ACT SCIENCE PRACTICE PAPER 8

SET 1

Directions: 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.

The oceans of Earth are exposed to various climates and consequently have different physical properties. Deep oceans can be divided into zones based on temperature gradient and penetration of sunlight. Figure 1 shows the zones of a typical deep-water ocean, the depth of the zone boundaries in meters (m), and the overall pressure at those depths in kilopascals (kPa). Figure 2 shows the water temperature in degrees Celsius (°C) in warmer tropical oceans and cooler temperate oceans at varying depths. Sound waves are used to measure water temperature at depth, and readings from two different ocean regions are recorded in Table 1.

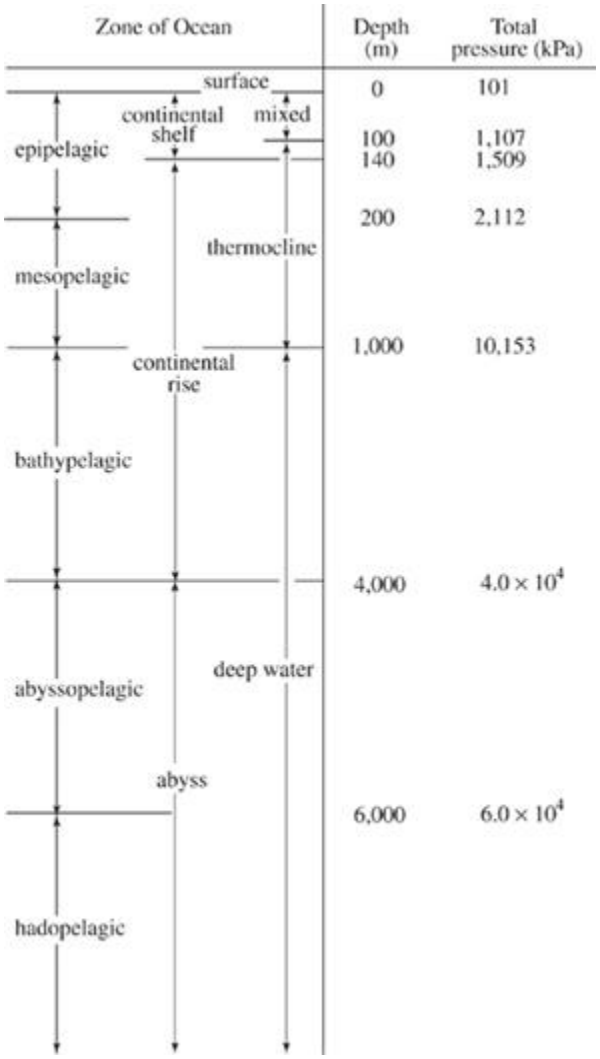


Figure 1

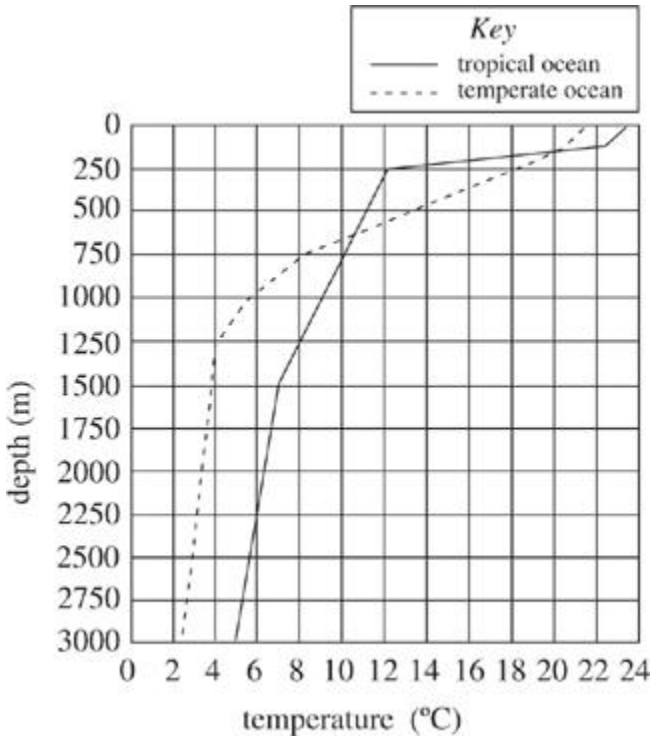


Figure 2

Table 1

Total pressure (kPa)	Depth (m)	Ocean temperature (°C)	
		Region 1	Region 2
101	0	24	21
200	9.8	22	20
300	19.8	14	11
400	29.7	11	9
500	39.7	10	8
600	49.6	9	8
700	59.6	7	6
800	69.5	5	3
900	79.5	4	2

