



ACT Science Homework
Science 1, Set 1
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

Pill bugs, also known as potato bugs or roly pollys, are small isopods. In order to study the environmental preferences of these small animals, researchers placed 20 pill bugs in a device that has two petri dishes connected by a small bridge (shown in Figure 1). They then tested the bugs' preference by placing two different conditions on each side of the container and recording the number of bugs on each side at 2 minute intervals for 10 minutes.

Figure 1:

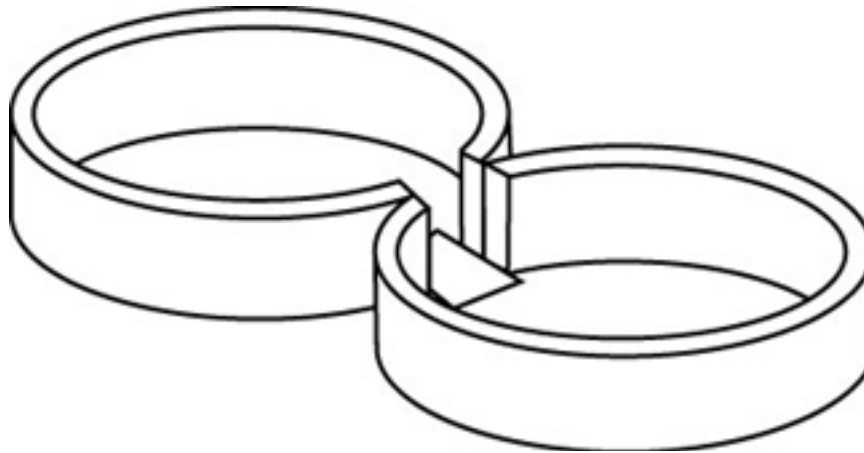


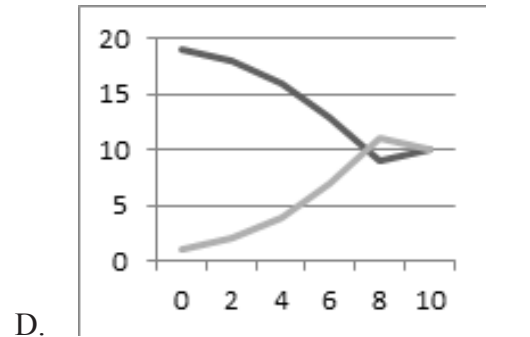
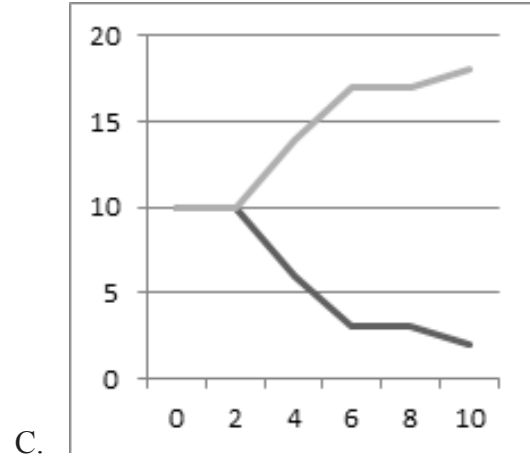
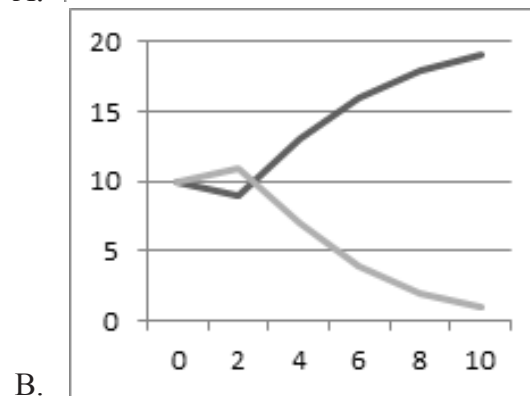
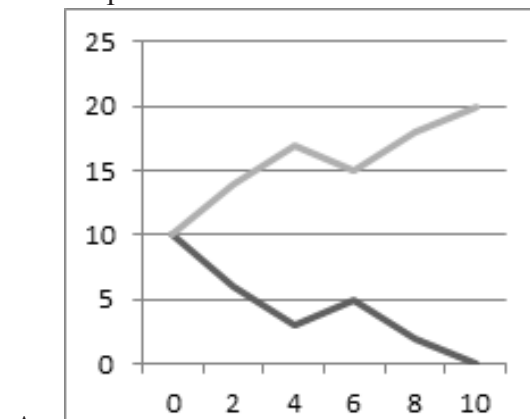
Table 1:

Time(Minutes)	Amount of Light		pH		Surface Texture	
	Light	Dark	Neutral	Acidic	Smooth	Rough
0	10	10	10	10	10	10
2	6	14	9	11	10	10
4	3	17	13	7	6	14
6	5	15	16	4	3	17
8	2	18	18	2	3	17
10	0	20	19	1	2	18



- Based on the data, in what type of environment would you most likely find pill bugs?
 - Smooth surface, limited light, neutral pH
 - Smooth surface, light, neutral pH
 - Rough surface, limited light, neutral pH
 - Rough surface, limited light, acidic
- Based on the data provided, if the experiment testing time had continued beyond 10 minutes, one would expect that:
 - the pill bugs on the acidic and smooth sides at 10 minutes would move to the neutral and rough sides, respectively.
 - some of the pill bugs on the neutral and rough sides at 10 minutes would move to the acidic and smooth sides, respectively.
 - some of the pill bugs on the dark and neutral sides at 10 minutes would move to the light and acidic sides, respectively.
 - some of the pill bugs on the dark and rough sides at 10 minutes would move to the light and smooth sides, respectively.
- The gall midge is a small insect that is found in bright areas with acidic soil. Would you expect to find pill bugs in the same environment as gall midges?
 - No, because pill bugs prefer dark areas
 - No, because pill bugs prefer areas with rough surfaces
 - Yes, because pill bugs prefer light areas
 - Yes, because pill bugs prefer acidic areas
- According to the data, to which environmental change did the pill bugs most quickly react?
 - Texture of surface
 - pH of surface
 - Amount of light
 - Cannot be determined from the data

- Which of the following best represents the data for the pH of the surface?



**Passage II**

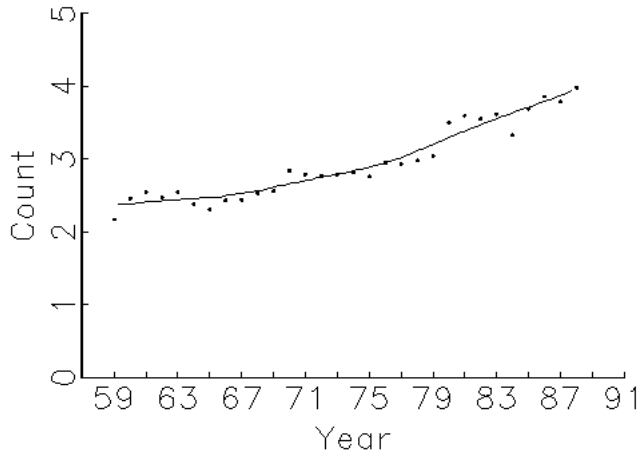
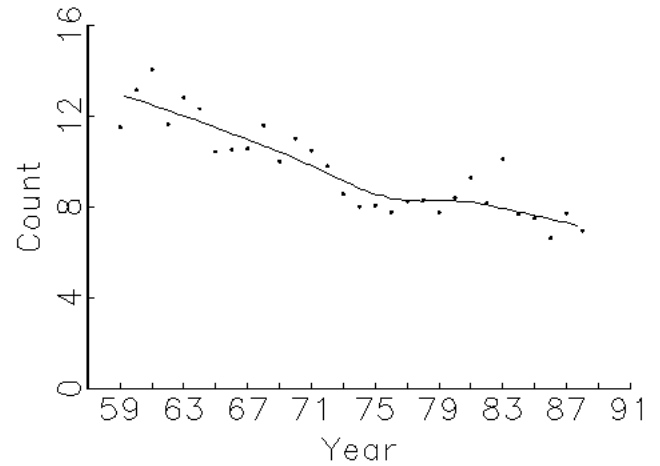
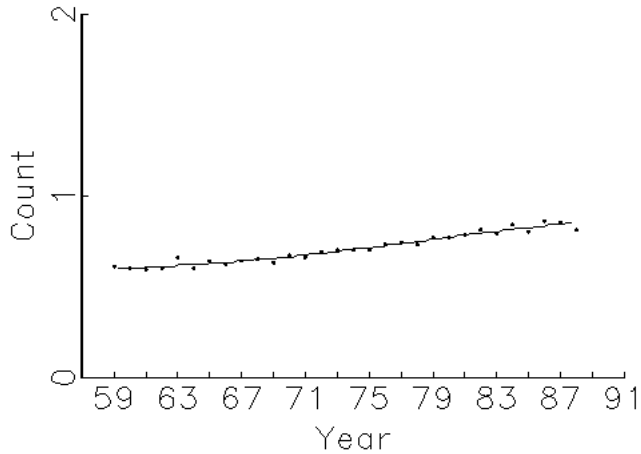
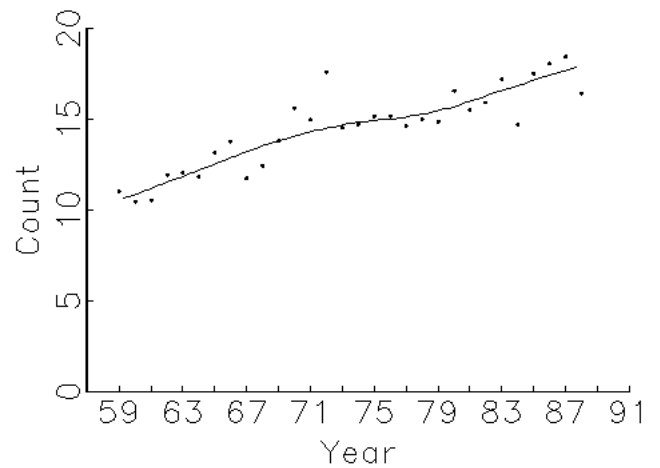
When the pressure of a gas (measured in torr) is changed, the volume also changes. The pressure and volume also change with temperature and the amount of gas, as shown in the table below.

