SUPPLEMENTAL MATERIALS APPENDIX C: ASSESSMENT TOOLS

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SUPPLEMENTAL APPENDIX C

ASSESSMENT TOOLS

Appendix C1 - ACT Science Pretest and Post-test

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

Scientists categorized each of the 300 pearly mussel species native to North America. If there were sufficient data to determine a species' risk of extinction, it was placed in 1 of 5 risk categories: otherwise, it was place in a separate category (see Table 1).

Table 1

Category		Percent of species
increasing risk of extinction →	Extinct	7
	Endangered	26
	Special concern	24
	Threatened	15
	Stable	24
Insufficient data		4

Table 1 adapted from Upper Midwest Environmental Sciences Center, "Development of Landscape Models for Conservation of Freshwater Mussels in the Upper Mississippi River Basin." U.S. Geological Survey, 2003.

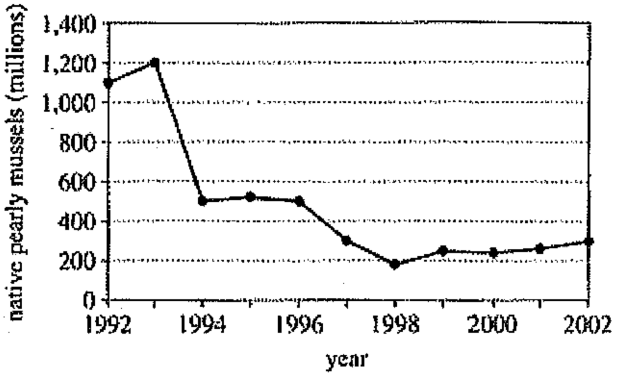


Figure 1

Figure 1 adapted from David Strayer, "Pearly mussels are well worth closer inspection." ©2004 by Poughkeepsie Journal.

Zebra mussels (a nonnative species) are thought to damage pearly mussel populations in North America. Zebra mussels became abundant in the Hudson River estuary in late 1992. Figure 1 shows the number of native pearly mussels in the Hudson River estuary late in each year from 1992 through 2002.

1. According to Table 1, what percent of the pearly mussel species native to North America could not be place in a category based on their risk of extinction?
A. 0%
B. 4%
C. 7%
D. 24%

2. Based on Figure 1, how many pearly mussels were most likely present in the Hudson River estuary when zebra mussels became abundant there?
F. Less than 1,000 million
G. Between 1,000 million and 1,200 million
H. Between 1,200 million and 1,400 million

J. More than 1,400 million

3. Based on Table 1, what percent of the pearl mussel species native to North America were the scientists able to place in a risk category but did not classify as extinct or stable?

A. 7%
B. 26%
C. 50%
D. 65%

4. Assume that zebra mussels do damage pearly mussel species native to North America. Based on Figure 1, if all the zebra mussels in the Hudson River estuary had been removed in 2002, the population of native pearly mussels in the estuary in 2005 most likely would have been:

F. less than or equal to 25 million
G. between 25 million and 125 million
H. between 125 million and 225 million
J. greater than or equal to 225 million

5. Which of the mussels, the zebra mussels or the pearly mussels, if either, would, when encountered in the Hudson River estuary, be considered an invasive species?

A. Zebra mussels only
B. Pearly mussels only
C. Both zebra mussels and pearly mussels
D. Neither zebra mussels and pearly mussels

Passage II

Physics students studied electrical current and resistance using the electrical circuit shown in Figure 1 below.

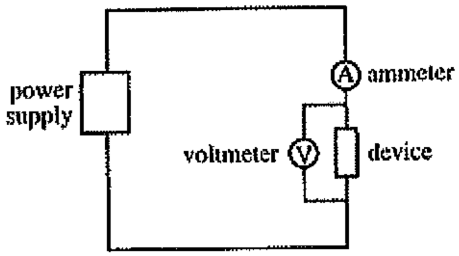


Figure 1

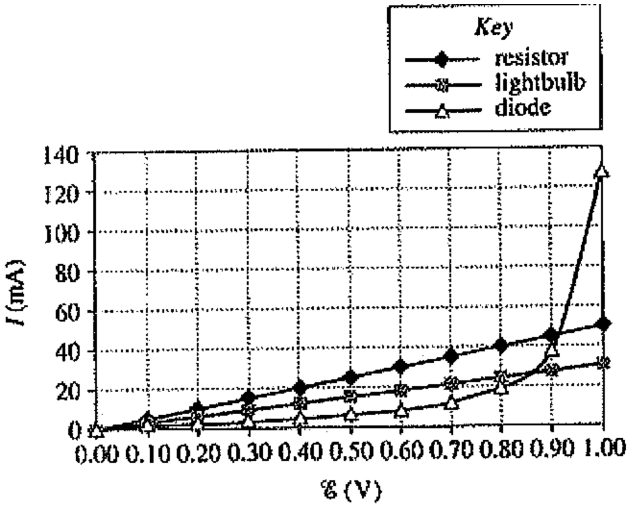


Figure 2

The students determined the electrical current, I, flowing through each of 3 devices- a resistor, a lightbulb, and a diode- for various voltages, ℰ, across the device. At each voltage, the students also determined the resistance, R, of each device.

Figure 2 shows graphs of I, in milliamperes (mA), versus $\mathscr{E}$, in volts (V), for each device. Figure 3 shows graphs of R, in ohms (Ω), versus $\mathscr{E}$ for each device.

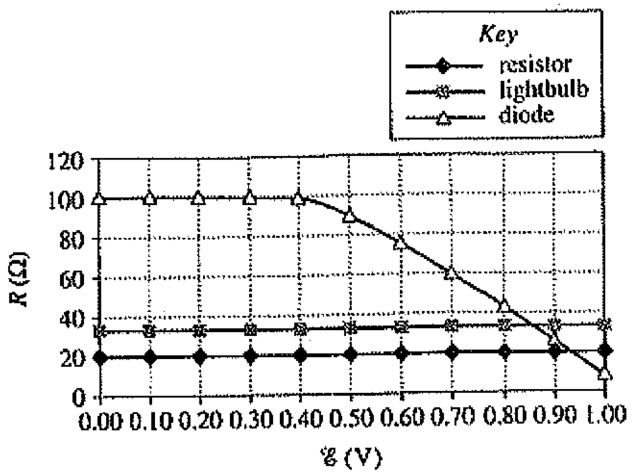


Figure 3

6. Based on Figure 2, at 1.10 V, I for the diode would most likely be:
F. less than 20 mA
G. between 20 mA and 80 mA
H. between 80 mA and 130 mA
J. greater than 130 mA

7. For each of the devices tested, as $\mathscr{E}$, increased, I:
A. increased only
B. decreased only
C. varied, but with no general trend
D. remained the same

8. For a device in an electrical circuit that follows Ohm's law, the ratio of the voltage across the device to the current flowing through the device is constant. Based on Figure 2, which of the 3 devices followed Ohm's law throughout the interval from $\mathscr{E}$= 0.00 V to $\mathscr{E}$=1.00 V?
F. Resistor only
G. Diode only
H. Resistor and lightbulb only
J. Lightbulb and diode only

9. Based on Figures 2 and 3, when R for the diode equaled 60(Ω), I for the diode was closest to which of the following?
A. 12 mA
B. 20 mA
C. 38 mA
D. 50 mA

10. Based on Figure 3 the diode best conducted electricity when $\mathscr{E}$ for the diode equaled which of the following?
F. 0.20 V
G. 0.40 V
H. 0.60 V
J. 0.80 V

Passage III

Suppose a ball is dropped from a height H above a horizontal surface. The ball falls straight down until it collides with the surface; then it bounces straight up, attaining a maximum height y before it begins to fall again. The coefficient of restitution, C, for the collision equals $\frac{y}{H}$, Therefore:

$$y = CH$$

Physics students went to a high-altitude laboratory to conduct the studies of C for various balls bouncing off different horizontal surfaces. The air temperatures and air pressure were constant in the laboratory throughout the studies.

Study 1

The students dropped a racquetball from various H onto a particular horizontal surface, and after each drop they measured y. Then they graphed y versus H (see Figure 1); C equaled the slope of the graph.

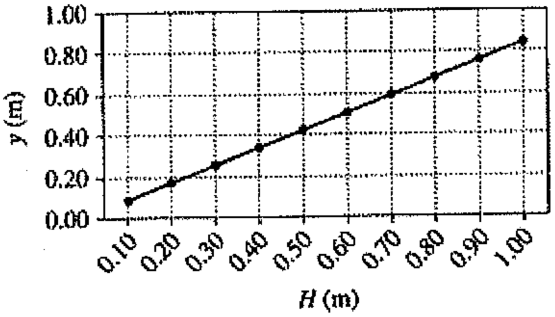


Figure 1

Table 1		
	C for ball's collision with:	
Ball	bare concrete surface	foam-covered concrete surface
Racquetball	0.85	0.76
Golf ball	0.82	0.79
Tennis ball	0.75	0.66
Steel ball	0.65	0.42
Baseball	0.55	0.33

Study 2

The students repeated the procedure in Study 1 and determined C for various balls dropped onto both a bare concrete surface and a concrete surface covered with a thin layer of foam. Both surfaces were horizontal. The results are given in Table 1.

11. Suppose that, in an additional trial in Study 1, H had equaled 0.75 m. Based on the results of the study, y would have been the closest to which of the following values?

A. 0.45 m
B. 0.55 m
C. 0.65 m
D. 0.75 m

12. Suppose, while testing a particular ball during Study 2, the students had obtained a value for C that was greater than 1.0. Which of the following statements would best explain this result?

F. The ball was not spherical in shape
G. The ball broke upon impact
H. The ball was thrown downward rather than dropped
J. The ball stuck to the surface upon impact rather than bouncing upon impact

13. Suppose, in an additional trial in Study 2, the students had dropped a ball onto the bare concrete surface, and the ball stuck to the surface without bouncing. C for this collision would have equaled what value?

