

# ACT PRACTICE

Test 4 (ACT IV)

# SCIENCE

February

State ACT Testing  
March 18, 2014

# Model Science Reasoning ACT IV

40 Questions—35 Minutes

**INSTRUCTIONS:** This test has seven passages. Each passage is followed by five to seven questions. After reading a passage, choose the best answer to each question and fill in the corresponding circle on your answer sheet. You may look back at the passages as often as you like.

You CANNOT use a calculator on this test.

Check pages 586–588 for answers and explanations.

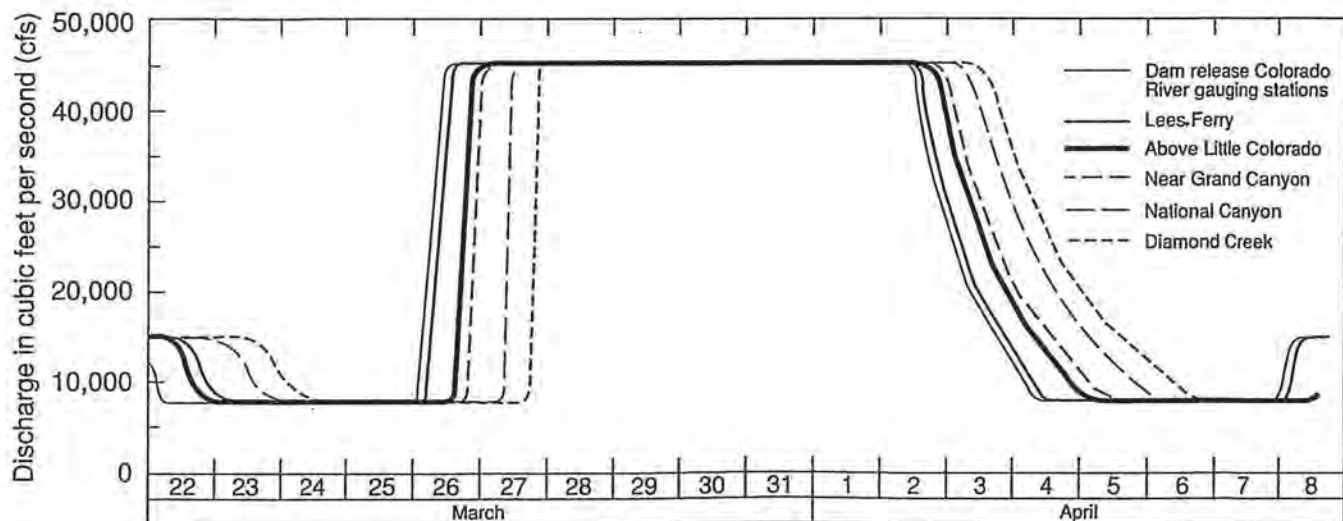
## PASSAGE I

Scientists planning an experimental flood release from the Glen Canyon Dam conducted studies to show the impact of the release on the Colorado River. The accompanying graph and table show the results of these studies.

### Study 1

A steady flow of 8,000 cubic feet per second (cfs) through the dam will be maintained for 4 days. Beginning on March 26, the flow will be increased over 10 hours to a steady flow of 45,000 cfs. The steady flow of 45,000 cfs will be maintained for 167 hours and then be reduced over 42 hours to 8,000 cfs. The scientists made the accompanying graph to estimate hydrograph readings in cubic feet per second at the dam and at Colorado River stream flow gauging stations.

Figure 1

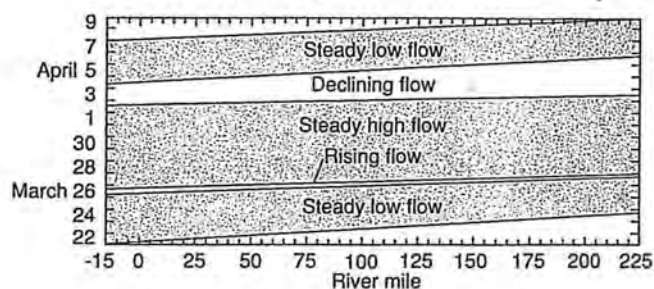


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## Study 2

The scientists also made a graph to show the duration of the flows along the river.

Figure 2



The location of different stream flow gauging stations is given in the table.

