EXAM QUESTIONS (BIOE 484)

Questions with BOLD numbers are from the Addenda file.

(1.2) Engineers are mostly concerned with which stage of technology development:
- a. random.
- b. qualitative.
- c. quantitative.
- d. control.
- e. marketing.

(1.2) A major difference between engineer and scientist approaches to knowledge in their field is that:
- a. engineers are deductive whereas biologists are inductive.
- b. engineers are inductive whereas biologists are deductive.
- c. engineers are deductive whereas biologists are seductive.
- d. engineers are smarter.
- e. scientists are smarter.

(1.2) Sushi science and hamburger science illustrate that:
- a. hamburgers are available locally but sushi is not.
- b. food science can drastically change the final form of the food.
- c. the way scientific results are presented depends on societal culture.
- d. an apple a day keeps the doctor away.
- e. hamburgers and sushi together make a full meal.

(1.2) Phylogeny is the study of:
- a. engineering vs. science.
- b. connections.
- c. the Greek language.
- d. manicures.
- e. phyling cabinets.

(1.2) Distinguishing between modern scientists and engineers has become more difficult because:
- a. engineers have begun to wear white lab coats.
- b. scientists have become more entrepreneurial.
- c. engineers and scientists are both eating sushi.
- d. the scientific literature has been hijacked by engineers.
- e. they all go to MIT.

(1.3) The scientific method does not involve:
- a. formulating hypotheses.
- b. throwing out data.
- c. observation.
- d. revision.
- e. planning experiments.

(1.3) Robert Koch developed a means to establish the microbial cause of a disease. First,

a. the microbe was cultured in the laboratory.
b. the cultured agent was inoculated into health hosts.
c. the suspected microorganism was isolated from the victim of the disease.
d. the suspected microbe was grilled by police.
e. the microbe was given an antibiotic.

(1.3) Progress in science does not depend on:
a. the scientific method.
b. observations.
c. induction.
d. careful scrutiny.
e. previous scientific results.

(1.3) The scientific method is based on logic. Which of the following is a true statement?
a. If a cure to a disease in a child follows the injection of stem cells, then the stem cells must have cured the disease.
b. If a child is sick without the injection of stem cells, then stem cells are necessary to cure the child.
c. If stem cells are injected into many sick children, and all recover, the stem cells must be the cause.
d. If the DNA of healthy cells in children who were cured after the injections of the stem cells does not match the DNA of unhealthy cells, then the stem cells must be the cure.
e. If a child gets sick after stem cells are injected, then stem cells must be the cause.

(1.4) What does the word "translational" mean in modern technology?
a. moving in a plane.
b. talking a different language.
c. application of.
d. use of computers.
e. using algebra.

(1.4) Why are engineers particularly suited for translational medicine?
a. they approach a problem from the general to the specific.
b. they need the help.
c. they know more than physiologists.
d. they use inductive logic.
e. they can spell the word "translational".

(1.4) The scientific method is to biologists as _____ is to engineers:
a. control systems
b. modeling
c. calculation
d. professional ethics
e. the world

(1.4) The reason nonessential characteristics of an element are thrown out from the model is:
a. it is difficult to comprehend these characteristics.
b. there is not enough room for them all.
c. other people can't understand them.

d. the model must be as simple as possible.
e. they are contaminated.

(1.4) Two essential steps in modeling are calibration and validation. What is the difference between them?

a. calibration uses one set of data whereas validation uses an independent data set.
b. calibration is done in the laboratory whereas validation is done on the computer.
c. calibration can be done by anyone, whereas validation must be done by a specialist.
d. calibration requires a complete set, whereas validation only requires a partial set.
e. calibration follows validation.

(1.4) The difference between a stochastic model and a deterministic model is:

a. I think I know what deterministic means.
b. Stochastic models are sarcastic.
c. Stochastic models are always harder than deterministic models.
d. An element of randomness is an essential part of stochastic models.
e. knowing stochastic models is deterministic.

(1.4) Interfacing of model elements must be carefully done because:

a. model elements must be able to transfer variable information among them.
b. model elements are meant to be independent.
c. models look more attractive with their elements interfaced.
d. interfaces require intermakeup.
e. model elements are inclined to act independently.

(1.4) Mathematical models are often preferred because they are:

a. subcint.
b. succinct.
c. sudcint.
d. suecint.
e. suscint.

