SCIENCE REASONING 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

Bacteria reproduce by a process in which a single cell divides into two cells. The average time required for bacteria to divide and their population to double is called the *generation time.* Table 1 presents the generation time for a variety of bacteria at a given temperature.

Bacterial population growth occurs in a series of distinct steps referred to as a *bacterial growth curve.* It consists of 4 phases, which reflect changes in the cells' environment and metabolism over time. See Figure 1.

Table 1

Bacterium	Growth medium	Temperature (°C)	Generation time (min)
Clostridium botulinum	glucose broth	37	35
Escherichia coli	glucose broth	37	17
Lactobacillus acidophilus	milk	37	66
Mycobacterium tuberculosis	synthetic medium	37	792
Pseudomonas aeruginosa	glucose broth	37	31
Shigella dysenteriae	milk	37	23
Staphylococcus aureus	glucose broth	37	32
Streptococcus lactis	lactose broth	30	48
Streptococcus lactis	glucose milk	37	26
Streptococcus lactis	peptone milk	37	37
Streptococcus pneumoniae	glucose broth	37	30
Xanthomonas campestris	glucose broth	25	74

Table adapted from P. L. Altman and D. S. Dittmer, eds., *Biology Data Book.* ©1972 by Pergamon Press PLC.

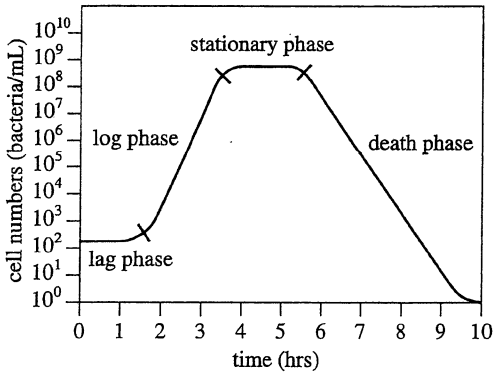

Figure 1

1. On the basis of the data presented in Table 1, if *Streptococcus lactis* was placed in a test tube containing growth medium at 37°C, one would predict its generation time to most likely be:

   A. less than 10 min.
   B. between 10 and 15 min.
   C. between 15 and 25 min.
   D. between 25 and 40 min.

2. The bacterial population increases most rapidly during which of the following phases?

   F. Lag phase
   G. Log phase
   H. Stationary phase
   J. Death phase

3. Based on the data presented in Table 1, which of the following bacteria growing in glucose broth took the longest time to double its population?

   A. *Pseudomonas aeruginosa*
   B. *Staphylococcus aureus*
   C. *Streptococcus pneumoniae*
   D. *Xanthomonas campestris*

4. Samples of growth medium containing milk were inoculated with the microorganisms depicted in Table 1 and put in an environmental chamber at 37°C. Which of the following bacteria would take closest to 1 hour to double its population?

   F. *Lactobacillus acidophilus*
   G. *Mycobacterium tuberculosis*
   H. *Shigella dysenteriae*
   J. *Streptococcus lactis*

5. Which of the following hypotheses about bacterial populations is supported by the data presented in Figure 1 ?

   A. Bacteria populations change at a constant rate throughout all the growth phases.
   B. Bacteria begin to increase immediately after transfer to a new growth medium.
   C. Bacteria begin to decrease immediately after transfer to a new growth medium.
   D. Bacteria require a period of adjustment before they begin to reproduce in a new growth medium.

Passage VI

An atom has a *nucleus*, which consists of *protons* (positively charged particles) and *neutrons* (uncharged particles), surrounded by one or more *electrons* (negatively charged particles) which move in *orbits* (see Figure 1).

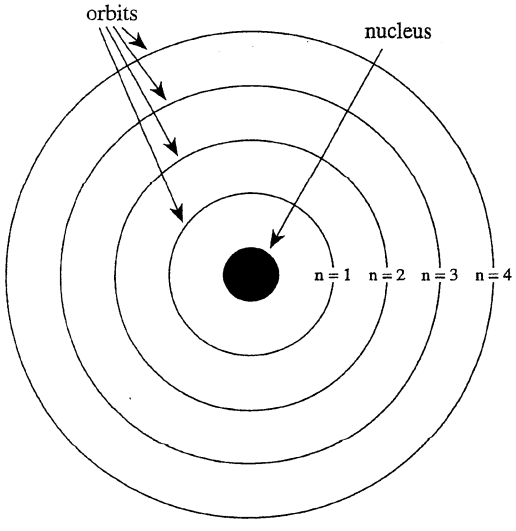

Figure 1

Note: Drawing is NOT to scale.

Table 1 contains data for several neutral and charged atoms containing only one electron. Table 1 includes the number of protons (Z); the identification of the initial orbit (n); the radius of the orbit (r); the energy (I, in electron volts, or eV) to remove an electron from the atom; and the energy (E) of a photon emitted when an electron falls from its initial orbit to the orbit where n = 1.

Table 1

Element	Z	n	r($\times 10^{-8}$ cm)	I (eV)	E (eV)
H	1	4	8.5	0.85	12.7
H	1	3	4.8	1.5	12.1
H	1	2	2.1	3.4	10.2
He^{+}	2	4	4.2	3.4	51.0
He^{+}	2	3	2.4	6.0	48.4
He^{+}	2	2	1.1	13.6	40.9
Li^{+2}	3	4	2.8	7.7	115.0
Li^{+2}	3	3	1.6	13.6	109.0
Li^{+2}	3	2	0.7	30.5	91.9
Be^{+3}	4	4	2.1	13.6	204.0
Be^{+3}	4	3	1.2	24.2	194.0
Be^{+3}	4	2	0.5	54.2	163.0

31. For a given value of Z, the data indicate that as n increases, I:

A. increases.
B. increases, then decreases.
C. decreases.
D. decreases, then increases.

32. According to Table 1, for element H, n = 5, the most likely value for I would be:

F. 0.54 eV.
G. 0.90 eV.
H. 2.7 eV.
J. 3.4 eV.

33. According to the information provided in the passage, an atom has a net positive charge when it has more:

A. neutrons than protons.
B. protons than neutrons.
C. protons than electrons.
D. electrons than neutrons.

34. The hypothesis that for a given value of n, r decreases as net positive charge increases, is supported by the data for:

F. H and He^{+} only.
G. H and Li^{+2} only.
H. H, He^{+}, and Li^{+2} only.
J. H, He^{+}, Li^{+2}, and Be^{+3}.

35. The most energetic photons will be emitted when an electron falls from orbit:

A. n = 2 to n = 1 in He^{+}.
B. n = 2 to n = 1 in Be^{+3}.
C. n = 4 to n = 1 in H.
D. n = 4 to n = 1 in Be^{+3}.