Station	River mile
Glen Canyon Dam	-15
Lees Ferry	0
Above Little Colorado	62
Near Grand Canyon	88
National Canyon	166
Diamond Creek	225

1. If the dam release occurred on midnight March 24 instead of midnight March 26, which of the following choices best represents the hydrograph reading at the dam on April 2?

A. 45,000 cfs  
B. 25,000 cfs  
C. 19,000 cfs  
D. 8,000 cfs

2. The hydrograph readings at each station go up abruptly as the release reaches the station, but go down gradually as the water release subsides. Which of the following choices gives the best explanation for this outcome?

F. Gravity slows the water as it moves down the river, creating a differential flow.  
G. Water molecules bond together, making the water denser as it flows down the river.  
H. The water release was stopped more slowly than it was started.  
J. The stream flow gauging stations are different distances apart.

3. Which of the following conclusions can be drawn from the flow periods shown in Figure 2?

A. The water moved down the river at a constant rate.  
B. Water at the end of the release reached the last gauging station more slowly than water at the beginning of the release.  
C. The declining flow will last a shorter time at Diamond Creek than at the dam.  
D. The declining flow will last a longer time at Diamond Creek than at the dam.

4. Will the data from this simulated release be close to the actual release?

F. Yes, because the scientists have accurate models to plot the simulated release.  
G. Yes, because computers permit simulations to be very accurate.  
H. No, because no simulation can come close to matching the real thing.  
J. No, because the hydrographs may be broken at some of the gauging stations during the actual release.

5. Which assumption in the simulation is critical to successful modeling of the release?

A. The duration of the flows at river mile 100  
B. The time of day of the initial release  
C. The distance downstream to the gauging stations  
D. The duration of the releases at the dam

6. The scientists conducting the simulation conclude that the experimental data about stream flow heights are accurate. Which of the following would help confirm that conclusion?

F. Measuring the current water heights at the gauging stations  
G. Measuring water heights at gauging stations during thunderstorms  
J. Replicating the simulation using different release amounts and durations  
H. Conducting a simulation on a working model of the dam and river

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## PASSAGE II

Scientists use the geologic time scale shown below to help date events from more than one-half billion years ago to the present.

<i>Geologic Period</i>	<i>Millions of Years Ago</i>
Quaternary .....	Present
Tertiary.....	1.6
Cretaceous .....	66
Jurassic .....	138
Triassic.....	205
Permian.....	240
Pennsylvanian.....	290
Mississippian .....	330
Devonian.....	360
Silurian .....	410
Ordovician .....	435
Cambrian .....	500
	570

### Study 1

In order to help date events and fossils, and place them on the geologic time scale, scientists studied isotope decay. Scientists found that some atoms decay at a steady rate, and determined the time it takes for half of the parent atoms to decay to daughter atoms. This time is called the half-life. The half-life of some useful atoms is shown in the isotope dating table.

### Study 2

Scientists used isotopic dating and other techniques to place animal and plant species on the geologic time scale, as shown in the fossil succession chart.

### Isotope Dating

<i>Isotope</i>		<i>Half-life of parent (years)</i>	<i>Useful range (years)</i>
<i>Parent</i>	<i>Daughter</i>		
Carbon-14	Nitrogen-14	5,730	100–30,000
Potassium-40	Argon-40	1.3 billion	100,000–4.6 billion
Rubidium-87	Strontium-87	47 billion	10 million–4.6 billion
Uranium-238	Lead-206	4.5 billion	10 million–4.6 billion
Uranium-235	Lead-207	710 million	10 million–4.6 billion

### Fossil Succession

PERIOD	ANIMALS					PLANTS				
Quaternary										
Tertiary										
Cretaceous										
Jurassic										
Triassic										
Permian										
Pennsylvanian										
Mississippian										
Devonian										
Silurian										
Ordovician										
Cambrian										

