ACT PRACTICE

Test 6

SCIENCE

~~February 19, 2013~~

State ACT Testing
March 1~~9~~, 201~~3~~4

– Practice 6 –

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SCIENCE TEST

35 MINUTES—40 QUESTIONS

Directions: There are seven 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.

Passage I

A *catalyst* is a substance that speeds up a reaction, but is chemically unchanged at the end of the reaction. Catalysts can be divided into two main types—*heterogeneous* and *homogeneous*. In a heterogeneous reaction, the catalyst is in a different phase (such as solid, liquid, or gas) from the reactants. In a homogeneous reaction, the catalyst is in the same phase as the reactants. Most examples of heterogeneous catalysis go through the same stages (see Table 1).

Table 1

Stage	Description
1	One or more of the reactants are absorbed onto the surface of the catalyst.
2	There is some sort of interaction between the surface of the catalyst and the reactant molecules, which makes them more reactive.
3	The reaction happens.
4	The product molecules are desorbed, meaning that the product molecules break away.

Students did experiments to convert propanol to propene using alumina beads, and then to convert propene to propanol using a palladium catalyst.

Experiment 1

Two glass syringes were connected to an alumina-bead catalyst tube (see Figure 1). The 1 mL syringe was filled with 1 mL of propanol. Next, the apparatus was held above a burner's flame and the alumina-bead catalyst tube was gently heated while the liquid propanol was slowly introduced into the catalyst tube. The liquid flowed through the tube until it hit the hot region. Then it vaporized, reacted with the catalyst, and exited the catalyst tube as gaseous propene into the 60-mL receiver syringe. The procedure was repeated with various amounts of propanol and alumina beads and the amount of gaseous propene collected was recorded (see Table 2).

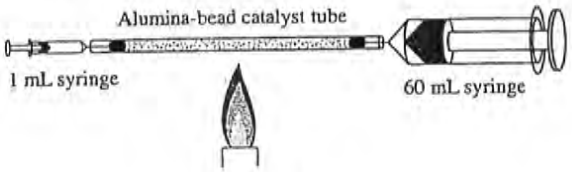

Figure 1

Table 2

Trial	Volume of Propanol (mL)	Volume of Alumina Beads (g)	Volume of Propene (mL)
1	1	1.75	58
2	1	1	49
3	0.5	1.75	28
4	0.75	1.75	45

Experiment 2

A reactant syringe was filled with equal volumes of hydrogen and propene. The reactant syringe and receiver syringe were connected to the catalyst tube filled with solid palladium as shown in Figure 2. Then the hydrogen-propene mixture was slowly passed over the catalyst, the reaction occurred, and the propane was collected in the receiver syringe. The procedure was repeated several times, varying the amount of time the reactant was passed over the catalyst. The results are shown in Table 3.

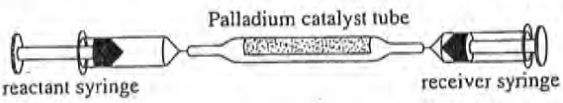

Figure 2

Table 3

Trial	Volume of Hydrogen (mL)	Volume of Propene (mL)	Time Reactant Passed Over Catalyst(s)	Volume of Propane in Receiver Syringe (mL)
1	30	30	60	56
2	30	30	45	52
3	30	30	30	49
4	30	30	15	0

1. In Experiment 2, as the amount of time the reactant was passed over the catalyst decreased, the volume of propane created:

   A. increased only.
   B. decreased only.
   C. increased and then remained constant.
   D. decreased and then remained constant.

2. Which is the most likely explanation for why 0 mL of propane was produced in Trial 4 of Experiment 2?

   F. There was not enough volume of hydrogen and propene to create a reaction.
   G. Fifteen seconds was too long a time for the reactant to pass over the catalyst.
   H. There was not enough volume of palladium in the catalyst tube to create a reaction and produce propane.
   J. The reactant was not allowed enough time to interact with the catalyst; therefore no reaction occurred and no propane was produced.

