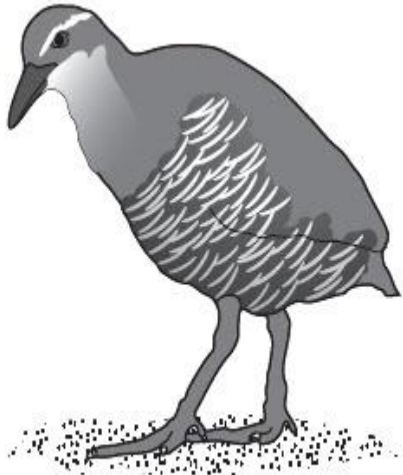
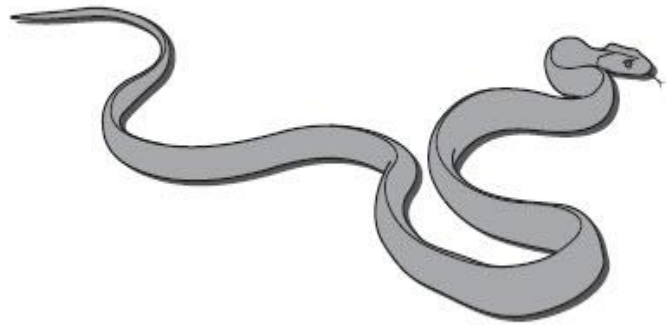


## Benchmark 04

- 1.** The Guam rail is a flightless bird found on the island of Guam. It builds a shallow nest on the ground and lays eggs throughout the year. There are no native species of snakes on Guam, so the Guam rail had no experience with snake predators until the brown tree snake was accidentally introduced sometime between 1944 and 1952. These snakes, which eat a wide variety of animal species, quickly established a large population on Guam.



Guam rail



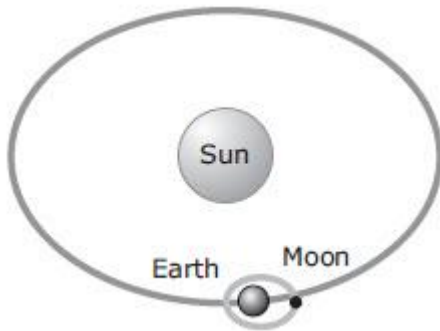
Brown tree snake

How was the Guam rail most likely affected by the introduction of the brown tree snake?

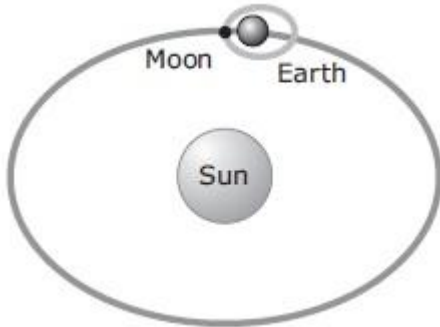
- A.** The brown tree snake ate only species that lived in trees, so it had no effect on the Guam rail.
- B.** The Guam rail quickly developed the ability to fly in order to escape from the brown tree snake.
- C.** The population of the Guam rail declined, and the species nearly became extinct.
- D.** The Guam rail began to build its nests in trees.

2. Different relative positions of the sun, the moon, and Earth have different effects on Earth's oceans. Which model shows the positions of the sun, the moon, and Earth that have the greatest effect on ocean tides?

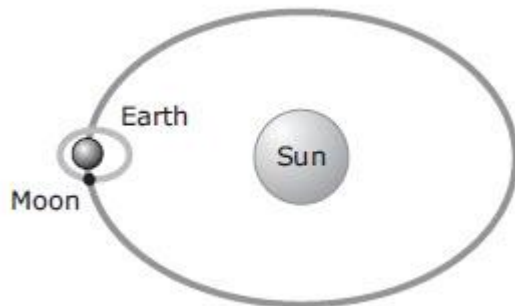
F.



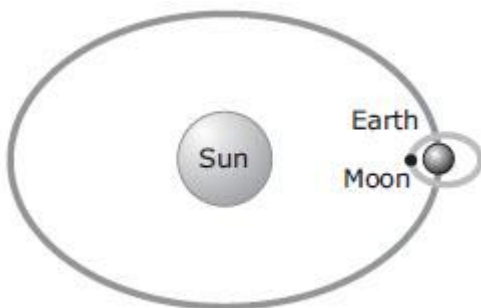
G.



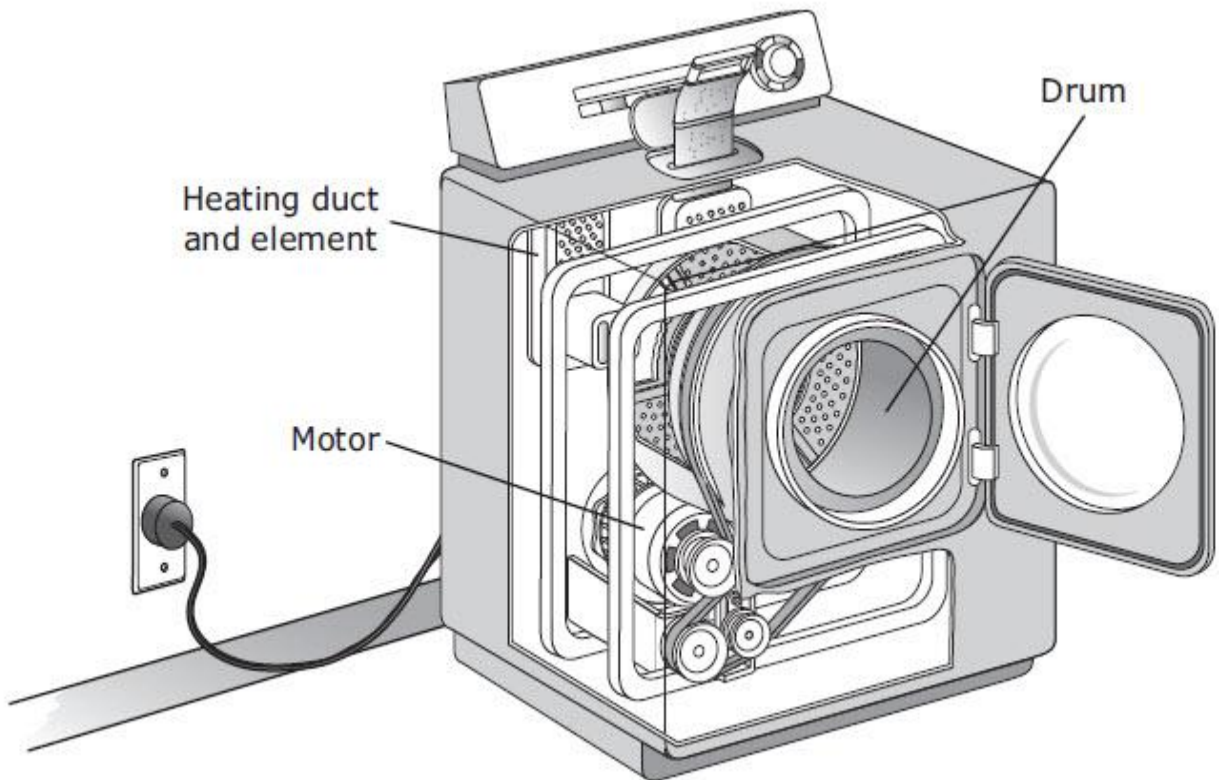
H.



J.



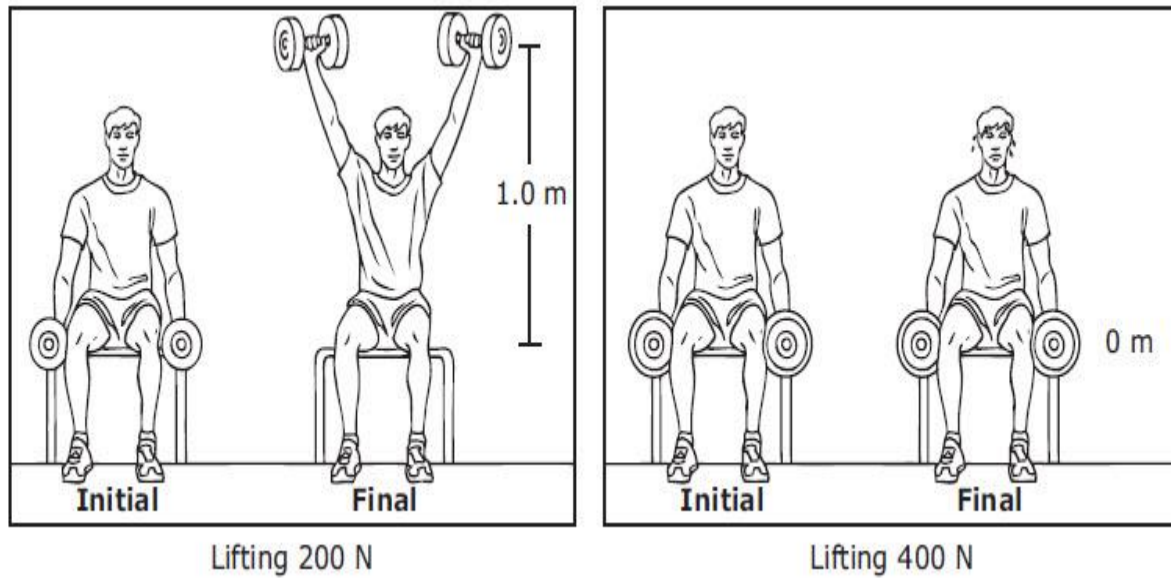
3. The main parts of a working clothes dryer are shown in the diagram.



