

# **SCIENCE FULL-LENGTH PRACTICE TESTS 3**

**SCIENCE TEST***40 Minutes–40 Questions*

**Directions:** There are six passages in this test. Each passage is followed by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

You are NOT permitted to use a calculator on this test.

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**Passage I**

The *apoptotic index (AI)* for a group of dividing cells is calculated as shown below:

$$AI = \frac{\text{number of cells undergoing } \textit{apoptosis} \text{ (cell death)}}{\text{total number of cells}}$$

Figure 1 shows the *AI* for a culture of fibroblast cells as a function of the surrounding concentration, in parts per million (ppm), of a cell toxin.

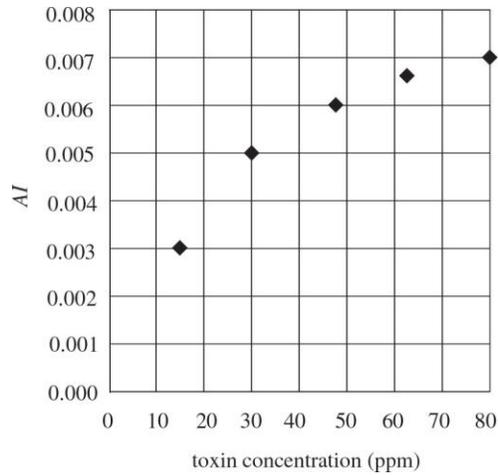


Figure 1

One thousand actively dividing fibroblast cells in culture were studied. Figure 2 shows the distribution of the cells in each of the stages of the dividing cell cycle.

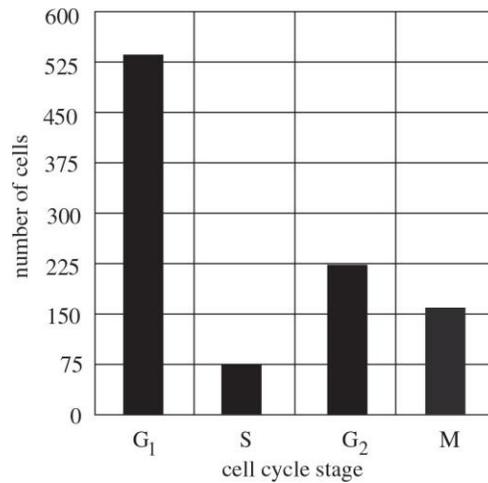


Figure 2

Electron micrographs were taken of the fibroblasts in culture. Figure 3 shows an example of cells in each of the 4 stages of the dividing cell cycle. Although the cells are *not* arranged in the sequence of the cell cycle, each stage is shown only once.

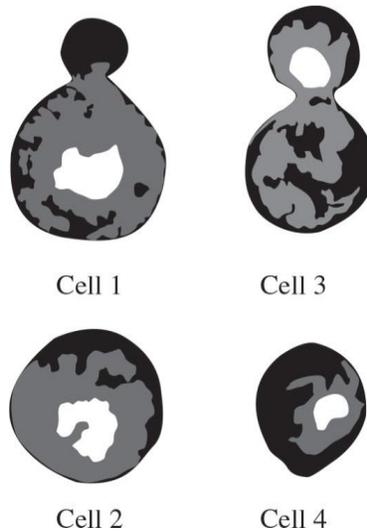


Figure 3

1. Which cell in Figure 3 is most likely in the stage of the cell cycle during which cytokinesis is occurring as mitosis nears completion?
  - A. Cell 1
  - B. Cell 2
  - C. Cell 3
  - D. Cell 4
  
2. Based on Figure 1, if a culture of fibroblast cells was surrounded by a toxin concentration of 90 ppm, the percent of those cells that would undergo apoptosis is most likely:
  - F. less than 0.5%.
  - G. between 0.5% and 0.6%.
  - H. between 0.6% and 0.7%.
  - J. greater than 0.7%.
  
3. Which of the following cells in Figure 3 is most likely in the first stage of the actively dividing cell cycle?
  - A. Cell 1
  - B. Cell 2

- C. Cell 3
- D. Cell 4

**4.** According to Figure 2, how did the number of fibroblast cells in stage  $G_2$  compare with the number of cells in stage S? The number in  $G_2$  was approximately:

F.  $\frac{1}{4}$  as great as the number in S.

G.  $\frac{1}{3}$  as great as the number in S.

H. 3 times as great as the number in S.

J. 4 times as great as the number in S.

**5.** Based on Figure 2, of the fibroblast cells that were in the actively dividing cell cycle, the proportion that were in  $G_1$  is closest to which of the following?

A.  $\frac{540}{1000}$

B.  $\frac{300}{540}$

C.  $\frac{1000}{540}$

D.  $\frac{540}{300}$

**6.** Suppose that 3,000 cells are cultured in a surrounding toxin concentration of 30 ppm. Based on Figure 1, the number of these cells undergoing apoptosis is most likely closest to:

- F. 1.5.
- G. 15.
- H. 150.
- J. 1,500.

**Passage II**

A *polymorphism* is the persistent occurrence of different appearances for a particular trait in a species. All humans have slight differences in their *genotypes* (genetic code) that result in different *phenotypes* (observable characteristics). Genetic polymorphisms are persistent variations in gene sequences at a particular location in chromosomes, such as those accounting for different blood types. Variations that cannot be observed with the naked eye require techniques such as *capillary electrophoresis* (the separation of genetic or protein material based on charge characteristics using an electric field).

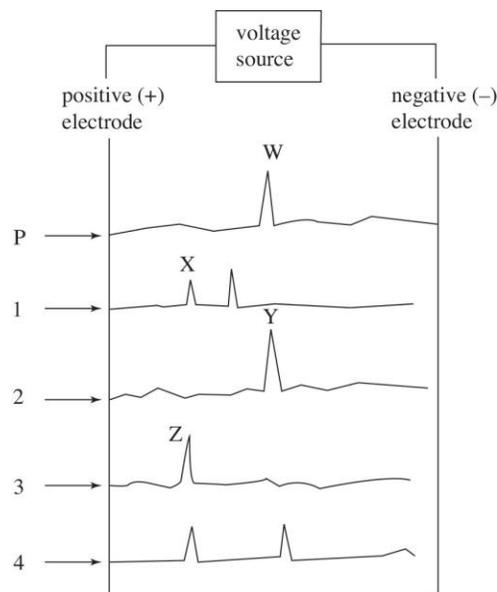
The label on a vial of blood from a hospital patient was lost. The sample just tested positive for a disease of the blood protein hemoglobin that is very common in the hospital population. The sample was traced to a room with 4 patients who were subsequently tested to determine the source of the initial vial.

*Tests and Results*

Smears of the blood from the unidentified patient (P) and from the 4 newly tested patients (1–4) were observed under the microscope for the presence of any cells with an abnormal appearance (target or sickle cells). Results are shown in Table 1.

Table 1	
Patient	Blood smear findings
P	Sickle cells
1	Target cells
2	Sickle cells
3	No abnormal cells

Serum was isolated from the blood of Patient P and from Patients 1–4 and placed in separate tubes. A buffer was added to each vial to establish a pH of 8.6. One at a time, samples from each tube were injected into the capillary electrophoresis device set at 7.5 kilovolts (kV) to separate the types of hemoglobin present into peaks. The hemoglobin proteins composing a peak had similar charge characteristics. Figure 1 shows the peaks that resulted from all 5 samples.



Note: Each peak is made up of hemoglobin proteins.  
W, X, Y, and Z are 4 specific peaks.

Figure 1

- 7.** What is the most likely reason that the serum samples were treated with a buffer to bring pH to 8.6 ?
- A.** Hemoglobin protein breaks down at that pH.
  - B.** All bacteria and viruses are destroyed at that pH.
  - C.** Capillary electrophoresis separation of hemoglobin functions best at that pH.
  - D.** Capillary electrophoresis separation of hemoglobin does not function at that pH.