3. What type of catalyst was used in Experiment 1?

   A. It cannot be determined from the information given.
   B. A liquid catalyst
   C. A heterogeneous catalyst
   D. A homogeneous catalyst

4. In Experiment 2, the hydrogen-propene mixture turns into propane at what stage of the catalysis?

   F. Stage 1
   G. Stage 2
   H. Stage 3
   J. Stage 4

5. Based on the data in Table 2, which two trials illustrate the effect that varying the volume of the catalyst has on the volume of propene produced?

   A. Trials 1 and 2
   B. Trials 1 and 3
   C. Trials 3 and 4
   D. Trials 2 and 4

6. Which of the following best describes what occurred to the plunger of the 60-mL syringe during Experiment 1? When propanol was injected into the catalyst tube, the distance between the end of the plunger and the syringe tip:

   F. decreased slowly over 30 seconds.
   G. increased immediately, and then decreased as the reaction occurred.
   H. remained in place until the reaction occurred, and then decreased.
   J. remained in place until the reaction occurred, and then increased.

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Passage II

Table 1 lists two genes found in *Sesamum indicum* (sesame), the possible alleles of each gene, and the possible genotypes for each gene.

Table 1

Gene	Alleles	Genotypes
P	P, p	PP, Pp, pp
L	L, l	LL, Ll, ll

Table 2 lists various sesame genotypes and the phenotype associated with each genotype. Each gene affects only one of the phenotype traits listed.

Table 2

Genotype	Phenotype	
	Pod Number	Leaf Texture
PPLL	1	normal
PpLL	1	normal
ppLL	3	normal
ppLl	3	normal
PpLl	1	normal
PPLl	1	normal
PPll	1	wrinkled
Ppll	1	wrinkled
ppll	3	wrinkled

Table 3 lists four sesame plant crosses, the genotypes of the parents, and the percent of offspring that had each phenotype for the traits listed in Table 2. In each cross, each parent donated one allele to each offspring at each gene.

Table 3

Cross	Genotype of:		Offspring Phenotype	
	Female parent	Male parent	Pod number	Leaf texture
1	PpLL	ppll	50% 1 pod	50% normal
2	PpLl	Ppll	75% 1 pod	50% wrinkled
3	ppLl	ppLl	100% 3 pods	75% normal
4	PPLL	PPLL	100% 1 pod	100% normal

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7. Based on Table 2, which of the 2 genes affects leaf texture?

   A. P
   B. L
   C. Neither
   D. Both

8. Based on Table 2, a sesame plant with 2 recessive alleles for each of the 2 genes will have which of the following phenotypes?

   F. 1 pod and normal leaves
   G. 3 pods and normal leaves
   H. 3 pods and wrinkled leaves
   J. 1 pod and wrinkled leaves

9. Based on the information provided, all of the offspring of Cross 3 had 3 pods because each received:

   A. allele p from its female parent and allele p from its male parent.
   B. allele L from its female parent and allele l from its male parent.
   C. allele l from its female parent and allele L from its male parent.
   D. allele P from its female parent and allele P from its male parent.

10. In Cross 3, what percent of the offspring had genotype pp?

    F. 0%
    G. 25%
    H. 50%
    J. 100%

11. Based on the information provided, a sesame plant with 3 pods and normal leaves could have which of the following genotypes?

    A. PPll
    B. PPLL
    C. ppll
    D. ppLl

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Passage III

To determine the effect of ambient ultraviolet radiation (UVR) on the *chlorophyll* production, growth rate, and cell death of Antarctic *phytoplankton*, scientists conducted experiments on phytoplankton communities exposed to natural levels of solar radiation.

Experiments were conducted during three different periods of time. Experiment 1 took place February 1–6, Experiment 2 February 7–12, and Experiment 3 February 13–20. A meteorological station automatically recorded solar radiation for the duration of the study (see Figure 1).

The experiments involved sampling surface seawater, placing them in bottles submersed in incubators, and exposing them to either natural solar radiation (UVR) or radiation filtered to exclude ultraviolet radiation (PAR).