(1.4) Fitting mathematical expressions to laboratory data is an important step in the formulation of:

a. empirical models.
b. dismay and confusion.
c. translation to hierarchical form.
d. deductive induction.
e. theoretical equations.

(1.4) First principles of engineering originated as:

a. Greeks.
b. philosophical ideas.
c. poor folks
d. descriptions of empirical data.
e. some smart aleck idea.

(1.4) If the results of a model match the data, then the model must be an accurate description of the action mechanisms of the system that is being modeled.

a. true
b. false
c. maybe
d. all of the above
e. none of the above

(1.4) A stochastic model must be run many times because each time the model is run:

a. there is additional confidence that the results will always be the same.
b. probabilities multiply.
c. the outcome is likely to be different.
d. the modeler is given a bonus.
e. it results in stochasm.

(1.4) Why might mathematical models meant to replace animal experimentation actually increase animal use?

a. Their DNA needs to be determined first.
b. The models need to be validated with experimental data.
c. There are not enough mathematicians to complete the model.
d. The animals raised to be experimental subjects need to be used.
e. Models such as this require sacrifice.

(1.4) Which if these is *not* a reason to abandon animal testing of drugs:

a. there are ethical and moralistic concerns about animal use and care.
b. animals often give poor predictions of human responses.
c. animals are expensive and inconvenient.
d. animal populations used for drug testing usually have uniform genotypic and phenotypic characteristics, and so do not display idiosyncratic reactions.
e. animals are inferior to human beings.

(1.5) A specialist in technical diversity does *not* mean that biological engineers:

a. have a broad technical foundation.
b. are able to understand a wide range of topics.
c. include all ethnic groups, religions, and national origins.
d. have no particular application for their education.
e. have many possible career choices.

(1.5) Biological engineers are just like other engineers except:

a. they are biologically originated.
b. they do not study engineering sciences.
c. their models are more complicated.
d. their primary domain of interest is the science of biology.
e. they are more brilliant.

(1.5) Agricultural, environmental, and medical engineering are all:

a. applications-based engineering disciplines.
b. science-based engineering disciplines.
c. to be avoided.
d. broad and fundamentally oriented.

e. based on different fundamental principles.

(1.5) Which is *not* a desired attribute of an engineer, according to Boeing:
a. good understanding of engineering science fundamentals.
b. good communications skills.
c. able to solve all problems with one or two methods.
d. good team members.
e. good grasp of engineering.

(1.6) Which is *not* an expectation for a biological engineer?
a. the ability to transfer information known about familiar living systems to those unfamiliar.
b. the ability to avoid or mitigate unintended consequences of dealing with any living system.
c. the knowledge of biological principles and generalizations that can lead to useful products and processes.
d. sufficient knowledge of biology to replace biologists.
e. familiarity with biological principles.

(1.6) The biological engineer must remember that:
a. she or he could finish this test early.
b. living things are constantly reacting and changing.
c. politics is not something to be involved with.
d. biological systems are all the same.
e. biology is easy.

(1.6) Plants genetically modified to solve one disease problem are sometimes found to become more susceptible to other diseases or insects. This is an example of:
a. an unintended consequence.
b. a chronic disease.
c. GMO economic estimates.
d. the best laid plans of mice and men.
e. facing the future.

(1.6) Plants genetically modified to solve one disease problem are sometimes found to be more susceptible to other diseases. This is analogous to:
a. cloning household pets.
b. curing acute human diseases and making it more likely that they contract chronic diseases.
c. plants producing toxins to ward off herbivores.
d. microbes communicating among themselves in a biofilm.
e. substituting one type of chocolate for another.

(1.6) The case of glyphosate resistant weeds demonstrates how genetically-altered crops can lead to unintended consequences. Why don't things like this happen all the time in nature?
a. Living things aren't glyphosate resistant.
b. BU don't know about unintended consequences.
c. Biology is self-directed.
d. Evolution keeps it from happening.
e. Living things depend on redundant mechanisms.

(1.6) Depending on one mode of action, one drug, or one pesticide to control living things can often lead to:

a. expensive treatments.
b. familiarity.
c. unintended consequences.
d. perpetual control.
e. monopolies.

(1.7) Engineers must be able to predict in order to:

a. make lots of money.
b. impress their friends.
c. have confidence in their designs.
d. know how much to pay for a Big Mac.
e. use induction in design.