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7. A researcher believes that a particular type of plant appeared about 50 million years before reptiles first appeared on Earth. If the researcher is correct, during which period did the plant first appear?
- A. Permian
  - B. Pennsylvanian
  - C. Mississippian
  - D. Devonian
8. Based on the information in the studies, one can generalize that if one knows the half-life of the parent isotope, the substance can be correctly dated:
- F. to a particular geologic period.
  - G. if the numbers of remaining parent atoms and daughter atoms are known.
  - H. within 100,000 years.
  - J. if one knows the geologic period in which the half-life was reached.
9. Which isotopes would be needed to date substances from the earliest part of the geologic scale until about 250,000 years ago?
- A. Carbon-14
  - B. Potassium-40
  - C. Rubidium-87
  - D. Uranium-238
10. The fossil succession chart shows that reptiles and mammals were both present on Earth from about 210,000,000 years ago. Would Study 2 have to be modified to estimate the length of time mammals and reptiles coexisted on Earth?
- F. Yes, because Study 2 does not show when specific reptiles, such as dinosaurs, and mammals both inhabited Earth.
  - G. Yes, because Study 2 does not show when more advanced mammals appeared on Earth and the presence of these advanced mammals is of great interest to researchers.
  - H. No, because Study 2 gives enough information to estimate the length of time mammals and reptiles coexisted.
  - J. No, because humans are mammals and human fossils don't appear earlier than the Tertiary Period.
11. New data reveal that fossils for shelled animals are entirely missing in one part of the United States for the Cretaceous Period. Does a conclusion of faulty isotope dating explain these new data?
- A. Yes, because the fossil succession chart clearly shows that these fossils have been found for these dates.
  - B. Yes, because isotope dating can frequently have dating errors of millions of years.
  - C. No, because shelled animals were not present for most of the Cretaceous Period.
  - D. No, because these fossils may just not be present in this area.
12. Scientists determine that all of the carbon-14 atoms in a substance have turned to nitrogen-14 atoms. Based on this information, the scientists can reasonably conclude:
- F. the substance is about 5,730 years old.
  - G. the substance is between 100 and 30,000 years old.
  - H. the age of the substance is unknown, but it is more than 57,300 years old.
  - J. the age of the substance can be determined by uranium dating.

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## PASSAGE III

Gravity is a force that attracts bodies of matter to one another. Large bodies of matter, such as Earth, the Earth's moon, and the planets, exert substantial amounts of gravity. The mass of a body of matter is constant. The weight of an object is the mass of the object times the gravity. The weight of a body of matter varies with the amount of gravity.

*Experiment 1*

Scientists simulated the gravity of Earth, Earth's moon, Mars, Neptune, and Pluto. They used solid balls that weighed 5 and 7 pounds on Earth and found the weight of these objects on the moon, Mars, Neptune, and Pluto. The results of this experiment are shown in Table 1.

**Table 1. Weight of Two Objects on the Surface of Various Celestial Bodies, Pounds**

	<i>Object A</i>	<i>Object B</i>
Earth	5.0	7.0
Earth's moon	0.85	1.19
Mars	1.9	2.66
Neptune	5.65	7.91
Pluto	0.35	0.49

*Experiment 2*

Using the same experimental conditions, the scientists dropped the objects from a height of 80 meters. The results of this experiment are shown in Table 2.

**Table 2. Time for Two Objects to Free Fall 80 Meters on the Surface of Various Celestial Bodies, Seconds**

	<i>Object A</i>	<i>Object B</i>
Earth	4	4
Earth's moon	23.5	23.5
Mars	10.5	10.5
Neptune	3.5	3.5
Pluto	57	57

13. To confirm the force of gravity, an object weighing 80 pounds on Earth was weighed in Pluto's gravity field. The weight of this object on Pluto is most like the weight of a 5-pound object on which celestial body shown in Table 1?
  - A. Earth's moon
  - B. Mars
  - C. Neptune
  - D. Pluto
14. An object weighing 10 pounds is dropped from 80 meters, in gravity twice as strong as the gravity on Earth's moon. To the nearest second, about how long will it take the object to reach the ground?
  - F. 6 seconds
  - G. 9 seconds
  - H. 12 seconds
  - J. 15 seconds
15. A scientist knows the weight of an object on a planet not listed here. The scientist also knows how long the object takes to free fall to the surface of that planet and to free fall to the surface of Earth. Can the scientist closely estimate the weight of the object on Earth?
  - A. Yes, because free-fall time is proportional to a planet's gravity.
  - B. Yes, because the weight of an object determines the free-fall time.
  - C. No, because the weight of an object does not determine the free-fall time.
  - D. No, because free-fall times are not related to the planet's gravity.