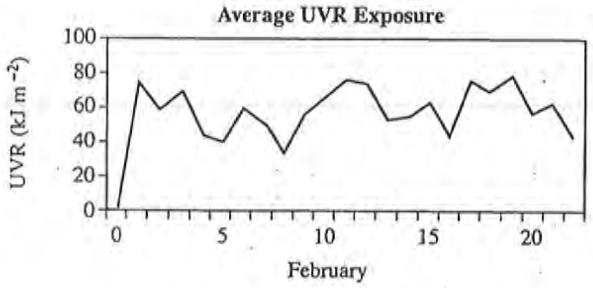

Figure 1

Every two days, duplicate samples were taken from each location to determine chlorophyll amounts and phytoplankton cell death (see Table 1 and Figure 2). Net population growth rates were calculated for *diatoms* and *flagellates* from the cell abundances obtained at the beginning and end of the experiments (see Figure 3).

Table 1

Amount of Chlorophyll per Experiment	Time (d)				
	0	2	4	6	8
1-UVR	0.8	1	1.3	1.4	–
1-PAR	0.8	1.2	1.5	17	–
2-UVR	0.7	0.9	1	1.2	–
2-PAR	0.7	1	4	15	–
3-UVR	0.2	1	1.3	2	4
3-PAR	0.2	1	3	10	24

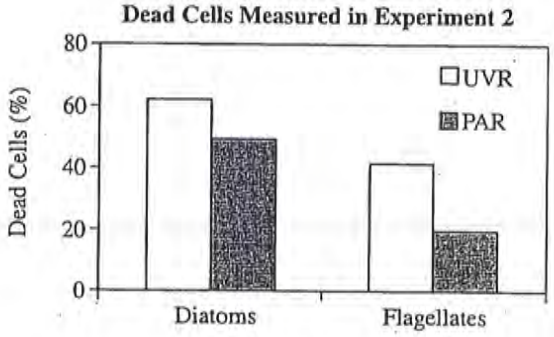

Figure 2

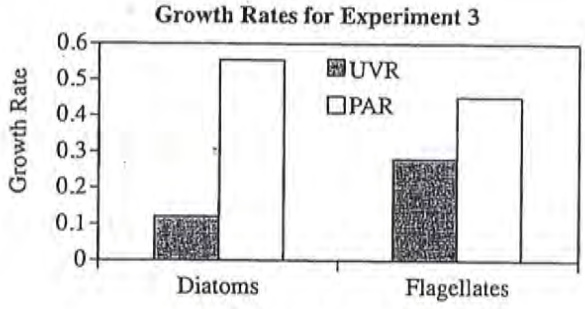

Figure 3

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12. Based on the data in Table 1, how much chlorophyll was measured in Experiment 3 for the sample exposed to UVR after 4 days?

    F. 1
    G. 1.3
    H. 3
    J. 4

13. Based on the information presented in Table 1, UVR seems to have what effect on the amount of chlorophyll measured?

    A. UVR seems to inhibit the production of chlorophyll.
    B. UVR seems to stimulate the production of chlorophyll.
    C. UVR seems to have no effect on the production of chlorophyll.
    D. It cannot be determined what the effect of UVR is on chlorophyll.

14. According to the data shown in Figure 3, which cells showed the least growth in Experiment 3?

    F. Diatoms shielded from UVR
    G. Diatoms exposed to UVR
    H. Flagellates shielded from UVR
    J. Flagellates exposed to UVR

15. Based on the information presented in Table 1, if Experiment 1 had been continued for another 2 days, the amount of chlorophyll measured in the samples that were not exposed to UVR would most likely be closest to what amount?

    A. 0
    B. 17
    C. 3
    D. 36

16. Based on the results displayed in Figure 2, it can be assumed that ultraviolet radiation (UVR) has what effect on the life of the diatoms and flagellates found in phytoplankton?

    F. The presence of UVR leads to fewer dead diatoms and more dead flagellates.
    G. The presence of UVR leads to more dead diatoms and fewer dead flagellates.
    H. The presence of UVR leads to fewer dead cells for both diatoms and flagellates.
    J. The presence of UVR leads to more dead cells for both diatoms and flagellates.

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Passage IV

Ecological *indicators* are used to assess the condition of the environment, to provide early warning signals of changes in the environment, or to diagnose the cause of environmental problems. Some important criteria for selecting an indicator include:

1. The indicator should provide an accurate picture of what it is supposed to indicate, such as "ecosystem health."
2. The indicator should respond quickly to environmental changes.
3. The indicator should be easy to monitor.
4. The responses of the indicator in one or a few locations should indicate the state of the ecosystem in a larger area.