1. According to

Figure 1, the regions of several ocean zones overlap. Which of the following pairs of ocean zones share part of a common depth range?

A. Bathypelagic and mesopelagic

B. Bathypelagic and epipelagic

C. Epipelagic and thermocline

D. Epipelagic and mesopelagic

2. According to

Figure 1, an oceanographic reading taken at a total pressure of 1,200 kPa is most likely from which of the following zones?

F. Abyss

G. Continental rise

H. Mixed

J. Continental shelf

3. According to

Figure 2, a sonographic measurement of temperature would be unable to distinguish the difference between tropical and temperate oceans at which of the following depths?

A. 250 m

B. 500 m

C. 625 m

D. 750 m

4. According to

Table 1, the relationship between depth and ocean temperature is best described by which of the following statements?

F. The water temperature increased with increasing depth in Region 1 only.

G. The water temperature decreased with increasing depth in Region 1 only.

H. The water temperature increased with increasing depth in Region 2 only.

J. The water temperature decreased with increasing depth in Region 2 only.

5. According to

Figure 1 and

Table 1, if water temperature measurements were taken at depths greater than 79.5, the total pressure at those depths would most likely:

A. decrease to less than 101 kPa.

B. increase to more than 900 kPa.

C. stay at 900 kPa.

D. increase to 101 kPa.

Although many forms of bacteria are helpful for human health, they can also cause illness and even death from severe infections. *Antibiotics* are a class of medicines used to combat bacterial infections. *Bacteriostatic* activity inhibits bacteria cell division and *bactericidal* activity kills bacterial cells. Both actions eliminate populations of bacteria over time. Several classes of bacteriostatic and bactericidal antibiotics are described in Table 1.

The effectiveness of several antibiotics against a bacterium known to cause common skin infections was tested. Drugs were introduced to the bacterial culture by themselves or in combination with sulfamethoxazole (forming SMX compounds). The effectiveness of these antibiotics at eliminating the responsible bacterium is shown in Figure 1.

