

# SCIENCE



## FORMULA CHART

Density = $\frac{\text{mass}}{\text{volume}}$	$D = \frac{m}{v}$
$\left( \begin{array}{c} \text{heat gained} \\ \text{or lost} \end{array} \right) = \left( \begin{array}{c} \text{mass in} \\ \text{grams} \end{array} \right) \left( \begin{array}{c} \text{change in} \\ \text{temperature} \end{array} \right) \left( \begin{array}{c} \text{specific} \\ \text{heat} \end{array} \right)$	$Q = (m)(\Delta T)(C_p)$
Speed = $\frac{\text{distance traveled}}{\text{time}}$	$v = \frac{d}{t}$
Acceleration = $\frac{\text{final velocity} - \text{initial velocity}}{\text{change in time}}$	$a = \frac{v_f - v_i}{\Delta t}$
Momentum = mass $\times$ velocity	$p = mv$
Force = mass $\times$ acceleration	$F = ma$
Work = force $\times$ distance	$W = Fd$
Power = $\frac{\text{work}}{\text{time}}$	$P = \frac{W}{t}$
% efficiency = $\frac{\text{work output}}{\text{work input}} \times 100$	$\% = \frac{W_o}{W_i} \times 100$
Kinetic energy = $\frac{1}{2}(\text{mass} \times \text{velocity}^2)$	$KE = \frac{mv^2}{2}$
Gravitational potential energy = mass $\times$ acceleration due to gravity $\times$ height	$PE = mgh$
Energy = mass $\times$ (speed of light) <sup>2</sup>	$E = mc^2$
Velocity of a wave = frequency $\times$ wavelength	$v = f\lambda$
Current = $\frac{\text{voltage}}{\text{resistance}}$	$I = \frac{V}{R}$
Electrical power = voltage $\times$ current	$P = VI$
Electrical energy = power $\times$ time	$E = Pt$

<b>Constants/Conversions</b>		
$g = \text{acceleration due to gravity} = 9.8 \text{ m/s}^2$		
$c = \text{speed of light} = 3 \times 10^8 \text{ m/s}$		
speed of sound = 343 m/s at sea level and 20°C		
$1 \text{ cm}^3 = 1 \text{ mL}$		
1 wave cycle/second = 1 hertz (Hz)		
1 calorie (cal) = 4.18 joules		
1000 calories (cal) = 1 Calorie (Cal) = 1 kilocalorie (kcal)		
newton (N) = $\text{kgm/s}^2$		
joule (J) = Nm		
watt (W) = J/s = Nm/s		
volt (V)	ampere (A)	ohm ( $\Omega$ )





**DIRECTIONS**

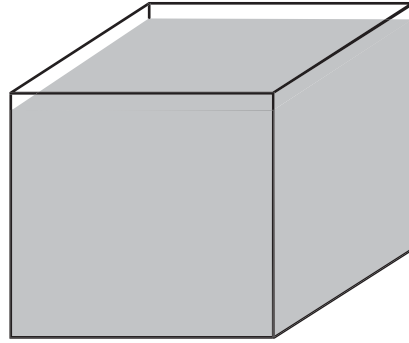
Read each question and choose the best answer. Then fill in the correct answer on your answer document.

**SAMPLE A**

When a 10% hydrochloric acid solution is heated in an open test tube, the test tube should always be pointed —

- A so bubbles are visible
- B at a 180° angle from the flame
- C toward a ventilated area
- D away from nearby people

**SAMPLE B**



Mass = 40 g

Volume = 20 mL

The picture shows a cube that contains 20 mL of a solution. The solution has a mass of 40 grams. What is the density in g/mL of this solution? Record and bubble in your answer on the answer document.



## Adult Onset Diabetes?

**Here's something better than  
your present diabetes pill!**

Glycotac has been proved to lower blood sugar more than other leading brands of medication.

When dieting and exercise don't lower your blood sugar enough, adding Glycotac may help. You may even be able to take less medication to control your blood sugar.

**Important Information:**

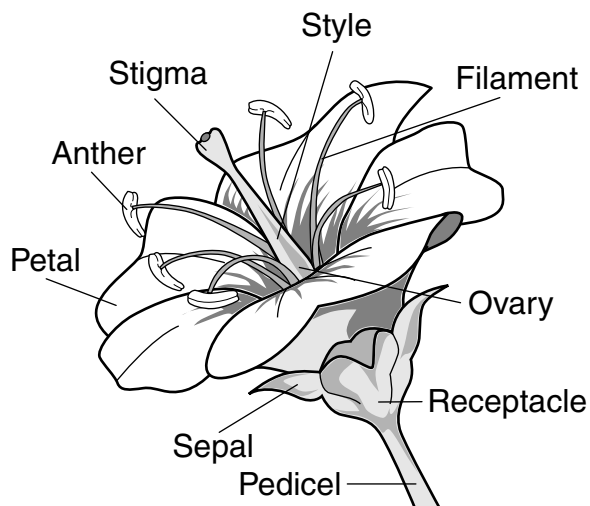
Glycotac is not for everybody. If you have kidney problems, in rare cases Glycotac may cause abnormally low blood pH and may even cause death. Avoid taking this drug if you are 75 or older, are taking medication for heart disease, or have a severe infection.

**Ask your doctor about new Glycotac and whether it may be right for you. Live life to the fullest.**

**For more information, call 1-877-555-7777.**

- 1 Which conclusion can reasonably be made about Glycotac based on the promotional brochure?
- A All people with diabetes can safely use the product.
  - B Glycotac is guaranteed to lower blood sugar in people without health problems.
  - C Using the product may lower blood-sugar levels.
  - D Glycotac eliminates the need to exercise to control high blood sugar.

