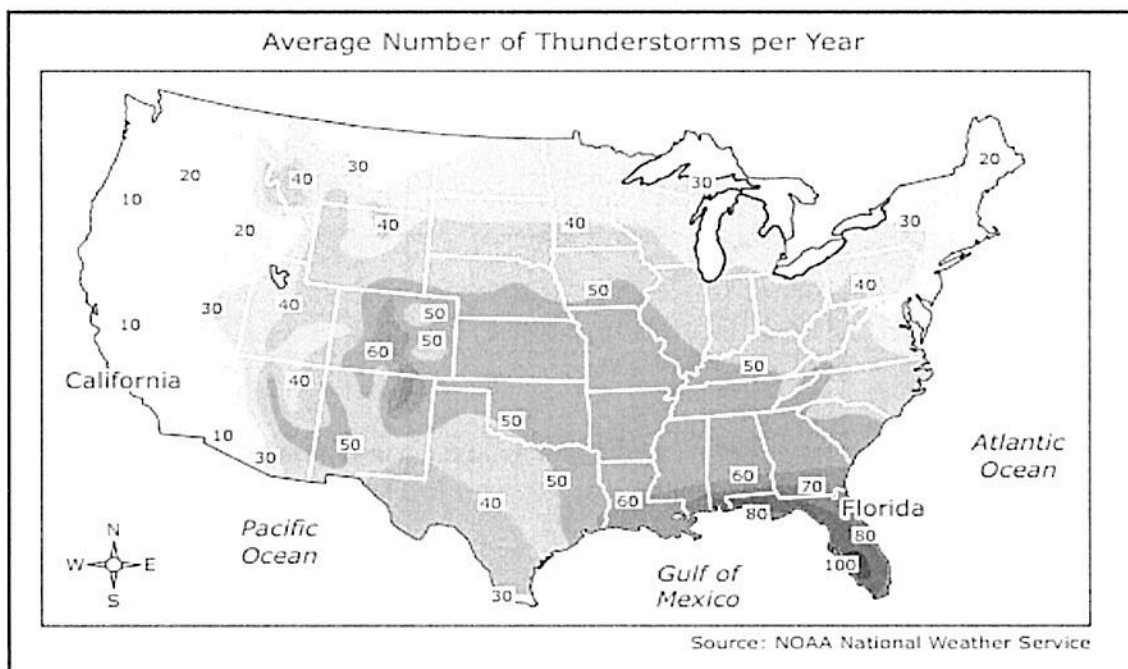
- a) widespread fog
- b) temperature inversion
- c) dreary overcast with light drizzle
- d) buildup of pollutants
- e) afternoon thundershowers

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27. Thunderstorms are more common in some areas than in others. The map shows the average number of thunderstorms per year in different parts of the United States.



Why are there significantly more thunderstorms in Florida than in California? (1 point)

- A) The state of Florida is smaller than the state of California.
- B) The air in Florida is more stable than the air in California.
- C) The air above Florida holds less moisture than the air above California.
- D) The ocean currents near Florida are warmer than the ocean currents near California.

28. A parcel of air has a temperature of 0°C as it crosses a mountain range at 3000 meters.

If it descends, what will its temperature be when it reaches sea level?

(1 point)

- a) 15°C
- b) 30°C
- c) 40°C
- d) 0°C
- e) none of these

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29. Downdrafts and updrafts found side by side relate to the _____ in the development of a thunderstorm. (1 point)

- a) cumulus stage
- b) mature stage
- c) dissipating stage
- d) sustaining stage

30. Which of the following should have the steepest pressure gradient? (1 point)

- a) tornado
- b) middle-latitude cyclone
- c) hurricane
- d) a, b and c should have equally steep pressure gradients
- e) both a and c have equally steep pressure gradients