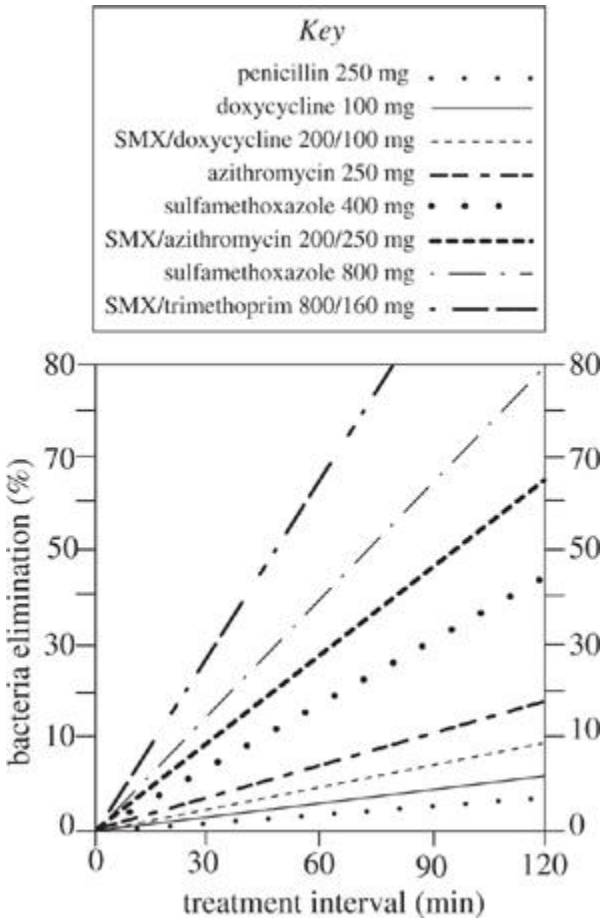


Figure 1

Table 1

Class	Example	Active against	Mechanism	Common uses
β-lactams	ampicillin	some gram-positive and gram-negative bacteria	disrupt cell wall synthesis; bactericidal	respiratory and skin infections
Tetracyclines	doxycycline	atypical gram-indeterminate bacteria	disrupt bacterial mRNA synthesis; mostly bacteriostatic	respiratory and genitourinary infections
Macrolides	azithromycin	gram-positive and atypical bacteria	disrupt bacterial protein synthesis; mostly bacteriostatic	atypical and respiratory infections
Aminoglycosides	gentamicin, streptomycin	gram-negative bacteria	disrupt bacterial protein synthesis; bactericidal	severe systemic infections
Quinolones	ofloxacin, gatifloxacin	broad spectrum of bacteria	disrupt bacterial DNA replication; bactericidal	respiratory, genitourinary, and gastrointestinal infections
Antifolates	sulfamethoxazole, trimethoprim	some gram-positive and gram-negative bacteria	disrupt bacterial DNA and RNA synthesis; mostly bacteriostatic	genitourinary and skin infections

6. According to the information in

Table 1 and

Figure 1, what can be concluded about the use of sulfamethoxazole as an antibiotic for common skin infections?

F. Using sulfamethoxazole 800 mg is ineffective as an antibiotic.

G. Increasing the dosage of sulfamethoxazole decreases its overall effectiveness as an antibiotic.

H. As an antibiotic, the mechanism of action of sulfamethoxazole is unknown.

J. Compounding antibiotics with sulfamethoxazole increases their effectiveness against common skin infections.

7. According to

Figure 1, if an investigator administered a sulfamethoxazole dose of 600 mg, 20% of the original bacteria would remain after a treatment interval:

A. greater than 120 min.

B. between 90 and 120 min.

C. between 60 and 90 min.

D. between 30 and 60 min.

8. After treatment of a bacterial culture similar to that in the passage with 250 mg of penicillin for 2 hours, the culture will probably contain:

F. less bacteria overall, but most will have survived.

G. less bacteria overall, and most will have been killed.

H. the same amount of bacteria overall, and most will have survived.

J. the same amount of bacteria overall, and most will have been killed.

9. Is the statement “antibiotics compounded with sulfamethoxazole are more effective against common skin infections than when administered alone” supported by the information shown in

Figure 1, and why?

A. No, because penicillin is more effective against a common skin infection bacterium than sulfamethoxazole 400 mg.

B. No, because azithromycin is more effective against a common skin infection bacterium than SMX/azithromycin.

C. Yes, because sulfamethoxazole 800 mg is more effective against a common skin infection bacterium than SMX/azithromycin.

D. Yes, because SMX/doxycycline is more effective against a common skin infection bacterium than doxycycline.

10. According to the passage, the most effective antibiotic against bacteria is one that results in the:

F. lowest percentage of bacterial elimination in the shortest treatment interval.

G. lowest percentage of bacterial elimination in the longest treatment interval.

H. greatest percentage of bacterial elimination in the shortest treatment interval.

J. greatest percentage of bacterial elimination in the longest treatment interval.

SET 2

Directions: 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.

A study was conducted regarding the fossil shells of a particular species of turtle that lives off the coast of the Opulasian Peninsula. Scientists discovered a continuous record of fossilized shells in the seabed off the coast dating back 120,000 years. In addition to examining the fossilized turtle shells, the scientists also examined the shells of living turtles.

From each layer of seabed, the scientists randomly selected five complete, unbroken fossilized shells. Each shell was carefully prepared, measured, and photographed. A bit of each shell was then clipped off and sent to a laboratory for radiocarbon dating to determine the precise age of each shell.

Study 1

All of the living turtles had a distinct band of hexagonal *scutes* (bony plates) running the length of their shells, from head to tail. The fossilized shells' scutes were not visible to the naked eye; however upon application of a particular dye, a similar band of scutes from head to tail was observed in every shell.