- 2 Species of the genus *Toxicodendron*, which includes poison ivy and poison oak, produce a gummy oil that causes a severe itchy rash in some animals. This substance is part of the *Toxicodendron* species' —
- F defense mechanisms
  - G nutritional processes
  - H support system
  - J clinging ability



- 3 The diagram illustrates the parts of this flower. Which of these parts are not directly involved in sexual reproduction?
- A Stigma and style
  - B Sepal and pedicel
  - C Anther and filament
  - D Receptacle and ovary

Students placed equal amounts of bread mold on 12 identical agar plates containing the same amounts and types of nutrients. Four plates were kept at 0°C, four were kept at 45°C, and four were kept at 22°C (room temperature). The plates were examined after five days.

- 4 Which of the following was probably the hypothesis for this experiment?
- F The growth of bread mold increases as temperature increases.
  - G The type of nutrient causes bread mold to grow faster at higher temperatures.
  - H The size of the plates determines the temperature of bread mold.
  - J The temperature of bread mold is determined by the mold's growth.

### Spring Stretch

Force (N)	$\Delta L$ (cm)
0.98	3.5
1.96	7.0
2.94	10.5

- 5 According to the data in the table, about how far can a spring be expected to stretch when a force of 3.92 N is applied?
- A 10.5 cm
  - B 13.6 cm
  - C 14.0 cm
  - D 17.3 cm

Use the information below and your knowledge of science to answer questions 6–8.

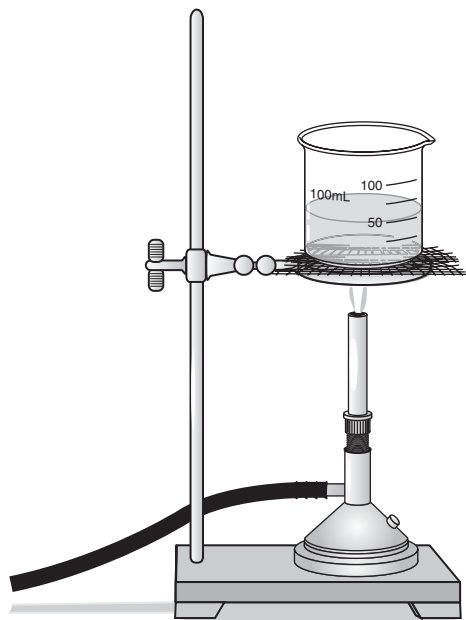
## Moon Chemistry

Samples collected by Apollo astronauts have provided new data about the moon. Some of these samples consisted of lunar soil, a fine-grained, sand-like material produced as a result of the destruction of moon rocks. Traces of beryllium-10 were found in the samples. Beryllium-10 is carried by the solar wind, which transports elements from the sun's surface and deposits them on the moon.

The solar wind may also result in the formation of new substances. Tiny teardrops of iron and specks of molybdenum were found inside the particles of lunar soil. This is interesting because these elements have not been found in an uncombined state on Earth. The metal oxides they originally were part of were possibly changed when bombarded by the positively charged particles of the solar wind.

Another interesting find was tiny (1 to 3 micrometers in length) crystals of silver sulfide. Because similar particles are found on Earth, it has been hypothesized that these crystals were created at a time when the moon had a molten core.

- 6** Which procedure is best to use when determining the density of a rock?
- F** Place the rock in a water-filled beaker and find the height at which the rock floats above the water.
  - G** Use a ruler to measure the rock's dimensions and then find its mass using an analytical balance.
  - H** Measure the mass of the rock on a balance and then find the volume of water it displaces in a graduated cylinder.
  - J** Place the rock in three liquids with different known densities and observe which liquid the rock floats in.
- 7** Which process in the rock cycle is most likely responsible for moon rocks being converted to lunar soil?
- A** Metamorphism
  - B** Weathering
  - C** Sedimentation
  - D** Volcanism
- 8** The moon's surface becomes hot during the long lunar day because the sun transfers heat to the moon. This heat transfer is accomplished almost entirely through the process of —
- F** convection
  - G** refraction
  - H** conduction
  - J** radiation



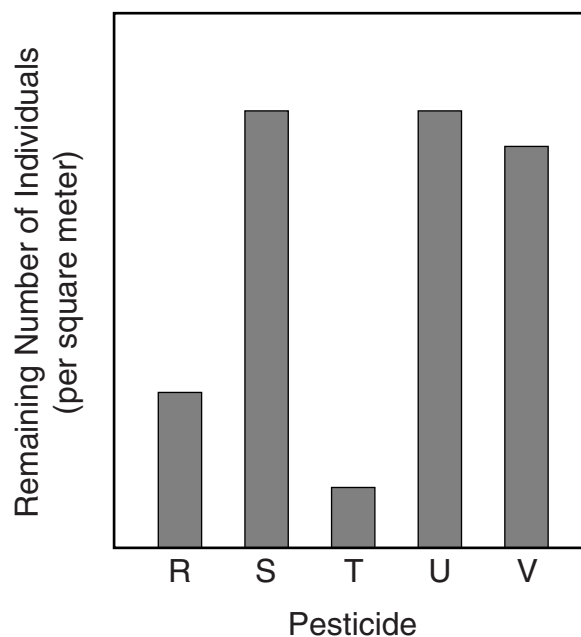
9 All of these procedures must be followed when using the setup shown above except —

- A putting on safety goggles
- B handling the beaker with tongs
- C securing loose clothing
- D wearing rubber gloves

10 Elements in Group 16 of the periodic table usually —

- F form large molecules
- G gain electrons when bonding
- H act like metals
- J solidify at room temperature