(1.7) Engineering predictions differ from scientific predictions in that engineering predictions:

a. lead to the occult.
b. lead to the establishment of new knowledge.
c. lead to successful application of existing knowledge.
d. are always successful.
e. are stressful for Karnak.

(1.7) A prediction is made better with:

a. more data.
b. inductive intuition.
c. one or two precise data points.
d. intended consequences.
e. mom's help.

(1.8) Before reaching for the calculator, an engineer must:

a. scratch.
b. know all the relevant equations.
c. be able to scale responses.
d. have an idea about how things will work.
e. remember where she put the durn thing.

(1.8) Biological engineering perspective is *not* important to:

a. choose the best solution to a problem.
b. recognize a "black-box" when one is seen.
c. avoid unintended consequences when using living things.
d. retain flexibility of approach.
e. incorporate biology into a design.

(2.0) The study of physics is important to the biological engineer because:

a. physics is an ordinary science.
b. it helps explain biological response to its physical environment.
c. no field of study is more important.
d. environmental responses are explained better using physics than using anything else.
e. physics is phun.

(2.0) Living organisms completely and unequivocally obey the laws of physics.

a. true
b. false
c. maybe
d. all of the above
e. none of the above

(2.1) Flow always moves from higher effort to lower effort unless:

a. the process is irreversible.
b. there is an addition of energy.
c. capacity and resistance are present.
d. all of the above.
e. none of the above.

(2.1) Capacity stores:

a. positives.
b. effort.
c. flow.
d. nothing.
e. all of the above.

(2.1) Resistance stores:

a. positives.
b. effort.
c. flow.
d. nothing.
e. all of the above.

(2.1) Effort differs from flow because effort:

a. is the cause and flow is the effect.
b. is related to resistance but flow is related to capacity.
c. represents blood flow.
d. equals flow divided by resistance.
e. equals capacity divided by reality.

(2.1) Absolute values of velocity are difficult, but not impossible, to make.

a. true
b. false
c. maybe
d. all of the above
e. none of the above

(2.2) The rate of stuff in – the rate of stuff out + the rate of stuff generated =

a. the general balance equation.
b. the rate of stuff stored.
c. entropy.
d. the amount of stuff stored.
e. the rate of store stuffed.

(2.2) $\frac{1}{C}\int !\, dt$, where $!$ is a flow term, is a legitimate term for an effort balance.

a. true
b. false
c. maybe
d. all of the above
e. none of the above

(2.2) C$\frac{d\phi}{dt}$, where ϕ is an effort variable, is a legitimate term for a flow balance.

a. true
b. false
c. maybe
d. all of the above
e. none of the above

(2.3) The equation of state for a liquid could be:

a. liquid flow = constant.
b. density = constant.
c. pV = mRT.
d. pV = work.
e. "L" is the capital of Liquid State.

(2.3) The only state of matter with a general describing equation is:

a. crystal.
b. glass.
c. metal.
d. liquid.
e. gas.

(2.3) The ideal gas law can *not* be used to determine:

a. gas density.
b. gas constant.
c. gas volume.
d. gas viscosity.
e. gas identity.

(2.3) When the vapor pressure reaches atmospheric pressure:

a. molecules in the liquid state transform into the gaseous state.
b. the liquid consumes the gas.
c. condensation and vaporization are equal.
d. temperature comes to a halt.
e. liquid is indistinguishable from gas.

(2.3) Glasses are:

a. another name for polymers.
b. made from silicon dioxide.
c. densely packed irregular arrangements of atoms.
d. less dense than crystals.
e. used for disguises.

(2.3) Polymers usually have:

a. entwined mers.
b. three sets of carbons.
c. composite properties.
d. most strength in the direction of the axis of the chain.
e. many French seas.

(2.3) A phase change is accompanied by:
a. water vapor condensing into liquid.
b. concomitant increments of accretions.
c. no temperature change with the addition or removal of heat.
d. a change of costume.
e. a different angle.

(2.3) A gas plasma consists of gas ions surrounded by:
a. red blood cells.
b. blood serum.
c. energized electrons.
d. un-ionized gas.
e. mesothelia.

(2.4) The final form of energy is:
a. heat.
b. electricity.
c. nothingness.
d. black holes.
e. space, the final frontier.

(2.4) Heat can be used to produce mechanical work as long as:
a. it is applied properly.
b. efficiency is at least 25%.
c. the work is outside the organism.
d. there is a suitable lower temperature heat sink available.
e. muscles are coiled.