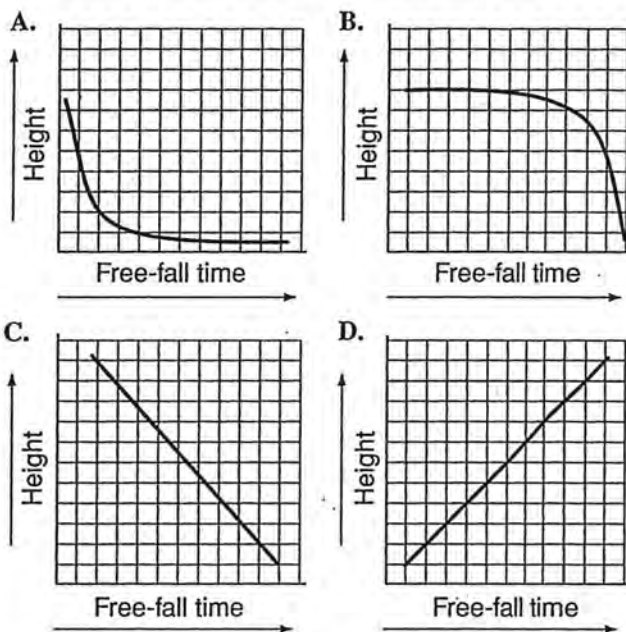
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16. Four objects are dropped at the same time from a height of 80 meters. According to the data in Table 1 and Table 2, which of the following objects would free fall to the surface most quickly?

- F. A ball weighing 25 pounds on Earth's moon
- G. A cube weighing 100 pounds on Pluto
- H. A ball weighing 2 pounds on Neptune
- J. A cube weighing 1 pound on Mars

17. Which of the following graphs best represents the relationship between height and free-fall time?



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## PASSAGE IV

Chemists study acid-base reactions.

Acids dissociate in water to produce hydrogen ions ( $H^+$ ).

Bases dissociate in water to produce hydroxide ions ( $OH^-$ ).

pH measures the degree of acidity of a solution.

pOH measures the degree of basicity of a solution.

Solutions with a pH less than 7 are acidic.

Solutions with a pH more than 7 are basic.

The sum of pH and pOH is 14 ( $pH + pOH = 14$ ).

Scientists add indicators to determine the pH of a solution. The table below shows how some indicators react in solutions. The reaction takes place only in the pH range of color change.

Reactions to Indicators

<i>Indicator</i>	<i>Color in acid</i>	<i>pH range of color change</i>	<i>Color in base</i>
Congo red	Blue	3–5	Red
Methyl orange	Red	3.2–4.5	Yellow
Methyl red	Red	4.3–6	Yellow
Litmus	Red	4.5–8.2	Blue
Bromthymol blue	Yellow	6.0–7.6	Blue
Phenolphthalein	Colorless	8.3–10	Pink
Alizarin yellow	Yellow	10.1–12.1	Red

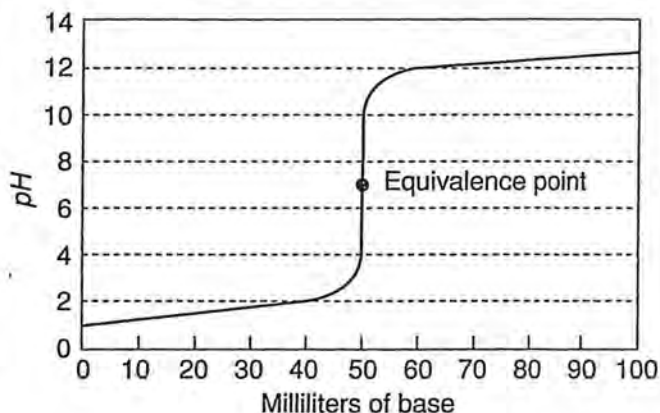
18. Which of the following indicators would be best to identify whether a substance with a pH near 7 was an acid or a base?
- F. Congo red  
G. Bromthymol blue  
H. Phenolphthalein  
J. Alizarin yellow
19. A solution turns red when mixed with the indicator alizarin yellow. According to the information in the table, what is the minimum pOH of the solution?
- A. 1.9  
B. 2.9  
C. 3.9  
D. 4.9
20. The indicator methyl red is mixed with a solution and the solution turns red. The indicator litmus is mixed with a solution and the solution turns red. What conclusion can a researcher draw about the pH of the solution?
- F. The pH is 6.  
G. The pH is 4.3 to 4.5.  
H. The pH is 4.5 to 6.  
J. The pH is 4.3 to 6.
21. Based on the information in the table, which of the following reactions indicates that a solution is a base?
- A. A reaction to congo red  
B. A reaction to methyl red  
C. A reaction to litmus  
D. A reaction to alizarin yellow