Effects of Pesticides

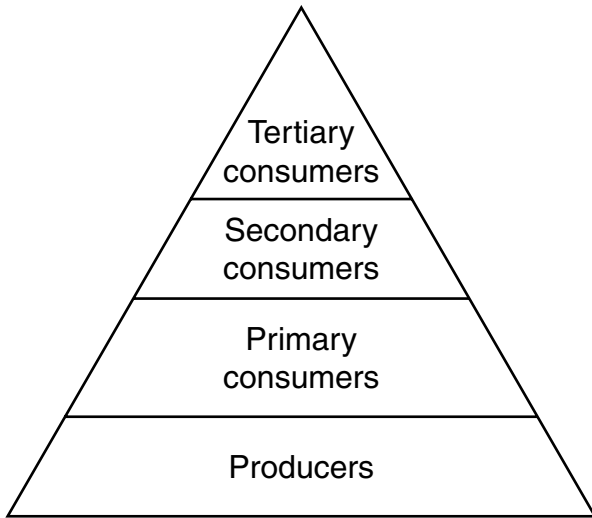


11 The graph shows the results of a study testing chemical pesticides on a pest species common to cotton plants. Different chemical pesticides were used in five different areas. According to these results, which of the following is the most effective chemical for controlling this pest species?

- A R
- B S
- C T
- D V

12 Which of the following is an example of solar energy being converted into chemical energy?

- F Plants producing sugar during the day
- G Water evaporating and condensing in the water cycle
- H The sun unevenly heating Earth's surface
- J Lava erupting from volcanoes for many days



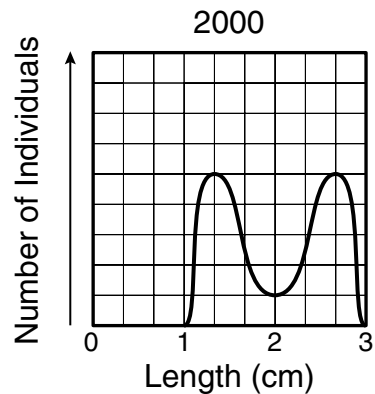
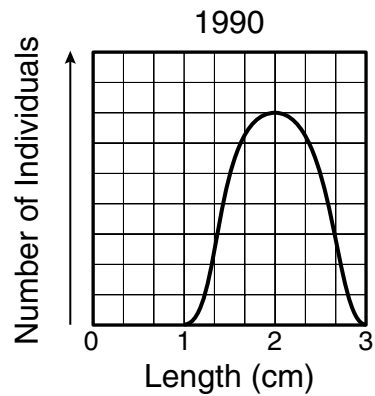
13 In this food pyramid, which level contains the greatest amount of energy?

- A Tertiary consumers
- B Secondary consumers
- C Primary consumers
- D Producers

14 Which of the following factors helps spread disease-causing bacteria?

- F Low temperatures
- G Access to new hosts
- H Mutation by heat energy
- J Availability of light

### Body Length of Mosquitoes in a Specific Area



15 Which of these conclusions can be made based on the graphs shown above?

- A Larger mosquitoes have migrated into the area.
- B Smaller mosquitoes are being eaten by larger mosquitoes.
- C A mosquito length of 2 cm has become a disadvantage in this environment.
- D Mosquitoes with a body length of 3 cm have the longest life span.

Habitat	Productivity (g/m <sup>2</sup> /yr)	Bird Diversity (average number of species/km <sup>2</sup> )
Marsh	2000	14
Grassland	500	12
Shrub land	600	8
Desert	70	3
Coniferous forest	800	17
Upland deciduous forest	1000	21
Floodplain deciduous forest	2000	24

16 Which question could be formed based on these data?

- F What types of plants have increased productivity in different habitats?
- G Is there a relationship between productivity and bird diversity in a habitat?
- H How does the number of birds in a population affect habitats?
- J Do habitats display changes in productivity and bird diversity during different seasons?

17 Which situation best represents a mutualistic relationship?

- A A tapeworm absorbing nutrients from the intestine of a dog
- B An orchid being pollinated by a nectar-collecting wasp
- C A human losing blood to a feeding mosquito
- D An armadillo rooting in the soil at the base of an oak tree

18 Why are photosynthesis and cellular respiration often considered opposites?

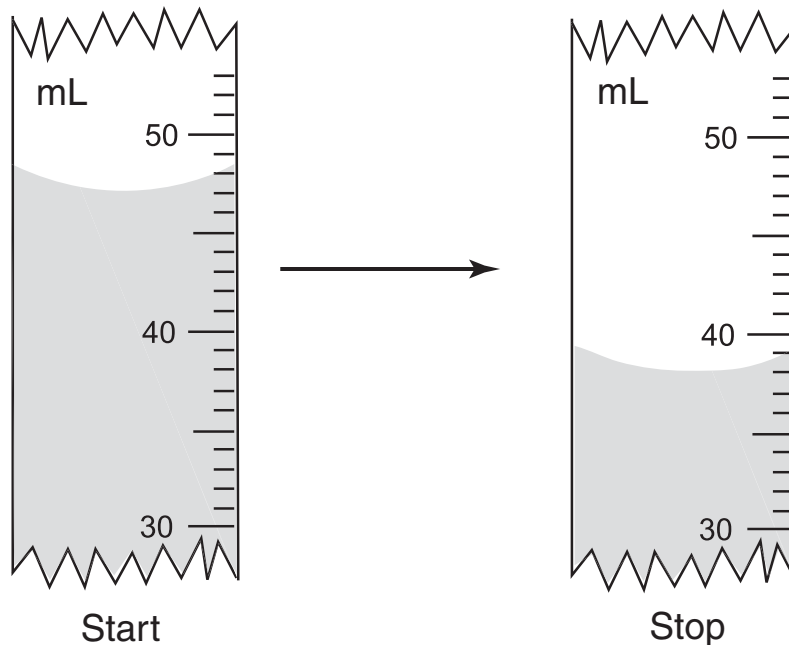
- F Photosynthesis produces twice as many ATP molecules as cellular respiration does.
- G Water is released during photosynthesis and consumed during cellular respiration.
- H Photosynthesis occurs during the day, and cellular respiration occurs at night.
- J Oxygen is produced during photosynthesis and used during cellular respiration.