This appliance dries clothes primarily by converting —

- A. electrical energy to heat and mechanical energy
  - B. mechanical energy to heat and electrical energy
  - C. electrical energy to heat and light
  - D. mechanical energy to heat and vaporization
4. Which list of characteristics describes organisms classified as animals?
- F. Unicellular, prokaryotic, autotrophic
  - G. Multicellular, eukaryotic, heterotrophic
  - H. Unicellular, eukaryotic, heterotrophic
  - J. Multicellular, eukaryotic, autotrophic

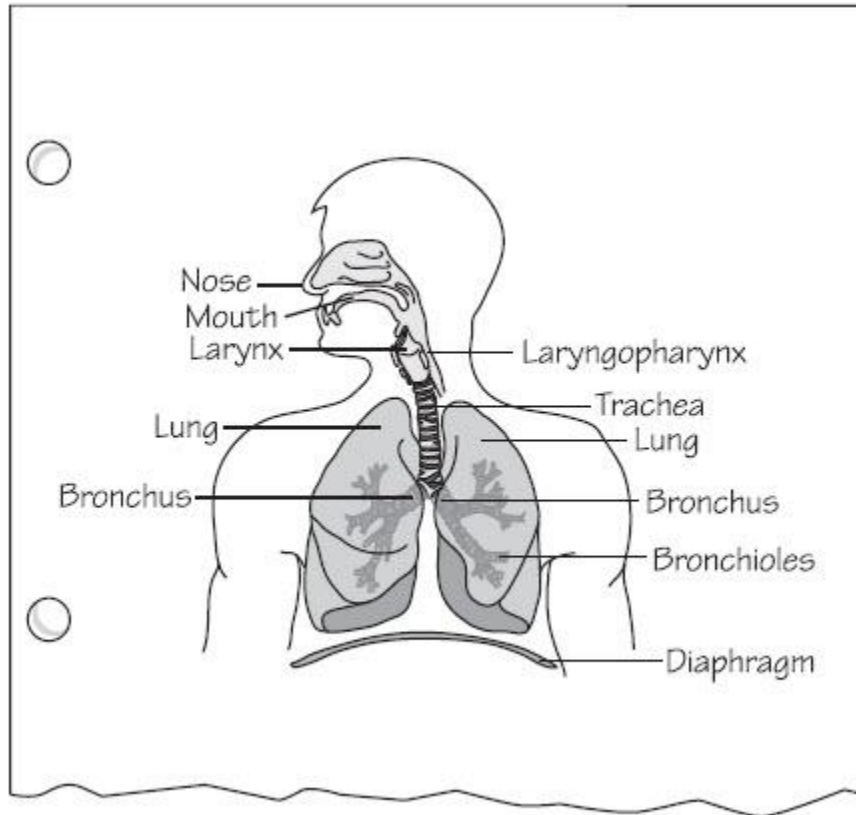
5. An athlete is trying to lift some weights. He successfully lifts 200 N weights, but when he tries to lift 400 N weights, he is unsuccessful.



Which of these correctly compares the amount of work the athlete does on the weights?

- A. The athlete does no work on either the 200 N weights or the 400 N weights.
- B. The athlete does no work on the 200 N weights but does work on the 400 N weights.
- C. The athlete does work on both the 200 N weights and the 400 N weights.
- D. The athlete does work on the 200 N weights but does no work on the 400 N weights.

6. A student drew the picture of a human body system shown below. The student labeled some of the organs of the system.



The main function of this human body system is to —

- F.** sense odors in the environment
- G.** exchange gases with the environment
- H.** chew food as it enters the mouth
- J.** trap particles that enter the nose

7. A phase of the moon is shown below.



Which pair of diagrams shows the moon's phase immediately before and immediately after this phase?

A.



Before



After

B.



Before



After

C.



Before

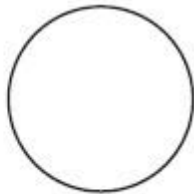


After

D.

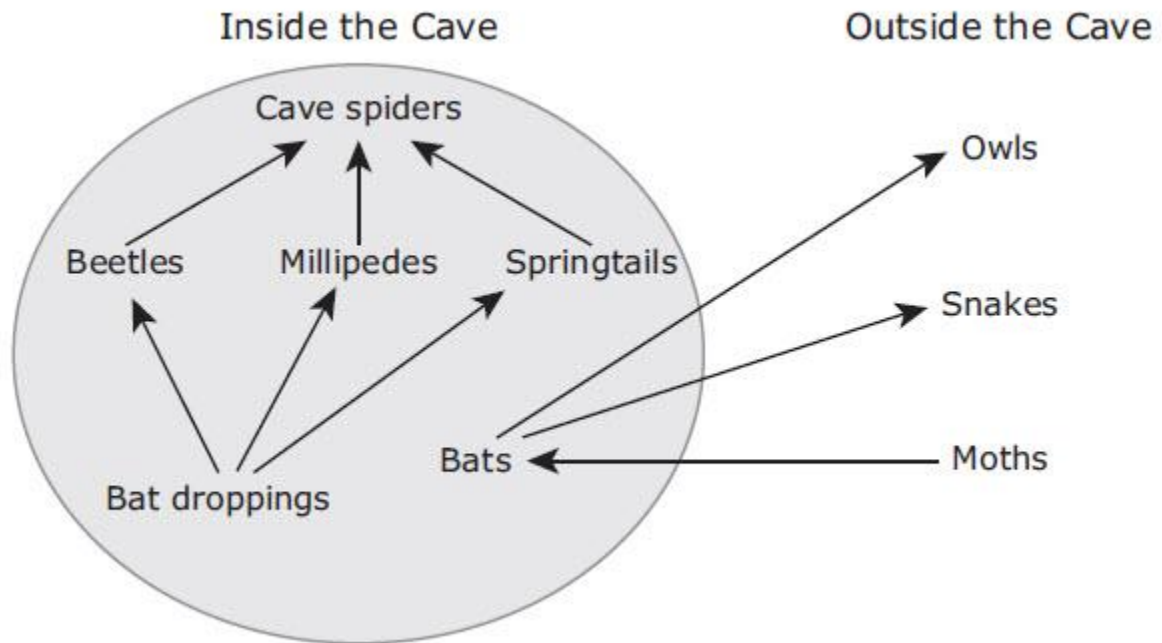


Before



After

8. Many Texas caves provide a habitat for animals that live in total darkness. The caves are damp and cool, and most of the caves are rich in the mineral calcite. The diagram below shows the relationships of some organisms involved in a cave ecosystem.



Based on the diagram, which of the following statements is valid?

- F. Owls are predators of bats, and bats are predators of moths.
  - G. Beetles compete with bats and cave spiders.
  - H. Snakes prey on bats and owls.
  - J. None of the above
9. Coal contains carbon and other elements. Carbon dioxide forms when coal burns in the presence of oxygen. Which of these is the best evidence that a chemical reaction occurs when coal burns?
- A. The shape of the coal changes.
  - B. Oxygen is present.
  - C. A new substance is produced.
  - D. Coal is made up of more than one element.

- 10.** A student wants to use a spinning basketball to model the day-and-night cycle on Earth.

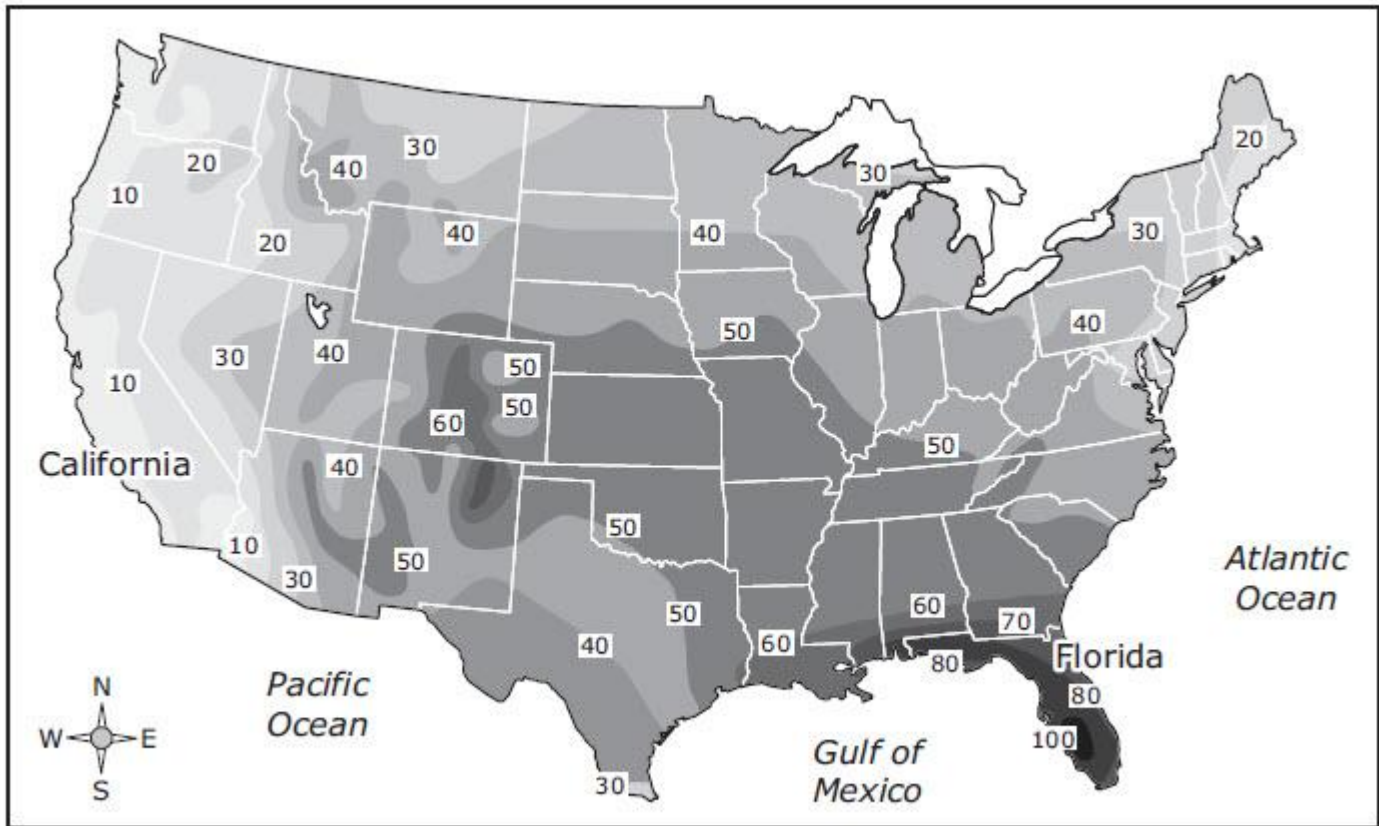


What should the student do in order to best model the cause of the day-and-night cycle?