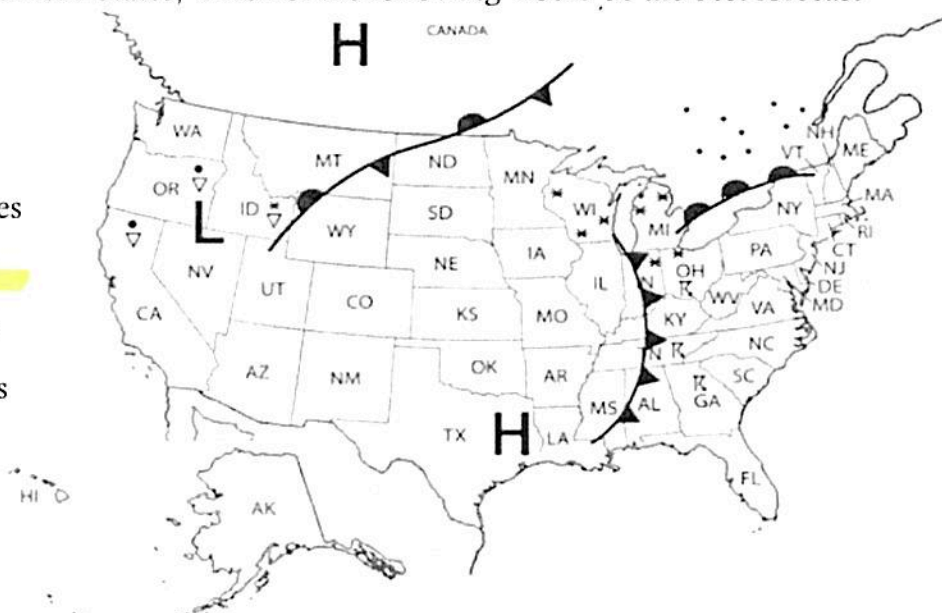
31. Why is strong heating of the ground by the sun associated with thunderstorms? (1 point)

- a) leads to greater instability
- b) reduces the relative humidity
- c) reduces the dew point
- d) increases the pressure gradient
- e) increases the wind speed

32. Using the weather map below of the United States, which of the following would be the best forecast for Texas the next several days?

(1 point)

- A) cloudy, rainy, and warmer temperatures
- B) clear, sunny, and cooler temperatures
- C) cloudy, rainy, and cooler temperatures
- D) clear, sunny, and warmer temperatures



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32. What causes the dissipating stage of a thunderstorm? (1 point)

- a) converging winds aloft
- b) release of latent heat within the cloud
- c) converging surface winds
- d) spreading downdraft cuts off air inflow
- e) loss of radiant energy from cloud top

33. What is the difference between: cumulus humilis, cumulus congestus, and cumulus mediocris clouds? (3 points)

Answer: Cumulus humilis have a height smaller than their width, mediocris have heights similar to width, and congestus have heights greater than their width.

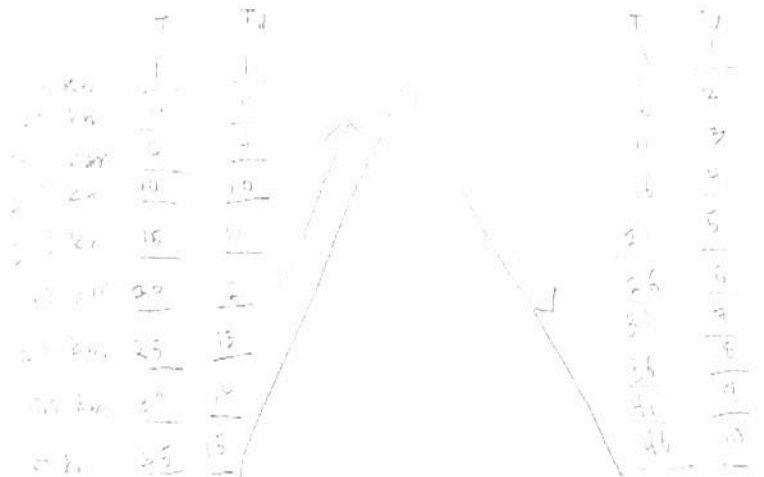
34. There is a 4.0 km mountain. Wind is blowing a parcel of air that has a temperature of 35°C and a dew point of 15°C up and over this mountain. The dry adiabatic lapse rate is $10^{\circ}\text{C}/\text{km}$, the moist adiabatic lapse rate is $6^{\circ}\text{C}/\text{km}$, and the dew point lapse rate is $2^{\circ}\text{C}/\text{km}$. (5 points)

A) If the air was lifted forever, what height would clouds form at? Answer: 2.5 km (2 points)

B) Will it rain on the mountain? Answer: YES (1 point)

C) What will the temperature of the air be once it reaches ground level on the other side of the mountain?