### Mass Measurements of a Platinum Cylinder

Balance	First Measure (g)	Second Measure (g)	Third Measure (g)	Fourth Measure (g)
Q	24.94	25.26	25.29	24.51
R	25.50	24.50	25.00	24.49
S	24.99	24.99	25.20	25.92
T	24.99	25.03	24.98	25.02

19 The table shows four mass readings of one object as measured by four different balances. Which balance produced the most-consistent measurements?

- A Q
- B R
- C S
- D T



20 The illustration shows volume levels of a liquid in a graduated cylinder before and after a sample was removed. According to this information, what was the volume of the sample to the nearest milliliter? Record and bubble in your answer on the answer document.

### Amino Acid Composition of Cytochrome c in Some Organisms

Amino Acid	Fruit Fly	Screwworm Fly	Hornworm Moth	Silkworm Moth
Alanine	10%	10%	10%	10%
Arginine	4%	4%	4%	4%
Aspartic acid	6%	6%	6%	6%
Cysteine	6%	6%	6%	4%
Glutamic acid	12%	12%	8%	8%
Glycine	4%	2%	4%	4%
Valine	2%	1%	4%	6%

- 21 The table shows an amino acid comparison of cytochrome c, a protein involved in cellular respiration in aerobic organisms. The two organisms in the table that are least genetically related are the —
- A silkworm moth and the fruit fly
  - B silkworm moth and the screwworm fly
  - C fruit fly and the screwworm fly
  - D fruit fly and the hornworm moth

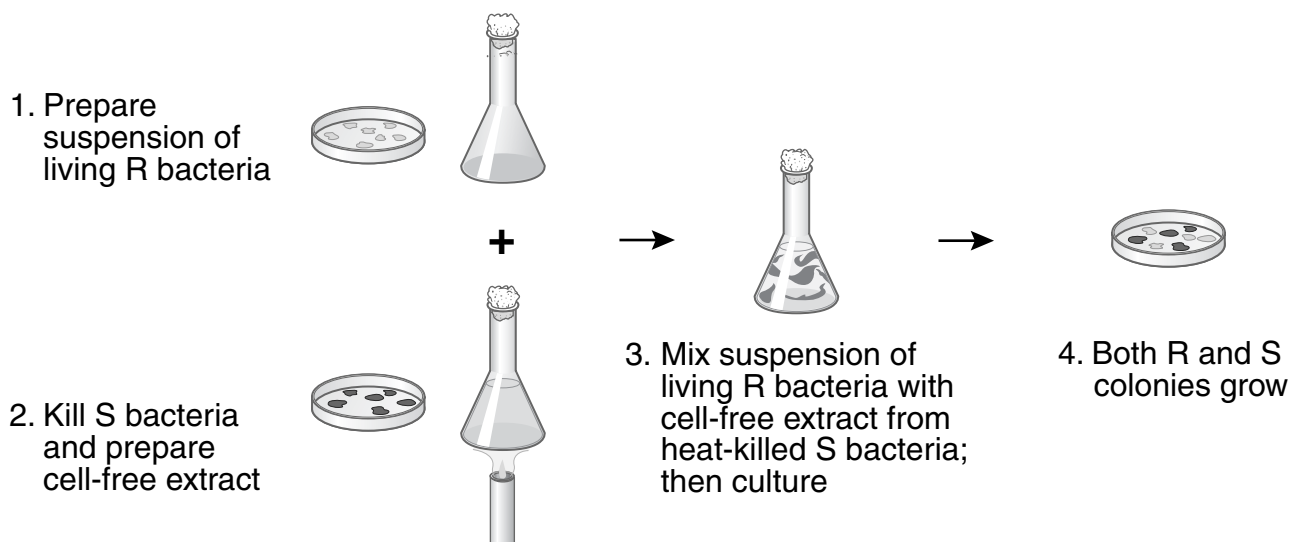
- 22 Mutations in DNA molecules can occur when —
- F replication of DNA is exact
  - G a DNA enzyme attaches to an RNA codon
  - H RNA codons are replaced by DNA nucleotides
  - J a change occurs in DNA nucleotide bases



- 23 According to this information, what is the chemical formula for aluminum sulfate?
- A  $\text{AlSO}_4$
  - B  $\text{Al}_2(\text{SO}_4)_3$
  - C  $\text{Al}_3(\text{SO}_4)_2$
  - D  $\text{Al}_6\text{SO}_4$

- 24 Bathwater normally has electrolytic behaviors even though distilled water does not. This is because bathwater —
- F contains isotopes of hydrogen
  - G has been heated
  - H is separated into  $\text{H}^+$  and  $\text{OH}^-$  ions
  - J contains dissolved minerals

## Avery and Associates' Investigation with *Pneumococcus*

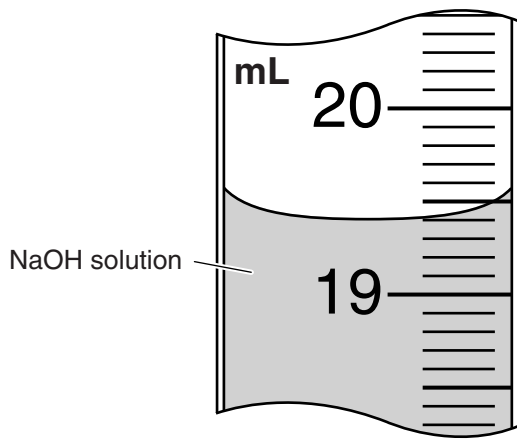


25 Which of the following best describes the question this set of procedures was designed to answer?

- A Can a substance from dead bacteria transform living bacteria?
- B Can R bacterial cells survive heating?
- C Can dead bacterial cells confer immunity to a living host?
- D Can bacterial cells be isolated from a healthy host?