- F.** Spin the ball in different directions
  - G.** Tilt the ball while it is spinning
  - H.** Paint one half of the ball black and the other half white
  - J.** Shine a bright light on one side of the ball
- 11.** The atoms of a certain element each contain 11 protons and 1 valence electron. Which statement correctly identifies this element and describes its chemical reactivity?
- A.** The element is sodium, and it is highly reactive.
  - B.** The element is fluorine, and it is not very reactive.
  - C.** The element is sodium, and it is not very reactive.
  - D.** The element is fluorine, and it is highly reactive.
- 12.** A bus travels 20 km in 30 minutes. What is the average speed of the bus?
- F.** 20 km/h
  - G.** 30 km/h
  - H.** 40 km/h
  - J.** 50 km/h

- 13** 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.

Average Number of Thunderstorms per Year



Source: NOAA National Weather Service

Why are there significantly more thunderstorms in Florida than in California?

- 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.

- 14.** During a demonstration of Newton's laws of motion, a student used the setup shown in Figure 1. The student flicked the index card with a fingertip, and the coin fell straight down into a plastic cup as shown in Figure 2.



Figure 1

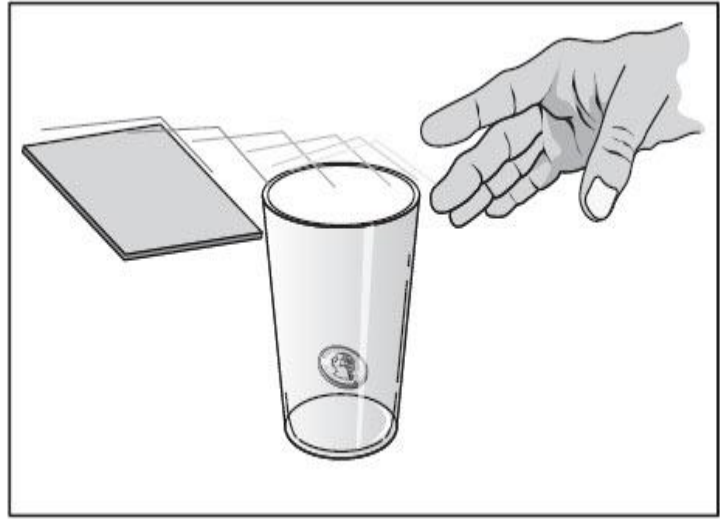


Figure 2

Which of these best explains why the coin fell straight down into the cup instead of remaining on the index card?

- F.** The coin was at rest until the card was removed, so it tended to remain in the same location. Once the card was gone, the unbalanced force of gravity caused the coin to fall.
- G.** Moving the card applied an action force on the coin. Since the card was gone, gravity applied a reaction force on the coin.
- H.** The card had less mass than the coin, so a smaller force of gravity acted on the card. The larger force of gravity on the coin made it fall.
- J.** The acceleration of the coin falling into the cup was equal and opposite to the acceleration of the card.

15. For an investigation a student records data about four unknown substances.

Data for Unknown Substances

Substance	Mass (g)	Volume (cm <sup>3</sup> )	Density (g/cm <sup>3</sup> )
1	6.95	4.0	
2	4.54	2.0	
3	5.40	3.0	
4	10.35	5.0	

The student then calculates the densities of the unknown substances and compares them with the table of densities of known substances shown below.

Densities of Some Known Substances

Substance	Density (g/cm <sup>3</sup> )
Calcium	1.54
Carbon	2.27
Magnesium	1.74
Phosphorus	1.82
Platinum	21.46
Sulfur	2.07

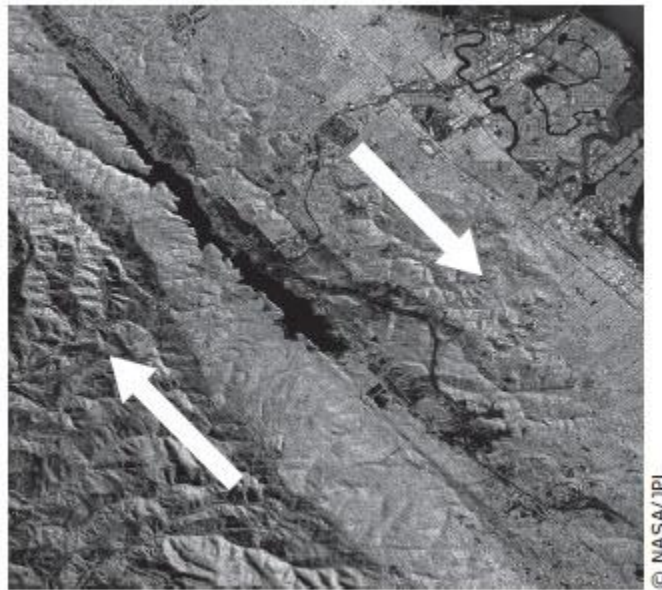
Which unknown substance is most likely carbon?

- A. Substance 1
  - B. Substance 2
  - C. Substance 3
  - D. Substance 4
16. Which of these human activities is most likely to cause the excessive growth of phytoplankton in the world's oceans?
- F. The use of chemical fertilizers that are carried by runoff into rivers
  - G. The logging of old-growth forests, which results in erosion
  - H. The spraying of chemical herbicides that reduce carbon dioxide in the air
  - J. The mining of fossil fuels, which requires digging underground tunnels

- 17.** An atom of a certain element has 36 protons, 36 electrons, and a mass number of 84. At room temperature this element is a very stable gas. How many neutrons are in this atom?

Record your answer and fill in the bubbles on your answer document. Be sure to use the correct place value.

- 18.** The image shows a plate boundary. Arrows have been added to indicate the movement of the plates.



What plate boundary feature is also shown?

- F.** A ridge formed by an inactive convergent boundary
- G.** A valley forming at an active divergent boundary
- H.** A fault forming at an active transform boundary
- J.** A volcano formed by an active transform boundary

19. Four students push carts filled with sports equipment across the gym. Each student pushes with the same amount of force. Which cart has the greatest change in speed?

A.



12 tennis rackets  
 $m = 10 \text{ kg}$

B.



15 sports balls  
 $m = 15 \text{ kg}$

C.



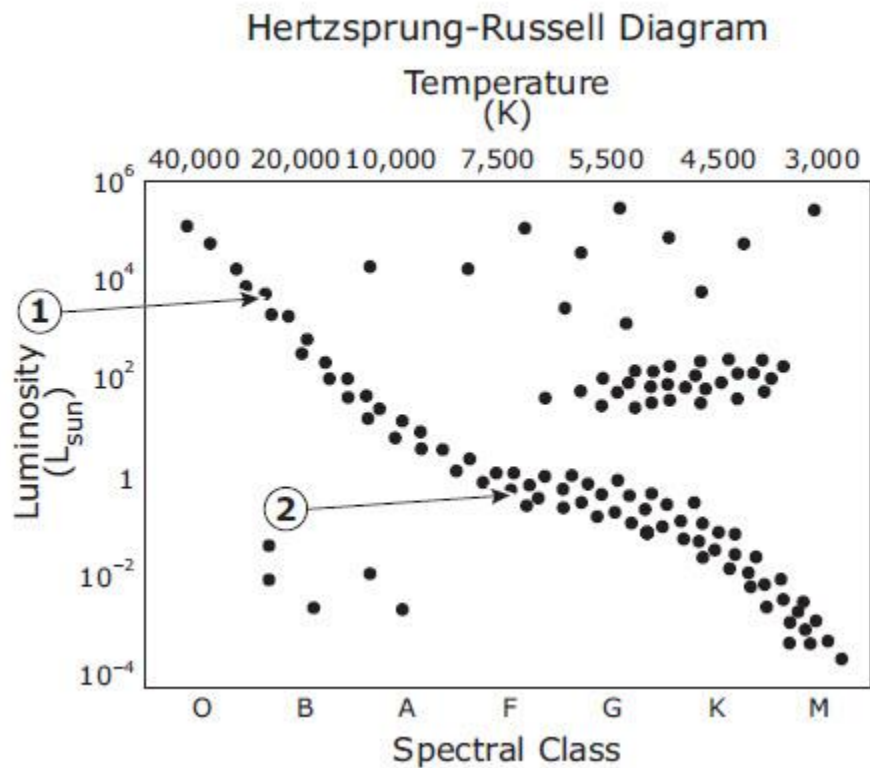
18 exercise mats  
 $m = 20 \text{ kg}$

D.



28 pieces of rope  
 $m = 25 \text{ kg}$

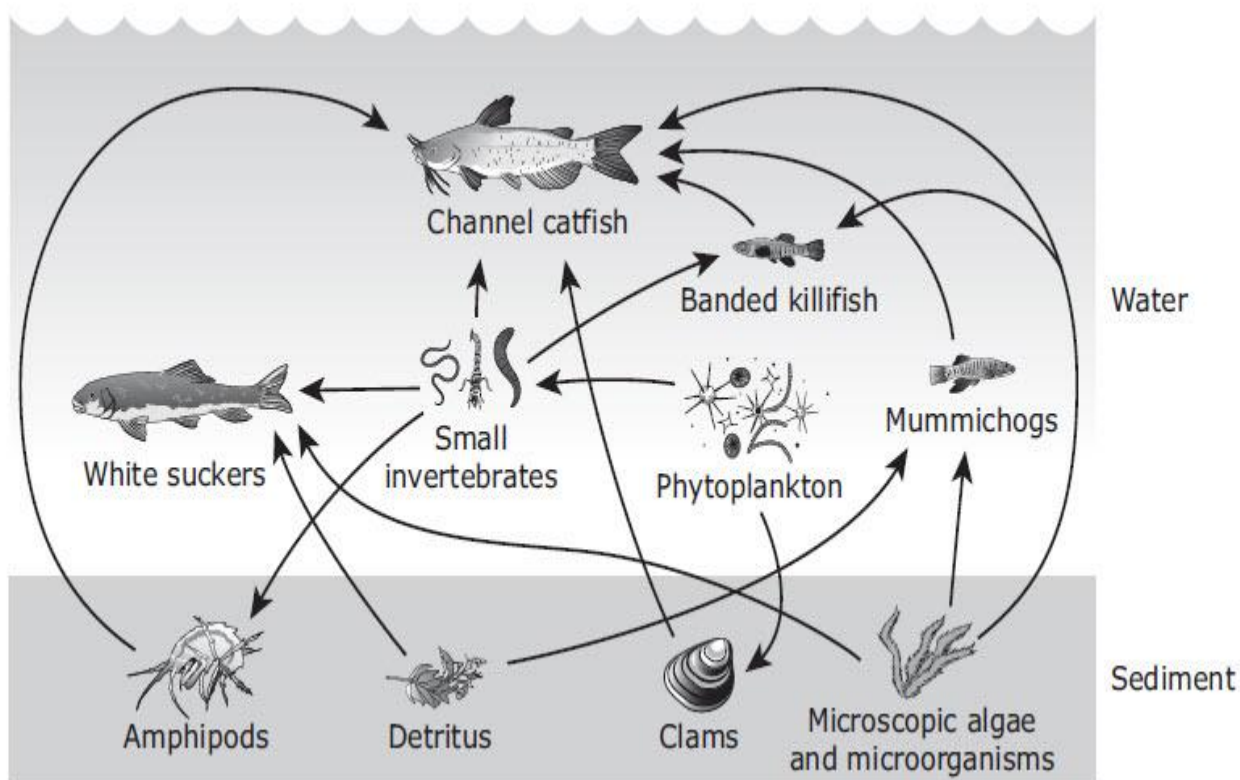
20. Two stars are identified on the Hertzsprung-Russell diagram below.