**8.** Are the data in Table 1 consistent with the hypothesis that Patient 4 and Patient P are the same person?

**F.** Yes; Patient 4 has the same blood cell appearance as Patient P.

**G.** Yes; Patient 4 has different blood cell appearance as Patient P.

**H.** No; Patient 4 has the same blood cell appearance as Patient P.

**J.** No; Patient 4 has different blood cell appearance as Patient P.

**9.** Based on the information in the introduction and test results, do Patients 2 and 4 likely have the same genotype?

**A.** Yes, because the blood smear findings of Patients 2 and 4 are the same.

**B.** Yes, because Patients 2 and 4 have the same protein peak patterns.

**C.** No, because the blood smear findings of Patients 2 and 4 are different.

**D.** No, because Patients 2 and 4 have different protein peak patterns.

**10.** Sickle cells are caused by certain hemoglobin genotype combinations of 3 different alleles. The  $Hb^A$  allele is responsible for normal hemoglobin, the  $Hb^S$  allele is responsible for one variant that results in sickle cells, and the  $Hb^C$  allele is responsible for a different variant also resulting in sickle cells. Based on Table 1, the genotype of Patient 4 could be which of the following?

**I.**  $Hb^A Hb^A$

**II.**  $Hb^A Hb^S$

**III.**  $Hb^A Hb^C$

**F.** II only

**G.** I or III only

**H.** II or III only

**J.** I, II, or III

**11.** According to Figure 1, the pattern of protein peaks produced by serum from Patient P most closely resembles the pattern produced by the

serum sample from:

- A. Patient 1.
- B. Patient 2.
- C. Patient 3.
- D. Patient 4.

**12.** Based on Figure 1, the hemoglobin proteins in which of the following two peaks were most likely closest in charge characteristics?

- F. W and X
- G. W and Z
- H. X and Y
- J. X and Z

**13.** During the capillary electrophoresis, all the hemoglobin proteins started with some quantity of charge before migrating from left to right in Figure 1. Therefore, the proteins resulting in peaks furthest to the left must have been the most:

- A. negative, as opposite charges attract each other.
- B. negative, as opposite charges repel each other.
- C. positive, as opposite charges attract each other.
- D. positive, as opposite charges repel each other.

### Passage III

*Carboxylic acids* are organic compounds containing a *carboxyl* (–COOH) group. These molecules are acidic since they are able to donate protons in solution. The acidity and other physical properties of carboxylic acids are affected by the composition of the atoms bound to the carboxyl group. Table 1 lists the freezing points and boiling points for several carboxylic acids.

Table 1			
Formula	Name	Freezing point (°C)	Boiling point (°C)

CHOOH	Formic acid	8.4	101
CH <sub>3</sub> COOH	Acetic acid	16.6	118
CH <sub>3</sub> CH <sub>2</sub> COOH	Propionic acid	-20.8	141
CH <sub>3</sub> (CH <sub>2</sub> ) <sub>2</sub> COOH	Butyric acid	-5.5	164
CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> COOH	Valeric acid	-34.5	186

Figure 1 shows how the vapor pressure (in mm Hg) of 3 carboxylic acids changes as a function of temperature.

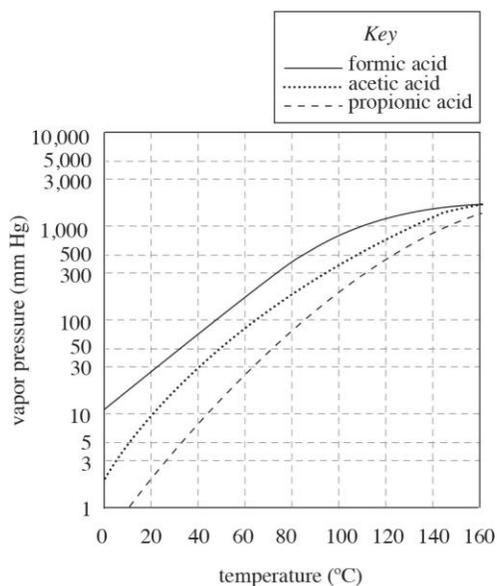


Figure 1

Figure 2 shows how the vapor pressure of the same 3 carboxylic acids changes as a function of concentration when mixed with water at 20°C.

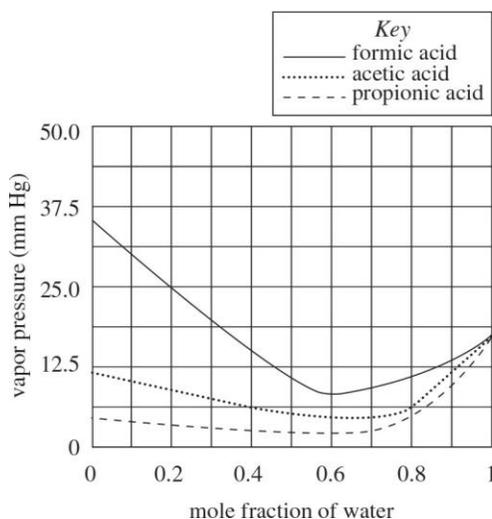


Figure 2

- 14.** Which of the carboxylic acids listed in Table 1 has the *highest* melting point?
- F. Propionic acid
  - G. Valeric acid
  - H. Acetic acid
  - J. Formic acid
- 15.** A carboxylic acid not listed in Table 1, pyruvic acid, has a boiling point of 165°C. Based on Table 1 and Figure 1, the vapor pressure of pyruvic acid at 40°C is most likely:
- A. less than 10 mm Hg.
  - B. between 10 and 100 mm Hg.
  - C. between 100 and 500 mm Hg.
  - D. greater than 500 mm Hg.
- 16.** According to Figure 2, the vapor pressure of a 0.5 mole fraction solution of water in formic acid is closest to the vapor pressure of which of the following water in formic acid solutions?
- F. 0.4 mole fraction
  - G. 0.6 mole fraction

H. 0.8 mole fraction

J. 0.9 mole fraction

**17.** According to Figure 2, as the mole fraction of water in an acetic acid and water solution increases from 0 to 1, the vapor pressure:

A. decreases, then increases.

B. increases, then decreases.

C. decreases only.

D. increases only.

**18.**  $\text{CH}_3(\text{CH}_2)_4\text{COOH}$  is the chemical formula for the carboxylic acid named hexanoic acid. Based on Table 1, this compound most likely boils at a temperature:

F. lower than  $180^\circ\text{C}$ .

G. between  $180^\circ\text{C}$  and  $215^\circ\text{C}$ .

H. between  $215^\circ\text{C}$  and  $250^\circ\text{C}$ .

J. higher than  $250^\circ\text{C}$ .

**19.** According to Figure 1, does acetic acid or formic acid resist vaporization more at  $60^\circ\text{C}$  ?

A. Formic acid, because formic acid has the lower vapor pressure.

B. Formic acid, because formic acid has the higher vapor pressure.

C. Acetic acid, because acetic acid has the lower vapor pressure.

D. Acetic acid, because acetic acid has the higher vapor pressure.

#### Passage IV

A solenoid is a device that creates a magnetic field from electric current and can be used to exert a force on a nearby bar magnet to activate a mechanical device.

Scientists performed experiments on the solenoid apparatus shown in Figure 1.