26 Fish survive through severe winters because of the property of water that allows water to —

- F form chemical bonds as it freezes, raising the water temperature below the ice
- G increase in density while it freezes, dissolving more oxygen from the air
- H expand when it freezes, creating a floating and insulating layer of ice
- J precipitate vital nutrients when it freezes, increasing the food supply



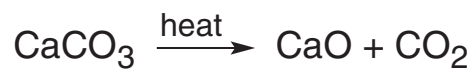
Section of pipette

**27** This pipette is filled with a 20% NaOH solution. The solution is at 20°C and has a density of 1.23 g/mL. According to this information, what is the mass of this NaOH solution?

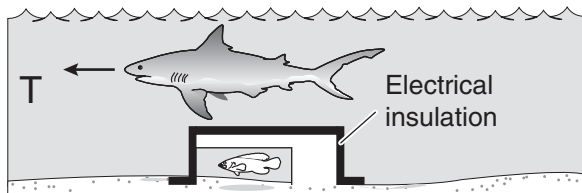
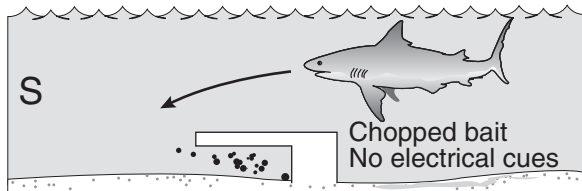
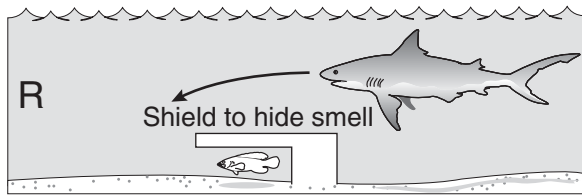
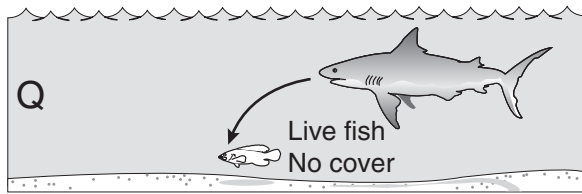
- A 3.88 g
- B 15.7 g
- C 23.9 g
- D 24.6 g

**28** When a person is frightened by a wild animal, some organ systems immediately become active, while others are suppressed. Which of these systems is likely to be suppressed?

- F Muscular system
- G Respiratory system
- H Endocrine system
- J Digestive system



- 29** The chemical equation shows  $\text{CaCO}_3$  being heated. Which of these statements best describes the mass of the products if 100 g of  $\text{CaCO}_3$  is heated?
- A** The difference in the products' masses is equal to the mass of the  $\text{CaCO}_3$ .
  - B** The sum of the products' masses is less than the mass of the  $\text{CaCO}_3$ .
  - C** The mass of each product is equal to the mass of the  $\text{CaCO}_3$ .
  - D** The sum of the products' masses equals the mass of the  $\text{CaCO}_3$ .



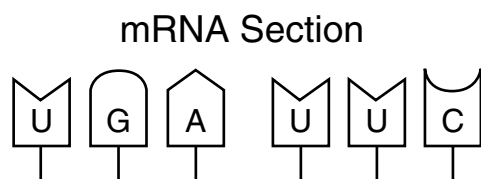
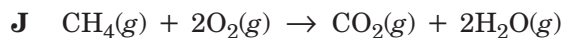
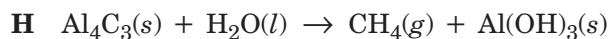
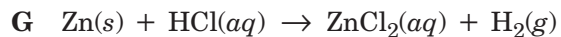
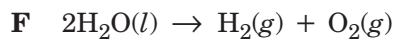
**30** The diagram shows different setups of an experiment to determine how sharks find their prey. Which experimental setup is the control?

- F** Q
- G** R
- H** S
- J** T

**31** The kingdom Animalia includes all of these except —

- A** jellyfish
- B** sponges
- C** amoebas
- D** roundworms

32 Which chemical equation supports the law of conservation of mass?



33 Which of these represents the DNA segment from which this section of mRNA was transcribed?

**A** ACTAAG

**B** TCUTT G

**C** GAAUCU

**D** UCCTGA

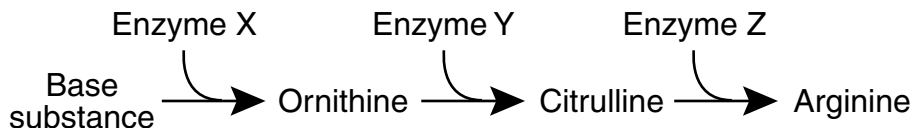
34 A certain commercial product used for cleaning ovens must be handled with rubber gloves. The product is slippery and turns litmus paper blue. It probably contains —

**F** an acid

**G** a base

**H** a salt

**J** an isotope

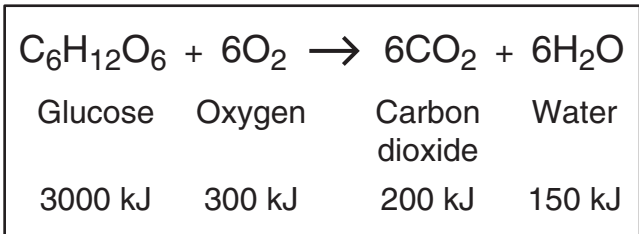


35 This diagram shows the biochemical pathway that produces arginine in *Neurospora*, a mold. *Neurospora* is easily grown on a simple jelly-like medium. Different substances can be added to the medium. A mutant *Neurospora* lacking Enzyme Y would have to have which of these added to its medium in order to survive?