Based on this diagram, how do the characteristics of Star 1 and Star 2 compare?

- F. Star 1 is cooler and less bright than Star 2.
- G. Star 1 is hotter and brighter than Star 2.
- H. Star 1 is cooler and brighter than Star 2.
- J. Star 1 is hotter and less bright than Star 2.

21. The partial food web shown below is found in an aquatic environment. This type of environment has many organisms in the same trophic levels.

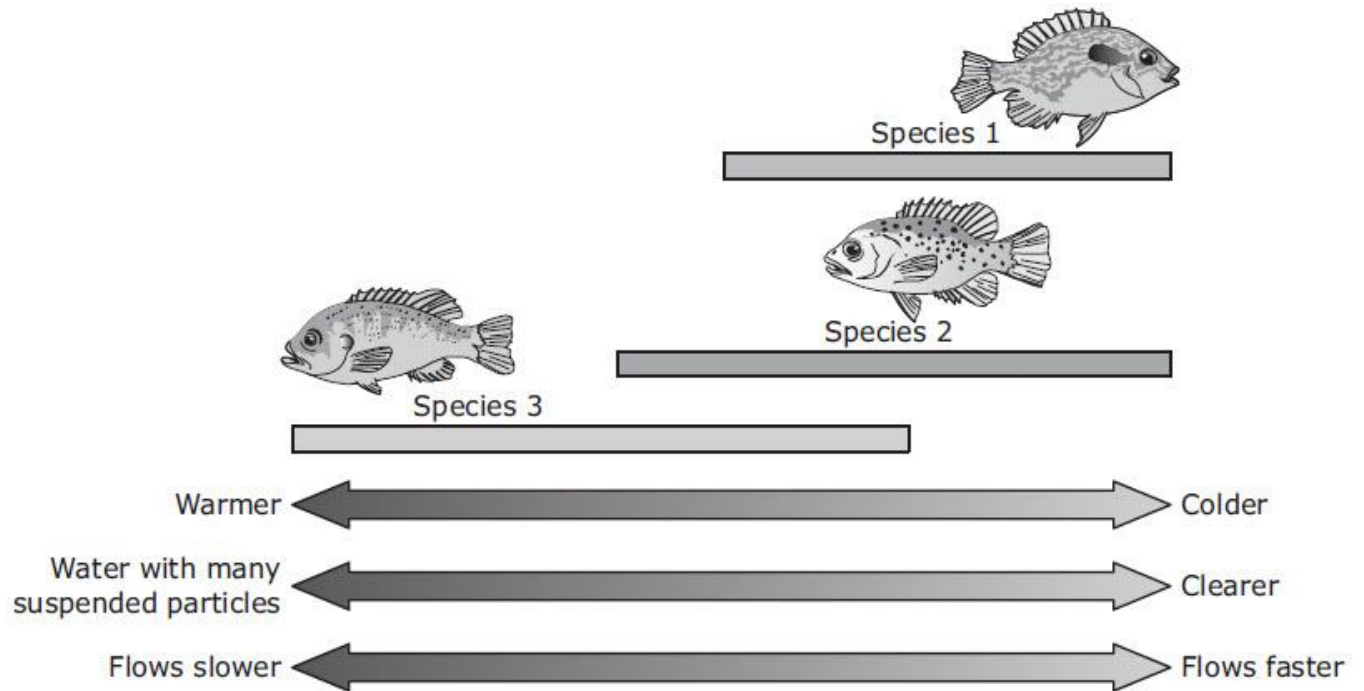


Which two types of organisms in this aquatic food web have a producer–consumer relationship?

- A. Microscopic algae and white suckers
  - B. Small invertebrates and amphipods
  - C. Phytoplankton and mummichogs
  - D. Amphipods and channel catfish
22. All the following reactions are correctly balanced except—

- F.  $2\text{C}_2\text{H}_2 + 5\text{O}_2 \longrightarrow 4\text{CO}_2 + 2\text{H}_2\text{O}$
- G.  $4\text{Fe} + 3\text{O}_2 \longrightarrow 2\text{Fe}_2\text{O}_3$
- H.  $\text{NaHCO}_3 \longrightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$
- J.  $2\text{CH}_3\text{OH} + 3\text{O}_2 \longrightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$

- 23.** The graph below shows the range of water conditions preferred by three species of fish in an Ozark stream.



Water with which of these conditions would cause the most competition for resources among all three species of fish?

- A.** Very cold, very clear, and very fast
- B.** Very warm, very clear, and very slow
- C.** Mild temperatures, some suspended particles, flows very fast
- D.** Mild temperatures, some suspended particles, flows at a medium speed

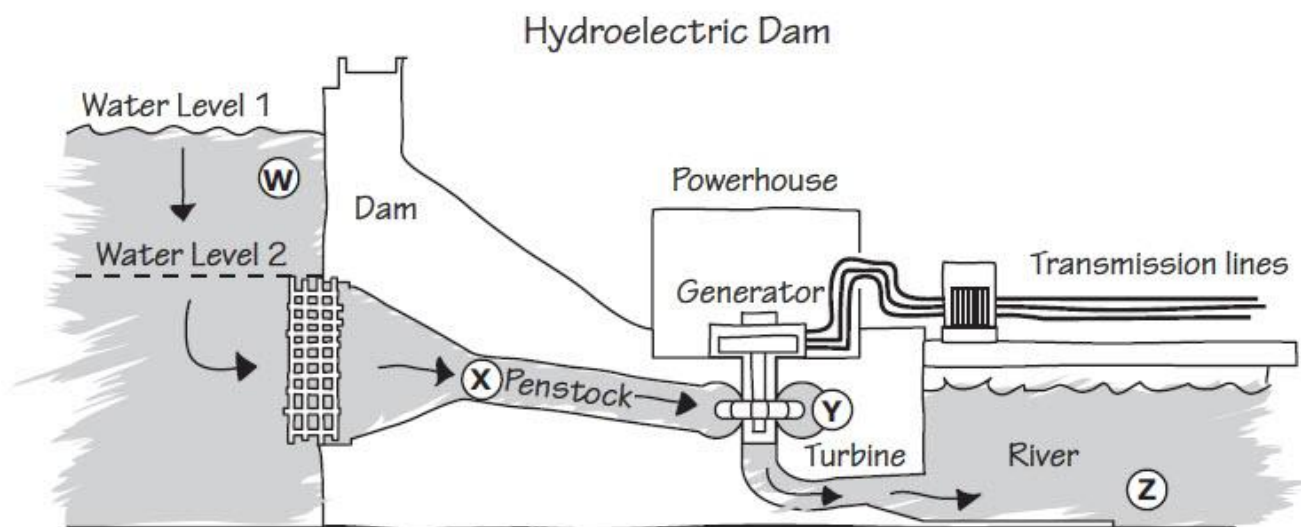
24. The periodic table is organized into groups and periods of elements. The characteristics of a certain group of elements are listed below.

### Characteristics of a Group of Elements

- Is shiny
- Is solid at room temperature
- Has atoms with two valence electrons

Which of these elements is in this group?

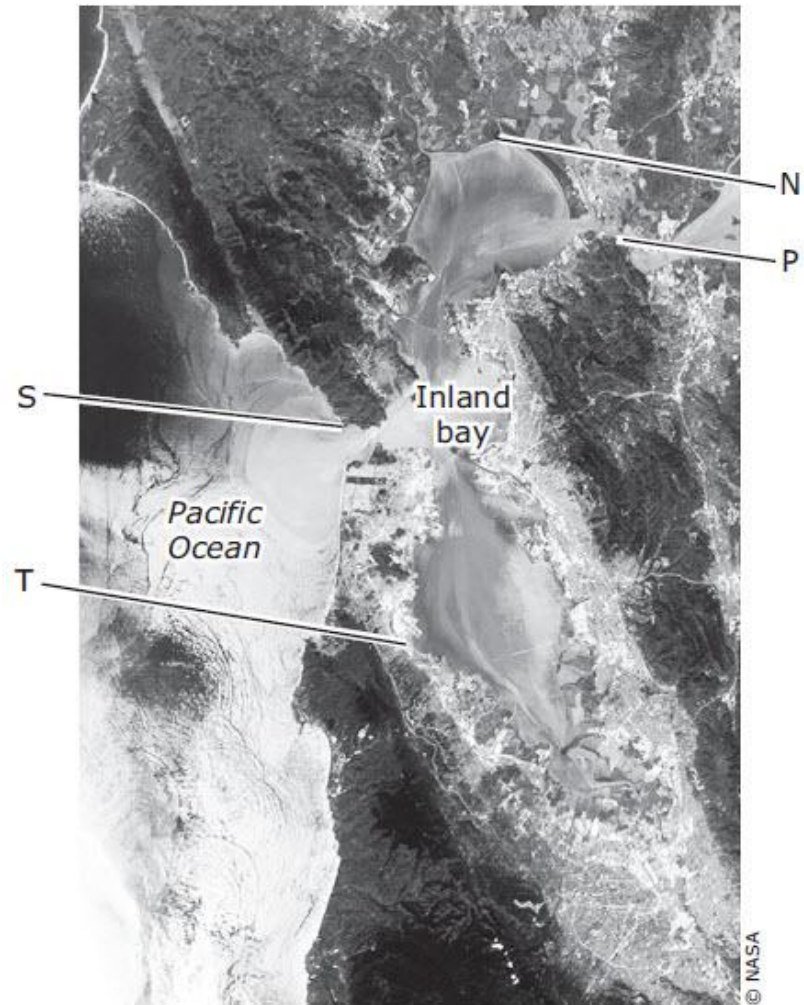
- F. Lithium  
G. Strontium  
H. Aluminum  
J. Silicon
25. A student drew the diagram below to show the movement of water through a hydroelectric dam.