Answer: 46°C (2 points)



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35. A front marks the boundary between two air masses. There is generally not a sharp change in which of the following, as a front passes? (1 point)

- a) cloud cover b) dew point c) precipitation d) pressure e) temperature

36. What causes destruction of the ozone layer? (1 point)

Answer: Chlorofluorocarbons [CFC] (also accept chlorine)

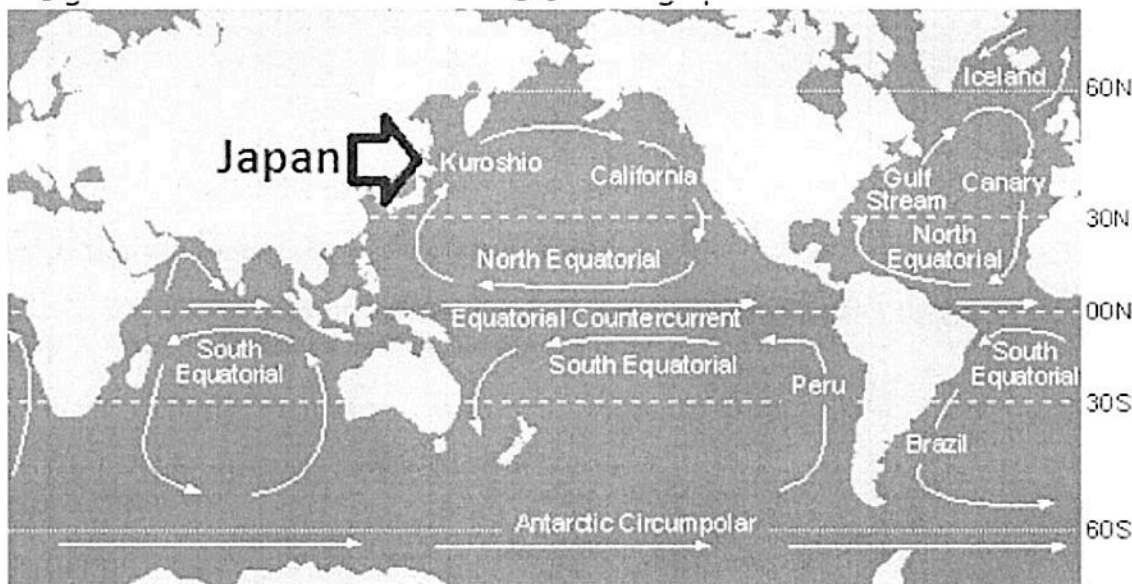
→ Where is the destruction most prominent? (1 point) Answer: it is most prominent over the poles.

37. Do cold fronts move faster than warm fronts or do warm fronts move faster than cold fronts? (1 point)

Answer: Cold fronts move faster than warm fronts.

→ Explain Why? (1 point) Answer: The high-density cold air can remove the low-density warm air faster than the warm air could remove the cold air.

38. Use the diagram below to answer the following question.



How would the climate of Japan be affected by the ocean current that is nearest to it? (1 point)

- A) The ocean current would cool down the climate of Japan.
 B) The ocean current would have no effect on the climate of Japan.
 C) The ocean current would cause typhoon rains for months at a time
D) The ocean current would warm the climate of Japan.

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39. When Earth first formed, there were only trace amounts of oxygen gas in the atmosphere.

