ACT Slam 2017: Science Reasoning

The science test is _____ minutes and consists of ____ multiple choice questions.

Students that score 27-36 get_____ questions correct out of 40.

Students that score 24-26 get _____ questions correct out of 40.

Students that score 21-25 get_____ questions correct out of 40.

ANSWER EVERY QUESTION! IT IS TO YOUR ADVANTAGE TO MARK EVERY BUBBLE!!!!

1 kilometer (km) =_____ meters (m)

1 meter (m) =_____centimeters (cm)

1 meter (m) =_____millimeters (mm)

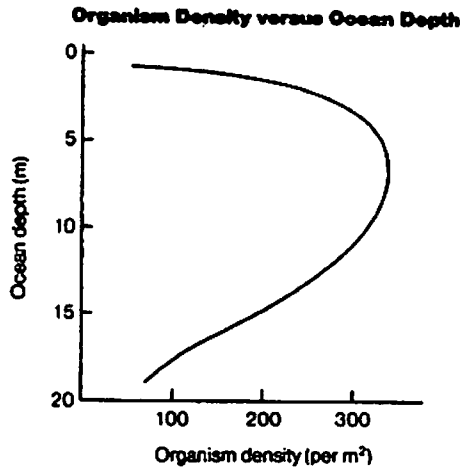
Scientists researching the relationship between birds and dinosaurs have chosen to carefully examine three fossils dating from the Jurassic period: an *archaeopteryx* (the oldest known bird) at the British Museum in London, a *compsognathus* (a dinosaur) at the Field Museum in Chicago, and a *teleosaurus* (a crocodile) at the National Museum in Beijing. All three creatures were about the same size as a turkey.

1. **The dinosaur studied by the scientists, *compsognathus*, was:**
   - **A. definitely a reptile.**
   - **B. definitely a bird.**
   - **C. about the size of a turkey.**
   - **D. larger than *archaeopteryx* or *teleosaurus*.**

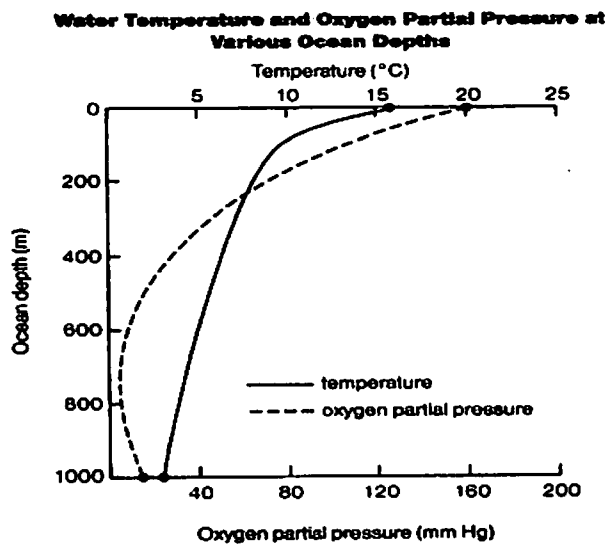
Three Passage Types:

1. **Data Representation:_____ questions**
2. **Research Summaries:_____ questions**
3. **Conflicting Viewpoints:_____questions**