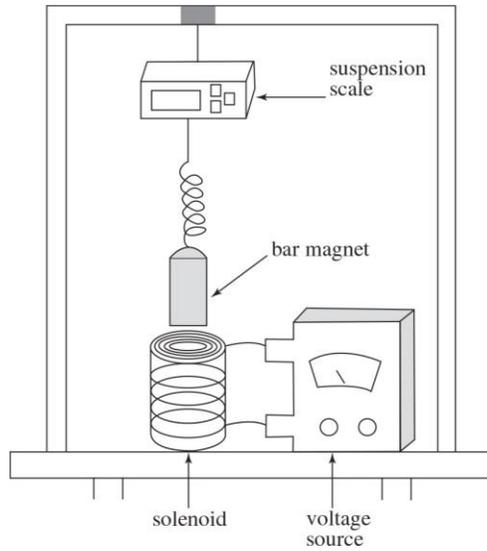


Figure 1

A wire carrying current from a voltage source was coiled into a hollow cylinder to form a solenoid with a length of  $XY$ . A solid cylinder bar magnet was suspended near the top of the solenoid as shown in Figure 2.

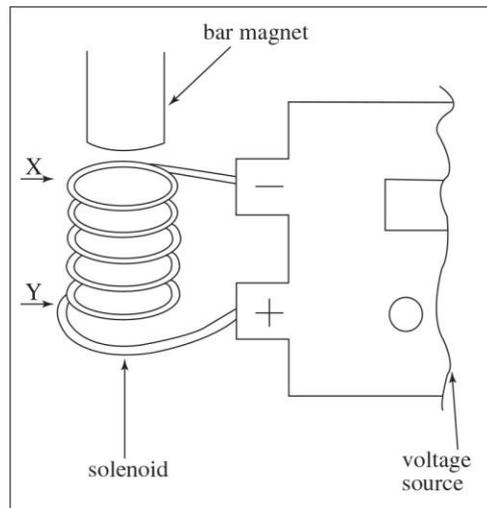


Figure 2

When the voltage source was turned on, the solenoid exerted a measurable force on the suspended bar magnet.

The bar magnet was attached to a digital suspension scale that measured weight in newtons (N). With the voltage source off, the scale read 4.7000 N. Prior to the start of each experimental trial, the scale was adjusted to read 5.0000 N.

*Experiment 1*

The scientists applied various levels of voltage in volts (V) to the circuit and recorded the weight indicated by the suspension scale for each trial. Results were recorded in Table 1.

Table 1	
Voltage (V)	Weight (N)
7.25	5.0078
8.00	5.0095
8.75	5.0113

*Experiment 2*

The scientists removed the bar magnet, inverted it, and reattached it to the suspension scale so that the opposite end was now facing the solenoid. The procedures of Experiment 1 were repeated and results were recorded in Table 2.

Table 2	
Voltage (V)	Weight (N)
7.25	4.9922
8.00	4.9905
8.75	4.9887

*Experiment 3*

The bar magnet was returned to the original alignment it was in during Experiment 1. The length XY of the solenoid coil was varied while a voltage of 8.00 V was applied to the circuit. Weights were recorded in Table 3.

Table 3	
Solenoid length XY (cm)	Weight (N)
7.50	5.0169
8.50	5.0131
9.50	5.0105

- 20.** Based on the results of Experiments 1 and 3, the length XY of the solenoid coil in Experiment 1 was most likely:
- F. shorter than 7.50 cm.
  - G. between 7.50 cm and 8.50 cm.
  - H. between 8.50 cm and 9.50 cm.
  - J. longer than 9.50 cm.
- 21.** In Experiments 1 and 2, the orientation of the bar magnet relative to the solenoid opening determined which of the following?
- A. Solenoid length XY
  - B. Direction of the force exerted by the solenoid on the bar magnet
  - C. Density of the bar magnet
  - D. Magnetic field strength of the solenoid
- 22.** Which of the following provides the best explanation for the results of Experiment 3 ? The force exerted on the bar magnet by the solenoid magnetic field:
- F. increased as the voltage applied to the circuit increased.
  - G. decreased as the voltage applied to the circuit increased.
  - H. increased as the length XY of the solenoid increased.
  - J. decreased as the length XY of the solenoid increased.

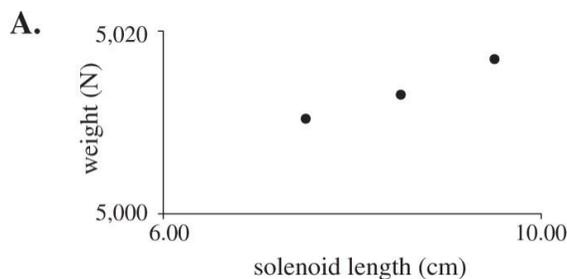
**23.** Suppose the scientists maintained the same bar magnet orientation in Experiment 3 as in Experiment 2. Based on the results of Experiments 1 and 2, with the solenoid length XY equal to 9.50 cm, the weight on the scale would most likely have been:

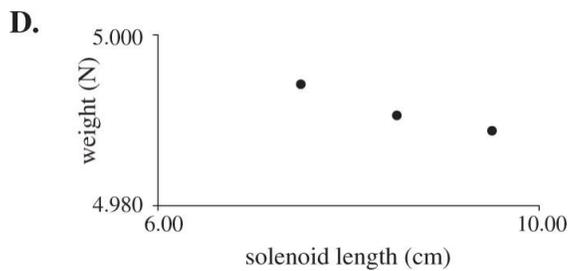
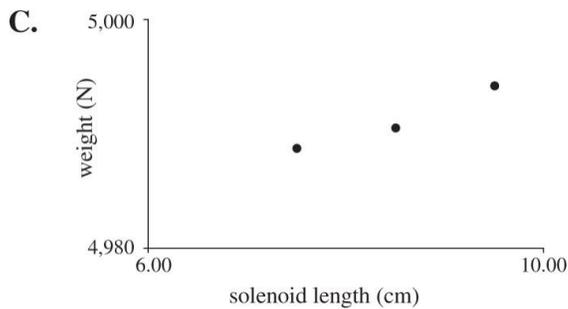
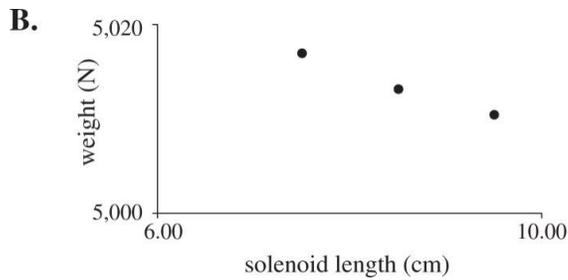
- A. 4.9831 N.
- B. 4.9895 N.
- C. 5.0105 N.
- D. 5.0169 N.

**24.** Prior to all experiments, the suspension scale was calibrated to read exactly 0 N when nothing was attached. Once the bar magnet was attached, the scientists made which of the following adjustments to the scale reading for each of the experimental trials?

- F. The displayed weight was adjusted downward by approximately 1.3 N.
- G. The displayed weight was adjusted upward by approximately 1.3 N.
- H. The displayed weight was adjusted downward by approximately 0.3 N.
- J. The displayed weight was adjusted upward by approximately 0.3 N.

**25.** Which of the following graphs best depicts the results of Experiment 3 ?





**26.** Suppose another trial had been conducted in Experiment 2 in which the voltage was 6.50 V. The weight measured on the scale would most likely have been closest to which of the following?

- F.** 4.9908 N
- G.** 4.9918 N
- H.** 4.9928 N
- J.** 4.9938 N

**Passage V**

Biodiversity is a measure of the variety of life in the world, and it can vary both due to natural factors and human activities.

Biodiversity is largely affected by the amount of available oxygen in the environment. When oxygen is plentiful, the number of species increases,

but when oxygen levels are low, mass extinctions lower Earth's biodiversity. The marine biodiversity over time can be estimated by analyzing sediment and fossils found beneath the ocean floor. Figure 1 shows the global marine biodiversity, measured in the number of invertebrate genera, from the year 1500 to the year 2000.