It has been suggested that seabirds are useful indicators. Two researchers discuss the effectiveness of using seabirds as indicators.

Researcher 1

Seabirds are valuable indicators because they are top predators in their ecosystem. Seabird populations and reproduction rates are regulated by prey abundance, and will therefore reflect environmentally induced changes in prey availability. The effects of reductions in prey resources, such as declining numbers of seabirds, are usually very rapid, due to the short food chain, which is another advantage.

A few species of small fishes are important species of the ecosystem, having a major effect on the ecosystem as a whole. Seabirds that eat mainly these key fish are good indicators of the ecosystem in general.

Additional demographic parameters that can easily be monitored in seabirds are population size, duration of foraging trips, and changes in body mass and offspring growth rate, all of which are useful environmental monitors.

Overall, seabirds are a cost-effective, useful, and meaningful indicator of environmental changes in ocean ecosystems.

Researcher 2

There are several reasons why seabirds may not be suitable as indicators of the impacts of environmental changes. First of all, not all marine ecosystems follow a top-down food chain. Some marine food webs are dynamic and can alternate between bottom-up and top-down. In addition, change in seabird numbers due to food scarcity usually has a lag of several months or even years. Because of this seabirds are not suitable as indicators of the food supply in all ecosystems.

In general, the effect of environmental change on seabird populations may take many years to become apparent. Its effect is complex and involves many physical and biological processes. This is a severe drawback to using seabirds as indicators. Another drawback is the handling effect. It is not fully understood what effect handling seabirds has on them. There is some evidence that bands placed on penguins to track them can reduce both breeding success and survival rates. With seabirds that are tagged and handled, it is difficult to be sure that observed effects are actually due to changes in the environment and not other factors.

The effect of environmental changes on seabirds is complex and it is not clear what the best way to monitor seabirds is. Therefore, seabirds are not a good choice for indicators.

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17. Based on Researcher 1's discussion, demographic factors that can be easily monitored in seabirds include all of the following EXCEPT:

    A. population size.
    B. changes in offspring growth rate.
    C. mortality rates.
    D. length of foraging trips.

18. Sardines are plentiful in Chiriqui Bay, and their presence affects the entire ecosystem of the bay. Kingfisher birds eat mostly sardines and because their numbers are declining, scientists are concerned about the environmental health of Chiriqui Bay. Is this concern consistent with the viewpoint of Researcher 1?

    F. No, because Researcher 1 states that changes in the food chain are not adequate indicators of the environmental health of a body of water.
    G. No, because Researcher 1 states that only changes in body mass and offspring growth rate are valuable indicators of environmental changes.
    H. Yes, because Researcher 1 states that the effect of environmental changes on seabirds will be slow due to the short food chain in a marine ecosystem.
    J. Yes, because Researcher 1 states that seabirds that consume key fish in an ecosystem are valuable indicators of the ecosystem in general.

19. Which researcher believes that handling seabirds may affect the validity of the results gathered by monitoring them?

    A. Researcher 1, because that researcher states that changes in prey resources are very quick, and therefore results gathered will be valid.
    B. Researcher 1, because that researcher states that overall, seabirds are a useful indicator of environmental changes.
    C. Researcher 2, because that researcher states that placing bands on penguins has been shown to reduce their survival rates.
    D. Researcher 2, because that researcher states that it is clear that handling seabirds will always reduce their breeding rates.

20. A study found that within two months of an oil spill in a bay, there was a drastic reduction in the number of small forage fish found in the water, and that the number of seabirds in the area was drastically reduced as well. Which researcher would most likely use this study to support his or her viewpoint?

    F. Researcher 1, because it would demonstrate how quickly environmental changes impact prey resources and seabird behavior.
    G. Researcher 1, because it would demonstrate how important seabirds are for the overall ecosystem.
    H. Researcher 2, because it would demonstrate how quickly environmental changes impact prey resources and seabird behavior.
    J. Researcher 2, because it would demonstrate how important seabirds are for the overall ecosystem.