A. 0.0
B. 0.5
C. 1.0
D. Cannot be determined from the given information

14. To determine if the surface tested in Study 1 was more likely bare concrete or foam-covered concrete, one would compare C in Study 1 with each C in Study 2 for the;
F. racquetball
G. golf ball
H. tennis ball
J. baseball

15. Suppose that in Study 2 the steel ball had been dropped onto the bare concrete surface and the foam-covered concrete surface from a height of 2.00 m. Approximately how much lower or higher would the steel ball have bounced after its collision with the bare concrete surface than after its collision with the foam-covered concrete surface?
A. 0.5 m lower
B. 1.0 m lower
C. 0.5 m higher
D. 1.0 m higher

16. Which of the following statements best explains why the students conducted the studies at the location referred to in the passage? The students most likely wanted to:
F. decrease the force exerted by gravity on the balls tested
G. decrease the force exerted by air resistance on the balls tested
H. increase the force exerted by gravity on the balls tested
J. increase the force exerted by air resistance on the balls tested

Passage IV

A researcher investigated the growth of 6 species of floodplain plants. Each species was classified as either flood-sensitive (S) or flood-tolerant (T) (see Table 1).

Table 1

Plant species	Abbreviation	Classification
Achillea ptarmica	Ap	T
Achillea millefolium	Am	S
Festuca arundinacea	Fa	T
Festuca rubra	Fr	S
Rumex palustris	Rp	T
Rumex thyrsiflorus	Rt	S

Experiment

Seeds from each of the 6 species were germinated in a growth chamber maintained at 25.5 degrees Celsius during the day and at 10 degrees Celsius at night

After germination, the seedlings of each species were planted in separate 0.5 L pots and grown for 4 weeks. The seedlings were watered 3 times per week.

At the end of the 4 weeks, each plant was repotted into its own 4 L pot containing a substrate composed of a 4:1 mixture, by mass, of sand to compost. The plants were grown for

Table 2

Treatment	Procedure
1	Pots were watered 3 times per week. Water level was always below the substrate surface.
2	Water level was maintained at the substrate surface.
3	Water level was maintained 2 cm above the substrate surface.
4	Water level was maintained 6 cm above the substrate surface.

2 more weeks; during this time, they were watered 3 times per week.

Next, the potted planted were placed in plastic tubs such that each tub contained 8 plants of each species. Each tub of plants was subjected to a different treatment (see Table 2) for 3 weeks.

At the end of the 3-week treatments, the plants were harvested, and their roots were washed. The roots were separated from the shoots, and then both were dried at 70 degrees Celsius for 48 hr. The average dry shoot biomass per plant and the average dry root biomass per plant were determined for each species and treatment combination (see Figures 1 and 2 respectively).

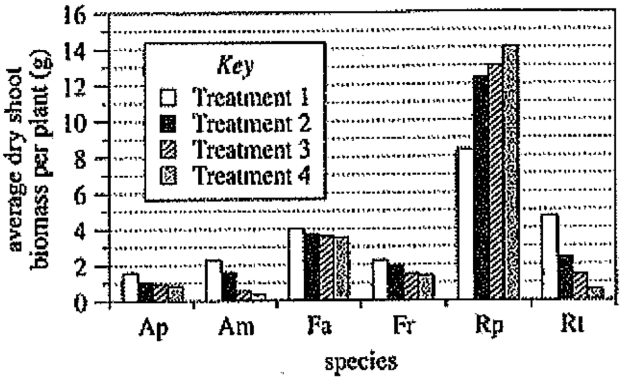


Figure 1

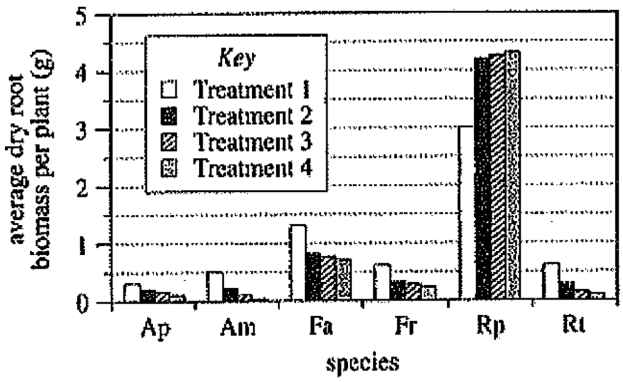


Figure 2

Figures 1 and 2 adapted from C. Jansen, H. M. Van De Steeg, and H. De Kroon, "Investigating a Trade-Off in Root Morphological Responses to a Heterogeneous Nutrient Supply and to Flooding." ©2005 by British Ecological Society.

17. Which treatment resulted in the greatest average dry shoot biomass per plant for Rp plants?

A. Treatment 1
B. Treatment 2
C. Treatment 3
D. Treatment 4

18. The roots were washed after harvest most likely to ensure that the:

F. roots had an opportunity to sprout after the plants were repotted.
G. intracellular water could be removed from the shoot biomass during the drying process
H. substrate particles attached to the roots were not included in the root biomass measurements.
J. Shoots were removed from the plants prior to the drying process

19. When the water level was maintained 2 cm above the substrate surface, which floodplain plants, the T species plants or the S species plants, had the greater dry average dry root biomass per plant?

A. The T species plants; the average dry root mass per plant was greater for Ap plants than for Am plants, greater for Fa plants than for Fr plants, and greater for Rp plants than for Rt plants
B. The T species plants; the average dry root mass per plant was greater for Am plants than for Ap plants, greater for Fr plants than for Fa plants and greater for Rt plants than for Rp plants
C. The S species plants; the average dry root mass per plant was greater for Ap plants than for Am plants, greater for Fa plants than for Fr plants, and greater for Rp plants than for Rt plants

D. The S species plants; the average dry root mass per plant was greater for Am plants than for Ap plants, greater for Fr plants than for Fa plants, and greater for Rt plants than for Rp plants.

20.Which of the following pieces of equipment was most likely used to collect the data presented in Figure 1?
F. Microscope
G. Balance
H. Hydrometer
J. Ruler

21. Which of the following comparisions of the shoot biomass and the root biomass produced by S and T flood-plain plants is best supported by the results of the experiment? Regardless of the water level:
A. Both S and T plants produce, on average, more shoot than root biomass per plant
B. Both S and T plants produce, on average more root than shoot biomass per plant
C. S plants produce, on average, more shoot than root biomass per plant, wheras T plants produce, on average, more root than shoot biomass per plant.
D. S plants produce, on average, more roof than shoot biomass per plant, whereas T plant produce, on average, more shoot than root biomass per plant.

22. The plants investigated in the experiment were from how many different genuses?
F. 2
G. 3
H. 4
J. 6

Passage V

Students were given unknown aqueous acid solutions UAX, UAY, and UAZ. Each solution had an acid concentration of 0.100 mole/L but contained a different acid. The students were also given Table 1, which gives the pK_a of each 5 acids (the lower the pK_a, the stronger the acid).

Table 1

Acid	pK_a
Pyruvic	2.5
Chloroacetic	2.9
Iodoacetic	3.2
Formic	3.7
Acetic	4.8

In a titration, the *titrant* (a solution of known identity and concentration) is slowly added to the *analyte* (a solution of unknown identity or concentration). Students used titration to attempt to identify the acid present in UAX, UAY, and UAZ.

Experiment 1

A 0.100 mole/L aqueous sodium hydroxide (NaOH, a base) solution was added to a *buret* (a graduated tube with a valve at the bottom that can be opened to dispense precise volumes of liquid). The initial volume of the solution in the buret was recorded. A beaker containing 20.00 mL of UAX was placed under the buret. A pH probe was placed in the beaker. Then 25.00 mL of the NaOH solution was added in

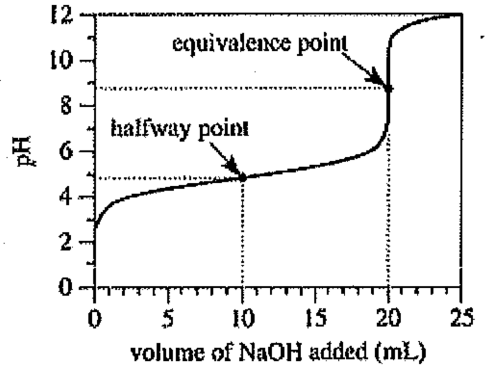


Figure 1

small increments to the acid solution while the acid solution was continuously stirred. After each addition, the pH of the solution in the beaker was recorded (see Figure 1).

In Figure 1, the *equivalence point* indicates the volumes of NaOH solution needed to react with all the acid in the solution in the beaker. At the *halfway point*, the volume of NaOH solution added is half of the volume needed to reach the equivalence point, and the pH of the solution in the beaker equals the pK_a of the acid in the solution.

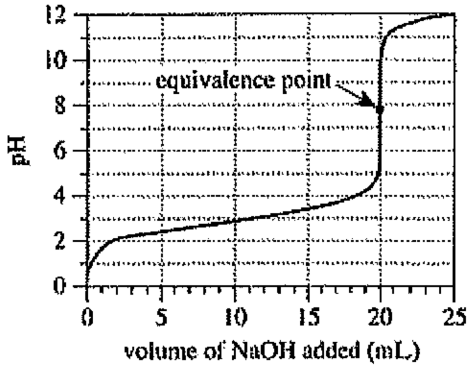


Figure 2

Experiment 2

The procedure from Experiment 1 was repeated with UAY instead of UAX (see Figure 2).

Experiment 3

The procedure from Experiment 1 was repeated with UAZ instead of UAX (see Figure 3).

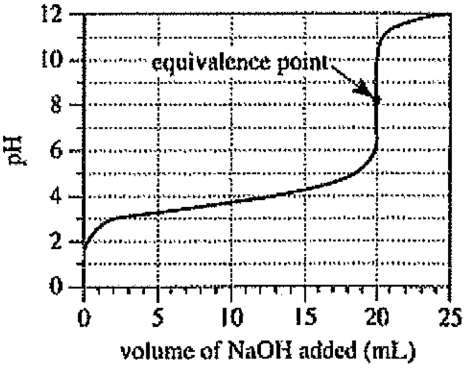
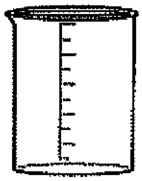


Figure 3

23. Based on the description of Experiment 1, which of the following diagrams best shows the apparatus that was used to dispense the titrant?