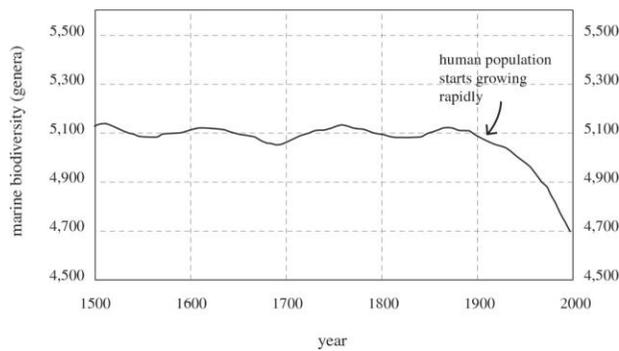


Figure 1

Figure 2 shows the global marine biodiversity and the atmospheric oxygen difference over the past 500 million years. The atmospheric oxygen difference is equal to:

(atmospheric oxygen concentration at a specific time) – (current atmospheric oxygen concentration)

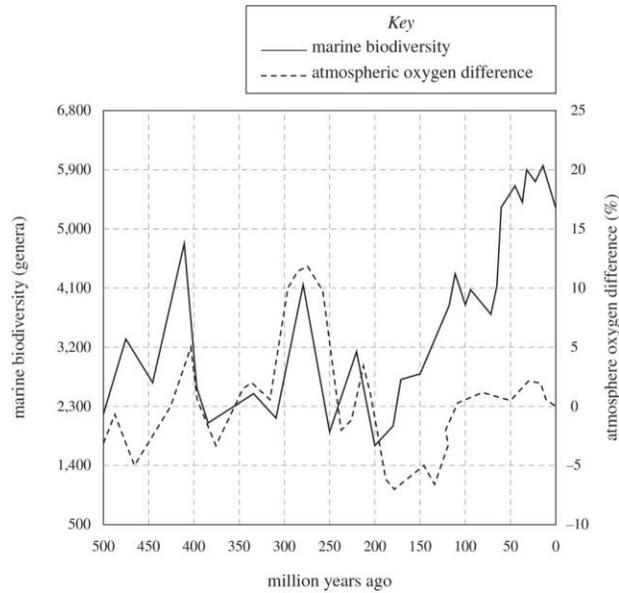


Figure 2

Two ecology students describe their theories on the loss of marine biodiversity since 1900.

*Student 1*

The rapid loss in marine biodiversity since 1900 is caused by human activities. Figure 1 shows that the marine biodiversity was stable for centuries until the human population surged upward, quadrupling between 1900 and present day. The deforestation and large-scale industry necessary to support the large population has led to a decrease of 0.50% in the atmospheric oxygen concentration since 1900. As a result, marine biodiversity has decreased at a rate faster than any other time in the past 500 million years. Since 2000, marine biodiversity has fallen by approximately 2% per decade.

*Student 2*

The loss in marine biodiversity is part of a natural cycle of growth and loss that has occurred many times over the past 500 million years. As natural processes such as volcanic eruptions, asteroid impacts, and weathering cause decreases and increases in the atmospheric oxygen levels,

marine biodiversity follows the same trend (see Figure 2). Human activities have very little effect on the atmospheric oxygen concentration, so the human impact on marine biodiversity is negligible.

- 27.** Given Figure 1, Student 1 would most likely claim that from the year 1500 to the year 1900, the atmospheric oxygen concentration:
- A.** increased by more than 1.0%.
  - B.** decreased by more than 1.0%.
  - C.** changed by 1.0%.
  - D.** changed by less than 1.0%, remaining relatively constant.
- 28.** According to Figure 2, over which of the following time intervals did the atmospheric oxygen concentration decrease more than 10 times as much as Student 1 claims it has decreased since 1900?
- F.** 440 to 420 million years ago
  - G.** 330 to 310 million years ago
  - H.** 260 to 240 million years ago
  - J.** 30 to 10 million years ago
- 29.** Student 1 claims that current marine biodiversity is falling at a faster rate than it did at any time in the past 500 million years. Does Figure 1 give sufficient basis for that claim?
- A.** No; Figure 1 shows the marine biodiversity level for the past few centuries only.
  - B.** No; Figure 1 shows the marine biodiversity for the past 500 million years.
  - C.** Yes; Figure 1 shows the marine biodiversity level for the past few centuries only.
  - D.** Yes; Figure 1 shows the marine biodiversity for the past 500 million years.
- 30.** According to Student 1, marine biodiversity has been decreasing at a constant rate since 2000. Given the marine biodiversity level in the

year 2000 in Figure 1, Student 1 would most likely conclude that the marine biodiversity in the year 2020 was closest to which of the following?

- F. 4,500 genera
- G. 4,600 genera
- H. 4,800 genera
- J. 4,900 genera

**31.** Suppose Student 2 stated that there have been times over the past 500 million years at which the atmospheric oxygen concentration has been lower than it is today. To support this statement, Student 2 would most likely cite oxygen data in Figure 2 for which of the following times?

- A. 405 million years ago
- B. 330 million years ago
- C. 180 million years ago
- D. 70 million years ago

**32.** Assume that the current atmospheric oxygen concentration is 21%. Given Figure 2, the two students would most likely claim that the atmospheric oxygen concentration 300 million years ago was closest to which of the following?

- F. 15%
- G. 19%
- H. 24%
- J. 27%

**33.** Which of the following statements about marine biodiversity would Student 2 most likely agree with?

- A. Marine biodiversity generally increases as the oxygen concentration decreases.
- B. Marine biodiversity generally decreases as the oxygen concentration decreases.

C. Marine biodiversity is affected only by human activities.

D. Marine biodiversity has remained constant for the past 500 million years.

### Passage VI

The force per unit area resulting from the separation of solutions of different concentrations by a selectively permeable membrane is called *osmotic pressure*. Molecules, including water, have a tendency to move from regions of high concentration to regions of low concentration. Selectively permeable membranes act as filters, only allowing molecules below a certain threshold size to pass through. Osmotic pressure is the pressure required to stop water from moving across such a membrane from a region of high to low water concentration.

Cupric ions ( $\text{Cu}_2^+$ ) and glucose were dissolved separately in equal volumes of water to make two solutions. The glucose solution was more dilute, meaning that it had a higher percentage of water molecules than the cupric ion solution. Of the three molecules used for the solutions, water is the smallest and glucose is the largest. Water and glucose solutions are colorless while cupric ion solutions are blue. However, mixing glucose and cupric ions results in a red solution.

#### *Experiment 1*

A U-shaped tube contains a selectively permeable membrane, dividing it into equal halves. Glucose solution is poured in the left and an equal volume of cupric ion solution is poured in the right. Over 2 hours, the water level fell on the left and rose on the right. At this time, the left-sided solution was red and the right-sided was blue.

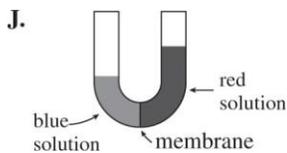
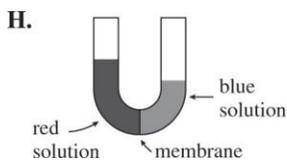
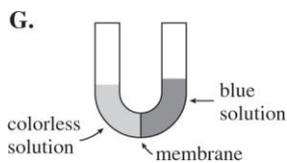
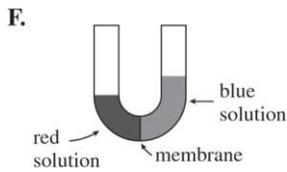
#### *Experiment 2*

Cupric ion solution is poured in the left side of the U-shaped tube and an equal volume of pure water is poured in the right. Over 2 hours, the water level fell on the right and rose on the left. At this time, both sides of the tube contained blue-colored solutions.

*Experiment 3*

Glucose solution is poured in the left side of the U-shaped tube and an equal volume of pure water is poured in the right. Over 2 hours, the water level fell on the right and rose on the left. At this time, both sides of the tube contained colorless solutions.