Why is there some much today? (2 points)

Answer: Oxygen came from photosynthesis

How much is there (to the nearest 1%)? (1 point)

Answer: 21 %

40. Which temperature and moisture conditions describe an air mass that originates over the Atlantic Ocean near the equator?

(1 point)

A) warm and dry

C) warm and humid

B) cool and dry

D) cool and humid

41. The chief reason why waters near the equatorial regions are warmer than waters near the polar regions is that- _____.

(1 point)

A) equatorial waters are closer to the sun

B) sunlight is reflected by ice and snow in the polar regions

C) sunlight falls more direct in the equatorial region

D) There is more CO₂ in the atmosphere near the equator

42. A region of land near the ocean can reasonably be expected to experience which of the following effects on its climate due to the influence of the nearby ocean?

(1 point)

A) less precipitation, especially during spring

B) warmer summers and colder winters

C) constant, large changes in temperature

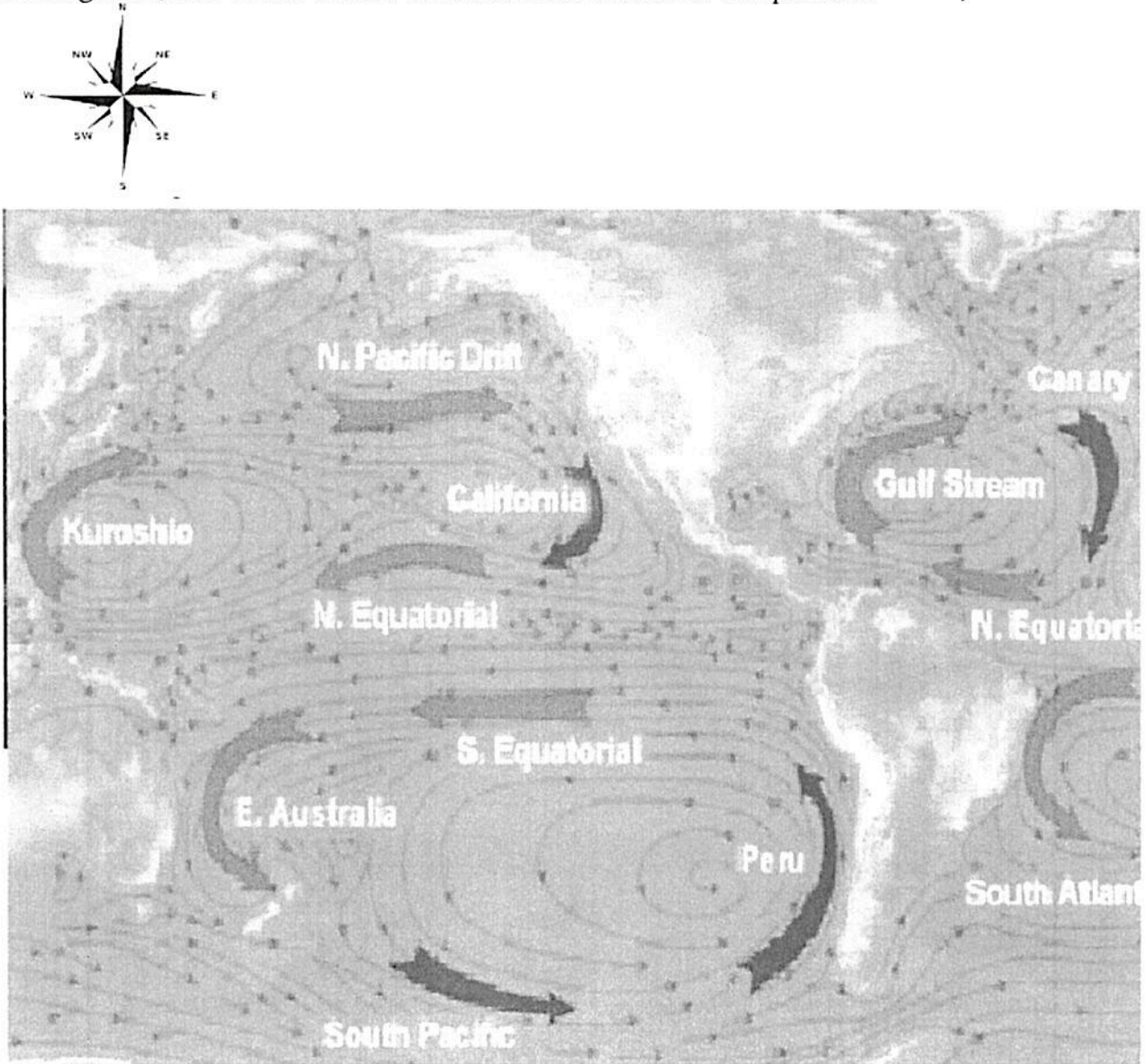
D) cooler summers and warmer winters

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44. Use the diagram below of the world's ocean currents to answer the question.