Scutes extending greater than $\frac{1}{8}$ of the length of the shell were labeled *major* (M), where scutes extending less than or equal to $\frac{1}{8}$ of the length of the shell were labeled *minor* (m). The pattern of scutes was recorded for each fossil. For each time period, the percent of fossils exhibiting each pattern is given in Table 1.

Table 1

	% shells with the following scute pattern:		
Age of shells (years)	M-m-M-M-m	M-M-m-m-M	M-m-M-m-M
120,000	46	44	10
90,000	42	54	4
87,000	30	67	3
85,000	21	72	7
80,000	20	66	14
50,000	76	21	3
27,000	100	0	0
15,000	100	0	0
8,000	100	0	0
4,000	100	0	0
1,000	68	28	4
300	74	20	6
0	86	2	12

Study 2

For each shell, the surface area of the shell, the height of the shell's *bridge* (the part of the shell linking the upper and lower plates), and the total number of scutes were recorded (see Figure 1).

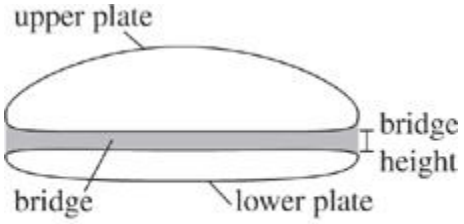


Figure 1

For the shells of each age, the average of each measurement was calculated. The results are presented in Figure 2.

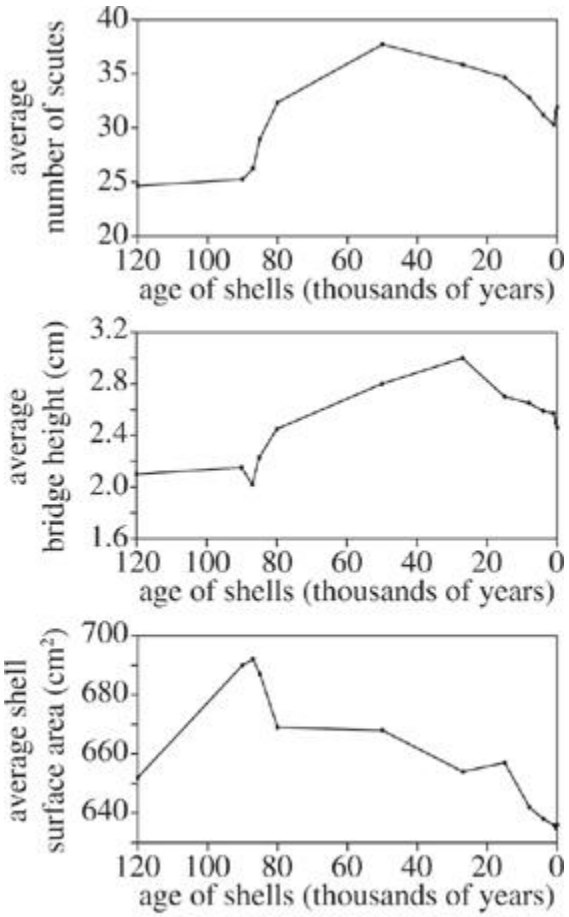


Figure 2

1. In a layer of seabed determined to be 250,000 years old, the scientists found fragments of twelve turtle shells, but no complete, intact shells. Which of the following is the most likely reason this layer of seabed was not included in the studies?

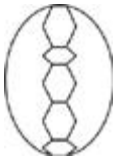
A. 250,000 years is too old to obtain an accurate radiocarbon date.

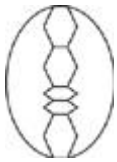
B. Shells that were 250,000 years old would have been irrelevant to the studies.

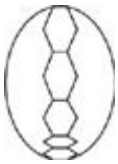
C. Accurate measurements of the dimensions of the shells could have been impossible to obtain.

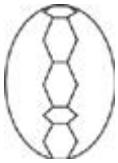
D. The scientists would not have been able to accurately determine the color of the shells.

2. With regard to the descriptions given in Study 1, the shells with the M-M-m-m-M band of scutes probably most closely resembled which of the following?

F. 

G. 

H. 

J. 