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22. A beaker contains 50 milliliters (mL) of a strong acid solution. A researcher adds 100 mL of a strong base, 10 mL at a time, and measures the pH of the solution after each addition of the base. The graph at right shows the results of this experiment. The equivalence point on the graph is where there are exactly 50 mL of base and 50 mL of acid. Which of the following conclusions can the researcher draw from the graph?

- F. The pH of a solution is 7 when the solution contains 50 mL of a strong acid.
- G. The solution is a base below the equivalence point on the graph.
- H. The pOH of the solution is 14 after 100 mL of the base is added.
- J. Most of the pH change is accounted for near the equivalence point.



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## PASSAGE V

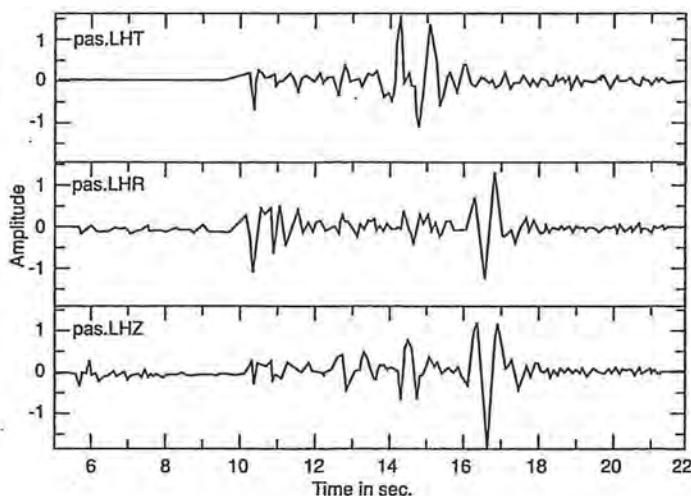
Caltech has a number of seismic stations in southern California, including one at Pasadena. The Pasadena site monitors seismic activity all over the world. Each day, the Pasadena station reports the most significant seismic activity in the world. This event is reported as the seismic record of the day.

General information and the seismograph records for three days in a recent year are shown in the following tables and figures.

The seismograph record shows the duration of the event in seconds. The three traces show ground displacement. The top two traces show the horizontal (back-and-forth) ground movement. The bottom trace shows the vertical (up-and-down) ground movement. The scales vary from one seismograph record to the other.

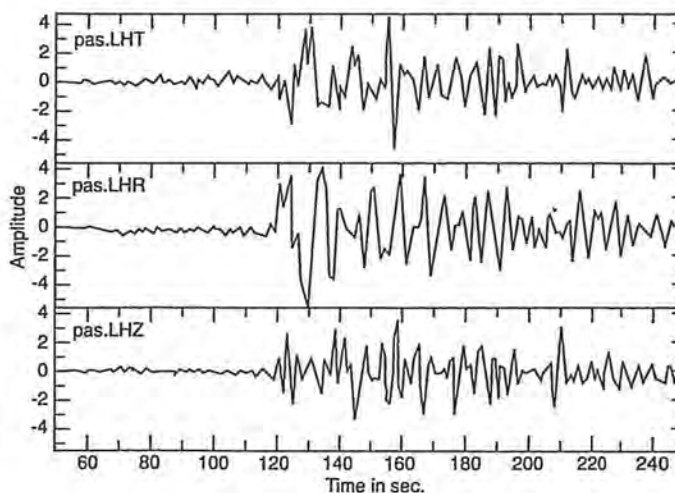
## Study 1

Region:	Northern Peru
Date:	October 28
Time (gmt):	6:15:18
Moment magnitude:	7.2
Latitude:	4.3 S
Longitude:	76.6 E
Depth (km):	125



## Study 2

Region:	California–Nevada border region
Date:	November 2
Time (gmt):	8:51:54
Moment magnitude:	5.2
Latitude:	37.8 N
Longitude:	118.1 E
Depth (km):	55