The east coast of the United States often has warm, humid summers, while the west coast experiences cooler, drier summers. Use the map above to give an explanation why the west coast is cooler and drier in summer. (1 point)

A) Warm California current

B) Cold California current

C) Warm Gulf Stream current

D) Cold Gulf Stream current

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Tie Breaker Questions:

TB (1): Would the “blanket effect” be a better name for the greenhouse effect?
Why? (2 points)

ANSWER: the greenhouse gases absorb IR radiation from Earth and radiate some back to Earth and some into space, similar to what a blanket does with heat from your body.

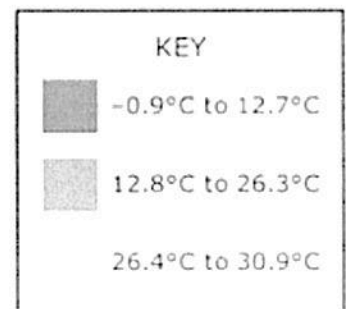
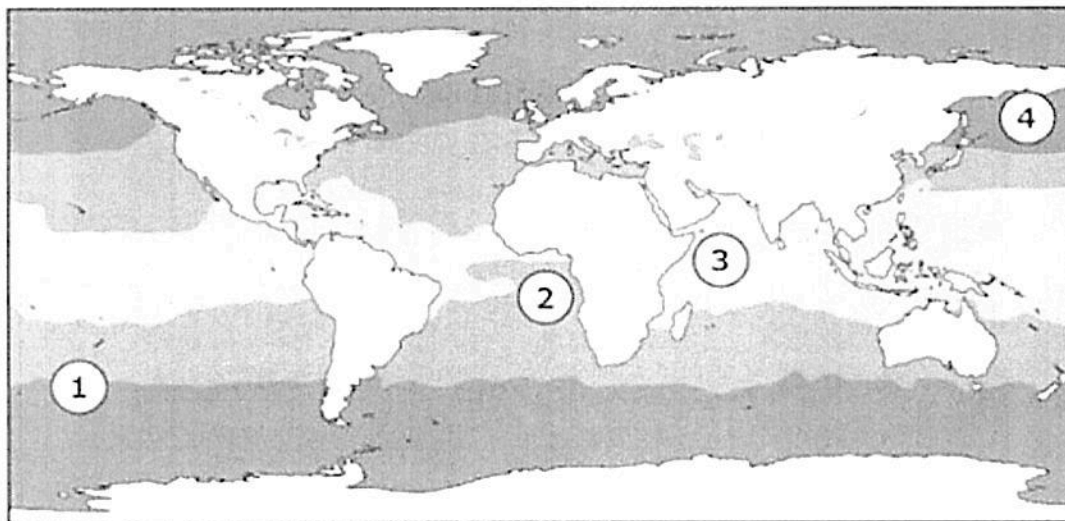
TB (2): What was the most common element in Earth’s first atmosphere? (1 point)

ANSWER: Hydrogen

TB (3):

Hurricanes and similar storm systems begin over oceans. The map below shows average surface temperatures of the oceans in the summer.

Oceanic Surface Temperatures in Summer



Source: NASA

Based on the map, which area probably produced the most violent storm systems?
(1 point)

Answer: Area 3