(2.4) The difference between mechanical work and physiological work is:
a. muscular inefficiency.
b. negative work.
c. life.
d. presumably small.
e. profoundly inconsequential.

(2.4) When the net force and the direction of movement are in opposite directions, the result is:
a. negative work.
b. Gibbs free energy.
c. heat.
d. pretty good.
e. a full net.

(2.4) The kinetic energy of a mass traveling twice as fast as another mass is _____ as the kinetic energy of the slower mass.
a. half as large

b. as large
c. twice as large
d. four times as large
e. eight times as large

(2.4) _____ happens during digestion, whereas _____happens when complex molecules are formed from simple molecules.
a. catabolism, Annapolis
b. anabolism, cannibalism
c. catabolism, anabolism
d. anabolism, catabolism
e. molecular formation, digestion

(2.4) The percentage of useful energy extracted from consumption of food is usually considered to be:
a. 95%.
b. 90%.
c. 85%.
d. none of the above.
e. all of the above.

(2.5) Maintenance of order requires:
a. police persons.
b. strict teachers.
c. energy.
d. sleep.
e. prison guards.

(2.5) Free energy expresses the idea that:
a. all processes are irreversible.
b. some processes can occur spontaneously.
c. the entropy of the universe constantly increases.
d. some energy comes without cost.
e. all of the above.

(2.5) Entropy is higher for:
a. more chaotic states.
b. ordered states.
c. cupcakes.
d. enthalpy.
e. better quality entropies.

(2.6) "Life is not spontaneously created" is a statement illustrating that:
a. deterioration of old wood cannot happen without oxygen.
b. cells need other cells.
c. procreation in higher animals requires both sexes.
d. energy is needed to create order.
e. evoloution needs something more.

(2.7) Animals constantly exposed to higher temperatures have a:
a. higher surface to volume ratio.

b. lower surface to volume ratio.
c. fever.
d. darker side.
e. good time.

(2.7) Biomass conversion efficiency from one trophic level to another is usually considered to be:
a. 1%.
b. 5%.
c. 10%.
d. 50%.
e. 75%.

(2.7) Movement of heat, mass, energy, and other flows are usually:
a. hard to understand.
b. directly proportional to area and inversely proportional to distance.
c. independent of the effort variable.
d dependent upon chemical equilibrium being established before thermal conductivity.
e. taken together.

(2.7) Birds fluff their feathers in the cold to reduce:
a. criticism from other birds.
b. the threat from rival birds.
c. conductive heat transfer.
d. body temperature.
e. attractiveness.

(2.8) The smaller size and mass of a microbe means that it is difficult to:
a. wave to its friends.
b. move through water.
c. diffuse oxygen.
d. pack everything in.
e. lose heat.

(2.8) The need for a circulatory system is:
a. due to the limitations of mass diffusion.
b. apparent when there is a cut in your skin.
c. in all plants and animals.
d. because the viscosity of blood is higher than the viscosity of water.
e. readily apparent to all living creatures.

(2.8) The ideal circulatory system:
a. conserves energy.
b. has a few larger vessels feeding many smaller vessels in parallel.
c. allows mass transfer at the sites of the tissues.
d. all of the above.
e. none of the above.

(2.8) Because diffusion is so slow and so limiting for multicellular organisms,
a. calculation of diffusion coefficients in those organisms is nearly impossible.

b. smaller amounts are supplied to the interior.
c. oxygen consumption for larger animals is confined to surface areas.
d. a circulatory system is necessary to move materials to and from the tissues.
e. they don't exist.

(2.8) Osmosis requires a concentration difference and a:
a. pressure on one side.
b. semipermeable membrane.
c. salt solution.
d. Greek letter.
e. no net movement.

(2.8) Homogenization of nutrient concentration is one function of the:
a. milk processing cycle.
b. circulatory system.
c. coelenterates.
d. federal government.
e. mix master.

(2.8) One way to move substances is to carry it in vessels. Which of these is *not* an example of this:
a. vesicles within cells.
b. encytosis
c. UPS, Fedex, or DHL trucks.
d. erythrocytes.
e. Grecian urns.

(2.8) Premature infants may be ventilated with perfluorocarbon liquid rather than air because:
a. air flow waveshapes do not have to be plotted.
b. gas transfer through the lung is cervical.
c. heat transfer is easier.
d. immature alveoli in contact with air tend to close.
e. PFCs are toxic.