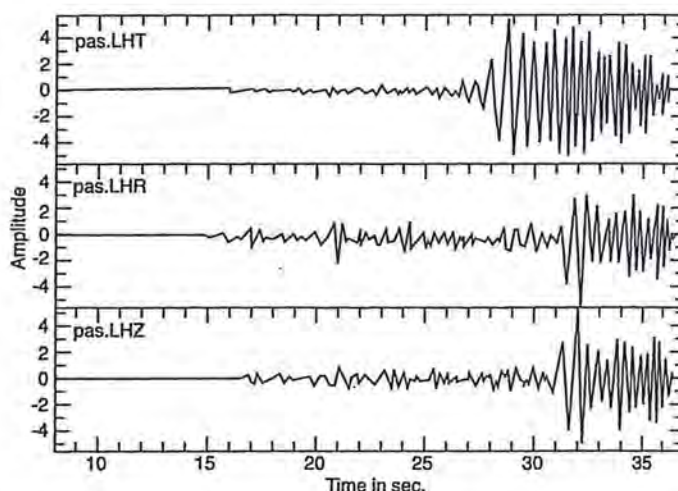


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## Study 3

Region: Xizang  
 Date: November 8  
 Time (gmt): 10:2:48  
 Magnitude: 7.5  
 Latitude: 35.0 N  
 Longitude: 87.3 W  
 Depth (km): 150



23. Relative to the seismograph traces for Study 1 and Study 3, the maximum, positive vertical displacement amplitude in Study 3 is about:
- twice the maximum positive vertical displacement amplitude in Study 1.
  - three times the maximum positive vertical displacement amplitude in Study 1.
  - four times the maximum positive vertical displacement amplitude in Study 1.
  - five times the maximum positive vertical displacement amplitude in Study 1.
24. Each seismograph uses a different amplitude scale. These different scales make it difficult to directly compare seismograph readings, but they are used because:
- the time of the event in seconds varies from event to event and different scales permit the entire length of the event to be shown most accurately.
  - the positive traces on the scale are often greater than the negative traces on the scale and different scales permit these differences to be shown most accurately.
  - the traces have to be shown on the same size strip for each event and different scales permit every event to be shown most accurately on this size strip.
  - the scale has to be the same for the entire length of the trace and different scales permit the scale to be the same length for each trace.
25. Suppose scientists deliberately caused the seismic activity in Study 2. Which of the following describes an experimental result?
- The time
  - The moment magnitude
  - The latitude
  - The depth
26. Asked to describe the seismic event in Study 2, a student correctly says:
- it is the strongest of the three seismic events described in these studies.
  - there was stronger side-to-side than up-and-down movement.
  - the event lasted about 4 minutes.
  - the event occurred along the San Andreas fault.
27. All three studies combined show that the magnitude of an event is related to which of the following factors?
- The depth of the event
  - The length of the event
  - The hemisphere of the event
  - The time between peak traces
28. A scientist studies the traces of other seismic events and identifies a trace in which the distance between the highest and lowest vertical amplitudes is about 7. This is most like the distance between the highest and lowest vertical amplitudes in which of the three studies described above?
- Study 1
  - Study 2
  - Study 3
  - Study 2 and Study 3

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## PASSAGE VI

Cover crops are planted after a harvest to protect the soil against erosion. These crops are usually plowed under the following spring. The following table gives information about cover crops and recommended planting practices in Ohio.

Ohio Vegetable Farm Cover Crops

<i>Crop</i>	<i>Pounds/Bushel</i>	<i>Pounds/Acre</i>	<i>Comments</i>
<b>Non-legumes</b>			
Rye	60	90	Most widely used cover crop. It germinates easily in the fall and survives severe winters.
Perennial ryegrass	34	15–20	Ryegrass can be seeded at the last cultivation of sweet corn, peppers, or eggplant. Plow in nitrogen with the ryegrass sod.
Field corn	56	50–60	Field corn can be drilled solid with a corn drill. Field corn can be used as a summer cover crop following early harvested spring vegetable crops.
Winter barley	48	80–100	Use in southern Ohio where winter killing is less severe. Root growth is not as extensive as rye or ryegrass.
<b>Legumes</b>			
Sweet clover	60	16–20	Use sweet clover for summer seeding. Use lime on soil to produce a pH of 6.5–7.0 to ensure successful growth.
Red clover	60	10–15	Red clover can be established in soil with lower pH than required for sweet clover.
Soybeans	60	90–100	Use as a summer cover crop. Soybeans have rapid growth but a limited root system in comparison to other legumes.
Alfalfa	60	15–20	Use this crop in rotation when it can stand for more than one year. Alfalfa needs lime and other minerals for good growth.