21. Based on Researcher 2's discussion, seabirds would not be effective indicators because they do not meet which criteria of a good indicator?

    A. Point 1 only
    B. Points 1 and 2 only
    C. Points 1, 2, and 3 only
    D. Points 2 and 3 only

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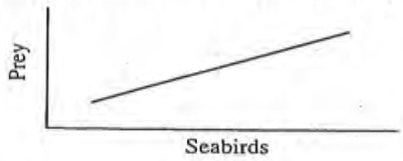
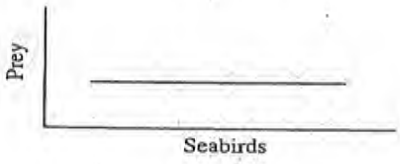
22. Which of the following graphs is most consistent with Researcher 1's view on the relationship between prey abundance and seabird population?

F.



G.



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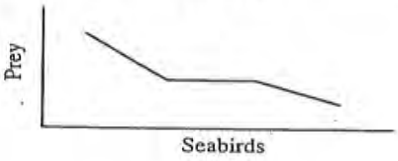
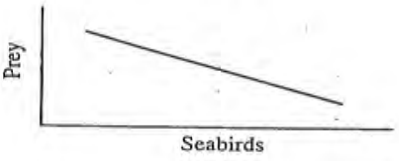


J.



23. Researcher 2 cites all of the following as reasons why seabirds may not be suitable as indicators EXCEPT:

A. the impact of food scarcity on seabird numbers may not be apparent for several months or years.
B. it is not known how handling seabirds might impact them.
C. it is expensive to use seabirds as indicators.
D. it is uncertain how to best monitor seabirds.

Passage V

Scientists used gas chromatography to analyze benzene concentrations in fuel vapors. The results of the analysis are displayed in Table 1.

Samples from four different brands of fuel were collected, with each brand offering both leaded and unleaded versions of fuel. A portion of each sample was analyzed for benzene concentration in the liquid, while the rest of the sample was placed in a vial and prepared for vapor analysis. Each vial was put into an oven, heated, and the gas chromatograph detected the concentrations of benzene in the vapor. Figure 1 displays the oven temperature during the experiment.

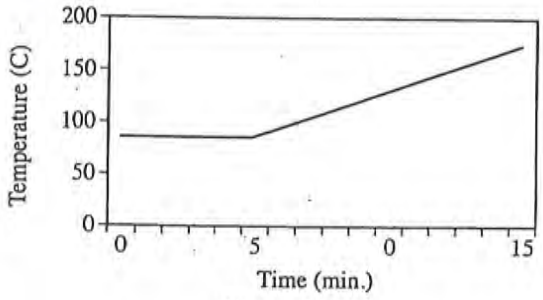


Figure 1

Table 1

Brand	Liquid (mg/l)	Vapor (mg/l)
A (leaded)	191	431
A (unleaded)	198	334
B (leaded)	176	447
B (unleaded)	271	414
C (leaded)	245	500
C (unleaded)	222	488
D (leaded)	197	513
D (unleaded)	264	350

A *gasohol* is a fuel blended with certain alcohols such as ethanol or methanol. Two of the fuels tested in this experiment (brands C and D) were gasohols. Figure 2 shows the average concentrations of benzene found in the liquid and vapor form of the leaded and unleaded fuels tested. Figure 3 compares the average concentrations of benzene found in gasohols and regular unleaded fuels.

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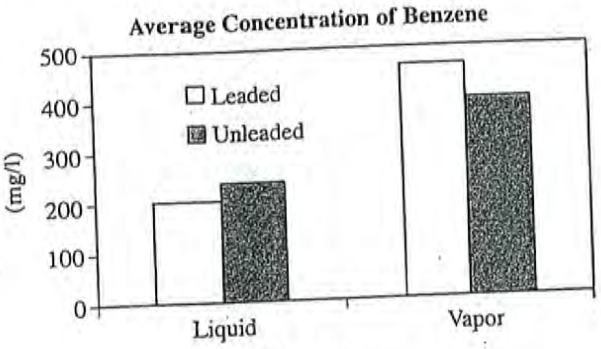