(2.8) Passage of hydrophilic materials through the endothelium occurs mainly through the:
a. endothelial cells.
b. endothelial intercellular cleft.
c. endothelial carbuncular craft.
d. epidermal layer.
e. it doesn't.

(2.8) Asian clams are osmo-conformers. That means that:
a. the clams have no opinions.
b. the clams can live in a range of salinities.
c. the clams can take on the shape of an osmofocal.
d. the male clams are attractive to female clams.
e. imaging can detect them.

(2.8) Mass transfer does *not* depend on:
a. surface area increased by invaginations.
b. diffusion distance reduced by circulation.

c. concentration difference increased by exuding chemicals into the environment.
d. concentration changed by pigmentation.
e. mass diffusivity.

(2.8) Small multicellular organisms are sometimes flat to:
a. reduce the diffusion distance from outside to inside.
b. play in a minor key.
c. fit between logs.
d. appear bigger than they really are.
e. lie low.

(2.8) Which of the following is *not* true for endocytosis?
a. it enables cells to incorporate molecules too large to pass through the cell membrane.
b. it is more likely to develop in adherent cells than in suspended cells.
c. it allows cells to passively ingest large molecules.
d. it is used by leukocytes to ingest foreign invaders.
e. it uses a vesicle to surround the substance.

(2.8) Water bears (tardegrades) need no circulatory or respiratory systems because:
a. they have redundant circulatory and respiratory systems.
b. they are so small that oxygen or nutrient diffusion are not limiting.
c. they are never found in dry environments.
d. they crawl all over doughnuts.
e. they can completely stop their metabolism if it is too dry.

(2.9) Suspended long-chain molecules:
a. influence flow properties of the fluid.
b. can't get back into school.
c. increase viscosity of fast-moving fluid.
d. are excluded from blood.
e. settle out.

(2.9) If it were important to mix two fluids, which type of flow should be chosen?
a. laminar.
b. turbulent.
c. smooth.
d. fluid A and fluid B.
e. all of the above.

(2.9) Microbes have:
a. high Reynolds numbers.
b. more difficulty than we do moving in water.
c. smooth surfaces.
d. none of the above.
e. all of the above..

(2.9) Hydrostatic pressure can substitute for _____
a. surface tension.
b. arthritic joints.
c. class attendance.

d. physical stiffness.
e. peer pressure.

(2.9) The diameter of a tube is reduced to one-half its original value. The resistance of that tube increased by what factor?
a. 1/16.
b. 2.
c. 8.
d. 16.
e. 64.

(2.9) When kinetic energy gained by a fluid equals the potential energy lost by the fluid:
a. increased velocity accompanies decreased pressure.
b. the energy level of fluid flowing in an ideal pipe decreases with distance.
c. fluid flowing faster will arrive at the end in less time.
d. increased velocity accompanies a change in viscosity.
e. pressure remains the same.

(2.9) Swimming in fish causes:
a. their hearts to pump blood throughout their bodies.
b. high pressure at the mouth, low pressure behind the gills, and no pressure difference at the location of the eye.
c. low pressure at the mouth, low pressure at the location of the eye.
d. discontinuities in fluid streamlines.
e. tsunamis.

(2.9) A cell surrounded by fluid must resist pressure exerted by the fluid. A larger diameter cell can resist _____ pressure than a smaller cell, all else being the same.
a. less
b. the same
c. more
d. none of the above
e. all of the above

(2.9) Gram positive bacteria are able to:
a. remain optimistic.
b. add numbers.
c. move freely.
d. take a stain.
e. share RNA.

(2.10) A typical force-deformation curve for biological materials is shaped like a:
a. “I”.
b. “D”.
c. “S”.
d. “P”.
e. “C”.

(2.10) If all forces on an object are balanced:
a. the object is at rest.
b. the object can be moving.

c. there are no reaction forces.
d. the object contains no kinetic energy.
e. all of the above.

(2.10) Newton's three laws do *not* state:
a. a body will continue to move in a straight line unless an unbalanced force is applied.
b. a moving body must have an unbalanced force applied.
c. for every action there is an equal counter reaction.
d. unbalanced forces result in accelerations.
e. acceleration accompanies unbalanced forces.

(2.10) The S-shaped curve does *not* describe:
a. unchecked population growth.
b. microbial growth in a bioreactor.
c. grass growth in a field.
d. enzyme activity on a substrate.
e. force to stretch biological tissues.