3. According to the results of Study 2, how do the average number of scutes and the average bridge height of living turtles of the Opulasian Peninsula compare to those of the turtles of the Opulasian Peninsula from 120,000 years ago? For the living turtles:

A. both the average number of scutes and the average bridge height are larger.

B. both the average number of scutes and the average bridge height are smaller.

C. the average number of scutes is larger, and the average bridge height is smaller.

D. the average number of scutes is smaller, and the average bridge height is larger.

4. Suppose, in Study 1, the scientists had found another seabed layer with fossilized shells that were radiocarbon dated and found to be 86,000 years old. Based on the results of Study 1, the scute pattern percents for the group of shells would most likely have been closest to which of the following?

M-m-M-M-m

F. 100%

G. 50%

H. 36%

J. 26%

5. In Study 2, the average shell surface area of fossilized turtle shells that were 80,000 years old was closest to:

A. 670 cm^2

B. 680 cm^2

C. 690 cm^2

D. 700 cm^2

6. Which of the following statements best describes how Study 1 differed from Study 2?

F. In Study 1, the scientists examined 3 characteristics regarding the shape and size of turtle shells; but in Study 2, the scientists examined the frequency of occurrence of different patterns of scutes on turtle shells.

G. In Study 1, the scientists examined the frequency of occurrence of different patterns of scutes on turtle shells; but in Study 2, the scientists examined the environment in which turtles live.

H. In Study 1, the scientists examined the frequency of occurrence of different patterns of scutes on turtle shells; but in Study 2, the scientists examined 3 characteristics regarding the shape and size of turtle shells.

J. In Study 1, the scientists examined 3 characteristics regarding the shape and size of turtle shells; but in Study 2, the scientists examined the environment in which turtles live.

The 4 different blood types in sheep are A, B, AB, and O. The blood type of an offspring is determined by the blood types of its parents. Each parent contributes a single gene to its offspring, forming a pair of genes. The *genotype* of an offspring refers to the arrangement of the offspring's new gene formed by the combination of the parents' genes.

There are three possible *alleles* (forms) of this gene: the type-A blood allele (I^A), the type-B blood allele (I^B), and the type-O blood allele (I^O). Both I^A and I^B are *dominant* to I^O, and I^O is *recessive* to I^A and I^B. This means that an individual with 1 I^A and 1 I^O will have type-A blood, and an individual with one I^B and one I^O will have type-B blood. When an individual has one I^A and one I^B allele, this individual will have type-AB blood, due to the *codominance* of the I^A and I^B alleles.

Table 1

Blood Type	Possible Genotypes
A	I^AI^A or I^AI^O
B	I^BI^B or I^BI^O
AB	I^AI^B

O	I^OI^O

To explore the inheritance patterns of blood types in sheep, researchers conducted 4 analyses. In each analysis, male and female sheep of differing blood types were mated and the resultant blood types of their offspring recorded.

Analysis 1

One thousand males with type-O blood were mated with 1,000 females with type-AB blood. The following blood types were observed in the offspring:

Type A: 50%

Type B: 50%

Analysis 2

Two hundred of the type-A offspring from Analysis 1 were mated with 200 type-O mates from no previous experiment. The following blood types were observed in the offspring:

Type A: 50%

Type O: 50%

Analysis 3

One hundred of the type-A offspring from Analysis 1 parented children with 100 type-B offspring from Analysis 1. The following blood types were observed in the offspring:

Type A: 25%

Type B: 25%

Type AB: 25%

Type O: 25%

Analysis 4

Twenty-five of the type-A offspring from Analysis 3 were mated with type-B mates with Genotype I^BI^B who were not from any previous analysis. The following blood types were observed in the offspring:

Type AB: 50%

Type B: 50%

7. The ratio of blood types containing at least one I^A allele to the blood types containing at least one I^B allele produced in Analysis 3 was:

A. 1:00

B. 1:01

C. 2:01

D. 3:01

8. An offspring whose blood type exhibits codominance has which of the following genotypes?

F. $I^{B}I^{B}$

G. $I^{B}I^{O}$

H. $I^{A}I^{B}$

J. $I^{A}I^{O}$

9. To produce only offspring with AB blood, one would mate two sheep with which of the following sets of genotypes?

A. $I^{A}I^{B} \times I^{A}I^{B}$

B. $I^{A}I^{B} \times I^{O}I^{O}$

C. $I^{A}I^{A} \times I^{B}I^{B}$

D. $I^{B}I^{B} \times I^{A}I^{O}$

10. In Analysis 3, the offspring used from Analysis 1 most likely had which of the following genotypes?

F. $I^{A}I^{O}$ and $I^{B}I^{B}$

G. $I^{A}I^{O}$ and $I^{B}I^{O}$

H. $I^{A}I^{A}$ and $I^{B}I^{B}$

J. $I^{A}I^{A}$ and $I^{B}I^{O}$

11. Some or all of the offspring had 1 allele for type-O blood in Analyses:

A. 1 and 2 only.

B. 2 and 3 only.

C. 1, 2, and 4 only.

D. 1, 2, 3, and 4.

12. Suppose that 300 offspring were produced in Analysis 3. Based on the results, the number of offspring with type-B blood produced in Analysis 3 would most likely have been closest to:

F. 25

G. 50

H. 75

J. 100

SET 3

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Vasoconstriction involves a narrowing of blood vessels that could lead to poor blood flow in the body if it persists over a long time. *Ergotamine* is a substance that can cause vasoconstriction. When ergotamine is injected into a normal blood vessel, vasoconstriction occurs quickly at the site of the injection (see Figure 1).

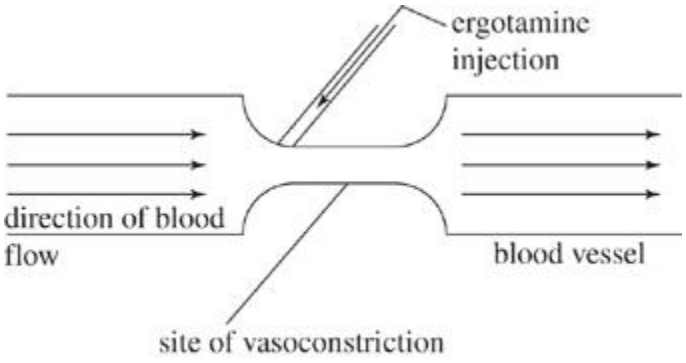


Figure 1

The diameter of the blood vessel at the site of vasoconstriction is less than the diameter of the normal blood vessel, so blood flow has a higher velocity through this narrow site. As a result, the blood pressure in the site of vasoconstriction is less than the blood pressure in the normal blood vessel. Moreover, the higher the velocity of the blood flow through the site of vasoconstriction, the lower the blood pressure at that site.

The percent change in blood pressure ($\%\Delta BP$) can be defined as:

$$\%\Delta BP = 100 \times \frac{(\text{Normal blood pressure} - \text{Pressure at site of vasoconstriction})}{\text{Normal blood pressure}}$$

Blood vessel sections of similar diameters were isolated from laboratory rats and $\%\Delta BP$ was measured over three experiments. When the researchers needed to create a site of vasoconstriction for some of the experimental trials, they would inject ergotamine to induce vasoconstriction within the blood vessel section.

Experiment 1

An artificial heart, which mimics a human's heartbeat, is used to move a constant volume of 500 mL of blood with each beat through four blood vessel sections. These four blood vessel sections were injected with the same amount of ergotamine, leading to sites of vasoconstriction of the same diameter. The rate at which the blood is pumped was varied for the four different blood vessel sections, and the $\%\Delta BP$ values that resulted were measured.

Table 1	
Rate of artificial heart beat (beats per minute)	$\%\Delta BP$
60	1.2
90	9.3
120	22.3
150	45.1

Experiment 2

The artificial heart used in Experiment 1 was then used to pump a constant volume of 500 mL of blood with each beat at a constant rate of 90 beats per minute through five other blood vessel sections. These blood vessel sections were injected with different amounts of ergotamine, resulting in sites of vasoconstriction with different diameters. The $\%\Delta BP$ values were then measured.

Table 2	
Diameter of site of vasoconstriction (cm)	$\%\Delta BP$
0.4	40.3
0.6	18.6
0.8	9.3
1.0	4.6
1.2	2.5

Experiment 3

The artificial heart used in Experiment 1 was used to pump different volumes of blood at a constant rate of 90 beats per minute through five blood vessel sections with the same diameter at the site of vasoconstriction. The $\%\Delta BP$ values were then measured.