The student used the diagram to describe changes in the potential and kinetic energy of the water. At which location is the gravitational potential energy of the water the greatest?

- A. Location W  
B. Location X  
C. Location Y  
D. Location Z

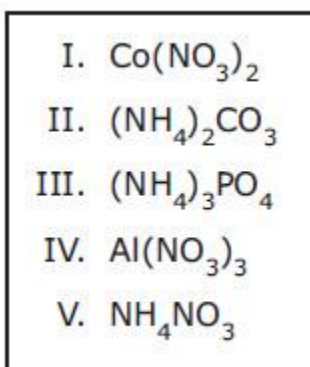
26. The satellite photo below shows San Francisco, California, which has many miles of coastline and an inland bay.



Which area of the coastline has most likely experienced the greatest effect of erosion from waves over hundreds of years?

- F. Area N
- G. Area P
- H. Area S
- J. Area T

**27.** Which of these formulas contain equal numbers of nitrogen atoms?



- A.** Formulas I and III
- B.** Formulas I and IV
- C.** Formulas II and III
- D.** Formulas I, II, and V

**28.** A student examines the winged insect shown below.



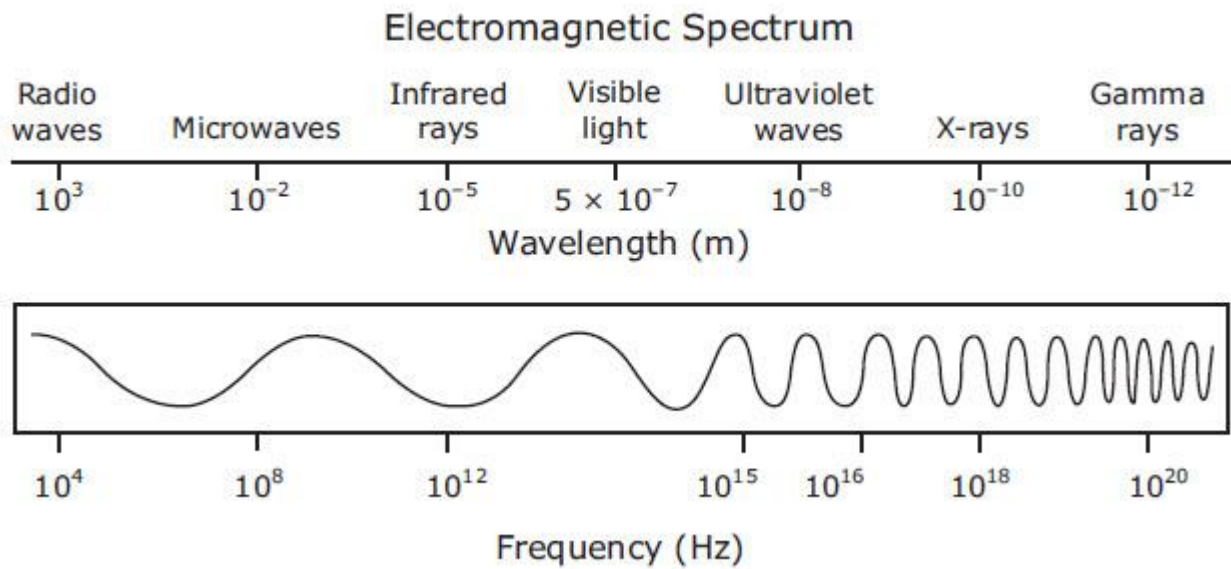
### Dichotomous Key

Step	Characteristics	Order
1a	Insect has an extremely long prothorax (neck)	Go to 2
1b	Insect has a short or no prothorax	Go to 3
2a	Forelegs come together in a "praying" position	Mantodea
2b	Forelegs do not come together in a "praying" position	Raphidioptera
3a	Wings are armor-like with membranous hind wings underneath	Coleoptera
3b	Wings are not armor-like	Go to 4
4a	Wings are triangular in shape	Go to 5
4b	Wings are not triangular in shape and head is elongated	Mecoptera
5a	Insect lacks a proboscis (long, slender snout) and has long filaments at abdominal tip	Ephemeroptera
5b	Insect has a proboscis and lacks long filaments at abdominal tip	Lepidoptera

Based on the dichotomous key, in what order should this insect be classified?

- F.** Mantodea
- G.** Raphidioptera
- H.** Coleoptera
- J.** Lepidoptera

29. Quasars are extremely distant celestial bodies. Investigators using a special telescope determined that a certain quasar was emitting waves with a frequency of  $14.1 \times 10^9 \text{ Hz}$ . An electromagnetic spectrum is shown.



The investigators were most likely using a telescope that detects —

- A. microwaves
  - B. visible light
  - C. x-rays
  - D. gamma rays
30. A basketball with a mass of 0.60 kg is accelerated with a force of 10.8 N. If resisting forces are ignored, what is the acceleration of the basketball to the nearest  $\text{m/s}^2$ ?

Record your answer and fill in the bubbles on your answer document. Be sure to use the correct place value.

- 31.** Scientists are studying the effects of climate change on the Baltic Sea. Some scientists predict that if current trends continue, the Baltic Sea will become less salty, and it will contain less dissolved oxygen. As a result of these changes, the Baltic Sea will have less biodiversity. The location of the Baltic Sea is shown on the map below.



Which statement best explains why biodiversity in the Baltic Sea could decrease if these changes occur?

- A.** Fewer types of plants and animals are found in warm water than in cool water.
- B.** Plants and animals adapted for living in saltwater will grow more slowly in water that has less salt.
- C.** Plants and animals adapted for living in saltier conditions will not be able to survive and reproduce.
- D.** Animals adapted for living in warm water will eat all the plants and animals adapted for living in cool water.

- 32.** On July 4, 1776, the American colonies declared their independence. The table shows the lunar phases for June 1776.

Lunar Phases for  
June 1776

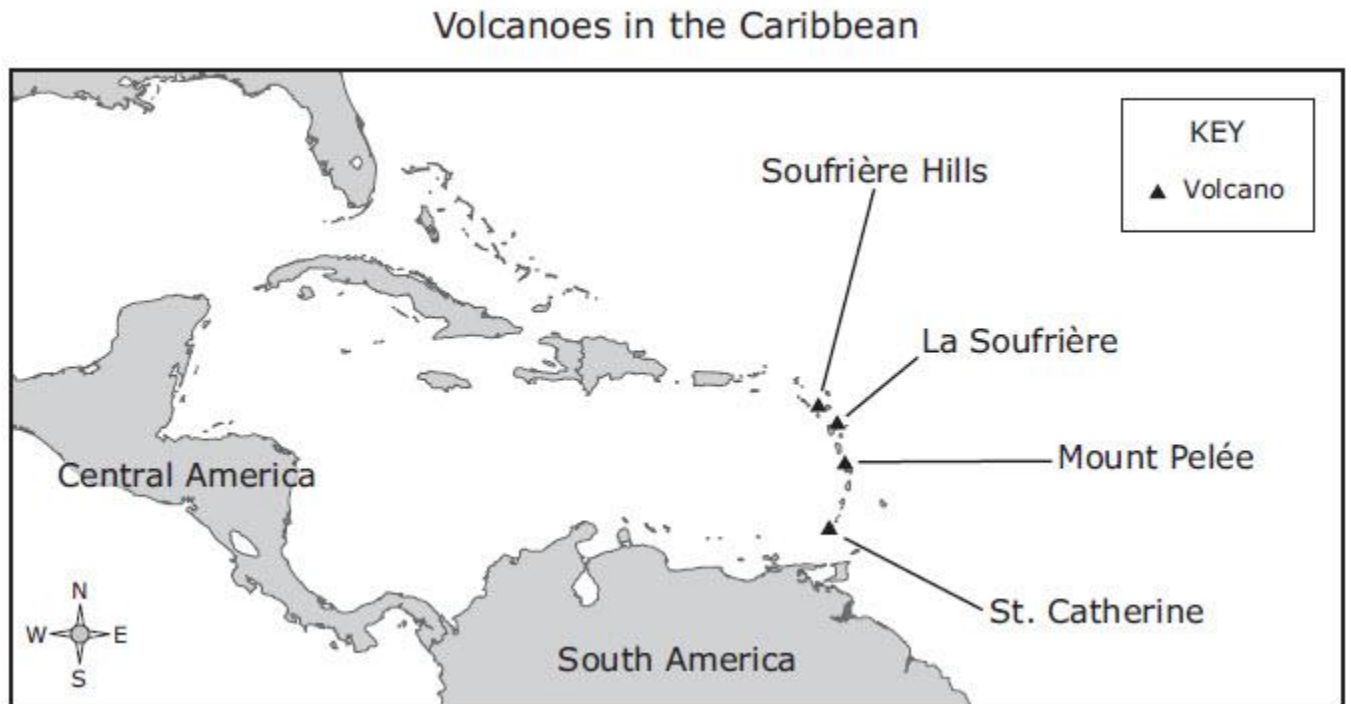
Date	Lunar phase
June 2	Full moon
June 9	Last-quarter moon
June 16	New moon
June 24	First-quarter moon

Source: NASA

What lunar phase occurred on July 4, 1776?