**34.** Which of the following diagrams could represent the results of Experiment 1 after the two hours had passed?



**35.** Albumin molecules do not pass through the selectively permeable membrane used in Experiments 1–3 and form clear solutions in water. If Experiment 2 were repeated, but the left side was filled with an albumin solution, the solution levels would:

- A.** fall on the left and rise on the right, resulting in a left-sided red solution and right-sided clear solution.
- B.** rise on the left and fall on the right, resulting in red solutions on both sides.

- C. fall on the left and rise on the right, resulting in red solutions on both sides.
- D. rise on the left and fall on the right, resulting in clear solutions on both sides.

**36.** In Experiments 1 and 2, cupric ion particles were able to move:

- F. through the membrane into both the glucose solution and pure water.
- G. through neither membrane into neither the glucose solution nor the pure water.
- H. only through the membrane separating it from the glucose solution.
- J. only through the membrane separating it from pure water.

**37.** In Experiments 2 and 3, what did the left side of the U-tube contain at the start of the experiment?

- A. Experiment 2: cupric ion solution, Experiment 3: pure water
- B. Experiment 2: glucose solution, Experiment 3: pure water
- C. Experiment 2: cupric ion solution, Experiment 3: glucose solution
- D. Experiment 2: glucose solution, Experiment 3: cupric ion solution

**38.** In Experiment 1, if a selectively permeable membrane that cupric ions, glucose, and water molecules could all pass through had been used, how, if at all, would the results have differed?

- F. The water level would have fallen on the right and risen on the left.
- G. A red color would have appeared on both sides of the U-tube.
- H. A blue color would have appeared on both sides of the U-tube.
- J. The same results would have been observed.

**39.** After watching Experiment 1 only, an observer asserted that since the left-sided solution ended up red, cupric ions must be bigger than water molecules. Is this a valid assertion?

- A. No; the results show only that cupric ions and water molecules are smaller than glucose molecules.
  - B. No; the results show only that cupric ions and water molecules are larger than glucose molecules.
  - C. Yes; the results show that water molecules but not cupric ions can pass through the selectively permeable membrane.
  - D. Yes; the results show that both water molecules and cupric ions can pass through the selectively permeable membrane.
- 40.** In Experiment 1, before the molecules began to move through the semi-permeable membrane, the appearance of the right-sided solution in the U-tube was:
- F. clear.
  - G. blue.
  - H. red.
  - J. purple.

**END OF TEST.**

**STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.**

# Answers and Explanations

# SCIENCE PRACTICE TEST 3 EXPLANATIONS

## Passage I

1. C

The question asks for the cell in Figure 3 that is most likely in the stage of the cell cycle in which mitosis is nearing completion. Read the description of Figure 3 to learn more about the images. The passage says the four images represent *cells in each of the 4 stages of the dividing cell cycle*. Since the question asks for a cell near the end of mitosis, look for the cell that has almost finished dividing into two cells. Cell 3 shows the clearest division into two cells. The correct answer is (C).

2. J

The question asks for an *AI* value for fibroblast cells in a toxin concentration of 90 ppm based on Figure 1. Look at the horizontal axis that shows toxin concentration in Figure 1. A concentration of 90 ppm is beyond the range of the graph, so extrapolate the pattern. At a toxin concentration of 80 ppm, the *AI* is approximately 0.007. The *AI* increases as toxin concentration increases, so the *AI* for 90 ppm would be a little higher than 0.007. The answer choices are all percentages, and the *AI* is a proportion, so it needs to be converted into a percentage. To convert *AI* to a percentage, multiply the *AI* by 100%, or  $0.007(100\%) = 0.7\%$ , so the percentage for 90 ppm would be a little higher than 0.7%. Eliminate (F), (G), and (H) as these are not higher than 0.7%. The correct answer is (J).

3. D

The question asks for the cell that is in the first stage based on Figure 3. Read the description of Figure 3 to learn more about the images.

The passage states that the four images represent *cells in each of the 4 stages of the dividing cell cycle*. Since the question asks for a cell in the *first stage* of the cycle, use POE to determine the correct cell. Cells 1 and 3 show visible signs of division, so they represent stages near the end of the cell cycle. Eliminate (A) and (C). Compare the remaining answer choices. Cells 2 and 3 are similar in appearance, but Cell 2 is larger. Cell 2 is also very similar in appearance to Cell 1, which is beginning to divide. Therefore, it is logical that Cell 2 is closer in the cycle to the division stage than Cell 1. Therefore, Cell 1 must be closer to the beginning of the cycle. The correct answer is (D).

4. **H**

The question asks how the number of fibroblast cells in stage  $G_2$  compares to the number of cells in stage S based on Figure 2. Look for the data for the number of cells in each cell cycle stage in Figure 2. Approximately 75 cells are in stage S, and approximately 225 cells are in stage  $G_2$ . There are more cells in stage  $G_2$ , so eliminate (F) and (G). Try (H): 75 times 3 is 225. The correct answer is (H).

5. **A**

The question asks for the proportion of cells in the cell cycle that were in stage  $G_1$  based on Figure 2. Look for the data for the number of cells in the  $G_1$  stage in Figure 2. Approximately 540 cells are in stage  $G_1$ . Use POE. The proportion must have the number of cells in stage  $G_1$  in the numerator, so eliminate (B) and (C). The proportion must have the total number of cells in the denominator, which must be greater than the number of cells in stage  $G_1$ , so eliminate (D). The correct answer is (A).

6. **G**

The question asks for the number of cells out of a sample of 3,000 cells that are undergoing apoptosis in a toxin concentration of 30 ppm. Look for 30 ppm along the horizontal axis in Figure 1. At 30 ppm, the *AI* is 0.005. The passage says the *AI* is calculated using the formula  $AI = \frac{\text{number of cells undergoing apoptosis}}{\text{total number of cells}}$ , so this is a proportion. Start with POE. Eliminate (J) because 1,500 cells would be half of the cells, which is 0.5 instead of 0.005. Eliminate (H), as this is 1/10 of (J), which would mean a proportion of 0.05 instead of 0.005. In (G), this is 1/100 of (J), which is 0.005. The correct answer is (G).

## Passage II

7. C

The question asks for the rationale behind treating samples with a buffer to reach a pH of 8.6. Since pH is not mentioned in either figure, look for where pH is mentioned in the passage. In the 4th paragraph, the passage states that *a buffer was added to each vial to establish a pH of 8.6*. Immediately after adding the buffer, the passage says *samples from each tube were injected into the capillary electrophoresis device*. Since the buffer is added right before the samples are run through the capillary electrophoresis device, the buffer must have something to do with this process. Eliminate (A) and (B) since they don't mention capillary electrophoresis. If a pH of 8.6 did not allow the electrophoresis separation to occur, there would be no purpose for the scientists to add the buffer. Eliminate (D). If

electrophoresis occurs best at a pH of 8.6, this explains why the buffer would have been added. The correct answer is (C).

8. **F**

The question asks if the information in Table 1 is consistent with the hypothesis that Patient 4 and Patient P are the same person. Refer to Table 1 and use POE. Since Patient P's blood smear and Patient 4's blood smear both contain sickle cells, they have the same blood cell appearance. Eliminate (G) and (J). Since the blood cell appearance is the same, they could be the same person. Eliminate (H). The correct answer is (F).

9. **D**

The question asks whether the information and data in the passage indicate that Patient 2 and Patient 4 likely have the same genotype. Look for information about genotypes in the passage. The first paragraph states that *all humans have slight differences in their genotypes (genetic code) that result in different phenotypes (observable characteristics)*. Since genotypes *cannot be observed with the naked eye*, scientists must rely on *capillary electrophoresis* to analyze the genetic code of different patients. Therefore, the data that will support or contradict a claim on genotypes must be in Figure 1, since that is the data from the capillary electrophoresis process. Eliminate (A) and (C) since they use data from Table 1 instead of Figure 1. Patient 2 has one large peak labeled Y, and Patient 4 has two smaller peaks in different locations. Eliminate (B) because the patients do not have protein peaks in the same locations. The correct answer is (D).