Mass (in grams)	Pressure (in torr)	Temperature (in Kelvin)	Volume (in L)
36.04	750	25	5
36.04	1650	55	5
36.04	2250	75	5
36.04	300	10	5
36.04	1000	25	3.75
36.04	312.5	25	12
36.04	375	25	10
72.08	1125	25	5
72.08	750	25	10

6. How does the pressure change when the volume changes?
- F. Pressure goes down when volume goes down.
G. Pressure goes down when volume goes up.
H. Pressure goes up when volume goes up.
J. Pressure and volume are not related.
7. How does temperature change when pressure is changed?
- A. When temperature goes down the pressure increases.
B. When temperature goes up the pressure increases.
C. When temperature goes down the pressure stays the same.
D. When temperature goes up the pressure decreases.
8. What would happen to pressure if temperature and volume were doubled?
- F. The pressure would increase.
G. The pressure would decrease.
H. It is impossible to tell.
J. The pressure would stay the same.
9. What is the mass (in grams) of a gas that has a pressure of 1125 torr, a temperature of 25 K, and a volume of 5 L?
- A. 36.04
B. 144.16
C. 18.02
D. 72.08
10. What would be the approximate pressure (in torr) of a gas with a mass of 36.04 grams, a temperature of 40 K, and a volume of 5 L?
- F. 1200
G. 525
H. 1950
J. 700

**Passage III**

Every year, since 1959, people participate in the Christmas Bird Count, an annual count of birds, looking at both population diversity and abundance.

Buteo jamaicensis (Red-tailed hawk)*Phasianus colchicus* (Ring-necked pheasant)*Bubo virginianus* (Great horned owl)*Cyanocitta cristata* (Blue jay)



11. How many *Phasianus colchicus* would you expect to see in 1993?
- A. 7
 - B. 10
 - C. 12
 - D. 15
12. Which species had the greatest population change in the 1970's?
- F. *Cyanocitta cristata*
 - G. *Bubo virginianus*
 - H. *Phasianus colchicus*
 - J. *Buteo jamaicensis*
13. Which species has the most stable population?
- A. *Phasianus colchicus*
 - B. *Bubo virginianus*
 - C. *Buteo jamaicensis*
 - D. *Cyanocitta cristata*
14. Which set of years saw the greatest change in the number of *Buteo jamaicensis* counted?
- F. 1980-1981
 - G. 1966-1967
 - H. 1977-1978
 - J. 1972-1973
15. Which of the species is the most common?
- A. *Bubo virginianus*
 - B. *Phasianus colchicus*
 - C. *Buteo jamaicensis*
 - D. *Cyanocitta cristata*

Passage IV

A study was performed at a hatchery to observe the different stages of a frog's life cycle. Three different frog species were compared. Eggs were fertilized and then placed in water baths in order to replicate conditions found in nature. The results of this study are summarized in the table below.