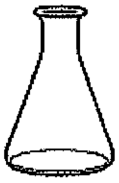
A.



C.

B.

D.



24. Which of the following statements describes a difference between Experiments 1 and 3?

F. In Experiment 1, the analyte was stirred; in Experiment 3, the analyte was not stirred

G. In Experiment 1, the titrant was stirred; in Experiment 3, the titrant was not stirred

H. The analyte in Experiment 1 was different from the analyte in Experiment 3

J. The titrant in Experiment 1 was different from the titrant in Experiment 3

25. Hydrazoic acid is a weaker acid than is formic acid but it is a stronger acid than is acetic acid. Based on Table 1, the pK_a of hydrazoic acid is:

A. less than 3.2

B. between 3.2 and 3.7

C. between 3.7 and 4.8

D. greater than 4.8

26. In Experiment 2, the solution in the beaker was neutral when the volume of NaOH added was at a value between:
F. 9 mL and 11 mL
G. 13 mL and 15 mL
H. 15 mL and 17 mL
J. 19 mL and 21 mL

27. A student claimed that the acid in UAX is pyruvic acid. Based on Table 1 and Figure 1, this claim is incorrect because the pK_a of pyruvic acid is:
A. less than was the pH at the equivalence point
B. greater than was the pH at the equivalence point
C. less than was the pH at the halfway point
D. greater than was the pH at the halfway point

28. Suppose Experiment 3 is repeated, but the concentration of the NaOH solution is 0.200 mole/L. Will the volume of NaOH added at the halfway point and at the equivalence point be less than, greater than, or equal to the corresponding results shown in Figure 3?

	Halfway point	Equivalence point
F.	less	less
G.	greater	less
H.	greater	greater
J.	equal	equal

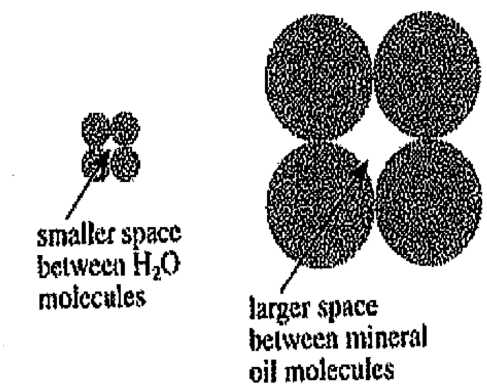
Passage VI

A teacher showed 2 beakers to a chemistry class. One beaker contained mineral oil and the other contained H_2O. Solid iodine was added to each beaker. The solid iodine quickly dissolved in the mineral oil, which turned pink. The solid stayed at the bottom of the H_2O, which remained colorless. The teacher asked 3 students to explain these results.

Student 1

Mineral oil is made up of very large molecules, while H_2O is made up of very small molecules. Thus, the spaces between mineral oil molecules are much larger than the spaces between H_2O molecules (see figure).

For a solid to dissolve in a solvent, its molecules must squeeze in between solvent molecules. The molecular mass (the mass of 1 molecule in atomic mass unit, amu) of a substance is a good indicator of molecular size, so if a solid has a molecular mass less



than that of a solvent it will most likely dissolve in the solvent. Therefore, the iodine dissolved in the mineral oil, but not in the H_2O.

Student 2

An H_2O molecule is *polar* because it has a region of positive charge and a region of negative charge. *Nonpolar* molecules, like those that make up mineral oil do not have differently charged regions. Polar molecules are attracted to each other and nonpolar molecules are attracted to each other, but polar molecules repel nonpolar molecules. Thus, polar solids dissolve in polar solvents, and nonpolar solids dissolve in nonpolar solvents. Therefore, the iodine dissolved in the mineral oil, but not help the H_2O. Molecular size is unrelated to solubility.

Student 3

Student 2 is correct, but with one exception. Nonpolar molecules are actually strongly attracted to polar molecules. The reason that nonpolar substances don't dissolve in polar substances is that polar molecules are too strongly attracted to each other to allow nonpolar molecules to come between them. If a drop of mineral oil is placed on the surface of a pan full of H_2O, the drop will spread to form the thinnest layer possible in order to maximize contact with H_2O molecules.

29. Which of the following terms best describes the mixture of iodine and solvent in each of the beakers at the end of the teacher's demonstration?

	Iodine and mineral oil	Iodine and H_2O
A.	heterogeneous	heterogeneous
B.	heterogeneous	homogeneous
C.	homogeneous	heterogeneous
D.	homogeneous	homogeneous

30. Base on Student 1's explanation, is it likely that solid H_2O would be soluble in mineral oil?
F. Yes, because the solute molecules and the solvent molecules are nonpolar
G. Yes, because H_2O molecules are much smaller than mineral oil molecules
H. No, because the solute molecules are polar and the solvent molecules are nonpolar
J. No, because H_2O molecules are much larger than mineral oil molecules

31. How would Student 1 most likely rank the 3 substances used in the demonstration, from the substance with the smallest molecular mass to the substance with the largest molecular mass?
A. Iodine < H_2O < mineral oil
B. H_2O < iodine < mineral oil
C. Mineral oil < iodine < H_2O
D. Mineral oil < H_2O < iodine

32. In Student 2's explanation, the sentence "Therefore, the iodine dissolved in the mineral oil, but not in the H_2O" implied that iodine molecules are:
F. nonpolar
G. polar
H. smaller than H_2O molecules
J. larger than H_2O molecules

33. Suppose it were observed that mineral oil molecules were smaller than iodine molecules. What impact, if any, would this observation have on Student 3's explanation?
A. It would prove that the explanation is correct.
B. It would support the explanation, but not prove that the explanation is correct
C. It would weaken the explanation, but not prove that the explanation is incorrect
D. It would have no impact on the explanation

34. Paraffin wax is nonpolar solid and acetic acid is a polar solvent. Based on Student 3's explanation, would paraffin wax be soluble in acetic acid?
F. Yes, because the paraffin wax molecules would be strongly attracted to the acetic acid molecules
G. Yes, because the paraffin was molecules would be more attracted to each other than the acetic acid molecules
H. No, because the paraffin wax molecules would be repelled by the acetic acid molecules
J. No, because the acetic acid molecules would be more attracted to each other than to the paraffin wax molecules.

35. The nonpolar solid 9,10-diphenylanthracene has a molecular mass of 330 amu and readily dissolves in benzene. Benzene is a nonpolar solvent with a molecular mass of 78 amu. These observations are inconsistent with the explanation(s) put forth by:
A. Student 1 only
B. Student 2 only
C. Student 1 and Student 2 only
D. Student 2 and Student 3 only

Passage VII

Radar observations of Saturn's moon Titan have revealed landforms that resemble longitudinal sand dunes found in some deserts on Earth. Such dunes are produced when sand-size solid particles are deposited in linear, parallel piles (see Figure 1). Figure 2 shows the average dune spacing and average dune height for each of a number of areas of dunes on Titan and in 4 deserts in Earth (Deserts A-D). Figure 3 shows plots of the *surface elevation* (elevation above a horizontal reference plane) across a 25 km wide perpendicular cross section of dunes on Titan in Desert A.

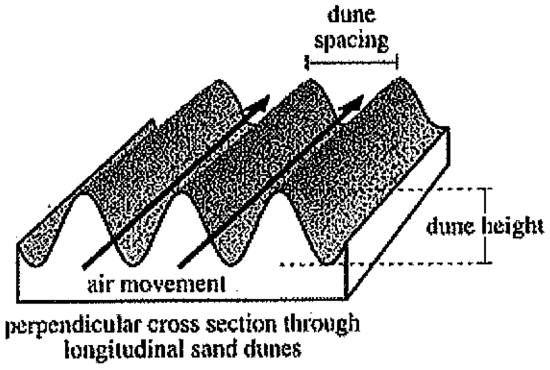


Figure 1

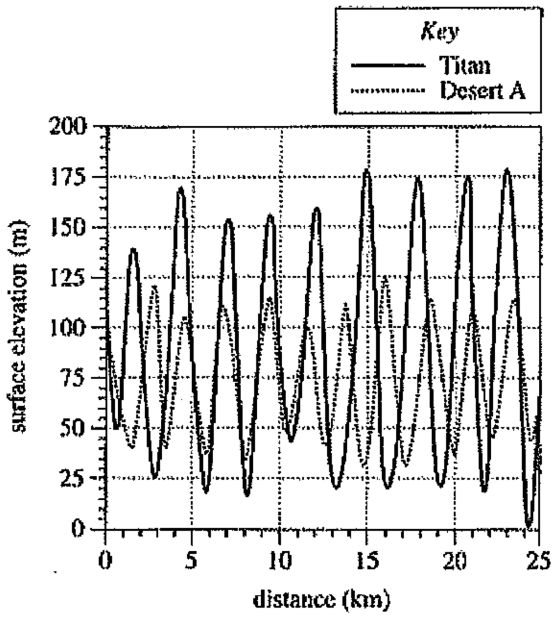
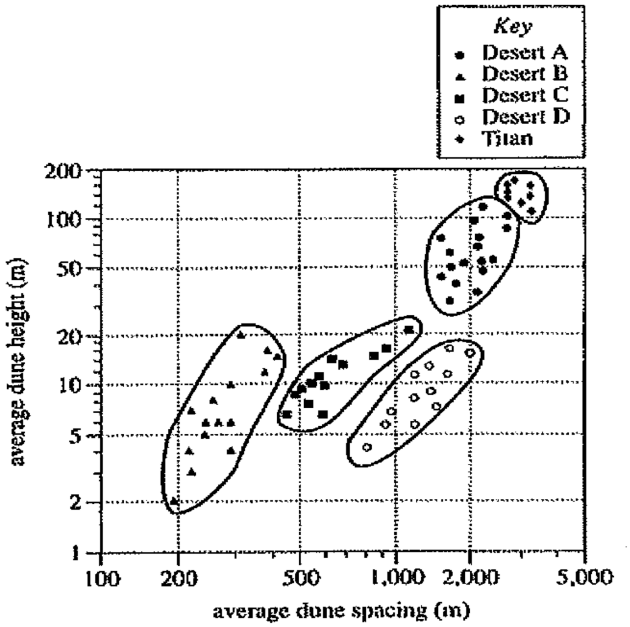


Figure 3

Figure 3 adapted from R. D. Lorenz et al., "The Sand Seas of Titan: Cassini RADAR Observations of Longitudinal Dunes," ©2006 by the American Association for the Advancement of Science.