Figure 2

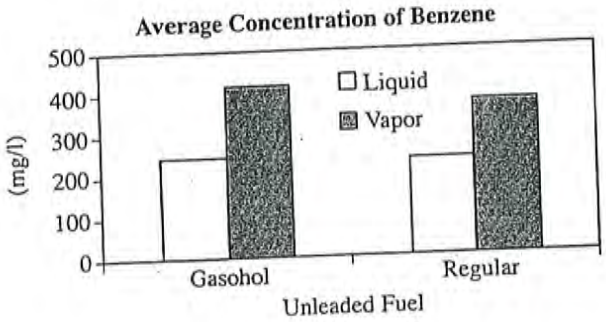

Figure 3

24. According to Figure 2, the average concentration of benzene found in the liquid form of leaded fuel was approximately:

F. 200 mg/l.
G. 240 mg/l.
H. 480 mg/l.
J. 400 mg/l.

25. Based on Figure 2, which type of fuel tested was found to contain the highest average concentration of benzene?

A. Liquid unleaded
B. Liquid leaded
C. Vapor leaded
D. Vapor unleaded

26. Suppose that during the experiment the samples of fuel had been kept in the oven for 20 minutes. Based on Figure 1, the temperature in the oven after 20 minutes would most likely have been:

F. less than 100°C.
G. between 100°C and 150°C.
H. between 150°C and 200°C.
J. greater than 200°C.

27. A scientist claimed that, in liquid form, a leaded fuel would emit more benzene than an unleaded fuel. Does the data in Table 1 support this claim?

A. Yes. For all fuel brands tested, the benzene levels were higher in the leaded fuel than in the unleaded fuel.
B. Yes. For all fuels tested, the amount of benzene found in the vapor form was higher than that found in the liquid form.
C. No. The amount of benzene found in the leaded fuel was only higher than the amount found in the unleaded fuel for one brand tested.
D. No. Only nongasohols emit more benzene in the leaded version of the fuel.

28. According to Figure 3, how did vaporizing the gasohol fuels affect the average concentration of benzene found in the fuel? In the gasohol fuels, the average concentration of benzene found in the liquid form of the gas was about:

F. two times the average concentration found in the vapor form.
G. one-half the average concentration found in the vapor form.
H. one-quarter the average concentration found in the vapor form.
J. the same as the average concentration found in the vapor form.

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Passage VI

Students conducted experiments to determine what factors affect the *period* of a *pendulum*. A pendulum is a swinging weight, or bob, attached to a string (see Figure 1). When released from an angle, a pendulum will move back and forth. One complete back-and-forth movement is called a *period*.

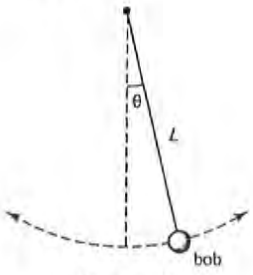

Figure 1

Three variables may affect the period of a pendulum: swing amplitude, measured as the angle at which the bob is released; the length of the string; and the mass of the bob. Students created pendulums by attaching a string to the ceiling and then tying a bob onto the other end of the string. They conducted three experiments. In each experiment all variables except the one tested were kept constant.

Experiment 1

In this experiment students varied the mass of the bob. Bobs of 20g, 100g, and 200g were tested for three trials each. The string length was 1m and the amplitude was 45 degrees. The results are shown in Table 1.

Table 1

Mass (g)	Trial 1 (s)	Trial 2 (s)	Trial 3 (s)	Average Period (s)
20	1.72	1.81	1.84	1.79
100	1.78	1.82	1.88	1.83
200	1.9	1.85	1.91	1.89

Experiment 2

The second variable tested was amplitude. Bobs were dropped from 15-, 45-, and 75-degree angles for three trials each. The string length was 1 m and the bobs used were 100 g. Figure 2 displays the average results.