DON'T CONFUSE TABLE 1 AND FIGURE 1

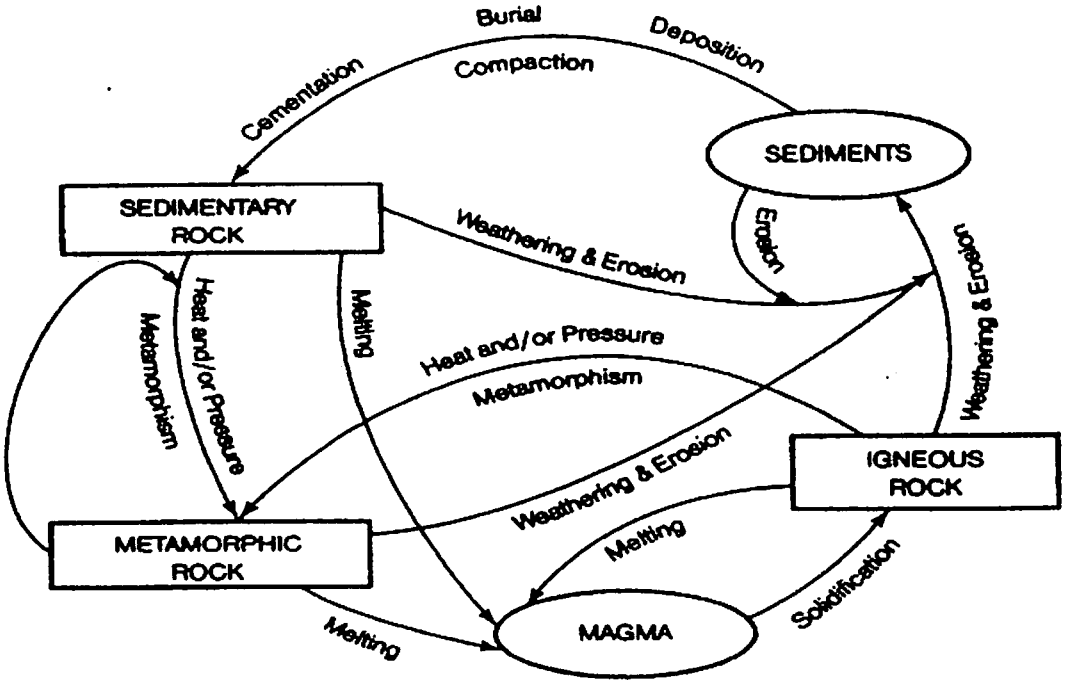


Where is the maximum organism density?



Graph with more than one variable: What temp is at a depth of 800 m?

Rock Cycle in Earth's Crust

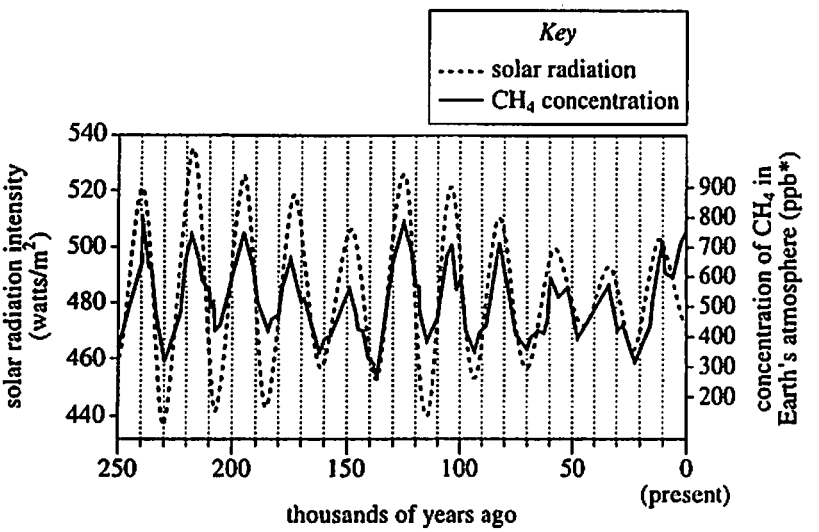


Based on *Earth Science Reference Tables*, 2001 Edition, The University of the State of New York, State Education Department.

- **Which conclusion is *not* supported by data in the diagram?**
- **A. Once heat and pressure reach a certain point, rocks melt and magma forms.**
- **B. Weathering and erosion of all rocks lead to sediments.**
- **C. When molten material deep inside Earth cools, it forms igneous rocks.**
- **D. Magma that reaches Earth's surface flows from volcanoes as lava.**

Passage III

Greenhouse gases such as methane (CH_4) warm Earth's climate. Figure 1 shows the concentration of CH_4 in Earth's atmosphere and the solar radiation intensity at Earth's surface for tropical Europe and Asia over the past 250,000 years. As the figure shows, the CH_4 concentration and the solar radiation intensity have increased and decreased at the same times over most of this period. Figure 2 shows the same types of data for the same region over the past 11,000 years. This figure is consistent with the hypothesis that the greenhouse gases from human activities may have begun warming Earth's climate thousands of years earlier than once thought.