Note: Each symbol on the graph represents data for a different area of dunes in a desert or on Titan.

Figure 2

Figure 2 adapted from Nicholas Lancaster, "Linear Dunes on Titan," ©2006 by the American Association for the Advancement of Science.

36. According to Figure 2, which of the following average dune spacings and average dune heights would be most likely for an area od Desert D dunes?

	dune spacing (m)	dune height (m)
F.	500	2
G.	500	7
H	1,000	2
J.	1,000	7

37. Assume that for the dunes represented in Figure 2, as average wind speed increases, average dune height increases. Did Desert A or Desert B more likely have the greater average wind speed?

A. Desert A, because the areas in that desert had greater average dune height
B. Desert A, because the areas in that desert had lesser average dune height
C. Desert B, because the areas in that the desert had greater average dune height
D. Desert B, because the areas in that desert had lesser average dune height

38. According to Figure 3, across the 25 km wide cross section of dunes on Titan and in Desert A, how does the surface elevation of the Titan dunes differ, if at all, from the surface elevation of the Desert A dunes? The surface elevation of the Titan dunes is:

F. the same at all distances
G. greater at all distances
H. less at all distances
J. greater at some distances but less at other distances

39. Consider in Figure 2 the greatest average dune height shown for an area of Titan dunes. That height is how many times higher than the greatest average dune height shown for an area of Desert C dunes?

A. Less than 2 times as high
B. Between 2 and 3 times as high
C. Between 3 and 5 times as high
D. More than 5 times as high

40. The 2 quantities for dunes that are defined in Figure 1— dune spacing and dune height— are directly analogous to which 2 quantities for electromagnetic waves?

	dune spacing	dune height
F.	amplitude	wavelength
G.	wavelength	amplitude
H.	frequency	amplitude
J.	wavelength	frequency

Appendix C2- Tables Practice Quiz

Hour _____ Date _____ Name _____

Table Practice Quiz

Passage III

A student performed 2 studies to investigate the factors that affect the germination of peony seeds.

Study 1

Peony seeds were placed in dry containers. Some of the containers were stored at 5°C for either 4, 6, 8, or 10 weeks. The temperature and time periods were defined as the *storage temperature* and the *storage period*, respectively.
The peony seeds were divided evenly so that there were 20 sets of 25 seeds. Twenty petri dishes were then prepared. Each contained damp paper. Each set of seeds was placed in a separate petri dish. Each Petri dish was maintained at 1 of 4 temperatures for 30 days. The temperature and time periods were defined as the *germination temperature* and the *germination period*, respectively. Table 1 shows the number of seeds that germinated in each dish.

Table 1

Storage period (weeks)	**Number of peony seeds that germinated when maintained at a germination temperature of:**			
	13°C	**18°C**	**23°C**	**28°C**
0	0	0	0	0
4	0	2	0	0
6	3	8	6	0
8	7	22	18	0
10	15	24	21	1

Study 2

Peony seeds were placed in dry containers. The containers were stored at various temperatures for 10 weeks.
The peony seeds were divided evenly so that there were 20 sets of 25 seeds. Twenty Petri dishes were then prepared. Each contained damp paper. Each set of seeds was placed in a Petri dish. The Petri dishes were maintained at 1 of 4 temperatures for 30 days. Table 2 shows the number of seeds that germinated in each dish.

Table 2				
Storage temperature (°C)	**Number of peony seeds that germinated when maintained at a germination temperature of:**			
	13°C	**18°C**	**23°C**	**28°C**
0	15	24	21	1
5	16	23	21	1
10	0	6	4	0
15	0	0	0	0
20	0	0	0	0

Tables adapted from Joel Beller, *Experimenting with Plants*. ©1985 by Joel Beller.

1. In general, the results of Study 2 suggest that peony seeds that are placed in a Petri dish containing damp paper are most likely to germinate when they are maintained at which of the following temperatures?

A. 13°C
B. 18°C
C. 23°C
D. 28°C

2. Suppose another storage period of Peony growth had been included in Study 1 and these seeds had a storage period of 12 weeks and a germination temperature of 18°C. Based on the information provided, the number of seeds that would have germinated after being maintained for 30 days would most likely have been closest to:

F. 18
G. 22
H. 24
J. 26

3. In Study 2, at the storage temperature of 0°C, as germination temperature increased from 13°C to 28°C, the number of seeds that germinated:

A. decreased only.
B. increased only.
C. decreased, then increased.
D. increased, then decreased.

4. Which of the following sets of seeds were exposed to the same conditions prior to being placed in the Petri dishes?

F. The seeds from Study 1 that were stored for 8 weeks and the seeds from Study 2 that were stored at 5°C
G. The seeds from Study 1 that were stored for 8 weeks and the seeds from Study 2 that were stored at 15°C
H. The seeds from Study 1 that were stored for 10 weeks and the seeds from Study 2 that were stored at 5°C
J. The seeds from Study 1 that were stored for 10 weeks and the seeds from Study 2 that were stored at 15°C

5. A student stored 100 peony seeds at a constant temperature for 10 weeks. The student then divided the seeds into 4 sets and maintained them as described in Study 2. The results were as follows:

Germination temperature (°C)	Number of seeds that germinated
13	14
18	24
23	21
28	2

These seeds most likely had a storage temperature of:

A. 0°C.
B. 5°C.
C. 10°C.
D. 15°C.

6. The experimental designs of Study 2 & Study 1 were the same in that in Study 1 and in Study 2:

F. storage temperature was held constant.
G. storage time was held constant.
H. germination temperature was varied.
J. germination time was varied.

Please write your answers below and continue:

1) _____ 2) _____ 3) _____

4) _____ 5) _____ 6) _____

Passage II

G. soja (a wild soybean) produces *γ-tocopherol* (a type of vitamin E). It then converts some *γ-tocopherol* into *α-tocopherol* (another type of Vitamin E). In *G. soja* the enzyme *TMT* catalyzes this reaction:

$$\gamma\text{-tocopherol} \xrightarrow{\text{TMT}} \alpha\text{-tocopherol}$$

A. thaliana (a mustard plant) produces *γ-tocopherol* but lacks TMT, so it produces only a small amount of *α-tocopherol*. Because *α-tocopherol* is more effective at reducing cellular damage than is *γ-tocopherol*, a scientist tried to transfer *G. soja* TMT gene into *A. thaliana*.

Experiment 1

Four versions of *G. soja*'s TMT gene (TMT1-TMT4) were cloned. Each gene was incorporated into a *vector* (a biological structure that carries a gene and transfers it into the cells of an organism).Six genetically identical lines of *A. thaliana* were developed (L1-L6). As shown in Table 1, L1-L4 were each exposed to vector carrying 1 of the 4 cloned genes; L5 was exposed only to the vector; and L6 was left untreated. Next, 10 plants from each line were grown. Table 1 gives the tocopherol concentration and the percent (%) by mass of the 2 types of tocopherol in the plants.

Experiment 2

Four genetically different strains of *A. thaliana* were grown (S1-S4). S1-S4 were exposed to a vector carrying TMT1. Next, 10 plants from each strain were grown. Table 2 shows the tocopherol concentration and the percent by mass of the two types of tocopherol in the plants.

Table 1

Line	Treatment	Tocopherol concentration (mg/kg)	*γ-tocopherol* (%)	*α-tocopherol* (%)
L1	Vector + TMT1	360	3	97
L2	Vector + TMT2	360	3	97
L3	Vector + TMT3	360	51	49
L4	Vector + TMT4	360	2	98
L5	Vector	360	99	1
L6	Untreated	360	99	1

Table 2

Strain	Treatment	Tocopherol concentration (mg/kg)	*γ-tocopherol* (%)	*α-tocopherol* (%)
S1	Vector + TMT1	390	1	99
S2	Vector + TMT1	360	3	97
S3	Vector + TMT1	320	9	91
S4	Vector + TMT1	310	99	1

Tables adapted from D. Shintani and D. DellaPenna, "Elevating the vitamin E Content of Plants Through Metabolic Engineering." ©198 by the American Association for the Advancement of Science.

1. At the end of Experiment 2, which of the 4 strains had the least amount of *α-tocopherol* per kilogram of plant material?
    A. S1
    B. S2
    C. S3
    D. S4

2. If the scientist wanted to do a trial in Experiment 2 with a strain of *A. thaliana* strains that was genetically identical to the *A. thaliana* used in Experiment 1 L3. What would its expected *α-tocopherol* % be?
    F. 99
    G. 51
    H. 49
    J. 1

3. What line in Experiment 1 was the control group?
    A. L3
    B. L4
    C. L5
    D. L6

4. The scientist believed that 4 different strains of *A. thaliana* in Experiment 2 produced an enzyme that was more effective than the enzyme produced by the other 3 strains. Based on the results, the strain was most likely:
    F. S1
    G. S2
    H. S3
    J. S4

5. After reviewing the data from experiment 1, the scientist concluded that the transfer of the TMT gene to 1 of the strains was moderately unsuccessful. This strain was most likely:
    A. L1
    B. L2
    C. L3
    D. L4

6. Which of the following best explains the results of Experiment 2:
    F. All the strains of *A. thaliana* increased the amount of *α-tocopherol* produced
    G. None the strains of *A. thaliana* increased the amount of *α-tocopherol* produced
    H. Only strains S1-S3 increased increased the amount of *α-tocopherol* produced
    I. Only strains S2-S4 increased the amount of *α-tocopherol* produced

Please write your answers below and turn in this assignment:

1) _____ 2) _____ 3) _____

4) _____ 5) _____ 6) _____

Appendix C3- Bar Graph Practice Quiz

Hour _____ Date _____ Name _____

ACT Bar Graph Practice Quiz

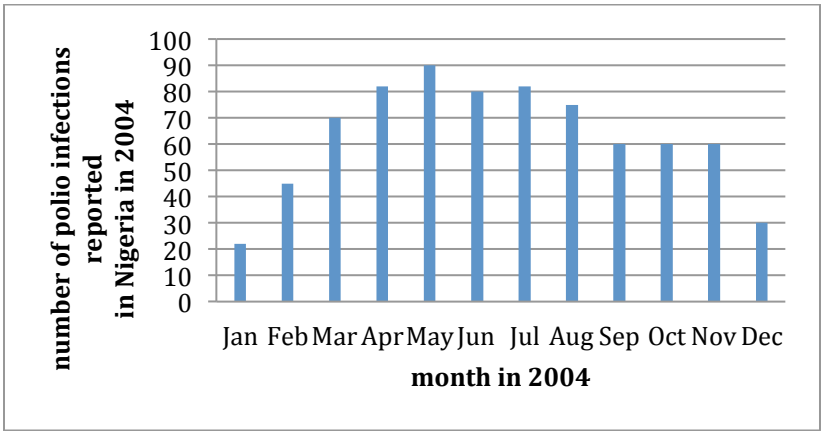
Passage II

Despite a global campaign since 1988 to eradicate *poliomyelitis* (polio), the virus that causes this disease continues to be endemic in four countries. This polio virus, which can exist as Type I, Type 2, or Type 3, is most often transmitted through water that is contaminated by human waste. People can be immunized from this virus with a highly effective vaccine, which can be administered orally or by injection. Recent analyses of polio virus transmission have focused on the four polio-endemic countries India, Pakistan, Afghanistan, and Nigeria.

Study 1

In 2004, a temporary ban on polio vaccines was instituted in Nigeria in response to concerns that they were contaminated. Researchers reviewed World Health Organization (WHO) records to determine the number of Type 1 polio virus infections that were reported in Nigeria in 2004 and tallied their findings by month (see Figure 1). The World Health Organization has noted that in polio-endemic countries, official records underestimate the number of people actually infected, because numerous infected individuals do not report their symptoms to clinics or rely on local therapists who are not surveyed. In a polio-endemic country, for every person who has reported an infection, as many as ten people may actually be infected in the local population.

Figure 1

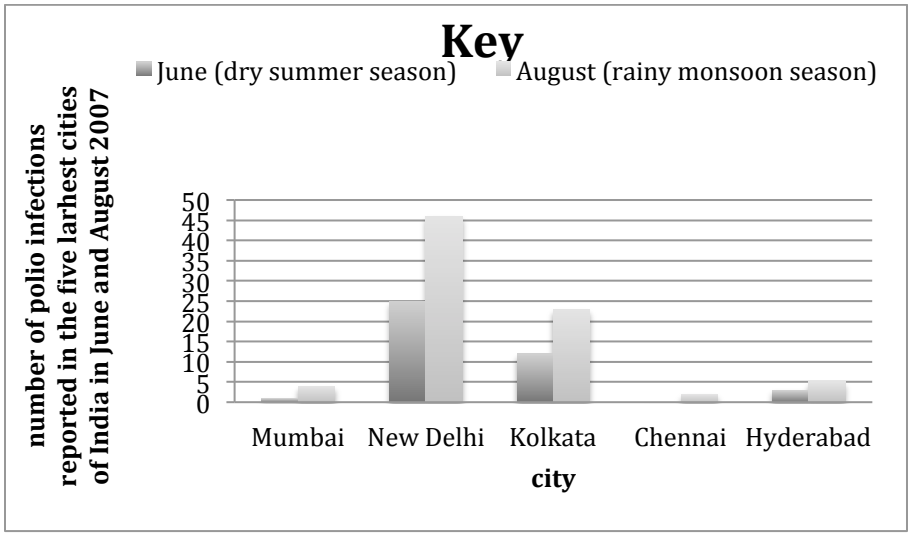


Study 2

Although polio eradication efforts have been most consistent in the urban areas of polio-endemic countries, these areas also have a high risk for a reemergence of polio, especially when the large urban populations are exposed to water contaminated with wastes that harbor the polio virus. In 2007, researchers analyzed the number of people who reported infections with Type 3 polio virus in the five largest cities in India. These cities were Mumbai in western India, New Delhi and Kolkata in northern India, and Chennai and Hyderabad in Southern India. The analysis was undertaken in the months of June and August. June 2007 was chosen as a representative

month for the dry summer season in India, during which there was minimal rainfall. August 2007 was chosen as a representative month for the wet monsoon season in India, during which there was daily rainfall. The results of the findings are shown in Figure 2.

Figure 2



7. According to Figure 2, the largest difference between the number of reported polio infections in India from June to August occurred in which city??

A. Mumbai
B. New Delhi
C. Kolkata
D. Chennai

8. It is estimated that for every person infected with the polio virus is an endemic country, there are 200 people at risk for contracting the virus. Given the results of Study 1, how many people would have been at risk for becoming at risk for becoming infected with the polio virus in Nigeria in December 2004

F. 2,000
G. 6,000
H. 12,000
J. 16,000

9. Given the information in Figure 1, which of the following might explain the difference in reported cases of polio in Nigeria between April and August of 2004?

A. Water is more likely to become contaminated with polio-infected human waste in periods of high rainfall.
B. Water is less likely to become contaminated with polio-infected human waste in periods of high rainfall.
C. The polio virus infects more people in Nigeria during the spring and summer seasons than during the fall and winter seasons.
D. Those diagnosed with the polio virus in June are able to recover by August.

10. Which of the following hypotheses was most likely tested in Study 1?

F. The number of reported cases of polio infections will increase after the ban on vaccinations in Nigeria.
G. Most cases of polio infections are not reported to medical authorities in Nigeria.
H. The number of reported cases of polio infections will decrease after the ban on vaccinations in Nigeria.
J. The number of reported cases of polio infections in Nigeria is greatest during the summer months.

11. Polio-endemic countries are located in warm climates that lack advanced human waste treatment facilities. Would the absence of advanced human waste treatment facilities affect the transmission of the polio virus?

A. Yes, because the polio virus is primarily transmitted through parasites.
B. Yes, because the polio virus is primarily transmitted through human waste.
C. No, because the polio virus is primarily transmitted through parasites.
D. No, because the polio virus is primarily transmitted through human waste.

12. The comparison of reported polio infections in India in 2007, as shown in Figure 2, indicates that relative to the number of people in New Delhi infected with polio in August, the number of people infected with polio in New Delhi in June was approximately:

F. half as much.
G. the same.
H. A little less than twice as much.
J. ten times as much.

Please write your answers below and turn in this assignment:

7) _____ 8) _____ 9) _____

10) _____ 11) _____ 12) _____

Passage I

The magnitude of seismic energy released from an earthquake is often described using the logarithmic and unit-less Richter scale. Originating at the epicenter, seismic energy travels though the earth via wave such as L-waves, S-waves, and P-waves. Earthquakes with a Richter scale magnitude of 5.0 or greater can typically be detected throughout the world. Figure 1 depicts the layers of the earth and typical travel patterns of seismic waves. Table 1 lists characteristics of those seismic waves. Figure 2 shows the number of earthquakes (by magnitude) detected at a particular seismic activity monitoring station in the past 30 years, as well as the percentage probability of future earthquakes (by magnitude) in that same region in the next 30 years.

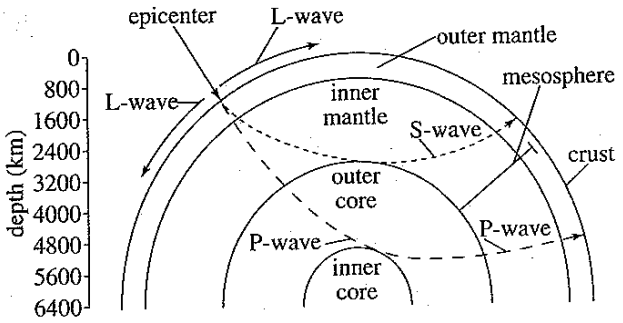
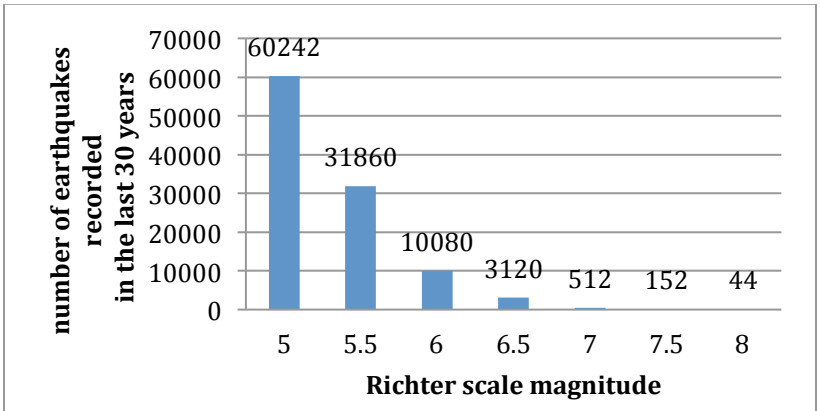


Figure 1

Table 1		
Seismic Waves	Depth range (km)	Crust velocity (m/s)
L-wave	0-10	2.0-4.5
S-wave	0-2921	3.0-4.0
P-wave	0-5180	5.0-7.0



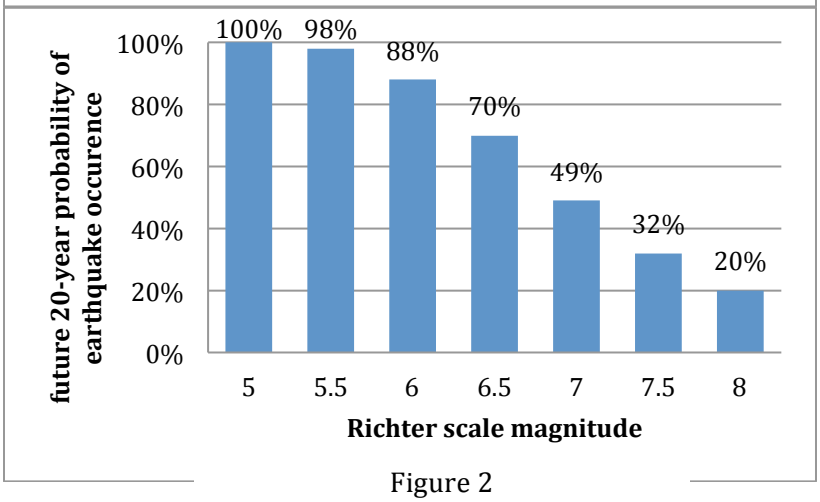


Figure 2

1. Figure 1 identifies where P-waves can travel within Earth which regions of Earth can P-waves travel in?

I. Outer Core
II. Inner Mantle
III. Outer Mantle

A. II only
B. I and II only
C. II and III only
D. I, II, and III

2. A series of seismic waves was observed from an observatory station. The average crust velocity of these waves was 3.5 m/s, and their maximum depth occurred on the crust's surface. Based on Figure 1 and Table 1, the seismic waves observed were most likely:

F. L-waves
G. S-waves
H. P-waves
J. K-waves

3. Given the data in Figure 2, the future probability of an earthquake occurrence decreases the least between which of the following 2 magnitudes?