29. According to the information in the table, cover crops:

- A. need more pounds of seed per acre when there are fewer pounds of seed per bushel.
- B. are always planted in the fall following harvest.
- C. are sometimes used in the summer.
- D. are better if there are more pounds per bushel.

30. Scientists at the state extension center say that additives help make some cover crops grow successfully. The information for which of these cover crops supports that proposition?

- F. Rye
- G. Perennial ryegrass
- H. Red clover
- J. Alfalfa

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31. Researchers are working on a cover crop similar to rye. The new cover crop requires as many pounds of seed per acre as rye, but has half the number of pounds per bushel as rye. About how many bushels of seed for the new cover crop are needed for one acre?
- A. 0.5
  - B. 2
  - C. 3
  - D. 4
32. Which of the following generalizations agrees with the data in the table?
- F. Cover crops grow better when lime is added to the soil.
  - G. Perennial ryegrass seeds are smaller than rye seeds.
  - H. pH level is most important for growing clover cover crops.
  - J. The summer cover crops are legumes.
33. A scientist looking over the information in this table concludes that cover crops that can be harvested are summer cover crops. Information about which of the following cover crops does NOT support this conclusion?
- A. Sweet clover
  - B. Field corn
  - C. Barley
  - D. Soybeans

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# PASSAGE VII

The oldest known dinosaur fossils are from rocks about 230,000,000 years old, but it is likely that dinosaurs existed on Earth before that time. Mammals were also present when dinosaurs were the dominant species on Earth. Then suddenly, about 65,000,000 years ago, dinosaurs died out, although birds may be the descendants of dinosaurs. There are many theories to explain the cause of dinosaur extinction. Two of these theories are the impact theory and the cooling theory.

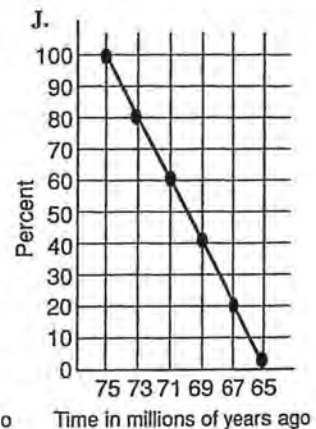
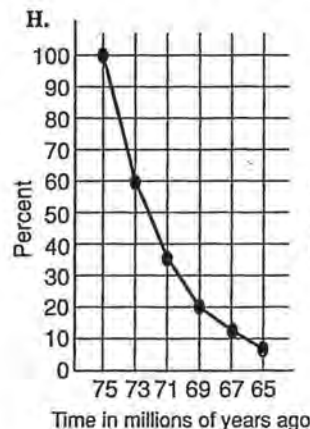
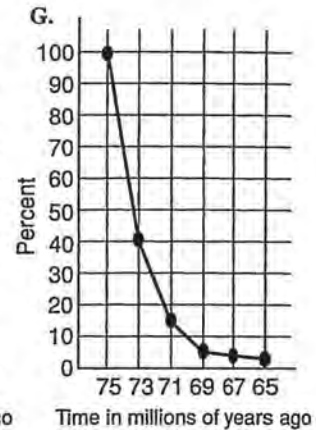
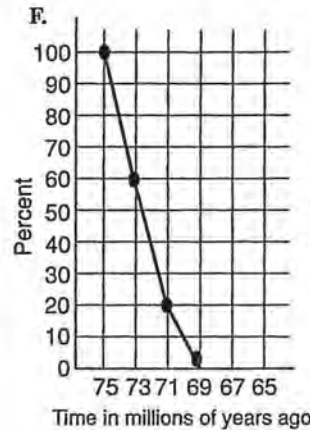
## Comet or asteroid impact

The dinosaurs became extinct in the aftermath of comet or meteor impact on Earth. About 65,000,000 years ago, a huge meteor or comet struck Earth. NASA scientists have located a huge crater in the Yucatan peninsula in Mexico. These scientists have evidence the impact took place around 65,000,000 years ago. The devastating impact of this type of event was seen recently when fragments of a comet struck Jupiter. The impact created a number of huge explosions, some of which were larger than Earth. Such an explosion could certainly have led to dinosaur extinction.