*ppb = parts per billion

Figure 1

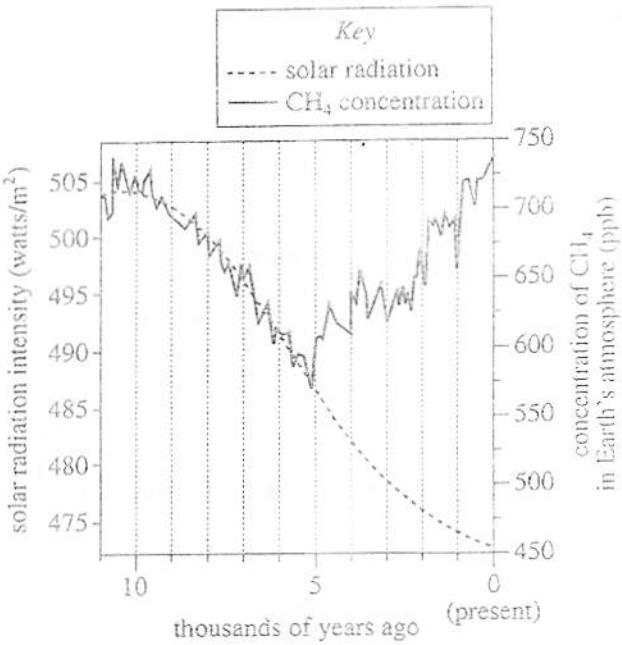


Figure 2

Figures adapted from William Ruddiman, *Plows, Plagues & Petroleum*. ©2005 by Princeton University Press.

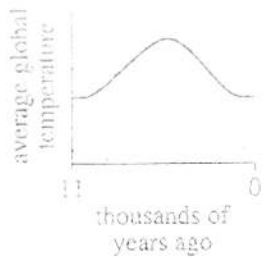
15. According to Figure 2, the solar radiation intensity 8,000 years ago was closest to which of the following?

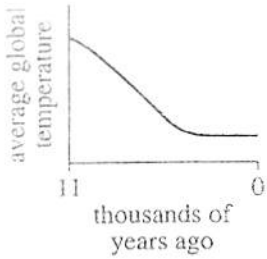
A. 490 watts/m^2
B. 495 watts/m^2
C. 500 watts/m^2
D. 505 watts/m^2

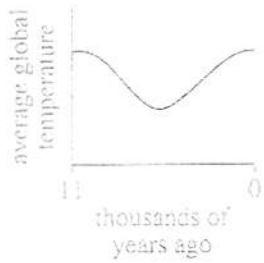
16. According to Figure 2, if the trend in the CH_4 concentration had continued to match the trend in the solar radiation intensity, the CH_4 concentration at present would most likely be:

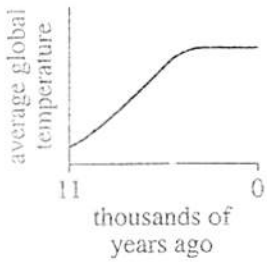
F. less than 550 ppb.
G. between 550 ppb and 600 ppb.
H. between 600 ppb and 650 ppb.
J. greater than 650 ppb.

17. Suppose that whenever the CH_4 concentration increases, a corresponding, immediate increase in average global temperature occurs, and that whenever the CH_4 concentration decreases, a corresponding, immediate decrease in average global temperature occurs. Based on Figure 2, which of the following graphs best represents a plot of average global temperature over the past 11,000 years?

A.


C.


B.


D.


18. Based on Figure 1, the average solar radiation intensity over the past 250,000 years was closest to which of the following?

F. 400 watts/m^2
G. 440 watts/m^2
H. 480 watts/m^2
J. 520 watts/m^2

19. One *solar radiation cycle* is the time between a maximum in the solar radiation intensity and the next maximum in the solar radiation intensity. According to Figure 1, the average length of a solar radiation cycle during the past 250,000 years was:

A. less than 15,000 years.
B. between 15,000 years and 35,000 years.
C. between 35,000 years and 55,000 years.
D. greater than 55,000 years.

20. Which of the following statements best describes the primary effect of CH_4 on Earth's climate?

F. CH_4 gives off visible light to space, cooling Earth's climate.
G. CH_4 gives off ultraviolet radiation to space, warming Earth's climate.
H. CH_4 absorbs heat as it enters Earth's atmosphere from space, cooling Earth's climate.
J. CH_4 absorbs heat that comes up from Earth's surface, warming Earth's climate.

Research Summaries

-Focus on scientific experiments, scientific method, design of the experiment, and drawing conclusions
-the correct answer can usually be found within the information in the passage

VOCABULARY NEEDED:

1. Hypothesis- proposed explanation of a scientific phenomenon
2. Control variable: stays constant in an experiment
3. pH: numerical scale 1-14, to represent acidity (1) or alkalinity (14)
4. control group: used for comparison against experimental groups
5. Independent variable: controlled by the investigator: EX: you might grow crops with different amounts of light
6. Dependent variable: measured by the investigator: EX: you would measure how the crops grow after exposing them to different amounts of light

Conflicting Viewpoints

*****Learn to identify and do these questions LAST! They take up the most time and are considered the most difficult.**

1. **Understand the points of disagreement. Jot these down.**
2. **Cite data in the passage that supports or refutes each argument.**

This type of passage gives a brief summary or description of the problem and explanations of the conflicting viewpoints of the scientists.