- F.** Waning gibbous
  - G.** Waxing gibbous
  - H.** Waning crescent
  - J.** Waxing crescent
- 33.** Aluminum, sulfur, and chlorine are elements found on the periodic table. Tests involving these three elements would show that at normal room temperature —
- A.** sulfur is malleable and aluminum conducts electricity
  - B.** chlorine is malleable and conducts electricity
  - C.** aluminum is malleable and conducts electricity
  - D.** all three elements are malleable and conduct electricity

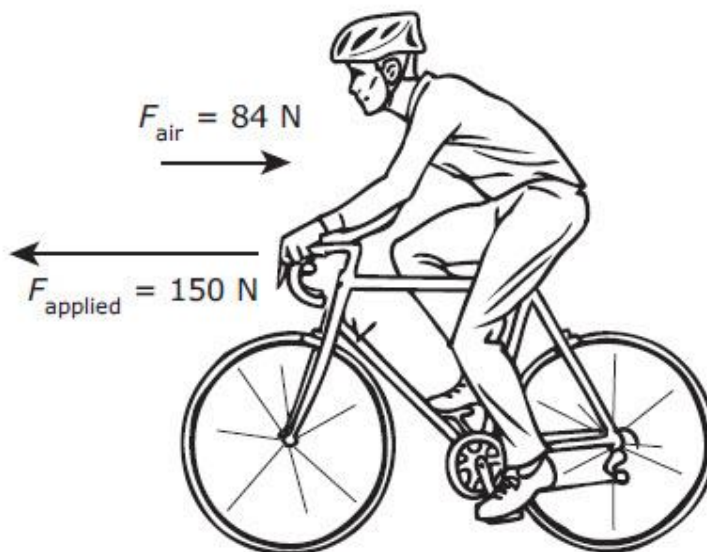
- 34.** The map below shows the locations of four active volcanoes in the Caribbean Sea.



What do these volcanoes indicate about plate tectonics in the region?

- F.** The volcanoes form an island arc, indicating a converging plate boundary.
- G.** The volcanoes form a line, indicating a diverging plate boundary.
- H.** Two plates are moving past each other, causing faulting and magma formation.
- J.** Two plates are moving apart, creating new seafloor.

35. The diagram below shows two different forces acting on a cyclist riding a bicycle.



The total mass of the cyclist and the bicycle is 100.0 kg. Based on this information, what is the acceleration of the cyclist?

- A.  $0.66 \text{ m/s}^2$  backward, because the force of the air slows the cyclist down
  - B.  $0.66 \text{ m/s}^2$  forward, because the applied force is greater than the force of the air
  - C.  $2.3 \text{ m/s}^2$  backward, because the forces are opposite and not equal
  - D.  $2.3 \text{ m/s}^2$  forward, because the cyclist's inertia is greater than the force of the air
36. The equation below represents a chemical reaction that occurs in living cells.

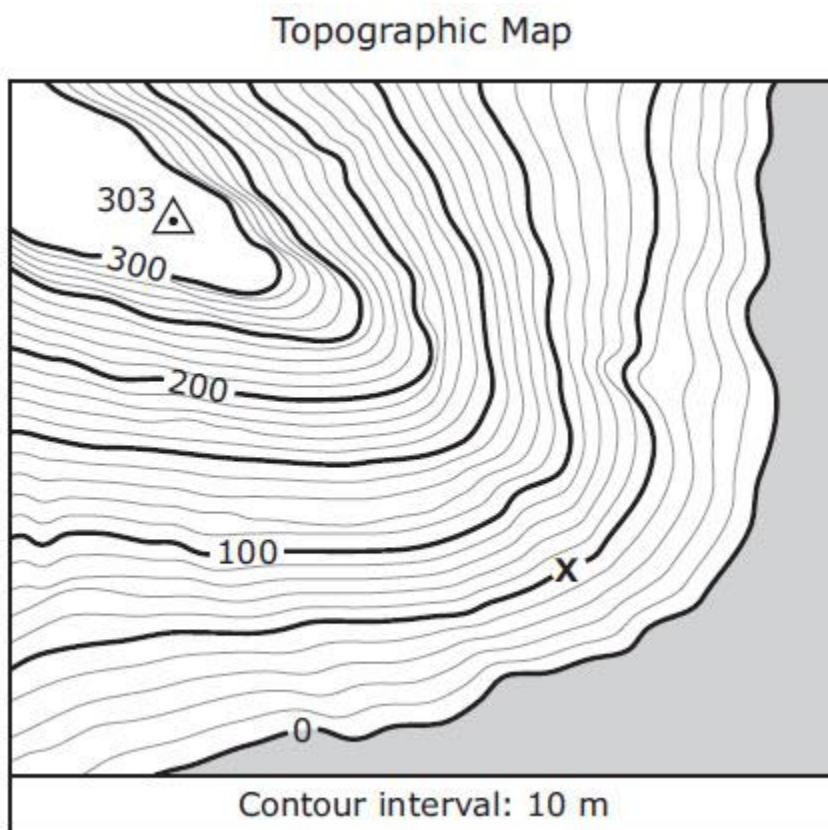


How many atoms are represented in the reactants of this equation?

- F. 6
  - G. 12
  - H. 24
  - J. 36
37. Which of the following best describes the velocity of an object?

- A. 30 m/s
- B. 30 m east
- C. 30 m/s east
- D.  $30\text{m/s}^2$

- 38.** A student stands at the point marked X on the topographic map below.



What height in meters must the student climb in order to reach the top of the hill?

Record your answer and fill in the bubbles on your answer document. Be sure to use the correct place value.

- 39.** A chemist is identifying the elements present in a sample of seawater. What characteristic of an element's atoms always determines the element's identity?
- A.** The number of protons
  - B.** The number of neutrons
  - C.** The location of valence electrons
  - D.** The number of valence electrons

- 40.** Copper compounds are used in large amounts to control the growth of algae and other aquatic plants. Copper interferes with photosynthesis in these organisms. What would be the most likely result of an accidental spill of these compounds in an aquatic environment?
- F.** The fish would grow larger than usual.
  - G.** The zooplankton population would increase.
  - H.** The plants would increase in size but decrease in number.
  - J.** The plant populations would be reduced.

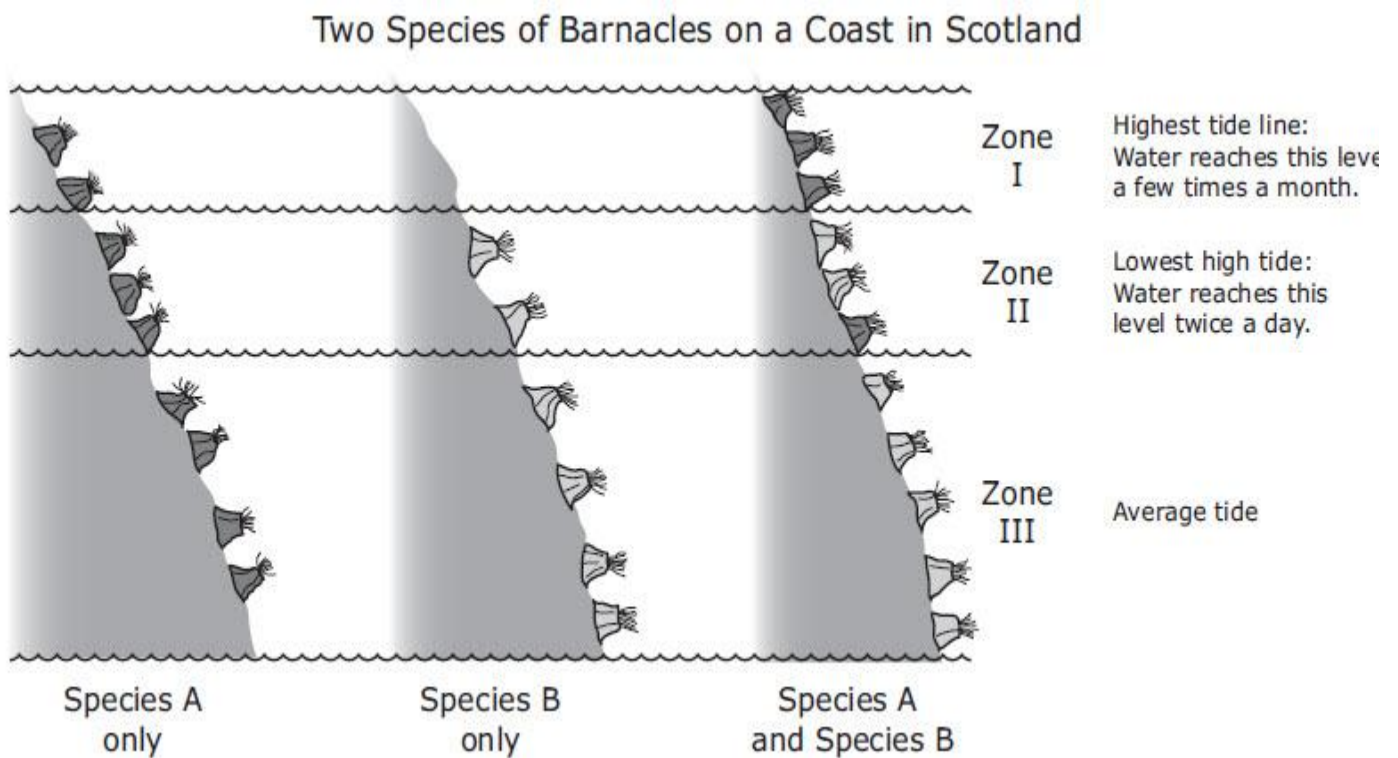
41. In the summer many people enjoy going to the beach. The photograph shows a beach in Argentina, which is located in the Southern Hemisphere.



Which diagram shows the position of Earth when it is summer in Argentina?