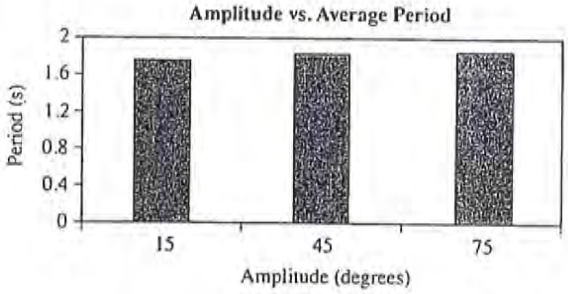

Figure 2

Experiment 3

Next the students tested the effect of varying the string length. Strings of 1 m, 0.6 m, and 0.3 m were tested in three trials each; 100 g bobs were used and the amplitude was 45 degrees. The results are displayed in Table 2 and Figure 3.

Table 2

Length (m)	Trial 1 (s)	Trial 2 (s)	Trial 3 (s)	Average Period (s)
1	1.85	1.84	1.84	1.84
0.6	1.44	1.44	1.47	1.45
0.3	0.97	1.06	1.06	1.03

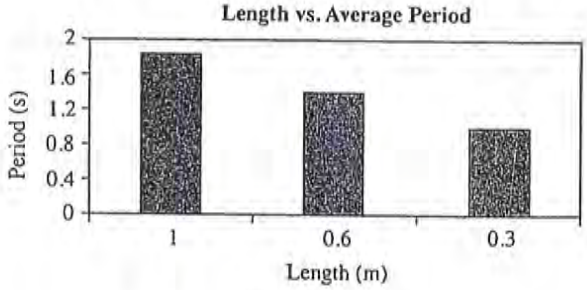

Figure 3

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29. Based on the results of Experiment 1, the average period for a bob of 100 g was:

A. 1.79 s.
B. 1.83 s.
C. 1.89 s.
D. 1.91 s.

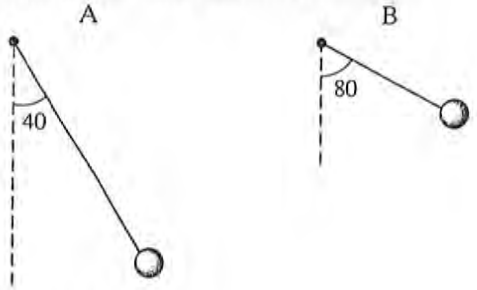
30. If an additional trial had been conducted in Experiment 3 with the length of the string being 1.4 m, the average period would most likely have been:

F. 2.21.
G. 1.75.
H. 1.33.
J. 0.87.

31. For each trial in Experiment 1, as the mass of the bob increased, the time of the period:

A. stayed the same.
B. increased.
C. decreased.
D. increased and then decreased.

32. Based on the information presented in Figure 2, which of the following pendulums would have the longest average period? Assume that the string length and bob weight are equal.



F. Pendulum A
G. Pendulum B
H. The average period would be about the same.
J. It is impossible to determine from the information given.

33. In Experiment 3, Trial 2, how long did it take the pendulum with the string length of 0.6 m to complete one back-and-forth movement?

A. 1.06 s
B. 1.44 s
C. 1.47 s
D. 1.84 s

34. Which of the following variables was NOT tested during the experiments conducted by the students?

F. Mass of the bob
G. Length of string
H. Size of bob
J. Swing amplitude

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Passage VII

Scientists conducted a series of experiments to determine the effect of changes in temperature on the intertidal rocky shore crab, *Petrolisthes granulsus* (*P. granulosus*). Several fitness-related traits, such as body size and reproductive capacity in *P. granulosus* individuals from three sites were compared after the crabs were exposed to various temperatures. In addition, metabolic rate experiments were conducted to determine the energetic cost associated with crab exposure to high temperatures.

Table 1 displays the temperatures (°C) used in the experiments. Thermal category TC1 refers to the maximum temperature registered at each site, while TC2 refers to the average of maximum temperatures recorded every day. The Control thermal category is defined as the average temperature experienced by the crabs during the acclimation period.

Table 1

Thermal Category	Site		
	Iquique	Coquimbo	Concepcion
TC1	26	22	19
TC2	22	20	17
Control	16	16	16

Figure 1 displays the average size (cephalothorax length) of *P. granulosus* in the 3 populations, while Figure 2 displays the average egg volume in the 3 populations.