TRYING TO DECIDE WHICH HYPOTHESIS IS CORRECT IS A WASTE OF TIME. The test will not ask you to choose the right one!!!!

As you scan the passages think of these six questions:

1. **What is the basic question that is argued?**
2. **What is the position of each scientist?**
3. **What is the evidence of scientist #1?**
4. **What is the evidence of scientist #2?**
5. **What flaws does scientist #2 find with scientist #1?**
6. **What flaws does scientist #1 find with scientist #2?**

SCIENCE:

S- Scan the passage
C-Check for the main idea
IE- Ignore the extras
N-Note the reference in the question (figure 1 or table 2)
C-Choose the best answer
E-Eliminate the incorrect answers

4 4

Passage V

A typical *acid-base indicator* is a compound that will be one color over a certain lower pH range but will be a different color over a certain higher pH range. In the small range between these pH ranges—the *transition range*—the indicator's color will be an intermediate of its other 2 colors.

Students studied 5 acid-base indicators using colorless aqueous solutions of different pH and a *well plate* (a plate containing a matrix of round depressions—*wells*—that can hold small volumes of liquid).

Experiment 1

The students added a pH = 0 solution to 5 wells in the first column of the well plate, then added a pH = 1 solution to the 5 wells in the next column, and so on, up to pH = 7. Next, they added a drop of a given indicator (in solution) to each of the wells in a row, and then repeated this process, adding a different indicator to each row. The color of the resulting solution in each well was then recorded in Table 1 (B = blue, G = green, O = orange, P = purple, R = red, Y = yellow).

Table 1

Indicator	Color in solution with a pH of:							
	0	1	2	3	4	5	6	7
Metanil yellow	R	R	O	Y	Y	Y	Y	Y
Resorcin blue	R	R	R	R	R	P	P	B
Curcumin	Y	Y	Y	Y	Y	Y	Y	Y
Hessian bordeaux	B	B	B	B	B	B	B	B
Indigo carmine	B	B	B	B	B	B	B	B

Experiment 2

Experiment 1 was repeated with solutions that had a pH of 8 or greater (see Table 2).

Table 2

Indicator	Color in solution with a pH of:						
	8	9	10	11	12	13	14
Metanil yellow	Y	Y	Y	Y	Y	Y	Y
Resorcin blue	B	B	B	B	B	B	B
Curcumin	O	R	R	R	R	R	R
Hessian bordeaux	B	R	R	R	R	R	R
Indigo carmine	B	B	B	B	G	Y	Y

Experiment 3

Students were given 4 solutions (Solutions I–IV) of unknown pH. The well plate was used to test samples of each solution with 4 of the 5 indicators (see Table 3).

Table 3

Indicator	Color in Solution:			
	I	II	III	IV
Metanil yellow	Y	Y	Y	O
Resorcin blue	B	B	R	R
Curcumin	R	R	Y	Y
Indigo carmine	B	Y	B	B

Tables adapted from David R. Lide, ed., *CRC Handbook of Chemistry and Physics*, 78th ed. ©1997 by CRC Press LLC.

27. One way Experiment 2 differed from Experiment 3 was that in Experiment 2:

A. the solutions to which indicators were added were of known pH.
B. the solutions to which indicators were added were of unknown pH.
C. metanil yellow was used.
D. metanil yellow was not used.

28. Based on the description of the well plate and how it was used, the empty well plate would most likely have been which of the following colors?

F. Black
G. Blue
H. Red
J. White

29. Based on the results of Experiments 1 and 2, which of the following is a possible transition range for curcumin?

A. pH = 3.9 to pH = 7.3
B. pH = 4.2 to pH = 6.6
C. pH = 7.4 to pH = 8.6
D. pH = 8.4 to pH = 9.5

30. A chemist has 2 solutions, one of pH = 1 and one of pH = 6. Based on the results of Experiments 1 and 2, could indigo carmine be used to distinguish between these solutions?

F. No; indigo carmine is blue at both pH = 1 and pH = 6.
G. No; indigo carmine is blue at pH = 1 and is yellow at pH = 6.
H. Yes; indigo carmine is blue at both pH = 1 and pH = 6.
J. Yes; indigo carmine is blue at pH = 1 and is yellow at pH = 6.

31. The indicator *propyl red* has a transition range of pH = 4.6 to pH = 6.8. If propyl red had been included in Experiments 1 and 2, it would have produced results most similar to those produced by which of the 5 indicators?

A. Metanil yellow
B. Resorcin blue
C. Curcumin
D. Indigo carmine

32. A student claimed that Solution III has a pH of 7.3. Are the results of Experiments 1–3 consistent with this claim?

F. No, because in Solution III metanil yellow was yellow.
G. No, because in Solution III resorcin blue was red.
H. Yes, because in Solution III metanil yellow was yellow.
J. Yes, because in Solution III resorcin blue was red.