10. **H**

The question asks for possible genotypes of Patient 4. Look for information about genotypes in the passage. The first paragraph says *all humans have slight differences in their genotypes (genetic code) that result in different phenotypes (observable characteristics)*. Table 1 says Patient 4 has sickle cells in his or her blood smear. Therefore, Patient 4 must have a genotype that results in sickle cells. The question says that the  $Hb^A$  allele results in normal cells, and both the  $Hb^S$  and  $Hb^C$  alleles result in sickle cells. Genotype I has two copies of the normal  $Hb^A$  allele, so this genotype cannot result in sickle cells. Eliminate (G) and (J). Both alleles  $Hb^S$  and  $Hb^C$  cause sickle cells, so Patient 4 could have either genotype II or genotype III. Therefore, the correct answer is (H).

11. **B**

The question asks for a comparison between two samples represented in Figure 1. Patient P has one large peak labeled  $W$ . The only other sample with a single peak in a similar location is Patient 2. The correct answer is (B).

12. **J**

The question asks which protein peaks are *closest in charge characteristics* based on Figure 1. Look for the term *charge characteristics* in the description of Figure 1. The passage says *the hemoglobin proteins composing a peak had similar charge characteristics*, so the proteins with similar charge characteristics should be located in a similar location on the figure. Peaks X and Z are in similar locations, and peaks W and Y are in similar locations. Out of these two pairs, only X and Z are linked in an answer choice. The correct answer is (J).

13. **A**

The question asks for the charge of the proteins that resulted in peaks furthest to the left in Figure 1. Refer to Figure 1. The electrode on the left of the diagram is labeled *positive*, and the electrode on the right of the figure is labeled *negative*. Use POE to eliminate the illogical answers. Since the electrode on the left is positive, the proteins nearest to that electrode would be negative only if opposite charges attract. If opposite charges repel, the proteins would be positive. Eliminate (B) and (D) because they reverse this logic. To choose between the remaining answers, you need some outside knowledge. Opposite charges attract each other, so the proteins located nearest to the positive electrode would be negatively charged. Eliminate (C) since it says the proteins on the left are positive. The correct answer is (A).

### Passage III

#### 14. H

The question asks for the acid with the highest melting point based on data in Table 1. Look at the variables in Table 1. Melting point is not listed, but freezing point is. Melting and freezing occur at the same temperature since both processes transition between liquids and solids at this temperature. Therefore, the acid with the highest freezing point also has the highest melting point. The highest freezing point listed on Table 1 is for acetic acid at 16.6°C. The correct answer is (H).

#### 15. A

The question asks for the value of the vapor pressure of an additional acid at 40°C based on its boiling point and the data in Table 1 and Figure 1. Look for the trends for boiling point and vapor pressure in Table 1 and Figure 1. In Table 1, formic acid has the lowest boiling point and propionic acid has the highest boiling point. In Figure 1, formic acid has the highest vapor pressure and propionic acid has the lowest vapor pressure. Therefore, boiling point and vapor pressure exhibit an inverse relationship: as one variable increases, the other

variable decreases. The  $165^{\circ}\text{C}$  boiling point of pyruvic acid is greater than the boiling point of any of the three acids in Table 1 and Figure 1. Since vapor pressure decreases as boiling point increases, pyruvic acid should have a lower vapor pressure than any of the three acids. Find  $40^{\circ}\text{C}$  on the horizontal axis of the graph, and trace up to the dashed line for propionic acid. Read across to the vertical axis and note that propionic acid has a vapor pressure between 9 and 10 mm Hg. Pyruvic acid must have an even lower vapor pressure. The correct answer is (A).

16. H

The question asks, based on Figure 2, for the concentration of the formic acid solution that has the vapor pressure closest to that of a 0.5 mole fraction formic acid solution. Look for the vapor pressure of a 0.5 mole fraction of water formic acid solution in Figure 2. A 0.5 mole fraction of water formic acid solution, represented by the solid line, has a vapor pressure of approximately 10 mm Hg. Draw a horizontal line at this vapor pressure to see where else the formic acid solution has this value. The formic acid solution line intersects the 10 mm Hg vapor pressure line again at a mole fraction of 0.8. The correct answer is (H).

17. A

The question asks how the vapor pressure changes as the mole fraction of water increases from 0 to 1 in an acetic acid solution, based on Figure 2. Look for the trend between vapor pressure and mole fraction of water in Figure 2, making sure to use the dotted line for acetic acid. As the concentration increases from a mole fraction of 0 to 0.6, the vapor pressure decreases, and then from a mole fraction of 0.6 to 1, the vapor pressure increases. The correct answer is (A).

18. G

The question asks for the boiling point of an additional acid based on its chemical formula and the data in Table 1. Look for the trend between chemical formula and boiling point in Table 1. As the number of  $\text{CH}_2$  groups increases, the boiling point increases. In Table 1, valeric acid has the highest boiling point of  $186^\circ\text{C}$  and the greatest number of  $\text{CH}_2$  groups. The chemical formula of hexanoic acid has one more  $\text{CH}_2$  group than valeric acid, so hexanoic acid has a higher boiling point than valeric acid. Eliminate (F). For each additional  $\text{CH}_2$  group added to the chemical formula, the boiling point increases by just over  $20^\circ\text{C}$ . Hexanoic acid has one more  $\text{CH}_2$  group than valeric acid, so the boiling point of hexanoic acid should be approximately  $23^\circ\text{C}$  more than the boiling point of valeric acid, or  $186^\circ\text{C} + 23^\circ\text{C} = 209^\circ\text{C}$ . This boiling point falls within the range of  $180^\circ\text{C}$  and  $215^\circ\text{C}$ . The correct answer is (G).

19. C

The question asks whether acetic acid or formic acid resists vaporization more at  $60^\circ\text{C}$ , based on Figure 1. Look for the data for vapor pressure in Figure 1, making sure to use the appropriate lines for each acid based on the key. At  $60^\circ\text{C}$ , the solid line for formic acid shows a vapor pressure of approximately 200 mm Hg, and the dotted line for acetic acid shows a vapor pressure of approximately 80 mm Hg. Eliminate (A) and (D) since both indicate that formic acid has a lower vapor pressure than acetic acid. Compare the remaining answer choices. For an acid to *resist* vaporization more, it must have the lower vapor pressure. Since acetic acid has the lower vapor pressure, the correct answer is (C).

## Passage IV

20. J

The question asks for the length of the solenoid coil in Experiment 1 based on the results of Experiments 1 and 3. Table 1 shows the results of Experiment 1, and Table 3 shows the results of Experiment 3. Since the question asks to synthesize information from two tables, look for the link between the data. Table 3 shows the weights for various solenoid lengths, while Table 1 shows the weights at various voltages. Read the description of Table 3 to find the voltage used in Experiment 3. The passage says *a voltage of 8.00 V was applied to the circuit*. Look for the weight for a voltage of 8.00 V in Table 1. At this voltage, the weight exerted on the suspension scale is 5.0095 N. Now, look at Table 3 to determine how solenoid length affects weight. As the solenoid length increases, the weight decreases. A weight of 5.0095 N is lower than any weight listed on Table 3, so the solenoid length must be longer than any length listed on Table 3. Since the maximum solenoid length listed is 9.50 cm, the solenoid length used in Experiment 1 must be longer than 9.50 cm. The correct answer is (J).