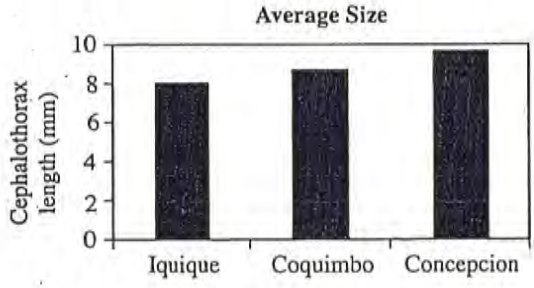

Figure 1

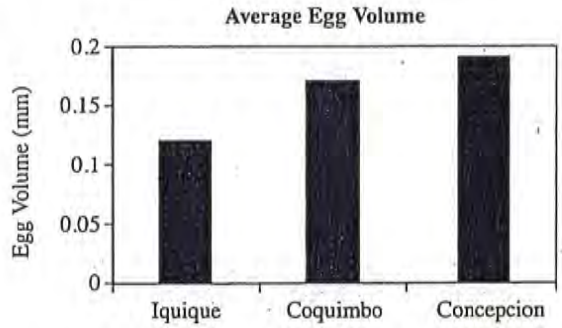

Figure 2

Figure 3 shows the average standard metabolic rates (SMR) of male crabs from the 3 populations exposed to 3 thermal categories.

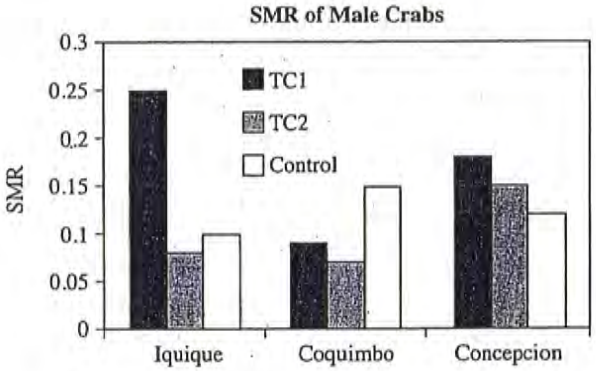

Figure 3

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35. According to Table 1, crabs from which site were exposed to the highest temperatures during the experiments?

    A. Iquique
    B. Coquimbo
    C. Concepcion
    D. Crabs at all of the locations were exposed to the same maximum temperatures.

36. Based on the information in Figure 2, the average eggs of crabs from the Coquimbo site were found to be closest to which size?

    F. 0.1 mm
    G. 0.17 mm
    H. 0.2 mm
    J. 0.25 mm

37. According to Figure 3, adult male crabs from which category were found to have the highest average standard metabolic rates?

    A. TC1 from Concepcion
    B. Control from Coquimbo
    C. TC1 from Iquique
    D. TC2 from Concepcion

38. Based on the information provided, which of the following best describes the effect that average maximum temperature has on the average size of the crabs?

    F. As the average maximum temperature increased, the average size of the crabs stayed the same.
    G. As the average maximum temperature increased, the average size of the crabs increased.
    H. As the average maximum temperature decreased, the average size of the crabs decreased.
    J. As the average maximum temperature decreased, the average size of the crabs increased.

39. Suppose the scientists had measured the average egg volume of crabs in the control groups. Based on the information in Table 1 and Figure 2, the average egg volume of crabs at the Concepcion site would have been closest to:

    A. 0.05 mm.
    B. 0.1 mm.
    C. 0.2 mm.
    D. 0.3 mm.

40. The scientists started this experiment with the theory that crabs exposed to higher temperatures would develop higher standard metabolic rates. Do the results of the experiment support this theory?

    F. Yes. The crabs at Iquique in the thermal category TC2 were exposed to the highest temperatures and were found to have the highest SMR.
    G. Yes. At all locations the crabs from thermal category TC1 were found to have the highest SMR.
    H. No. At all locations the crabs from thermal category TC1 were found to have the lowest SMR.
    J. No. The results were mixed. At two locations the crabs from thermal category TC1 were found to have the highest SMR, but at one location the crabs from the control group had the highest SMR.

If there is still time remaining, check your answers to this section.