33. Based on the results of Experiments 1–3, which of Solutions I–IV has the *lowest* pH ?

A. Solution I
B. Solution II
C. Solution III
D. Solution IV

Passage II

In the fall, monarch butterflies (*Danaus plexippus*) in eastern North America migrate to Mexico, where they overwinter in high-altitude forests of *oyamel fir* (an evergreen conifer). The butterflies store (accumulate) body lipids to use as a source of energy at a later time. Consider the following 3 hypotheses pertaining to when the butterflies store lipids and when the energy from the stored lipids is used, with respect to migration and overwintering.

Hypothesis 1

Monarch butterflies require energy from stored lipids for migration and during the overwintering period. The butterflies first store lipids before they begin their migration. During migration, as stored lipids are converted to energy, lipid mass continuously decreases. When the butterflies reach the overwintering sites, ending their migration, they must store lipids again before beginning the overwintering period.

Hypothesis 2

Monarch butterflies require energy from stored lipids for migration but not during the overwintering period. The butterflies store lipids before they begin their migration. During migration, as stored lipids are converted to energy, lipid mass continuously decreases. Because energy from stored lipids is not required during the overwintering period, the butterflies do not store lipids while at the overwintering sites.

Hypothesis 3

Monarch butterflies require energy from stored lipids during the overwintering period but not for migration. The butterflies do not store lipids before they begin their migration. Instead, lipids are stored during migration; therefore, lipid mass continuously increases from the beginning of migration until the end of migration. The butterflies arrive at the overwintering sites with enough lipids to provide themselves with energy during the overwintering period, so they do not store lipids while at the overwintering sites.

8. Which hypothesis, if any, asserts that monarch butterflies store lipids during 2 distinct periods?

   F. Hypothesis 1
   G. Hypothesis 2
   H. Hypothesis 3
   J. None of the hypotheses

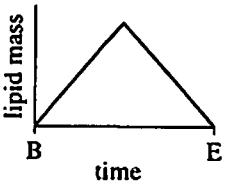
9. Which hypothesis, if any, asserts that monarch butterflies require energy from stored lipids neither for migration nor during the overwintering period?

   A. Hypothesis 1
   B. Hypothesis 2
   C. Hypothesis 3
   D. None of the hypotheses

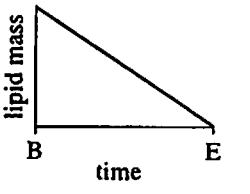
10. Based on Hypothesis 3, which of the following figures best depicts the change in the lipid mass of a monarch butterfly from the beginning of migration to the end of migration?

    (Note: In each figure, B represents the beginning of migration and E represents the end of migration.)

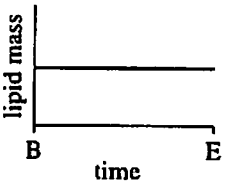
F.



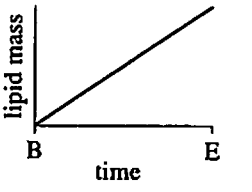
H.



G.



J.



11. Assume that changes in the body mass of a monarch butterfly are caused only by changes in the mass of the butterfly's stored lipids. The statement "The percent of a monarch butterfly's body mass that is made up of lipids is greater at the beginning of migration than at the end of migration" is supported by which of the hypotheses?

    A. Hypothesis 1 only
    B. Hypothesis 2 only
    C. Hypotheses 1 and 2 only
    D. Hypotheses 1, 2, and 3

12. To store lipids, monarch butterflies convert sugar from nectar they have consumed into lipids. A supporter of which hypothesis, if any, would be likely to claim that to ensure the butterflies can store lipids for the overwintering period, nectar must be present at the butterflies' overwintering sites?

    F. Hypothesis 1
    G. Hypothesis 2
    H. Hypothesis 3
    J. None of the hypotheses

13. Which of the following statements about lipids in monarch butterflies is consistent with all 3 hypotheses?

    A. The butterflies' lipid masses do not change during the overwintering period.
    B. The butterflies' lipid masses change during migration.
    C. The butterflies use energy from stored lipids during the overwintering period.
    D. The butterflies use energy from stored lipids for migration.

14. When the monarch butterflies use their stored lipids, the lipids must be broken down to produce energy-rich molecules that can be readily used by cells. Which of the following molecules is produced as a direct result of the breakdown of the lipids?

    F. ATP
    G. Starch
    H. DNA
    J. Amino acids