A. 5.0 and 5.5
B. 6.0 and 6.5
C. 6.5 and 7.0
D. 7.5 and 8.0

4. According to Figure 2, the probability of a future earthquake occurrence is highest for which of the following ranges of Richter scale magnitude?

F. 5.0 to 5.5
G. 6.0 to 6.5
H. 6.5 to 7.0
J. 7.0 to 7.5

5. Based on Figure 2, the ratio of Richter scale 6.0 earthquakes to Richter scale 5.5 scale earthquakes in the last 30 years can be expressed approximately by which of the following fractions?

A. 1/3
B. 1/2
C. 2/3
D. 3/2

Please write your answers below and turn in this assignment:

1) _____ 2) _____ 3) _____ 4) _____ 5) _____

Appendix C4- Single-Line Graph Practice Quiz

Hour _____ Date _____ Name _____

Single-Line Graph Practice Quiz

Passage VI

The pH at which a protein is uncharged is called its *isoelectric point (pI)*. As the surrounding pH decreases, proteins gain an increasing positive charge. As the surrounding pH increases, proteins gain an increasingly negative charge. In *gel electrophoresis*, a mixture of proteins are first dissolved in a solvent and then placed at the starting point of an agarose gel. A current is applied to the gel and the proteins migrate different distances according to their charge (see **Figure 1**).

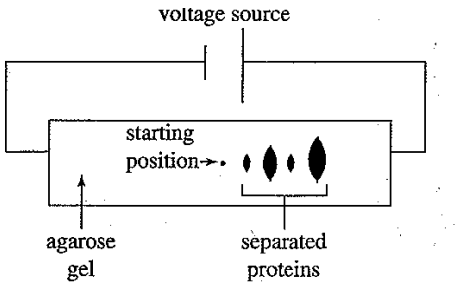


Figure 1

The following experiments were done to determine how varying the pH of a solvent affects the separation of proteins with gel electrophoresis. **Table 1** shows the isoelectric points of the proteins and the pH values of the solvents used. The pH scale is logarithmic. Solutions with a pH less than 7.0 are acidic, while those with a pH more than 7.0 are basic.

Table 1	
Protein	pI
A	8.2
B	7.4
C	6.8
D	5.9
Solvent	pH
1	8.9
2	9.6
3	10.2

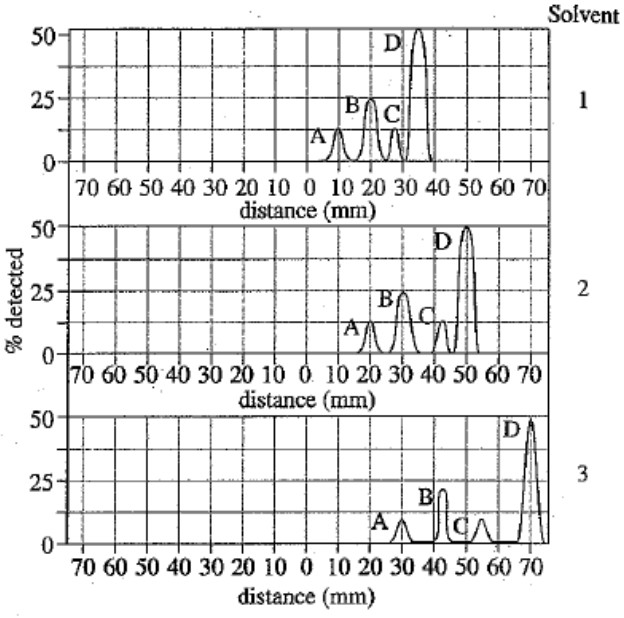


Figure 2

Experiment 1

A special paper 150 mm long is treated with an aragose gel. Electrodes were attached on each end and wired to a 100-volt source. A 150 μg mixture of proteins A-D was added to Solvent 1 to make a 200μL solution. The solution was placed at the starting point of the gel and allowed to separate for 60 minutes. The density of the separated proteins was plotted as a percentage over their distance traveled. The procedure was repeated for Solvents 2 and 3 and the results presented in **Figure 2**.

Experiment 2

The procedures of Experiment 1 were repeated after reversing the electrode attachments on the voltage source Results are shown in **Figure 3**.

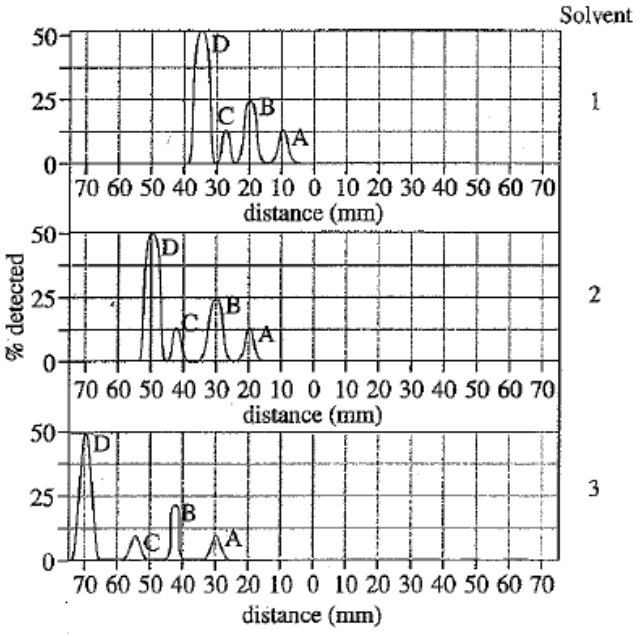


Figure 3

28. In Experiment 1, when Solvent 3 was used, the majority of Protein A migrated a distance from the starting point closest to:

F. 30 mm.
G. 42 mm.
H. 54 mm.
J. 70 mm.

29. Supposed that Experiment 1 were repeated using a solvent with a pH of 10.8. The migration distance of Protein A would most likely peak at:

A. less than 50mm
B. between 50 mm and 60 mm.
C. between 60 mm and 70 mm.
D. greater than 70 mm.

30. Protein L has an isoelectric point (*pI*) of 6.0. The results of Experiments 1 and 2 would be most similar to the plots shown in Figures 1 and 2 if, in each trial, Protein L were added to the protein mixture after removing:

F. Protein A
G. Protein B
H. Protein C
J. Protein D

31. The resolution of gel electrophoresis decreases as the overall distance between the peaks on the density plot decreases. Based on the results of Experiments 1 and 2, which of the following sets of conditions had the highest resolution for the separation?

Experiment 1	Experiment 2
A. Solvent 1	Solvent 1
B. Solvent 3	Solvent 3
C. Solvent 2	Solvent 3
D. Solvent 3	Solvent 1

32. Suppose that Experiment 1 will be repeated using Solvent 2, but Protein Y (*pI*=6.3) is added to the overall mixture. Which of the following best predicts the order of migration distances of the 5 proteins, from longest to shortest?

F. D, C, Y, B, A
G. D, Y, C, B, A
H. A, B, Y, C, D
J. A, Y, B, C, D

33. In Experiment 2, for Solvent 2, at the migration distance where Protein D went to its 50% migration detection, the percent of Protein C that migrated using Solvent 3 was closest to:

A. 0%
B. 10%
C. 20%
D. 30%

Please write your answers below and turn in this assignment:

28) _____ 29) _____ 30) _____

31) _____ 32) _____ 33) _____

Passage I

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 additional 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, measure, 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 1/8 of the length of the shell were labeled *major* (M), where the scutes extending less than or equal to 1/8 of the length of 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	300	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 (part of the shell linking the upper and lower plates), and the total number of scutes were recorded (see Figure 1).

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

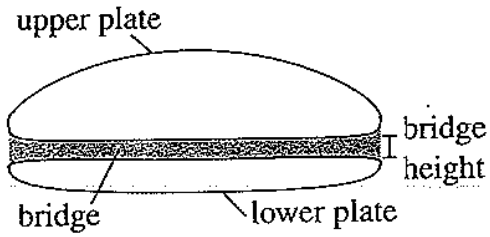


Figure 1

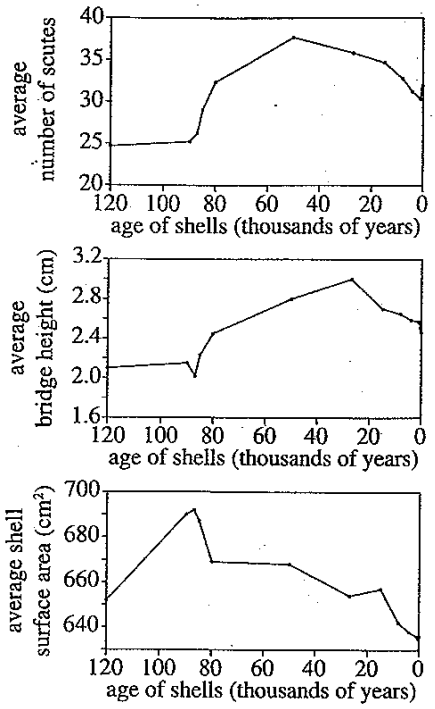
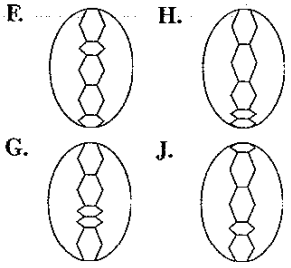


Figure 2

1. In a layer of seabed determined to be 250,000 years old, the scientists found complete intact shells of two turtle shells. Which of the following is the most likely reason this layer of seabed was not included in the study?