Stage	Age			Size mm	Characteristics of Stage
	Spadefoot Frog (<i>Pelobates fuscus</i>)	Common Frog (<i>Rana temporaria</i>)	Cane Frog (<i>Bufo marinus</i>)		

Tadpole					
1	-----	-----	-----	-----	Egg is fertilized
2	12-15 hours	8-10 hours	9-10 hours	-----	2 cells (yolk splits)
3	20-22 hours	16 hours	17-18 hours	-----	16 cells
4	30 hours	18-20 hours	24 hours	-----	32 cells
5	21 days	6 days	15 days	1.5	Egg hatches
6	22-23 days	7-10 days	19-20 days	1.7	Totally aquatic; eats algae; has external gills; lacks teeth
7	32-35 days	13-16 days	22-24 days	2.2	Begins to swim
8	7 weeks	5 weeks	6 weeks	6.3	Lungs begin to develop
9	11 weeks	6.5 weeks	7 weeks	10.7	Internal organs develop, skin grows over gills; tail grows

Metamorphosis of Tadpole to Froglet					
10	7 months	7-9 weeks	10-12 weeks	12.9	Hind legs begin to grow; tail starts to disappear
11	8 months	3 months	4 months	16.5	Front legs begin to grow; tail almost gone
12	8.5 months	3.8 months	4.6 months	20.0	Begins to swim to surface; breath air
13	10 months	5.2 months	6 months	23.0	Capable of living on land or in water

Adult Frog					
14	11.5 months	6 months	7.2 months	28.1	Eats arthropods and gastropods
15	1.3 years	9 months	9.5 months	35.5	Looks like miniature version of adult
16	2 years	11 months	1 year	62.0	Full size, may eat insects
17	3.1 years	1.4 years	2 years	62.0	Starts to reproduce & have offspring
18	5+ years	4+ years	3.5+ years	62.0	Death



16. A scientist scoops out a small net full of pre-adult frogs. She measures and records their lengths. If the average length is 10.2 mm, in which stage of development must the frog be?
- F. Stage 6
 - G. Stage 13
 - H. Stage 9
 - J. Stage 15
17. Based on the data provided, determine which of the following statements is true.
- A. All of the species need at least 2 years before they can reproduce.
 - B. The spadefoot frog reaches full size before the cane frog.
 - C. The lungs start to develop before the external gills.
 - D. *Pelobates fuscus* begins to swim after *Rana temporaria*.
18. Some species of frogs may not go through the metamorphosis phase until spring. If the eggs of all three of these observed species hatched in October, which of the following species must remain in the tadpole phase through winter?
- F. *Pelobates fuscus* and *Bufo marinus*
 - G. *Rana temporaria*
 - H. *Bufo marinus*
 - J. *Pelobates fuscus*
19. Which of the following characteristics does the common frog start to exhibit at 15 weeks?
- A. Swims to the surface and breaths air
 - B. Lungs begin to develop
 - C. Starts living on land
 - D. Begins to reproduce
20. During which phase(s) of the life cycle could the frog be considered more of an herbivore rather than an omnivore or carnivore?
- F. Tadpole and adult
 - G. Tadpole
 - H. Froglet and adult
 - J. Adult



Passage V

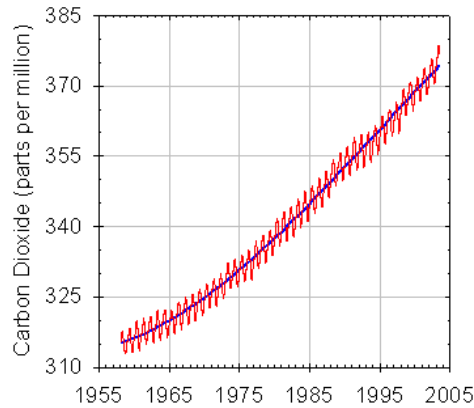
The amount of hydrocarbons in the atmosphere is increasing every year.