21. **B**

The question asks which variable was determined by the orientation of the bar magnet in Experiments 1 and 2. Look for where bar magnet orientation is mentioned in the passage. In the description for Experiment 2, the passage says *the scientists removed the bar magnet, inverted it, and reattached it*, but everything else stayed the same as Experiment 1. Compare the data from Experiment 2 to Experiment 1 to see how the change in bar magnet orientation affected the data. In Experiment 1, as the voltage increases, the weight increases. In Experiment 2, as the voltage increases, the weight decreases. Use POE. Choice (A) mentions *solenoid length*. Since the procedures are kept the same except for changing the orientation of the bar magnet, solenoid length is not affected. Eliminate (A). Choice (B) mentions *direction of the force exerted by the solenoid on the bar magnet*. Since Experiment 1 shows an increasing force, and Experiment 2 shows a

decreasing force, this is consistent. Keep (B), but check the other answers just in case. Choice (C) mentions the *density of the bar magnet* which is calculated by dividing mass by volume. Reorienting the bar magnet will not change its mass or volume, so eliminate (C). Choice (D) mentions the *magnetic field strength of the solenoid*. Since only the direction of the magnet changed, the magnetic field strength would not change. Eliminate (D). The correct answer is (B).

22. J

The question asks how the force exerted on the magnet by the solenoid electric field is changed as another variable is changed in Experiment 3. The results of Experiment 3 are shown in Table 3. The description of Table 3 states that *a voltage of 8.00 V was applied to the circuit*. Since the voltage is constant, eliminate (F) and (G). Since weight is a measure of force, look for the data in Table 3 to determine how solenoid length affects weight. As the solenoid length increases, the weight decreases. A lower weight indicates a lower force pulling the magnet downward. Therefore, the force decreased as the solenoid length increased. The correct answer is (J).

23. A

The question asks what the weight on the scale for a solenoid length of 9.50 cm would have been if Experiment 3 used the same bar magnet orientation as Experiment 2. In the description for Experiment 2, the passage says *the scientists removed the bar magnet, inverted it, and reattached it*, but everything else stayed the same as Experiment 1. Compare the data from Experiment 2, found in Table 2, to the data from Experiment 1, found in Table 1, to see how the change in bar magnet orientation affected the data. In Experiment 1 the weight increases from the 5.000 N as voltage increases, while in Experiment 2 it decreases from 5.000 N as voltage increases. Therefore, the bar magnet orientation in Experiment 2 causes weight to decrease instead

of increase. In the description for Experiment 3, the passage says *the bar magnet was returned to the original alignment it was in during Experiment 1*. If instead Experiment 3 had used the bar magnet orientation from Experiment 2, Experiment 3 would have exhibited the same pattern of decreasing weight instead of increasing weight. Eliminate (C) and (D) because they are greater than 5.000 N. At a solenoid length of 9.50 cm, the weight recorded in Experiment 3 was 5.0105 N, which is an increase 0.0105 N from 5.000 N. The new orientation should cause a decrease of 0.0105 N instead:  $5.0000\text{ N} - 0.0105\text{ N} = 4.9895\text{ N}$ . The correct answer is (A).

24. **J**

The question asks how scientists performed a calibration on the suspension scale. Look for where adjustment of the suspension scale is mentioned in the passage. In the fifth paragraph, the passage says *with the voltage source off, the scale read 4.7000 N*. The passage then states that *prior to the start of each experimental trial, the scale was adjusted to read 5.0000 N*. Eliminate (F) and (H) because they mention a downward adjustment, and the value of the scale reading increases. Find the difference between the two weights to determine the adjustment, or  $5.0000\text{ N} - 4.7000\text{ N} = 0.3\text{ N}$ . The procedure would require an adjustment upward of approximately 0.3 N. The correct answer is (J).

25. **B**

The question asks for a graph that best conveys the results of data from Experiment 3. The results for Experiment 3 are in Table 3. In Table 3, as the solenoid length increases, the weight decreases. Eliminate (A) and (C), since these graphs show weight increasing as solenoid length increases. Compare the remaining answer choices. Choice (D) shows all of the weights below 5.000 N, but Table 3 shows

all of the weights above 5.000 N. Eliminate (D). The correct answer is (B).

26. J

The question asks for the likely weight if an additional trial had been performed in Experiment 2 with a voltage of 6.50 V. Experiment 2 is represented by Table 2. As the voltage increases in Table 2, the weight decreases. An additional trial at 6.50 V is lower than any voltages listed in the table, so the additional trial should have a higher weight than the highest weight in the table, which is 4.9922 N. Eliminate (F) and (G). Compare the values in Table 2 to determine how much higher the weight should be. A voltage of 6.50 V is 0.75 V below the first voltage listed on Table 2. To find the corresponding weight increase, determine the pattern of weight differences between voltages that are 0.75 V apart. As the voltage decreases from 8.75 V to 8.00 V, the weight increases from 4.9887 to 4.9905, which is an increase of 0.0018 N. As the voltage decreases from 8.00 V to 7.25 V, the weight increases from 4.9905 to 4.9922, which is an increase of 0.0017 N. Therefore, the approximate increase in weight from 7.50 V to 6.75 V should be 0.0016 N. Add this value to the weight at 7.25 V:  $4.9922 + 0.0016 = 4.9938$  N. The correct answer is (J).

## Passage V

27. D

The question asks what Student 1 would most likely claim about the atmospheric oxygen concentration from 1500 to 1900 based on Figure 1. Figure 1 shows the biodiversity over time. Based on Figure 1, marine biodiversity was relatively stable between 1500 and 1900. Look at Student 1's theory. Student 1 states that *the marine biodiversity was stable for centuries until the human population surged upward, quadrupling between 1900 and present day*. Student 1 goes on to say that this population surge caused *a decrease of 0.50%*

*in the atmospheric oxygen concentration since 1900*, which resulted in a decrease in biodiversity. If the change in oxygen concentration caused the change in marine biodiversity, then when the marine biodiversity is stable, the oxygen concentration should also be stable. Therefore, the student believes atmosphere oxygen concentrations were relatively stable prior to the population surge after the year 1900. The correct answer is (D).

28. **H**

The question asks for an interval on Figure 2 that shows an oxygen concentration decrease that is *more than 10 times* the amount mentioned by Student 1. Look for information about oxygen concentration decreases in Student 1's theory. Student 1 says human actions have led to *a decrease of 0.50% in the atmospheric oxygen concentration since 1900*. The question asks for a time interval that shows an *atmospheric oxygen concentration decrease more than 10 times* this, so multiply 0.50% by 10 to get a 5% decrease. Look at Figure 2. Atmospheric oxygen difference, which is the difference between atmospheric oxygen concentration at a given time and current atmospheric oxygen concentration, corresponds to the y-axis on the right side of the graph and the dotted line. Use POE. Choice (F) refers to the period from 440 to 420 million years ago. At that time, atmospheric oxygen concentration was increasing, not decreasing. Eliminate (F). Choice (G) refers to the period from 330 to 310 million years ago. During that time, atmospheric oxygen decreased from 2.5% more than present day to approximately 1% more than present day. This is only a 1.5% difference, so eliminate (G). Choice (H) refers to the period from 260 to 240 million years ago. During that time, atmospheric oxygen concentration ranged from about 11% more than present day to about 1% less than present day for a decrease of about 12%. Keep (H), but check (J) just in case. Choice (J) refers to the period from 30 to 10 million years ago. During that time, atmospheric

oxygen concentration ranged from about 2.5% to about 1%. Eliminate (J). The correct answer is (H).

29. **A**

The question asks if Figure 1 supports a student's claim that marine biodiversity is falling at a rate faster than it has at any point over the last 500 million years. Look for the data for marine biodiversity in Figure 1. The  $x$ -axis ranges from the years 1500 to 2000, which is only a period of 500 years. Eliminate (B) and (D) since both say the figure describes the last 500 *million* years. Compare the remaining answer choices. Since Figure 1 only covers approximately 500 years, it can't be used to provide evidence for the last 500 million years. Eliminate (C). The correct answer is (A).