Table 3	
Volume of blood pumped (mL)	$\%\Delta BP$
400	8.4
450	8.8
500	9.3

550	9.7
600	10.2

1. Under the conditions described for Experiment 3, a $\%\Delta BP$ of 9.0 would most likely be obtained if the entering volume of blood equaled:

A. 350 mL.

B. 475 mL.

C. 550 mL.

D. 650 mL.

2. Based on the results of Experiment 1, if the rate of the artificial heart beat had been less than 60 beats per minute, then the $\%\Delta BP$ would most likely have been:

F. less than 1.2.

G. between 1.2 and 9.3.

H. between 9.3 and 22.3.

J. greater than 22.3.

3. Which of the following is the most likely explanation for the results of Experiment 1? As the rate of the artificial heart beat increases, $\%\Delta BP$:

A. increases, because the velocity of blood through the site of vasoconstriction increases.

B. increases, because the velocity of blood through the site of vasoconstriction decreases.

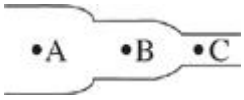
C. decreases, because the velocity of blood flow through the site of vasoconstriction increases.

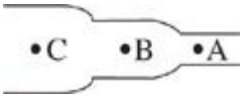
D. decreases, because the velocity of blood flow through the site of vasoconstriction decreases.

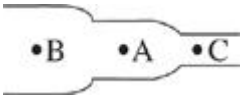
4. Consider blood flow through three regions of the same blood vessel, each of which has a different diameter. The velocity of blood flow is measured in milliliters per minute (mL/min) and the blood pressure is measured in millimeters of mercury (mmHg), and their values for each of the blood vessel regions are shown in the following table:

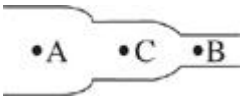
Location	Velocity of blood flow (mL/min)	Blood pressure (mmHg)
A	500	31
B	1,000	29
C	900	30

Based on the information in the passage about blood flow, which of the following diagrams best represents the relative diameters of the three blood vessel regions?

F. 

G. 

H. 

J. 

5. Based on the results of Experiments 1 and 2, what was the diameter of the site of vasoconstriction in the blood vessel section used in Experiment 3?

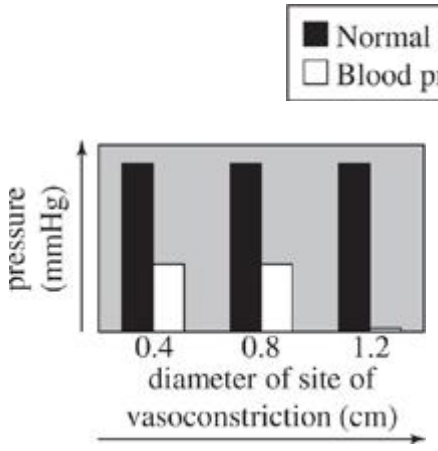
A. 0.4 cm

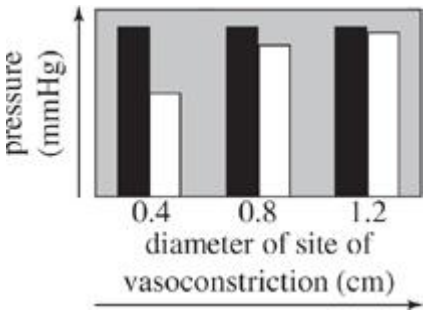
B. 0.6 cm

C. 0.8 cm

D. 1.0 cm

6. For the blood vessel sections used in Experiment 2 that had sites of vasoconstriction with diameters of 0.4, 0.8, and 1.2 cm, which of the following graphs best displays the comparison between blood pressure at each site of vasoconstriction and blood pressure in the normal region of the blood vessel leading to the site of vasoconstriction?

F. 

G. 