Caretakers of the Holy Grail of Environmental Science

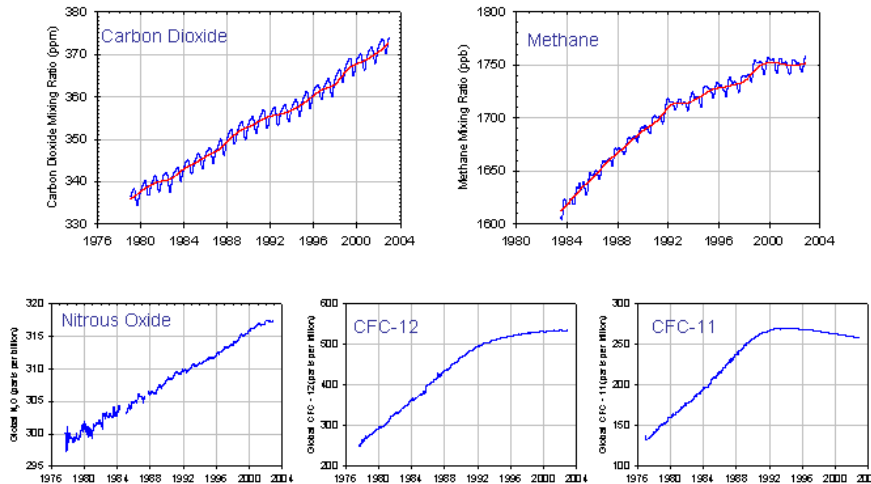
The Mauna Loa CO₂ Record

1958 Measurements of carbon dioxide began on top of the Mauna Loa volcano in Hawaii by Dave Keeling (Scripps Inst.) with the support of pre-NOAA (U.S. Weather Bureau) employees.

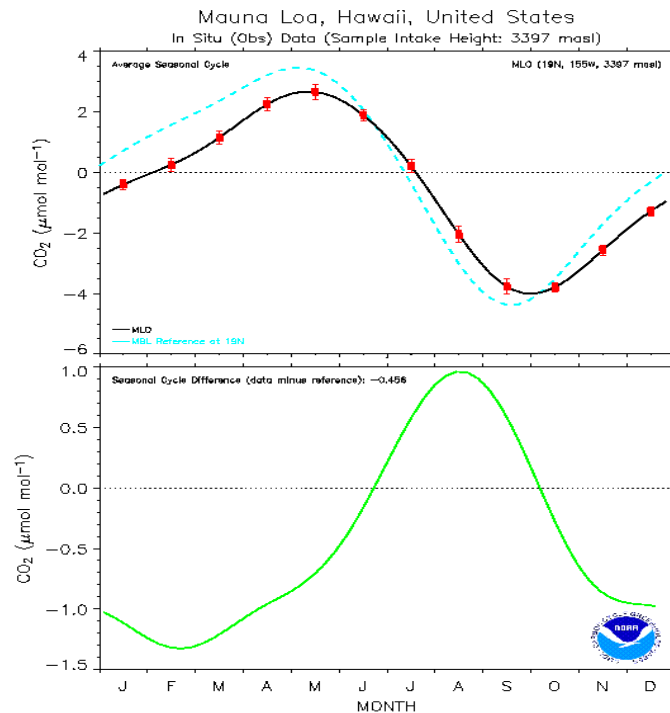
1970 NOAA Created. In 1973, four new Baseline Climate Observatories established at Barrow, Alaska; Mauna Loa, Hawaii; American Samoa; and South Pole, Antarctica



Global Trends in Major Greenhouse Gases to 1/2003



Global trends in major long-lived greenhouse gases through the year 2002. These five gases account for about 97% of the direct climate forcing by long-lived greenhouse gas increases since 1750. The remaining 3% is contributed by an assortment of 10 minor halogen gases, mainly HCFC-22, CFC-113 and CCl₄.