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. The scientists would not have been able to accurately determine the color of the shells.
D. The sample size of this turtle population is too small to provide accurate data.

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?



3. According to the results of Study 2, how do the average number of scutes and the average shell surface area of living turtles of the Opulasian Peninsula compare to those of the Opulasian Peninsula from 60,000 years ago?

For the living turtles:

A. Both the average number of scutes and the average shell surface area are larger.
B. Both the average number of scutes and the average shell surface area are smaller.
C. The average number of scutes is larger, and the average shell surface area is smaller.
D. The average number of scutes is smaller, and the average shell surface area 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 around 65,000 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	**M-M-m-m-M**	**M-m-M-m-M**
F.	100%	0%	0%
G.	43%	36%	8%
H.	29%	67%	4%
J.	16%	79%	5%

5. In Study 2, the average bridge height of fossilized turtle shells that were 60,000 years old was closest to:

A. 2.4 cm
B. 2.6 cm
C. 2.8 cm
D. 3.0 cm

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

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

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

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

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

Please write your answers below and turn in this assignment:

1) _____ 2) _____ 3) _____

4) _____ 5) _____ 6)_____

Appendix C5- Multi-Line Graph Practice Quiz

Hour _____ Date _____ Name _____

Multi-Line Graph Practice Quiz

Passage III

Osmotic pressure (II) is the amount of pressure, in atm, required to maintain equilibrium of a solvent across a semipermeable membrane. At a constant temperature, osmotic pressure is dependent only on a solute's ability to dissociate or ionize in the solvent (*van't Hoff factor, i*) and the concentration of solute particles. The osmotic pressure is determined by the equation:

$$\Pi = iMRT$$

M represents the concentration (in molarity, M), *R* is the ideal gas constant (0.0821 L atm mol^{-1} K^{-1}), and *T* (300 K) is the temperature in Kelvin (K). The value of *R* is assumed to be a constant for all osmotic pressure calculations.

The dissociation of a solute depends on its unique chemical properties. The van't Hoff factors for some common substances are displayed in Table 1. Higher van't Hoff factors correlate with greater dissociation or ionization. The effect of the van't Hoff factor on the osmotic pressure may be seen in Figure 1.

Table 1	
Substance	van't Hoff factor*
Sucrose	1.0
NaCl	1.9
$MgCl_2$	2.7
$FeCl_3$	3.4
*Values at 300 K	

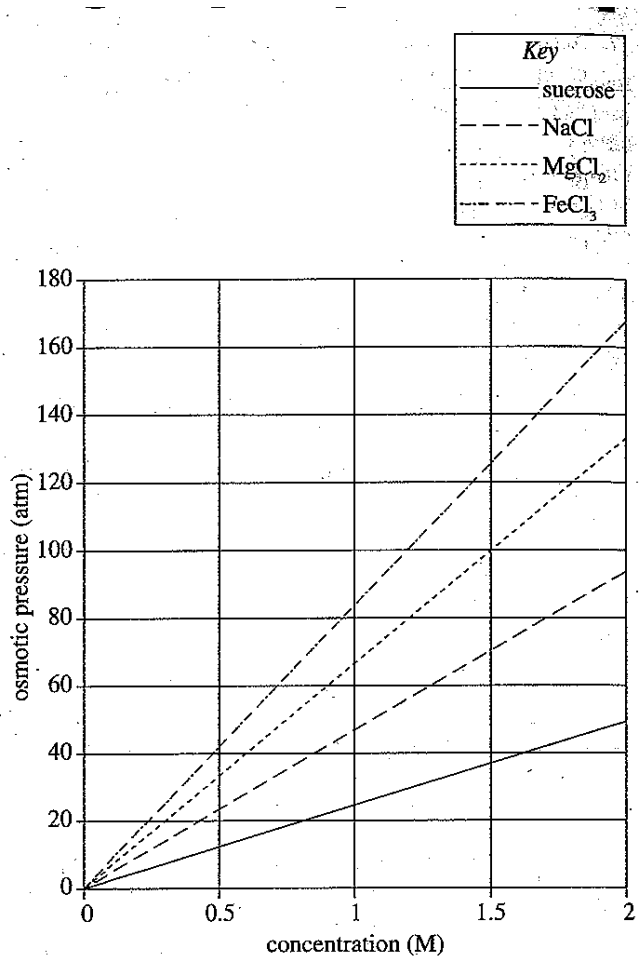


Figure 1

13. According to Figure 1, which of the following solutions would exhibit the *greatest* osmotic pressure?

A. 1.0 M $FeCl_3$ solution
B. 1.0 M $MgCl_2$
C. 2.0 M NaCl solution
D. 2.0 M sucrose solution

14. If 1.5 M solutions of various solutes were prepared, which of the following solutions would have the lowest level of ionization?

F. Sucrose
G. NaCl
H. MgCl2
J. $FeCl_3$

15. Which of the following solutions would exhibit the closest osmotic pressure to that of a 1.5 M Sucrose solution at 300 K, if the gas constant is 0.0821 L atm/mol^{-1} K^{-1}?

A. 1.5 M NaCl solution (i=1.0)
B. 2.0 M NaCl solution (i=1.9)
C. 2.9 M $MgCl_2$ solution (i=1.0)
D. 3.5 M $MgCl_2$ solution (i=1.0)

16. Based on Figure 1, as the concentration of solute increases, the pressure required to hold solvent concentration across a membrane at equilibrium will:

F. increase only.
G. decrease only.
H. remains constant.
J. increase, then remain constant.

17. A scientist recently discovered a compound that ionizes readily in a solution (i=0.6) and results in low osmotic pressures. Are the findings of this scientist consistent with Figure 1?

A. Yes, because $FeCl_3$ causes higher osmotic pressure than sucrose.
B. No, because sucrose causes higher osmotic pressure than $FeCl_3$.
C. Yes, because $FeCl_3$ causes lower osmotic pressure than sucrose.
D. No, because sucrose causes lower osmotic pressure than $FeCl_3$.

Please write your answers below and turn in this assignment:

13) _____ 14) _____ 15) _____ 16) _____ 17) _____

Passage VII

A scientist studying hemoglobin investigated the impact of temperature and carbon dioxide (CO_2) concentrations on the binding of oxygen (O_2). The scientist observed the binding of oxygen to hemoglobin molecules as the pressure of oxygen was increased. The temperature and CO_2 were varied to identify their direct impact on the binding capacity of O_2.

Figure 1 displays the impact of changes in temperature on the binding (percent of hemoglobin saturated) of oxygen. Figure 2 displays the impact of varying carbon dioxide concentrations on oxygen binding. Under normal conditions, the core body temperature is 37^0 C and has carbon dioxide and oxygen concentrations of 40mmHg and 100mmHg respectively.

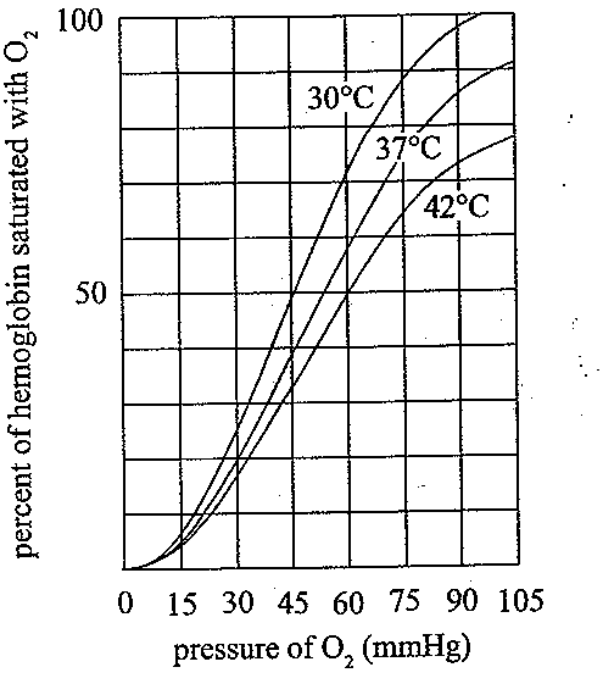


Figure 1

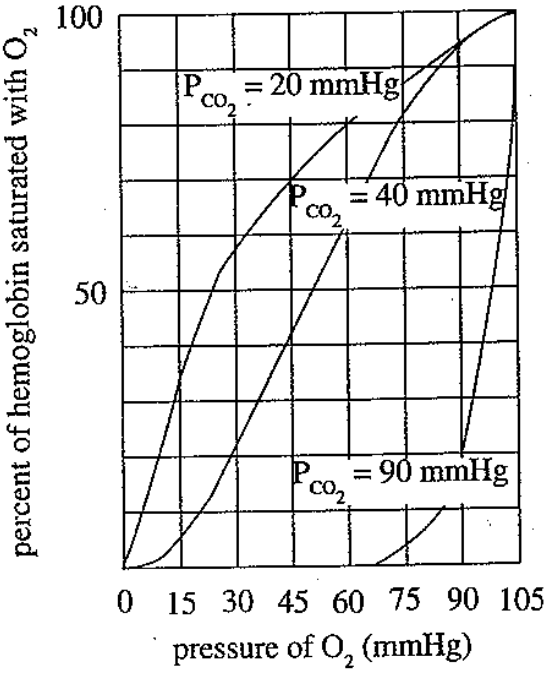


Figure 2

36. According to Figure 1, if the temperature is 42^0Cm which of the following changes in pressure of oxygen will cause the most increase in the percent of hemoglobin saturated with O_2?