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

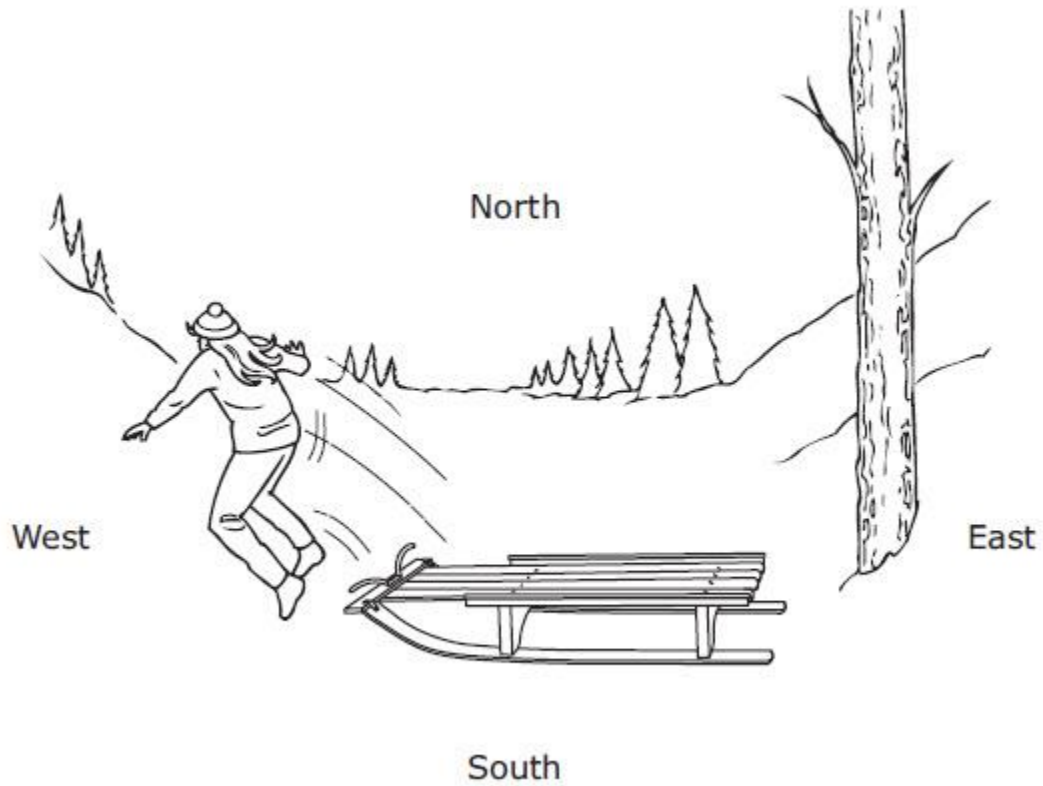
- 42** Barnacles are marine organisms that live attached to surfaces as adults. A scientist studies two barnacle species that live on rocks on a coast in Scotland. In some rocky areas Species A is found alone. In other rocky areas Species B is found alone. In still other rocky areas both species are found together. The diagram below shows the two barnacle species on rocks in their habitats.



If Species B were removed from the rocky areas it shares with Species A, Species A would most likely inhabit —

- F.** Zone I only
- G.** Zones I and II only
- H.** Zone III only
- J.** Zones I, II, and III

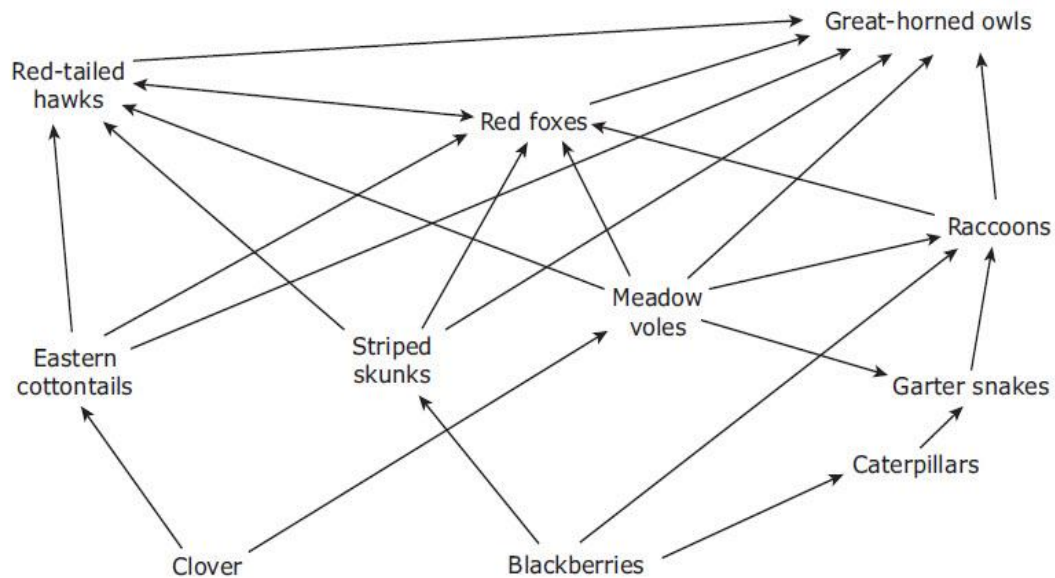
- 43.** A student jumps off a sled toward the west after it stops at the bottom of an icy hill.



Based on the law of action–reaction, in what direction will the sled most likely move as the student jumps off?

- A.** North
- B.** South
- C.** East
- D.** West

- 44.** Some students are studying the relationships between organisms in a food web.

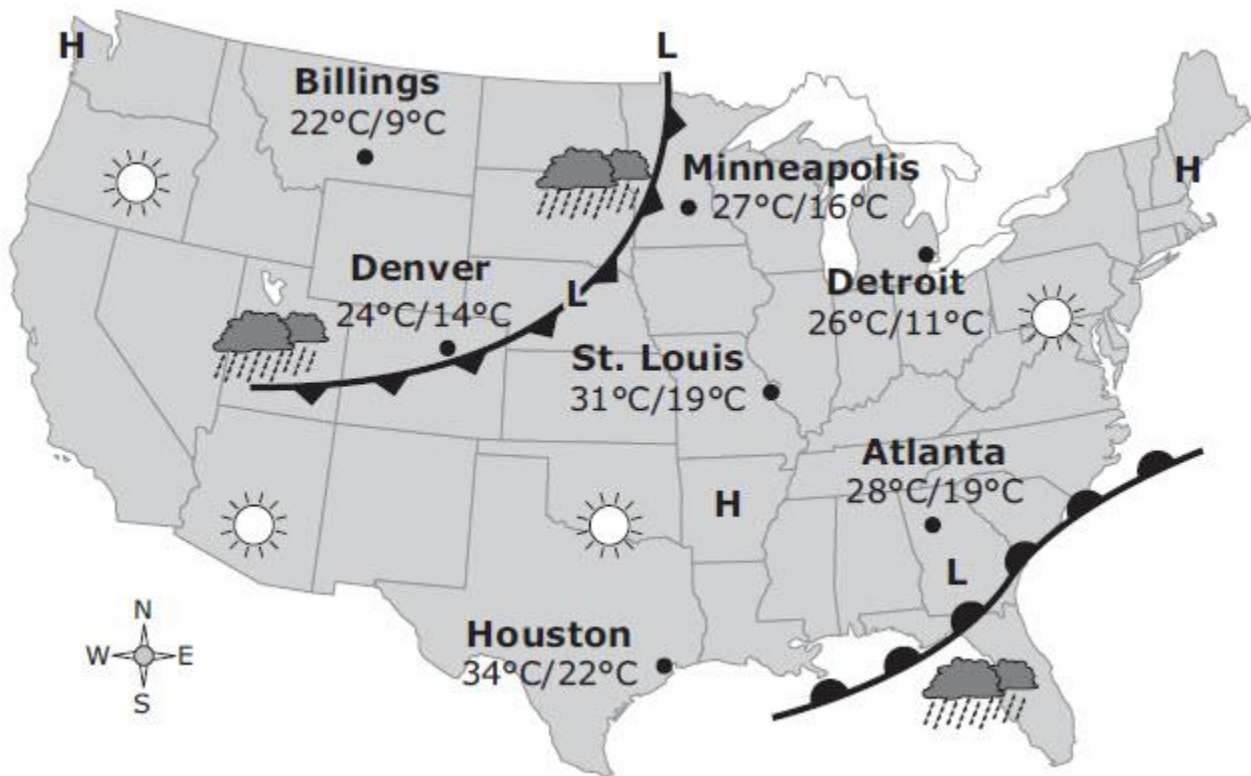


How many predators shown in this food web are omnivores?

Record your answer and fill in the bubbles on your answer document. Be sure to use the correct place value.

- 45.** In the early 1900s many scientists thought that an atom consisted of a positive substance with negative charges scattered throughout the substance. Then Ernest Rutherford completed an experiment that changed the concept of an atom. His discovery led to the understanding that an atom consists mostly of empty space with —
- A.** protons orbiting a dense nucleus made of electrons and neutrons
  - B.** electrons orbiting a dense nucleus made of protons and neutrons
  - C.** neutrons and protons orbiting a cloud of electrons
  - D.** electrons and protons orbiting a cloud of neutrons
- 46.** Tropical rain forests have the greatest biodiversity of any type of land ecosystem. How does biodiversity contribute to the sustainability of an ecosystem?
- F.** The presence of more species with different adaptations makes it more likely that some organisms will survive an ecological disaster.
  - G.** Greater genetic variation within species makes it more likely that some individuals will survive a disease outbreak.
  - H.** The presence of a variety of herbivore species that can feed on a large number of different producer species helps ensure abundant prey for predators in the ecosystem.
  - J.** All of the above

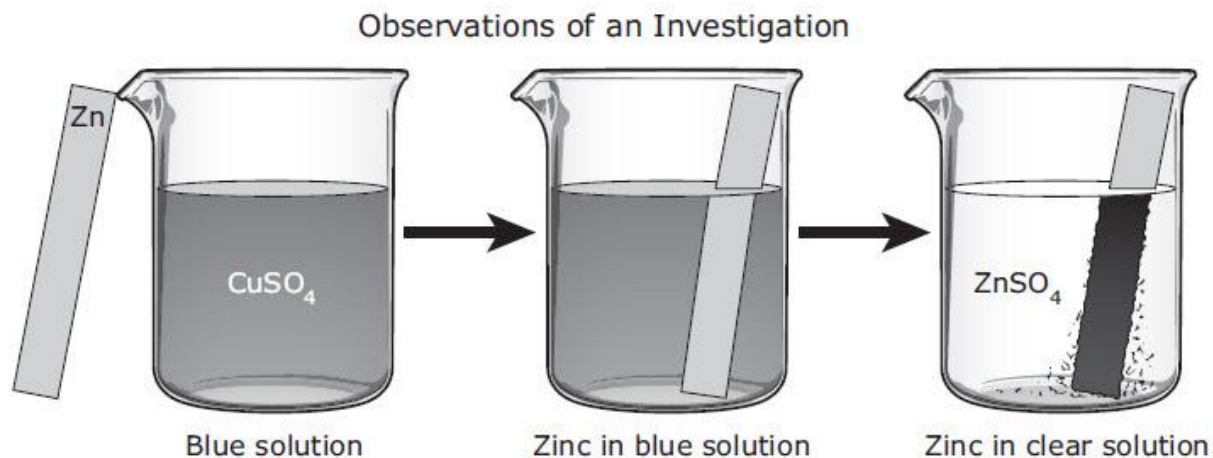
**47.** The weather map shows the weather conditions for one day across the United States.