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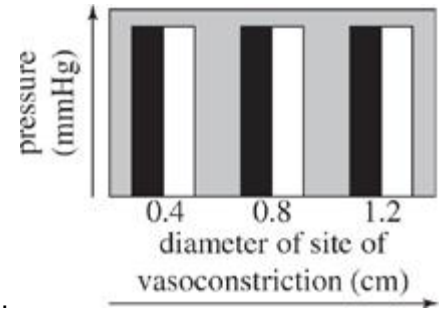

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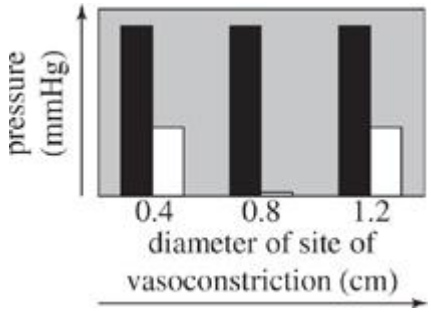

As the pressure on a gas is increased, the volume of that gas is expected to decrease by an inversely proportional amount. For example, if pressure is doubled the volume is halved. Under certain conditions, the volume of the gas will change by an amount that deviates from an inverse proportion. Various 10.00 L samples of gas were subjected to increases in pressure. Table 1 shows the resulting volume changes at 300°C, while Tables 2 and 3 show the volume changes at 25°C and -200°C, respectively. All pressures are measured in *atmospheres* (atm).

Table 1

300°C	Initial pressure (atm)	Final pressure (atm)	Volume change (L)
Oxygen	1	2	–5.00
Oxygen	2	4	–5.00
Oxygen	3	6	–5.00
Argon	2	4	–5.00
Argon	4	5	–2.00
Carbon Dioxide	1	5	–8.00
Carbon Dioxide	3	6	–5.00
Carbon Dioxide	4	10	–6.00

Table 2			
25°C	Initial pressure (atm)	Final pressure (atm)	Volume change (L)
Methane	1	2	–5.00
Methane	2	4	–5.00
Helium	1	2	–5.00
Helium	1	5	–8.00
Helium	2	5	–6.00
Nitrogen	1	5	–8.00
Nitrogen	2	4	–5.00
Nitrogen	4	5	–2.00

Table 3			
–200°C	Initial pressure (atm)	Final pressure (atm)	Volume change (L)
Neon	1	2	–5.02
Neon	2	4	–5.03
Neon	4	8	–5.06
Helium	1	2	–4.98
Helium	2	4	–4.97
Hydrogen	1	2	–5.01
Hydrogen	1	5	–8.02
Hydrogen	1	10	–9.03

7. Which of the following gases shown in **Tables 1**-**3** was compressed by the same amount each time the pressure was changed, regardless of its initial pressure?

A. Helium

B. Carbon Dioxide

C. Neon

D. Oxygen

8. Which of the following is the best explanation for the change in volume seen in any one of the samples of carbon dioxide in **Table 1**? As pressure on one sample of carbon dioxide was increased, the volume of that sample:

F. increased as the molecules of carbon dioxide were forced closer together.

G. increased as the molecules of carbon dioxide were forced farther apart.

H. decreased as the molecules of carbon dioxide were forced closer together.

J. decreased as the molecules of carbon dioxide were forced farther apart.

9. Based on **Table 2**, if the sample of nitrogen at a pressure of 4 atm were returned to its initial pressure of 2 atm, the volume would most likely:

A. decrease by 5.00 L.

B. decrease by 8.00 L.

C. increase by 5.00 L.

D. increase by 8.00 L.

10. Based on **Table 3**, if the pressure on a 10.00 L sample of neon gas is increased from 8 atm to 16 atm at a temperature of -200°C, the change in volume will most likely be closest to which of the following?

F. -5.12 L

G. -5.06 L

H. -5.03 L

J. -5.02 L

11. A scientist concludes that whenever the pressure on helium is increased, its volume will decrease. Based on **Tables 2** and **3**, is this a valid conclusion?

A. Yes; in every trial that the pressure of helium was increased, the change in volume was negative.

B. No; in every trial that the pressure of helium was increased, the change in volume was positive.

C. Yes; when the pressure on helium was increased from 1 to 2 atm, its change in volume was positive at 25°C and negative at -200°C.

D. No; when the pressure on helium was increased from 1 to 2 atm, its change in volume was negative at 25°C and positive at -200°C.