(2.10) The S-shaped curve describes:
a. microbial growth in a bioreactor.
b. grass growth in a field.
c. enzyme activity on a substrate.
d. force to stretch biological tissues.
e. all of the above.

(2.11) The most dangerous path for electricity flow through the human body is one that includes the:
a. liver.
b. heart.
c. brain.
d. arms.
e. all of the above.

(2.11) Gel electrophoresis does *not* separate proteins based on:
a. molecule distortion.
b. molecular mass.
c. elapsed time.
d. total molecule charge.
e. relative masses and charges.

(2.11) Electrical activity of living tissue is *not* responsible for:
a. EEG.
b. ECG.
c. ETC.
d. EMG.
e. EKG.

(2.11) Electric fields can be used to disrupt the cellular membrane in order to:
a. impose our will.
b. reshape the cell.

c. introduce Miranda rights.
d. introduce DNA into the cell.
e. spill the cellular contents.

(2.11) The safety limit for power dissipation of cranial electrodes is:
a. 1 μW.
b. 20 μW.
c. 30 mW.
d. 500 mW.
e. 2 W.

(2.11) The allowable temperature rise in the brain from cranial electrodes is:
a. 0.1 ˚C.
b. 0.5 ˚C.
c. 1 ˚C.
d. 2 ˚C.
e. 7 ˚C.

(2.11) Electrostatic discharge can damage sensitive electronic equipment, including instruments used in biology or human health care. Electrostatic discharge is worse in:
a. humid weather.
b. dry atmospheres.
c. metal objects.
d. sweaty hands.
e. summer.

(2.11) Electrostatic discharge from the human body is worse during:
a. your favorite TV show.
b. times of distress.
c. times of low humidity.
d. meals.
e. inclement weather.

(2.11) DNA vaccines produce immunity when:
a. they are injected.
b. the DNA that they carry directly provokes immune responses.
c. they are in the vial waiting to be injected.
d. the pathogen from which they come overwhelms the host.
e. plasmids they are made from produce proteins identified with the microbe.

(2.11) Electroporation is one way to:
a. make a cell talk.
b. get even.
c. close a cell membrane.
d. finish killing a cell.
e. force large molecules through a cell membrane.

(2.11) DNA vaccines use:
a. live bacteria or viruses to provoke an immune response.
b. plasmids to cause the host cell to produce foreign proteins.
c. only electroporation to move DNA into the host cell.

d. no known mechanism of immunity.
e. plant pharmacological material.

(2.12) Temperature affects many physical properties of matter. In general, the most temperature dependent property is:
a. viscosity.
b. solubility.
c. thermal conductivity.
d. diffusion coefficient.
e. bulk modulus.

(2.12) Phase transitions of bioimportant materials depend on:
a. presence of solids.
b. temperature.
c. glasses.
d. parsimony.
e. familiarity.

(3.0) Biological systems prefer:
a. irreversible chemical reactions.
b. extremely energetic biochemical forms.
c. highly acidic environments.
d. stable chemicals, but not too stable.
e. fast-acting forms.

(3.0) The study of chemistry is important to the biological engineer because:
a. chemistry is an ordinary science.
b. it helps explain biological responses to the chemical environment.
c. no field of study is more important.
d. environmental responses are explained better using chemistry than using anything else.
e. carbon chemistry is always included in a physical chemistry course.

(3.0) In general chemistry, one would likely study the properties of the element carbon. In which branch of chemistry would you be most likely to study carbon compounds and complexes?
a. general chemisty.
b. physical chemistry.
c. biochemistry.
d. planetary chemistry.
e. subchemistry.

(3.1) Elements that make up the same chemical family:
a. have the same number of electrons in their outer shells.
b. have similar chemical properties.
c. may be substituted for others of the same family.
d. all of the above.
e. many, but not all, of the above.

(3.1) Atoms with _____ electrons in the highest energy level are particularly stable.
a. 2

b. 4
c. 8
d. 16
e. 32

(3.1) Elements in the same chemical family can often substitute for each other, sometimes with toxic consequences, because they:
a. have the same atomic masses.
b. have the same number of electrons at all energy levels.
c. are identical.
d. have similar chemical properties.
e. are elantomers.

(3.1) Elements (alkali metals) on the left side of the periodic chart particularly like to bond with elements:
a. on the right side of the chart
b. at the bottom of the chart.
c. they agree with.
d. that are heterochemical in persuasion.
e. take the same chemopolitical positions.