F. 0-15mmHg
G. 15-20mmHg
H. 30-45mmHg
J. 45-60 mmHg

37. According to Figure 1, which of the following sets of temperature and pressure of oxygen results in the highest hemoglobin saturation with oxygen?

	Temperature (^{0}C)	Pressure of Oxygen (mmHg)
A.	37	45
B.	37	60
C.	42	45
D.	42	60

38. According to Figure 1, if the pressure of oxygen is 45 mmHg and 60% of hemoglobin molecules are saturated with oxygen then the core body temperature is most likely within which of the following ranges?

F. Less than 30^{0}C
G. 30^{0}C-37^{0}C
H.37^{0}C-42^{0}C
J. Greater than 42^{0}C

39. Based on Figure 2, if an individual has 60% of his hemoglobin molecules saturated at a pressure of 45 mmHg of oxygen, then the individual's carbon dioxide pressure is most likely closest to which of the following?

A. 30 mmHg
B. 50 mmHg
C. 70 mmHg
D. 90 mmHg

40. According to Figure 2, at a CO_2 pressure of 20 mmHg, as the pressure of O_2 is increased from 0 mmHg to 90 mmHg, the percent of hemoglobin saturated with oxygen:

F. remains constant, then increases.
G. remains constant, then decreases.
H. increase quickly, then increases slowly
J. decreases quickly, then increases slowly.

Please write your answers below and turn in this assignment:

36) _____ 37) _____ 38) _____

39) _____ 40) _____

Passage VII

An experiment is set up to look at the physics of bouncing a ball, as shown in Figure 1.

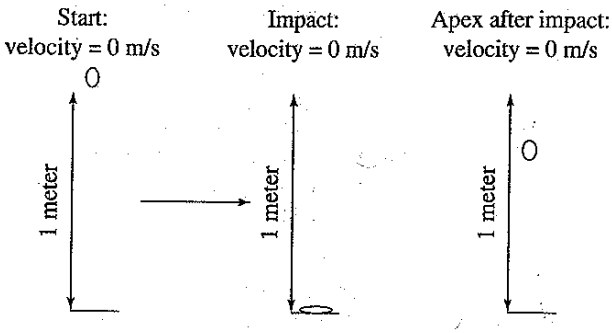


Figure 1

When a ball is dropped the initial velocity is 0 m/s. Velocity will increase until impact with the ground, at which point the ball's velocity immediately drops to 0 m/s again. After impact, velocity almost immediately increases to maximum post-impact velocity, and then begins to fall again as gravity works against it, slowing it down. The ball's velocity returns to 0 m/s when the ball is at its *apex*, or highest vertical point, post impact.

When a ball bounces, it deforms and become flatter. This is called *elasticity*. The more *elasticity* a material has, the better it is able to act like a spring and absorb force by being compressed, then use this force to "spring" back into the air. Post-impact velocity and the amount of time between velocity of 0 m/s at impact and velocity of 0 m/s at post-impact apex are affected by elasticity. Figure 2 shows the velocity of a ball versus time for balls with various elasticity and weight dropped from 1 meter height. Because gravity causes all objects to fall at the same speed regardless of weight, pre-impact velocities are identical for all balls.

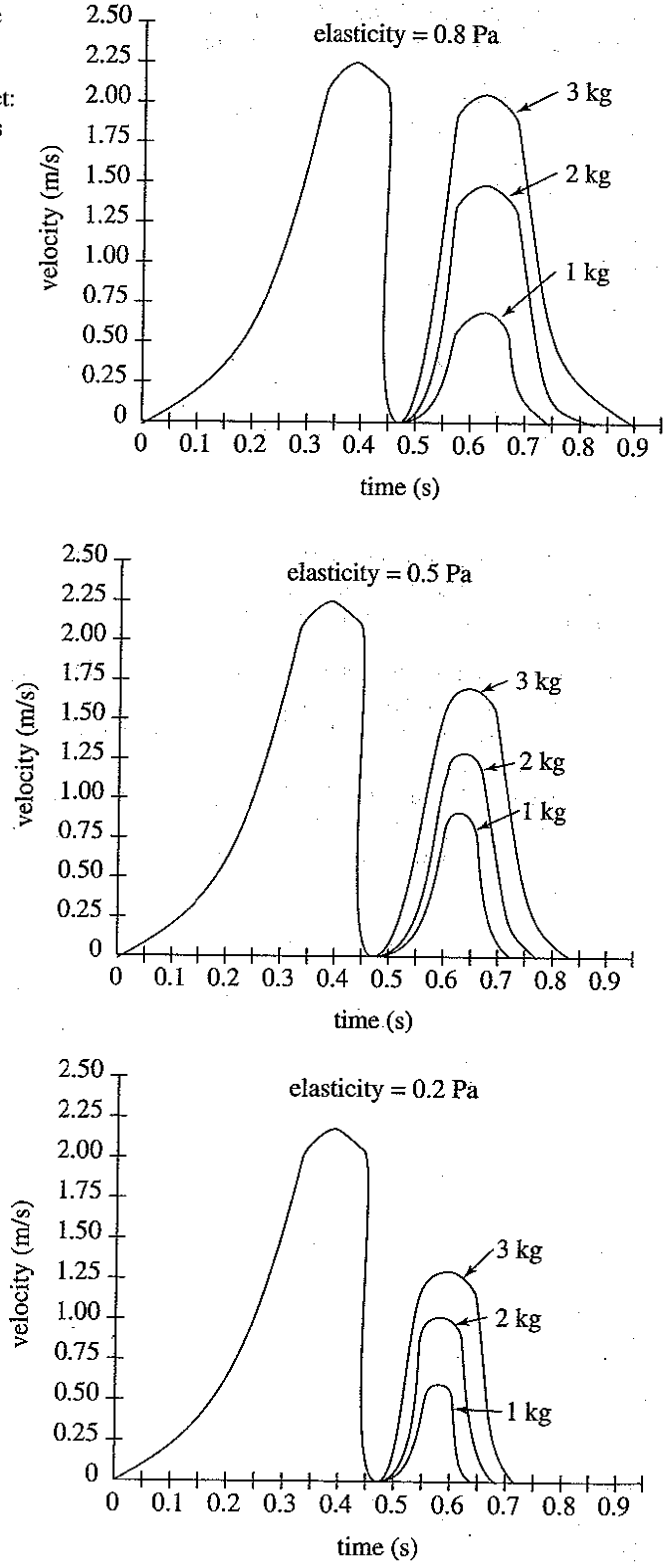


Figure 2

36. Based on data in Figure 2, the maximum post-impact velocity of a ball will be highest if the elasticity of the ball is:

F. between 1 and 1.5 Pa
G. between 0.5 and 0.8 Pa
H. 0.5 Pa
J. less than 0.5 Pa

37. Based on the information in Figure 2, a ball being dropped from 1 meter height with an elasticity of 0.5 Pa and a weight of 1.5 kg would have a maximum post-impact velocity of:

A. less than 1.25 m/s.
B. between 0.75 and 1.25 m/s.
C. between 1.25 and 2.00 m/s.
D. greater than 2.00 m/s.

38. Consider a ball as it completes one bounce, from drop to post-impact apex. If this ball has a weight of 1 kg and an elasticity of 0.80 Pa, based on the data in Figure 2, how many times does the ball have a velocity of 1.00 m/s?

F. One time
G. Two times
H. Three times
J. Four times

39. Based on the data in Figure 2, how does the velocity of a ball change as it goes from impact to apex?

	Impact to Apex	**Drop to Impact**
A.	Increases only	Increases only
B.	Decreases only	Increases then decreases
C.	Decreases then increases	Increases only
D.	Increase then decreases	Increases then decreases

40. A ball will deform permanently and not spring back off the ground if the velocity with which it hits the ground exceeds the ball's elastic limit. Based on the data in Figure 2, if a ball is dropped from one meter and has a weight of 2 kg, an elasticity of 0.2 Pa, and an elastic limit of 0.75 m/s, will the ball deform permanently?

F. Yes, because the velocity with which the ball hits the ground is less than its elastic limit.
G. Yes, because the velocity with which the ball hits the ground is greater than its elastic limit.
H. No, because the velocity with which the ball hits the ground is less than its elastic limit.
J. No, because the velocity with which the ball hits the ground is greater than its elastic limit.

Please write your answers below and turn in this assignment:

36) _____ 37) _____ 38) _____ 39) _____ 40) _____

Appendix C6- ACT Score Conversion Chart

Hour _____ Date _____ Name _____

How the ACT Science score works

Raw Score	Scaled Score (ACT Score)	Percent Correct
38-40	36	+95%
37	35	93%
36	34	90%
35	33	88%
34	32	85%
33	31	83%
32	30	80%
31	29	78%
30	28	75%
29	27	73%
28	26	70%
26-27	25	65-69%
24-25	24	60-64%
23	**23**	**58%**
21-22	22	53-57%
20	21	50%
18-19	20	45-49%
16-17	19	40-44%
15	18	38%
14	17	35%
13	16	33%
12	15	30%
11	14	28%
10	13	25%
9	12	23%
8	11	20%
7	10	18%
5-6	9	13-17%
4	8 or 7	10%

Average ACT Composite required for U of M

Average ACT Composite required for MSU

Average ACT Composite required for Grand Valley

Michigan Science Cut Score

Average ACT Composite required for Western Mi or Central Mi

Average ACT Composite required for Eastern Mi

LCC- depending on your score it could allow you to waive lower level classes (SAVES YOU LOTS OF MONEY!)

Appendix C7- Student Survey

ACT Science Survey

This survey is anonymous and for Ms. Hamilton's own personal interest. Please respond with completely honest answers.

1) What part(s) of this class helped you the most? Why?

2) What part(s) of this class helped you the least? Why?

3) Do you feel more comfortable with the science portion of the ACT? Why or why not?

4) Would you recommend this class to a friend? Why or why not?

5) How effective was Ms. Hamilton at explaining how to find the answers to the questions on the practice ACT passages?

6) If you could change anything about this class what would you change and why?

7) After having been in the science rotation and learning about the ACT would you have agreed to take this class? Why or why not?

If you have any other additional comments or ideas you'd like to share with Ms. Hamilton please write them on the back of this paper.