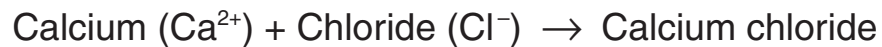
- A Enzyme X
- B Ornithine
- C Enzyme Z
- D Citrulline

36 Coat color in mice varies greatly, ranging from black to grizzly gray, black-and-white, spotted, or white. The nucleus from a body cell of a grizzly-gray mouse is fused with an egg from a black mouse from which the nucleus has been removed. The egg begins to divide and is then transplanted into a female white mouse. What will be the most likely coat color of the offspring?

- F Black
- G Black with white spots
- H Grizzly gray
- J White



- 37 Why is the sum of the products' energy in this reaction less than the sum of the reactants' energy?
- A Energy is given off as heat.
  - B The products absorb available energy.
  - C Energy is trapped in the reactants.
  - D The reactants' energy is less than the melting point of glucose.

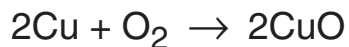


38 The chemical formula for calcium chloride is —

- F  $\text{Ca}_2\text{Cl}$
- G  $\text{CaCl}$
- H  $\text{CaCl}_2$
- J  $\text{Ca}_2\text{Cl}_3$

39 Over time an open soft drink will lose carbonation (dissolved  $\text{CO}_2$ ). Which of these allows the  $\text{CO}_2$  to remain in solution the longest?

- A Reduced air pressure
- B Exposure to direct sunlight
- C Increased air currents
- D Cooler temperatures



- 40 When 127 g of copper reacts with 32 g of oxygen gas to form copper (II) oxide, no copper or oxygen is left over. How much copper (II) oxide is produced?

F 32 g

G 95 g

H 127 g

J 159 g

- 41 Which of these is the best description of the action-reaction force pair when the space shuttle lifts off from the launchpad?

A The ground pushes the rocket up while exhaust gases push down on the ground.

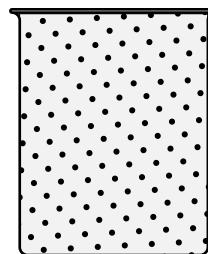
B Exhaust gases push down on air while the air pushes up on the rocket.

C The rocket pushes exhaust gases down while the exhaust gases push the rocket up.

D Gravity pulls the rocket exhaust down while friction pushes up against the atmosphere.

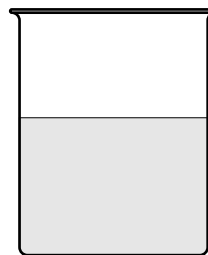
- 42 In which container is the substance unable to transfer heat by convection?

F



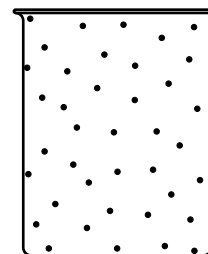
Chlorine

G



Water

H



Air

J



Aluminum

Initial Velocity of Ball (m/s)	Calculated Distance (m)	Actual Distance (m)
2.0	0.52	0.51
4.0	2.07	2.01
8.0	8.30	7.90

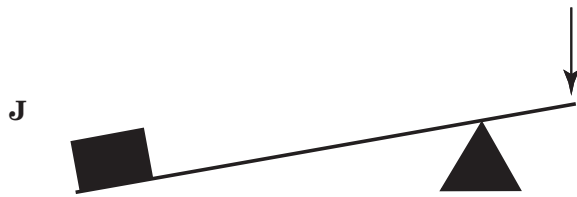
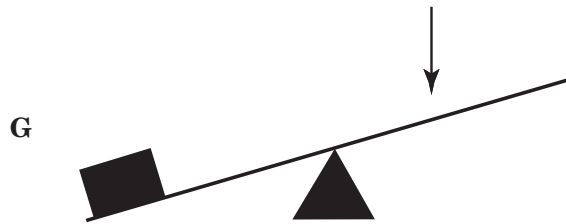
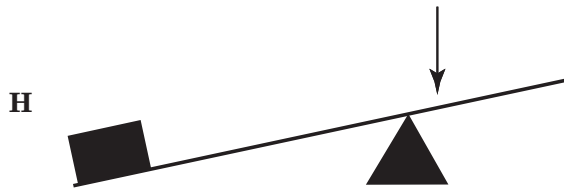
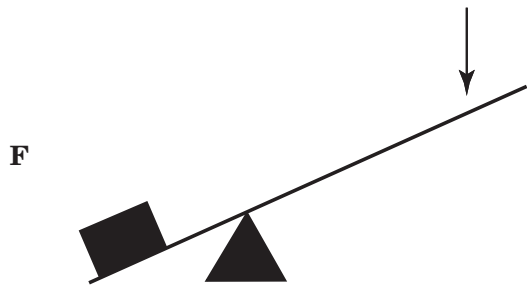
Mass of metal ball: 0.066 kg  
 Vertical height off ground,  $h$ : 0.89 m

- 43 A catapult was designed to project a small metal ball at a target. The resulting data are shown in the table. Which of these might explain the difference between the calculated and actual distances?
- A The ball landed short of the calculated distance because of an increase in momentum.
  - B Air resistance caused the ball to land short of the calculated distance.
  - C Initial mass of the ball changed with each trial.
  - D The metal ball was too small for accurate measurements to be made.