(3.1) Substitution of strontium for bone calcium and lead for carbon are examples of:
a. parallel elements.
b. Roman decline.
c. health food.
d. properties of families of elements.
e. chemical avatars.

(3.1) Sodium, with 1 electron in its outer shell, is particularly attractive to:
a. carbon (+4)
b. bromine (+7)
c. calcium (+2)
d. boron (+3)
e. neon (+8)

(3.1) The reason that phosphates have been banned from many detergents is that:
a. they fertilize bodies of water and cause excessive algal growth.
b. they form bones in clothes.
c. they set up a continuous cycle of phosphate chemical reactions.
d. they interfere with calcium uptake.
e. they don't get clothes clean.

(3.2) Which chemical bond is the strongest?
a. ionic bonds
b. covalent bonds
c. hydrogen bonds
d. Van der Waals bonds
e. bail

(3.2) Water is a very unusual substance because:
a. you can drink it.

b. it forms nonpolar molecules.
c. oxygen bonds cause the molecules to interact weakly.
d. its polar molecules attach to many other kinds of molecules.
e. it is rare.

(3.2) Dissociated solutes attract:
a. water molecules.
b. all other ions.
c. strange attractors.
d. cells.
e. other dissociated units.

(3.2) The gecko can climb on walls without falling because:
a. they are sober.
b. hydrogen bonds hold them there.
c. many small spatulae on their feet induce Van der Waals forces.
d. Peter Pan taught them how.
e. they have Geico insurance.

(3.2) Chemical reaction equations must be balanced so that:
a. there is an unequal number of each element appearing on both sides of the equation.
b. there is an unequal number of charges appearing on both sides of the equation.
c. there are different elements appearing on both sides of the equation.
d. there is an unequal reaction energy that appears on one side of the equation.
e. there is always a rare isotope appearing somewhere.

(3.2) Elements with very different electronegativities are likely to be:
a. very reactive.
b. polar.
c. difficult to produce.
d. incompatible.
e. politically and chemically incorrect.

(3.2) Pointing a laser beam at a chemical sample to excite the molecules results in:
a. hyperactive molecules.
b. very angry molecules.
c. Raman spectra.
d. a slow burn.
e. blindness.

(3.2) Redox reactions involve:
a. oxygen as the only electron acceptor.
b. elections of donors.
c. hydrogen bonds.
d. electron transfer.
e. reduction and induction.

(3.2) H_3O+ is the symbol for:
a. heavy water.

b. hydronium ion.
c. pet supplies.
d. alien hydrogen oxide.
e. an anion

(3.2) BOD stands for:
a. biological octagonal dementia
b. physical attributes of human beings
c. biological oxygen demand
d. barely outlandish demands
e. biological Octavian dementia

(3.2) A substance that loses electrons is oxidized; a substance that gains electrons is reduced.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(3.3) The presence of large concentrations of chemical reactants:
a. produces a lot of energy.
b. speeds up the reaction rate.
c. fills the container.
d. costs more.
e. constitutes a concentration camp.

(3.3) An exothermic reaction could be:
a. used to generate heat.
b. used to absorb heat.
c. used to extinguish fires.
d. used to generate nuclear energy.
e. used to cast spells.

(3.3) Reaction rates depend on concentrations of reactants. Thus, increasing the concentration of Argon in the air should increase the formation of Argon Oxide.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(3.4) Buffers play an important role in biological systems by:
a. helping to maintain the status quo.
b. interfering with telomerase.
c. upsetting homeostasis.
d. isolating isometric forms.
e. shining your automobile.

(3.4) When a salt dissociates in water solution, the result is:
a. a solution that can be acidic, basic, or neutral.
b. sodium chloride.

c. a low equilibrium constant.
d. political instability.
e. individual salt molecules.

(3.4) When the hydrogen ion concentrations of two acids are compared, the acid with a pH of 4 has how many times more hydrogen ions than the acid with a pH of 5?
a. 0.1
b. 1
c. 10
d. 100
e. 1000

(3.4) Weak acids or bases act especially well as:
a. gasoline additives
b. buffers
c. independent properties
d. computer storage devices
e. foils to strong acids or bases.

(3.4) Low pH can be:
a. corrected in the body by respiration and renal excretion
b. used to preserve foods
c. influential for enzyme activity
d. all of the above
e. many, but not all, of the above

(3.5) When two reactants are brought together, so that the number of collisions between reactants increases and the fraction of effective reactions remains high, then:
a. intermediate products will not appear.
b. the chemical reaction should proceed faster.
c. there will be a lot of damage done.
d. an exothermic reaction will result.
e. activation energy will prevent anything from happening.