30. **F**

The question asks what Student 1 would conclude about marine biodiversity in 2020 based on Figure 1. Look at the marine biodiversity values in Figure 1. Trace up from the year 2000 to determine the biodiversity in 2000: just under 4,700 genera. Student 1 states that *since 2000, marine biodiversity has fallen by approximately 2% per decade*. Eliminate (H) and (J) since both show an increase in the number of genera. Since 1% of 4,700 is 47, then 2% of 4,700 is  $47 \times 2 = 94$ . Therefore, the number of genera will drop almost 100 between 2000 and 2010 to approximately 4,600. The question asks about 2020 not 2010, so eliminate (G). The number of genera would fall by a little less than 100 again between 2010 and 2020. The correct answer is (F).

31. **C**

The question asks for the time period in Figure 2 that Student 2 would most likely cite the oxygen data for in order to support the claim that

there have been times over the past 500 million years in which oxygen concentration was lower than it is today. Look for the data for atmospheric oxygen difference in Figure 2. Atmospheric oxygen difference corresponds to the  $y$ -axis on the right side of the graph and the dotted line. Atmospheric oxygen difference is calculated by subtracting the current atmospheric oxygen concentration from the atmospheric oxygen concentration at a specific time. For the atmospheric oxygen concentration to be *lower than it is today*, the difference must be negative. Look for where the dotted line dips below 0%, which is between 200 and 120 million years ago. Eliminate (A), (B), and (D) because they do not fall in this range. The correct answer is (C).

32. **J**

The question asks for the value of atmospheric oxygen concentration 300 million years ago based on Figure 2, given that the current atmospheric oxygen concentration is 21%. Figure 2 graphs *atmospheric oxygen difference*. The equation in the introduction defines atmospheric oxygen difference as (atmospheric oxygen concentration at a specific time) – (current atmospheric oxygen concentration). Look at Figure 2 to find 300 million years ago along the  $x$ -axis. Draw a vertical line upward until you reach the dotted line, which represents oxygen level. Now draw a line to the right until you reach the vertical axis. The atmospheric oxygen difference at 300 million years ago is approximately 6%. Plug this value and the 21% present day value into the atmospheric oxygen difference equation to solve for the atmospheric oxygen concentration:  $6\% = (\text{atmospheric oxygen concentration 300 million years ago}) - 21\%$ . The atmospheric oxygen concentration 300 million years ago is equal to 27%. The correct answer is (J).

33. **B**

The question asks which statement about marine biodiversity Student 2 would most likely agree with. Use POE. Student 2 believes that *the loss in marine biodiversity is part of a natural cycle of growth and loss and the human impact on marine biodiversity is negligible*. Eliminate (D) because a cycle of growth and loss means the biodiversity is not constant. Eliminate (C) as Student 2 believes it is natural rather than caused by humans. Compare the remaining answer choices. The only difference between (A) and (B) is how marine biodiversity changes as oxygen concentration decreases. Student 2 states that *as natural processes such as volcanic eruptions, asteroid impacts, and weathering cause decreases and increases in the atmospheric oxygen levels, marine biodiversity follows the same trend*, which means that marine biodiversity and oxygen concentration exhibit a direct relationship: as one increases, so does the other. Eliminate (A). The correct answer is (B).

## Passage VI

34. F

The question asks for a diagram that represents the results of Experiment 1 after two hours. Read the description for Experiment 1 to determine the results. The passage states that *the water level fell on the left and rose on the right*. Eliminate (G) and (H) because they do not show a higher water level on the right. The passage also states that *the left-side solution was red and the right-sided was blue*. Eliminate (J) because it has the colors reversed. The correct answer is (F).

35. D

The question asks how repeating Experiment 2 with an albumin solution on the left would affect the results. Use POE. According to the description of Experiment 2, Experiment 2 uses cupric ion on the left side and water on the right side. If the cupric ion solution on the left was replaced with an albumin solution, then only albumin and

water would be in the tube. The question states that albumin molecules form clear solutions in water, so both sides would have to be clear. Eliminate (B) and (C). In the first paragraph, the passage says *molecules, including water, have a tendency to move from regions of high concentration to regions of low concentration*. The albumin particles cannot pass through the membrane, but the water molecules on the right side of the tube will move to the lower concentration on the left side, so the water level will rise on the left. Eliminate (A). The correct answer is (D).

36. F

The question asks how cupric ion particles move in Experiments 1 and 2. In Experiment 1, *glucose solution is poured in the left and an equal volume of cupric ion solution is poured in the right*. At the end of the experiment, *the left-sided solution was red and the right-sided was blue*. The introduction states that *mixing glucose and cupric ions results in a red solution*. Therefore, the only way the left solution would end up red is if cupric ion particles passed through the selectively permeable membrane into the glucose solution. Eliminate (G) and (J) since both contradict this idea. Compare the remaining two answer choices. The only difference is whether the cupric particles were also able to move into pure water. Read the description for Experiment 2. In Experiment 2, *cupric ion solution is poured on the left and an equal volume of pure water is poured in the right*. At the end of the experiment, *both sides of the tube contained blue-colored solution*. The introduction states that *cupric ion solutions are blue*, so the only way both solutions would be blue is if cupric ion particles passed through the selectively permeable membrane into the pure water. Eliminate (H). The correct answer is (F).

37. C

The question asks for the substance in the left half of the U-tube at the start of Experiments 2 and 3. Read the description for Experiment 2 to determine the substance. In Experiment 2, *cupric ion solution is poured in the left side*. Eliminate (B) and (D) since they say the substance on the left was glucose. Next, check the description for Experiment 3. In Experiment 3, *glucose solution is poured in the left*, so eliminate (A). The correct answer is (C).

38. G

The question asks how the results of Experiment 1 would have been different if a selectively permeable membrane that allows cupric ions, water, and glucose to pass had been used. Read the description for Experiment 1 to determine the solutions used for the experiment. In Experiment 1, *glucose solution is poured in the left and an equal volume of cupric ion solution is poured in the right*. In the original experiment, *the left-side solution was red and the right-sided was blue* after two hours. According to the introduction, *mixing glucose and cupric ions results in a red solution*. The only way the solution on the left would end up red is if cupric ion particles passed through the selectively permeable membrane into the glucose solution. The glucose particles must not have passed from the left to the right side though. In the new experiment, glucose can also pass through the selectively permeable membrane, resulting in a mixture of cupric and glucose ions on both sides of the membrane. This would cause red solutions to occur on both sides. The correct answer is (G).

39. A

The question asks if the assertion that cupric ions are bigger than water molecules is valid based on Experiment 1. In Experiment 1, *glucose solution is poured in the left and an equal volume of cupric ion solution is poured in the right*. At the end of the experiment, *the left-side solution was red and the right-sided was blue* after two hours.

According to the introduction, *mixing glucose and cupric ions results in a red solution*. The only way the left solution would end up red is if cupric ion particles passed through the selectively permeable membrane into the glucose solution. Eliminate (C) because it says cupric ion particles can't pass through the membrane. Look through the introduction for a reference to the size of molecules. The introduction states that *selectively permeable membranes act as filters allowing only particles below a certain threshold size to pass through and of the three molecules used for the solutions, water is the smallest and glucose is the largest*. Eliminate (B), as it says water molecules and cupric ions are larger than glucose molecules. Consider the reasons for the remaining choices. Choice (D) says that both water and cupric ions can pass through the selectively permeable membrane. If both can pass through the membrane, then that would not provide any evidence about whether cupric ions were larger than water molecules. Eliminate (D). Experiment 1 only shows that both cupric ions and water are small enough to pass through the membrane, but that glucose is too large to pass through the membrane. The correct answer is (A).

40. **G**

The question asks for the color of the substance in the right side of the tube at the beginning of Experiment 1. Read the description for Experiment 1 to determine the substance. In Experiment 1, *cupric ion solution is poured in the right*. Read the introduction to determine the color of cupric ion solution. The passage says *cupric ion solutions are blue*. The correct answer is (G).