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

- 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

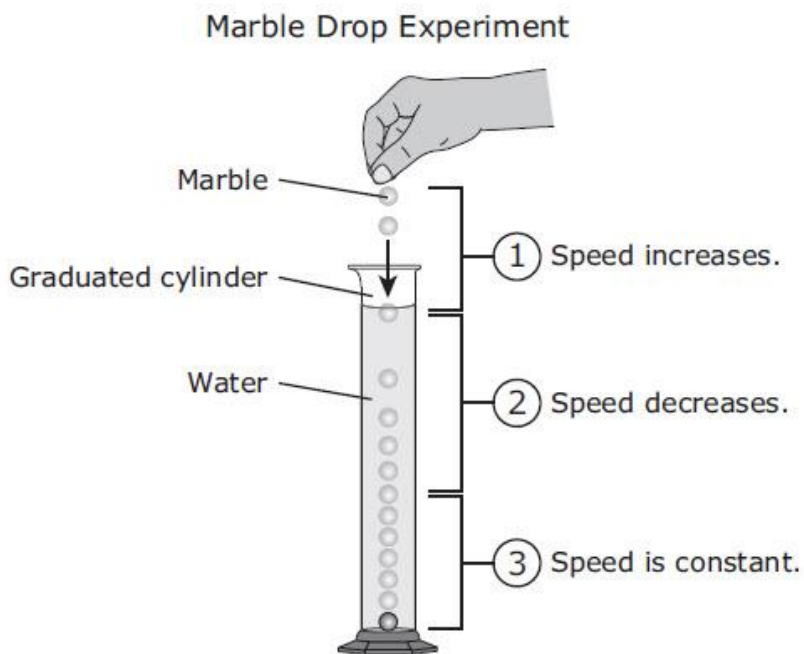
- 48.** For an investigation a student poured a blue solution of  $\text{CuSO}_4$  into a beaker. The student placed a shiny, silver-colored strip of zinc metal in the solution and observed the changes.



The student inferred that a chemical reaction occurred. What evidence supports this inference?

- F.** A dark solid formed on the zinc metal.
- G.** The zinc metal remained silver-colored and shiny.
- H.** The  $\text{CuSO}_4$  solution turned blue when the zinc metal was added.
- J.** None of these

49. A student used a video camera to record another student dropping a marble through water in a graduated cylinder. The students watched the video in slow motion and made the observations shown below.

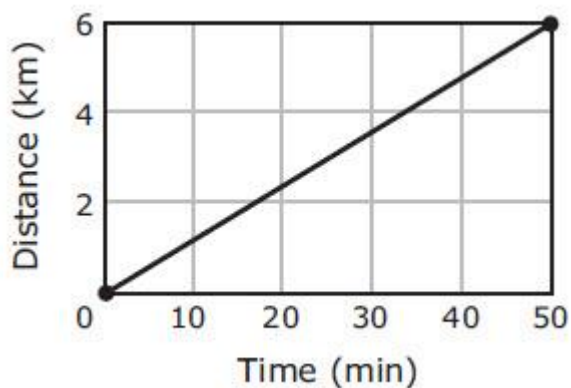


During which part or parts of the marble's fall did the marble experience unbalanced forces?

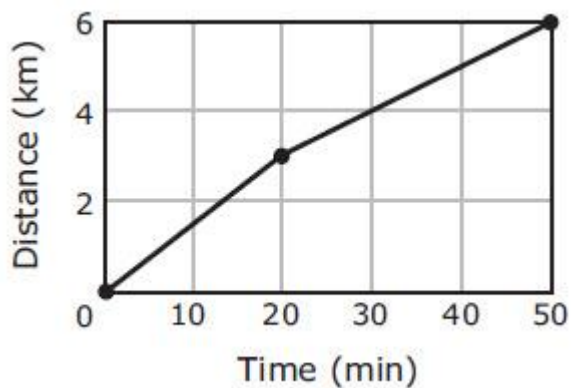
- A. Part 1 only
  - B. Parts 1 and 2 only
  - C. Part 3 only
  - D. Parts 2 and 3 only
50. Which of these correctly compares the masses of different objects in the universe?
- F. A moon has less mass than a star and more mass than the planet it orbits.
  - G. A planet has less mass than a galaxy and more mass than the star it orbits.
  - H. A galaxy has less mass than a moon and more mass than a planet.
  - J. A star has less mass than a galaxy and more mass than a planet.
51. Which two elements on the periodic table are in the same period?
- A. Sn and Rb
  - B. F and Cl
  - C. K and Ba
  - D. Se and Te

52. A student runs two times around a running path at a local park. Each lap is 3 km. The student completes the first lap in 20 minutes. The student then sits on a bench and rests for 5 minutes before completing the second lap in 25 minutes. Which graph best represents the student's motion?

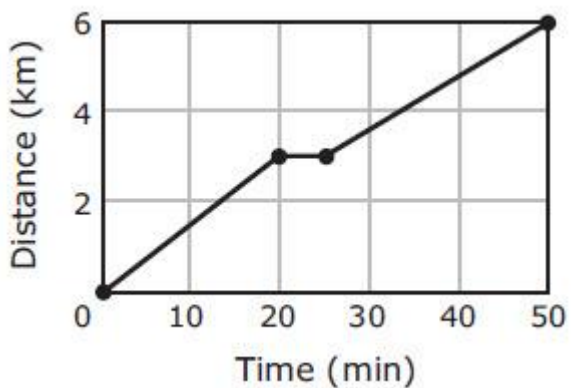
F.



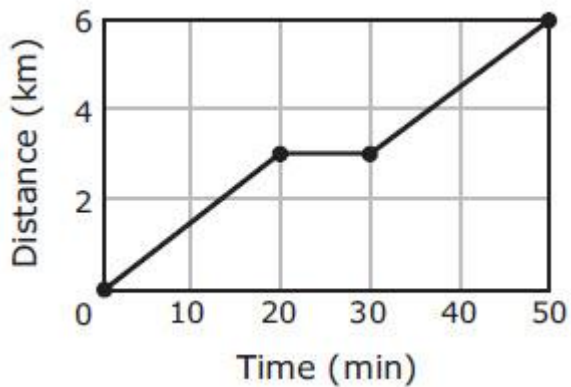
G.



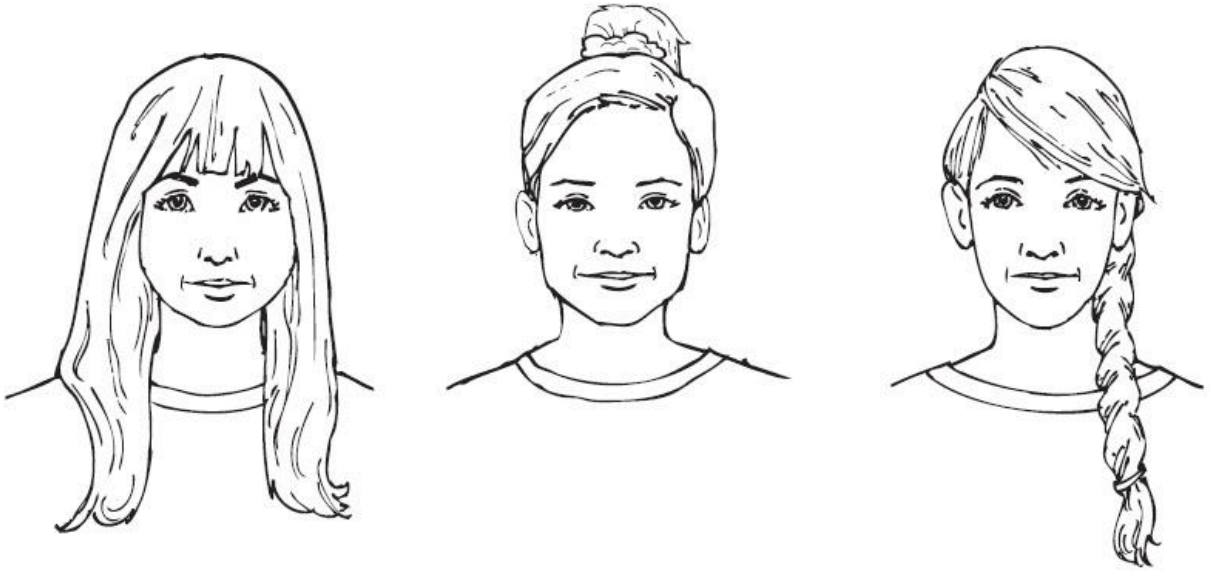
H.



J.



- 53.** Three cousins have a similar appearance but different face shapes.



Which of these cell components are most involved in determining the basic shape of each girl's face?

- A.** Genes, chromosomes, and nucleus
  - B.** Cytoplasm, chloroplasts, and genes
  - C.** Vacuoles, nucleus, and chromosomes
  - D.** Chromosomes, chloroplasts, and vacuoles
- 54.** In which of these compounds are there twice as many oxygen atoms as hydrogen atoms?
- F.**  $\text{H}_3\text{PO}_4$
  - G.**  $\text{H}_2\text{SO}_4$
  - H.**  $\text{HClO}_3$
  - J.**  $\text{H}_2\text{O}$