The top graph shows the seasonal pattern of the amount of CO₂ in the atmosphere while the bottom graph shows the monthly difference between what is expected and what actually happened

http://www.cmdl.noaa.gov/gallery/cmdl_overview_source_material

21. Which greenhouse gas is increasing the most quickly?
 - A. CFC-11
 - B. Nitrous oxide
 - C. Methane
 - D. Carbon dioxide
22. What is a possible reason why some of the gases have leveled off or even decreased their amounts in the atmosphere?
 - F. The amount of gas released into the atmosphere has decreased.
 - G. Industry is able to create more of these gases.
 - H. They have all been converted into carbon dioxide.
 - J. These gases have been released into space.
23. How much has the amount of carbon dioxide increased from 1955-2004?
 - A. 10 %
 - B. 15%
 - C. 20%
 - D. 50%
24. Which gases are showing stagnation or waning?
 - F. CFC-12, CFC-11, methane
 - G. CFC-12, methane, nitrous oxide
 - H. CFC-12, CFC-11, carbon dioxide
 - J. CFC-11, methane, nitrous oxide
25. When is the difference greatest between what is expected and the actual?
 - A. July
 - B. August
 - C. May
 - D. September
26. In the average seasonal cycle of carbon dioxide, which season is the low point?
 - F. Winter
 - G. Summer
 - H. Autumn
 - J. Spring



Passage VI

The coast of much of America can be considered vulnerable to a rise in sea level. There are several factors that go into the ranking of vulnerability for a coastline. They are the geology of a coastline, where rocky cliffs are the most stable and sand beaches are the least stable; the coastal slope, a measure of the how fast the land rises from the coast, where the greater the incline the less vulnerable; shoreline erosion, measured in meters/year, where the greater the measure, the more vulnerable; and the mean wave height, where the greater the wave height the more vulnerable.

Site	Geology	Coastal Slope	Shoreline Erosion	Mean wave height
Long Island	Rocky Cliffs	Steep (1%)	-1.75 m/y	.045 m
Baltimore	Sandy Beaches	Gradual (.03%)	-1.55 m/y	1.0 m
Cape Canaveral	Sandy Beaches	Gradual (.04%)	-1.65 m/y	.65 m
Key West	Sandy Beaches	Gradual (.02%)	-2.1 m/y	1.1 m

27. Which of the sites would be the least vulnerable to a rise in sea level?
- Long Island
 - Baltimore
 - Cape Canaveral
 - Key West
28. Why does an increased mean wave height increase the vulnerability of the coastline?
- The extra amount of water added to the coast will lift the level of the sea.
 - The extra amount of water added to the coast will lower the level of the sea.
 - The energy of the wave adds more material to the shore.
 - The energy of the wave takes more material from the shore.
29. If a large hurricane were to generate greater erosion, which site would be most at risk?
- Key West
 - Cape Canaveral
 - Long Island
 - Baltimore
30. The impact of man is felt along the coastline, through building and destruction of marine habitats. An area with sandy beaches is more likely to have a large marine habitat. Which of the following proposed projects would have the least amount of impact on coastal vulnerability?
- Building barriers for the ocean off the coast of Baltimore
 - Harvesting scallops off the ocean floor near the coast of Long Island
 - Dredging the ocean bottom off the coast of Cape Canaveral
 - Building a floating resort near Key West.
31. Which of the following is the most vulnerable to a rise in sea level?
- Baltimore
 - Cape Canaveral
 - Long Island
 - Key West

Passage VII

The periodic table of the elements lists all of the naturally occurring elements and organizes them according to their number of protons, which is called the atomic number. The table also includes each element's average atomic mass. Elements are organized by general similarities: columns are called groups and rows are called periods.

Periodic Table of the Elements

Key																	
1 H Hydrogen 1.01											2 He Helium 4.00						
3 Li Lithium 6.94	4 Be Beryllium 9.01											5 B Boron 10.81	6 C Carbon 12.01	7 N Nitrogen 14.01	8 O Oxygen 16.00	9 F Fluorine 19.00	10 Ne Neon 20.18
11 Na Sodium 22.99	12 Mg Magnesium 24.31											13 Al Aluminum 26.98	14 Si Silicon 28.09	15 P Phosphorus 30.97	16 S Sulfur 32.07	17 Cl Chlorine 35.45	18 Ar Argon 39.95
19 K Potassium 39.10	20 Ca Calcium 40.08	21 Sc Scandium 44.96	22 Ti Titanium 50.94	23 V Vanadium 52.00	24 Cr Chromium 54.94	25 Mn Manganese 55.95	26 Fe Iron 55.85	27 Co Cobalt 58.93	28 Ni Nickel 58.69	29 Cu Copper 63.55	30 Zn Zinc 65.39	31 Ga Gallium 69.72	32 Ge Germanium 72.61	33 As Arsenic 74.92	34 Se Selenium 78.96	35 Br Bromine 79.90	36 Kr Krypton 83.80
37 Rb Rubidium 85.47	38 Sr Strontium 87.62	39 Y Yttrium 88.91	40 Zr Zirconium 91.22	41 Nb Niobium 92.91	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.90	54 Xe Xenon 131.29
55 Cs Caesium 132.91	56 Ba Barium 137.33	57 La Lutetium 138.91	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (269)	109 Mt Meitnerium (268)	110 Uun Ununilium (271)	111 Uuu Unununium (272)	112 Uub Ununbium (277)						