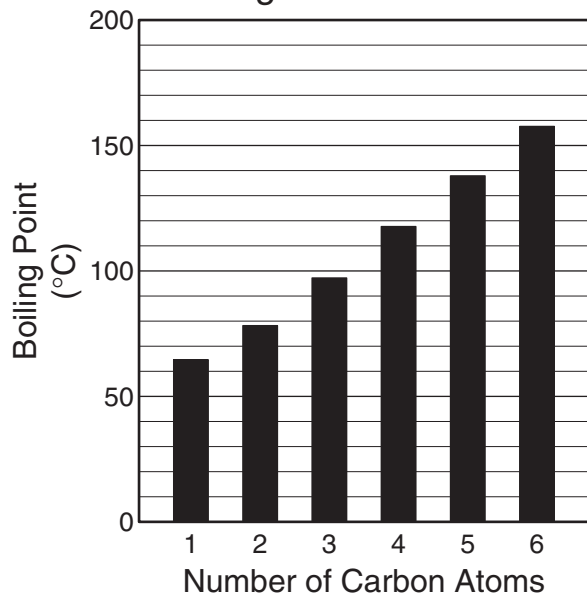
- 44 Viruses differ from bacteria in that all viruses —
- F cause insect-borne diseases
  - G can be destroyed by antibiotics
  - H have rigid cell walls
  - J must be reproduced in living cells

- 45 In West Texas and Southern California, high winds drive turbines that generate electricity. One advantage that wind energy has over energy generated from solar cells is that wind energy —
- A is plentiful everywhere
  - B can be generated at night
  - C produces cleaner energy
  - D is free of environmental hazards

46 Which lever arrangement requires the least effort force to raise a 500 N resistance?



Boiling Point of Alcohols



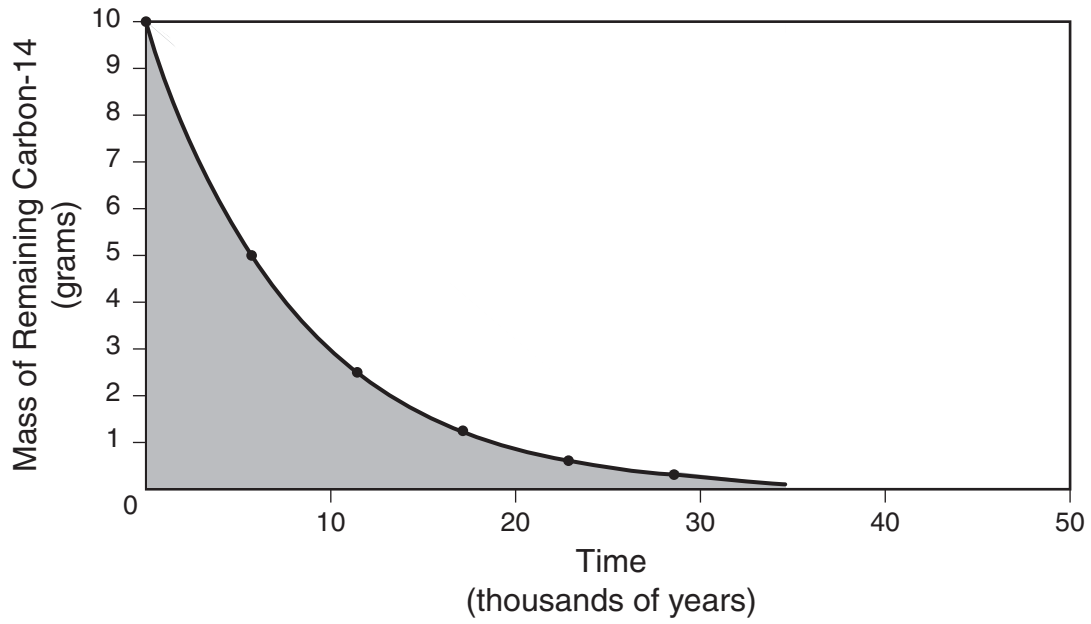
47 According to this information, what is the best prediction for the boiling point of the seven-carbon alcohol?

- A 169°C
- B 178°C
- C 186°C
- D 192°C

48 An inventor claims to have created an internal combustion engine that converts 100 kJ of chemical energy from diesel fuel to 140 kJ of mechanical energy. This claim violates the law of conservation of —

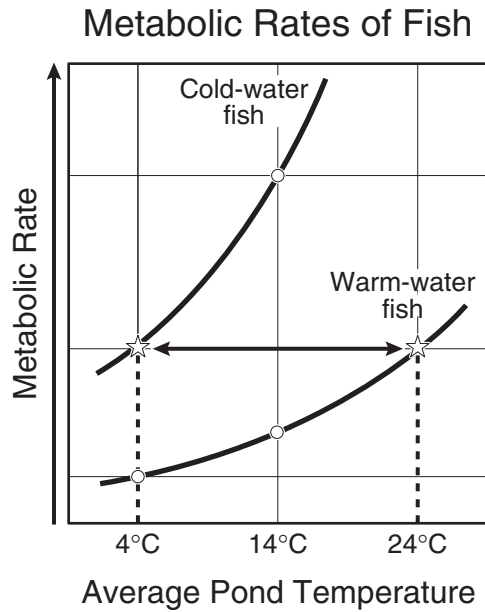
- F momentum
- G inertia
- H energy
- J mass