## Global cooling

The dinosaurs became extinct when the temperature of Earth's atmosphere cooled. Dinosaurs were cold-blooded animals. Like modern reptiles, dinosaurs relied on the air temperature to keep their blood warm enough for them to live. About 65,000,000 years ago there was a worldwide climatic cooling. As Earth cooled, dinosaurs started to die. When Earth reached its coolest temperature, most dinosaur species became extinct. The warm-blooded mammals survived and became the dominant large animal life-form.

34. Suppose the dinosaurs' extinction began 75 million years ago. A scientist has a theory that the number of dinosaurs at the end of a 2-million-year period was 40% less than the number of dinosaurs at the beginning of that 2-million-year period. Which of the following graphs correctly represents that theory?

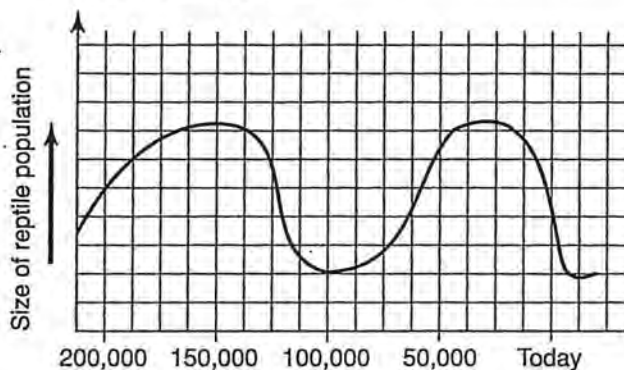


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35. The last ice age lasted about 100,000 years and ended about 10,000 years ago. During this time, glaciers covered the northern part of the United States. If the following graph is an accurate representation of the size of Earth's reptile population, which theory of dinosaur extinction is supported?



- A. Comet or asteroid impact, because the reptile population rose to a high 50,000 years ago
- B. Comet or asteroid impact, because the reptile population rose to a high 100,000 years ago
- C. Global cooling, because the reptile population dropped to a low 100,000 years ago
- D. Global cooling, because the reptile population was lower 100,000 years ago than it was 150,000 years ago
36. If an event described in the impact theory happened in the future, the most likely result would be:
- F. destruction of the entire planet Earth.
- G. a reduction in the number of green plants.
- H. extinction of the mammals.
- J. extinction of the reptiles.
37. Which of the following statements points out a significant weakness of one of the theories?
- A. The impact theory is weak because it does not describe the size of the meteor or comet.
- B. The impact theory is weak because it does not explain why mammals did not become extinct.
- C. The global cooling theory is weak because it does not explain why mammals did not become extinct.
- D. The global cooling theory is weak because it does not say how cool Earth became.
38. Other scientists believe that the extinction of dinosaurs was caused by a disease. Considering this theory along with the impact and cooling theories, which of the following is a true statement about the consistency or inconsistency of these theories?
- F. The impact theory and the disease theory are inconsistent because a disease would not have come after the impact.
- G. The global cooling theory and the disease theory are inconsistent because a disease could not have caused global cooling.
- H. The global cooling theory and the impact theory are consistent because the impact could have caused cooling.
- J. The disease theory and the cooling theory are consistent because the low temperature can cause people to catch a cold.
39. Dinosaurs are only one group of large reptiles that became extinct 65 million years ago. Other large reptiles, including the plesiosaurs and the pterosaurs, became extinct at the same time. Yet crocodiles and snakes survived and flourished. This variable survival rate is not consistent with the impact theory because:
- A. when the larger dinosaurs died, owing to inadequate vegetation, the meat-eating dinosaurs also would have died.
- B. dinosaurs laid eggs and all the eggs may have broken on impact.
- C. all cold-blooded creatures should have been affected in about the same way.
- D. humans could not have survived if dinosaurs became extinct.
40. What fact about dinosaurs is required for the global cooling theory, but not required for the impact theory?
- F. Dinosaurs did not live in the ocean.
- G. Dinosaurs had small brains.
- H. Dinosaurs were cold-blooded.
- J. Dinosaurs' legs were tucked under their bodies.

**END OF TEST 4**