* If this number is in parentheses, then it refers to the atomic mass of the most stable isotope.

58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.5	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.05	71 Lu Lutetium 174.97
90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)



32. Which of the following elements has an average atomic mass of approximately 64?
- F. Beryllium (Be)
G. Copper (Cu)
H. Gadolinium (Gd)
J. Zinc (Zn)
33. All of the following belong to the same group EXCEPT:
- A. Gallium (Ga).
B. Silicon (Si).
C. Aluminum (Al).
D. Thallium (Tl).
34. The atomic mass of the most stable isotope of radon (Rn) is:
- F. 222.
G. 86.
H. 103.
J. 85.
35. The bold line toward the right side of the periodic table divides metals (to the left of the line) from non-metals (to the right of the line). Given that most chemical compounds are formed by reactions between metals and non-metals, which of the following pairs would be most likely to react?
- A. Titanium (Ti) and calcium (Ca)
B. Chlorine (Cl) and zinc (Zn)
C. Nitrogen (N) and oxygen (O)
D. Radon (Rn) and xenon (Xe)
36. The size of an atom is determined by its atomic radius, which is the distance between its nucleus and its valence electrons. On the periodic table, atomic radius increases moving down a group and decreases moving from left to right across a period. Which of the following elements has the lowest atomic radius?
- F. Fluorine (F)
G. Barium (Ba)
H. Iodine (I)
J. Lithium (Li)

Passage VIII

Scientists look at the factors that make bacteria grow quickly and slowly in order to prepare conditions that will inhibit bacterial growth. Temperature is one of the variables that affect the growth rate of bacteria. The rate of growth is determined by how long it takes for a set of bacteria to double, forming a new generation.

Bacteria type	Time (in minutes) for one generation to form at 10 C	Time (in minutes) for one generation to form at 37 C	Time (in minutes) for one generation to form at 50 C	Time (in minutes) for one generation to form at 75 C
<i>Listeria monocytogenes</i>	98	52	5443208	10265132
<i>Staphylococcus aureus</i>	154	26	6158492	16523546
<i>Escherichia coli</i>	111	17	5132842	16512385
<i>Thermus aquaticus</i>	7515435	85873	943	75
<i>Streptococcus pyogenes</i>	1686	27	9135852	17349621
<i>Streptococcus pneumoniae</i>	18652	35	8732150	17594632
<i>Pyrobacterium brockii</i>	71398165	5570324	254310	13524



37. What approximately is the optimal temperature for *Pyrobacterium Brockii* to complete one generation of reproduction?
- A. 75
 - B. 30
 - C. 115
 - D. 50
38. Bacteria are classified by which their optimal temperature for reproduction. Which of the following bacteria would be a correct grouping?
- F. *Streptococcus pyogenes*, *Listeria monocytogenes*, *Pyrobacterium Brockii*
 - G. *Staphylococcus aureus*, *Escherichia coli*, *Streptococcus pyogenes*
 - H. *Pyrobacterium Brockii*, *Thermus aquaticus*, *Escherichia coli*
 - J. *Staphylococcus aureus*, *Listeria monocytogenes*, *Thermus aquaticus*
39. Which of the following would be a good strategy to inhibit the growth of *Escherichia coli*?
- A. Store it at 10 C
 - B. Store it at 50 C
 - C. Store it at 25 C
 - D. Store it at 37 C
40. What is the optimal temperature for the growth of *Listeria monocytogenes*?
- F. 75 C
 - G. 50 C
 - H. 10 C
 - J. 37 C