Decay of a 10-Gram Sample of Carbon-14

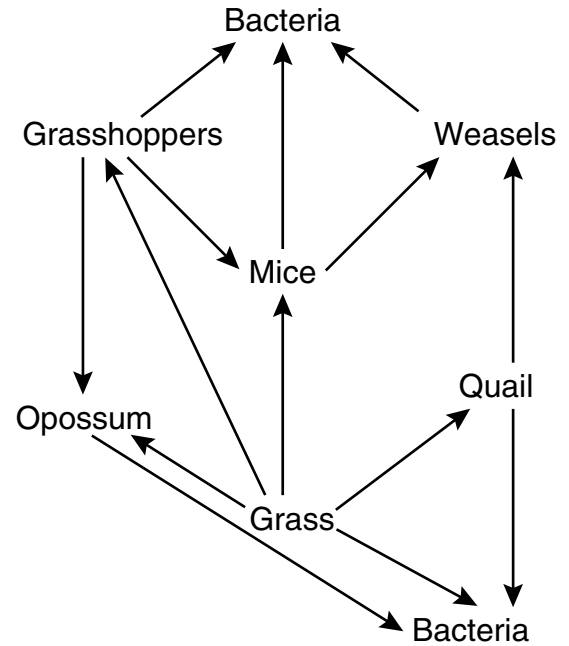


49 According to the graph, what is the approximate half-life of carbon-14?

- A 5.7 years
- B 5,700 years
- C 23,000 years
- D 1,000,000 years



- 50 The graph shows metabolic rates for two types of fish at different environmental temperatures. Which of the following conclusions can be drawn from these data?
- F Fish metabolism responds to temperature changes.
  - G Metabolic rates decrease as environmental temperatures increase.
  - H Fish body temperature results from high metabolism.
  - J Metabolic rates are independent of environmental temperature.



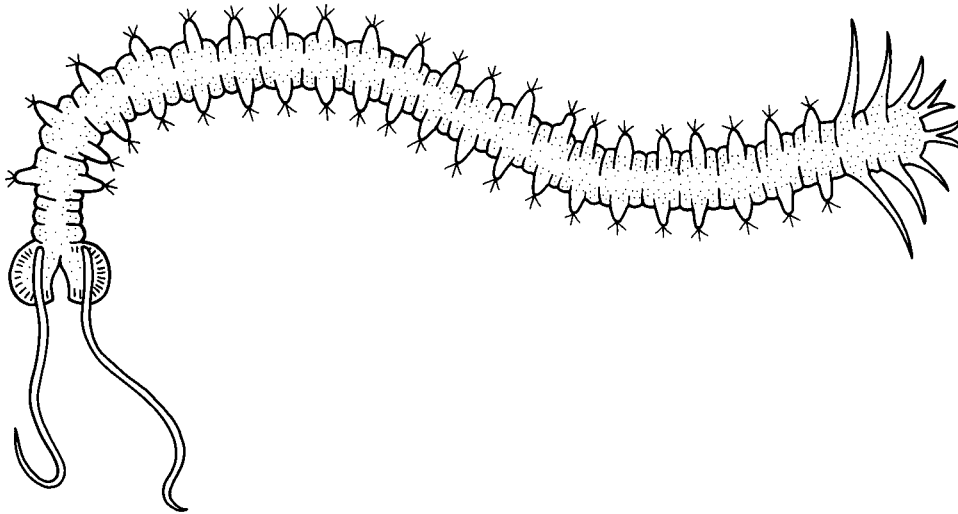
- 51 In this food web, the bacteria probably function as —
- A producers
  - B herbivores
  - C decomposers
  - D carnivores

## Solar Radiation and Earth

Effect	Amount of Energy per Second (terajoules)
Solar radiation reaching Earth	173,410
Radiation reflected back into space	52,000
Radiation heating atmosphere, landmasses, and oceans	81,000
Radiation producing winds and ocean currents	370
Radiation used in photosynthesis	40
Radiation resulting in evaporation of water	?

- 52 Assuming the chart contains all energy transformations in the Earth system, how much solar radiation goes toward evaporating water?
- F 40,000 terajoules
  - G 92,410 terajoules
  - H 121,410 terajoules
  - J 133,410 terajoules

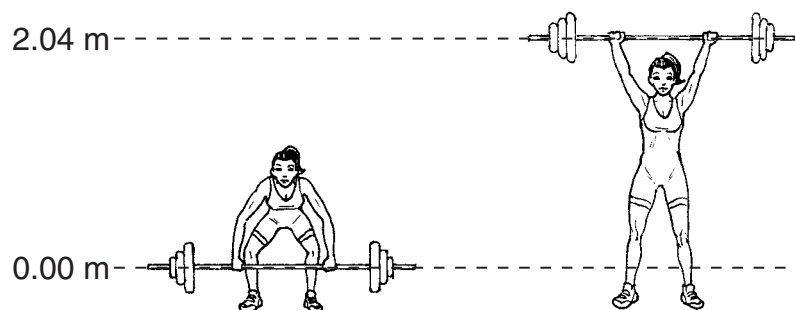
Phylum	Characteristics
Porifera	Asymmetrical, numerous pores, lacks tissues and organs
Annelida	Long segmented body, bilaterally symmetrical
Mollusca	Soft body consisting of foot, visceral mass, and mantle
Arthropoda	Segmented body, jointed legs, exoskeleton



53 This animal most likely belongs to phylum —

- A Porifera
- B Annelida
- C Mollusca
- D Arthropoda

Lift Height



54 The weight lifter used a force of 980 N to raise the barbell over her head in 5.21 seconds. Approximately how much work did she do in raising the barbell?

- F 380 J
- G 982 J
- H 2,000 J
- J 10,000 J

55 The pitch of a sound made by plucking a guitar string is determined by the —

- A frequency of the vibration produced
- B strength of the plucking force
- C distance between the strings
- D shape of the guitar body

BE SURE YOU HAVE RECORDED ALL OF YOUR ANSWERS  
ON THE ANSWER DOCUMENT.