(3.5) Enzymatic reactions reduce:
a. activation energy.
b. formation of intermediate products.
c. reaction rates.
d. course grades.
e. hydrogen.

(3.5) First order reactions:
a. are better than second order reactions.
b. proceed at a rate proportional to the concentration of reactants.
c. proceed faster with time.
d. are kinetically impossible.
e. are slower than molasses.

(3.5) When enzymes mediate a substrate reaction, the rate:
a. is called Michaelis – Mutten.
b. is higher than most are willing to pay.

c. reaches a limit as substrate concentration increases.
d. suddenly decreases.
e. decreases as enzyme concentration increases.

(3.5) If the energy of activation cannot be overcome,
a. interatomic collisions will cease.
b. reactions would not occur.
c. Standard Temperature and Pressure could not be defined.
d. there must be alternative routes.
e. bioawards will not be given.

(3.5) The series of chemical reactions:
$A + B \rightarrow C$
$C + B \rightarrow D$
$D + A \rightarrow AB$
a. occurs spontaneously.
b. produces products as fast as the fastest component.
c. can be replaced by $A + B \rightarrow AB$.
d. has activation energies equal to each other.
e. is reversible.

(3.6) Carbon forms what kind of bonds with other elements?
a. van der Waals.
b. hydrogen.
c. ionic.
d. covalent.
e. government.

(3.6) Which of the following configurations can *not* be formed in carbon compounds?
a. chains.
b. branches.
c. rings.
d. lattices.
e. none of the above.

(3.6) Biomolecules are based on carbon, but *not* because carbon is:
a. darkly colored.
b. common in the universe.
c. chemically reactive.
d. able to form stable compounds with hydrogen and oxygen.
e. found in the middle of the periodic table of elements.

(3.6) Biochemical functional groups are groups of elements that:
a. are changed through chemical reactions.
b. confer specific chemical properties to the molecules to which they are attached.
c. have odd names.
d. are unrelated.
e. dating each other.

(3.6) The condensation reaction:

a. removes water.
b. squeezes fruits to form juices.
c. is a second order reaction.
d. proceeds rapidly in aqueous solution.
e. is illegal.

(3.6) Animals consist of amino acids of chirality:
a. R
b. L
c. C
d. D
e. S

(3.6) There are how many amino acids commonly found in nature?
a. 12
b. 20
c. 21
d. 36
e. 64

(3.6) Which is *not* one of the four basic types of macromolecules?
a. proteins.
b. carbohydrates.
c. nuclear acids.
d. lipids.
e. none of the above.

(3.6) If you needed a substance that was stronger in one direction than another, you could choose a:
a. glue.
b. cross-link.
c. isomer.
d. polymer.
e. weak link.

(3.6) Higher molecular weight compounds commonly have:
a. higher melting and boiling points.
b. locations in body appendages.
c. normal personalities.
d. smaller molecules.
e. nothing in common.

(3.6) Free radicals are *not*:
a. extremists out on bail.
b. destructive to cellular essential biochemicals.
c. deadly to microbes.
d. chemical garbage.
e. ameliorated with antioxidants.

(3.6) Macromolecule sieves separate one kind of molecule from another based on:
a. size.

b. appreciation.
c. application.
d. tilt.
e. appearance.

(3.6) Carbon is such an unusual element because
a. it has four electrons in the outer shell.
b. it can form ionic bonds.
c. it can bond to Argon.
d. all of the above.
e. none of the above.

(3.6) Compounds that exist in two twisted forms, each with identical chemical formula, but each that acts much different from the other form are called:
a. proteins.
b. organic.
c. stereo isomers.
d. all of the above.
e. none of the above.

(3.6) An important feature of reactions between organic compounds is:
a. they are extremely fast.
b. they involve hydrogen.
c. only part of the molecules may take part in the reactions.
d. coenzymes are required.
e. they proceed spontaneously.

(3.6) Triglycerides are composed of:
a. three glycerines
b. proteins with side chains.
c. long-chain fatty acids.
d. the remains from triceratops.
e. LDL and HDL.

(3.6) Antioxidants protect against the bad effects of:
a. engine corrosion.
b. vitamin overdoses.
c. high cholesterol.
d. free radicals in cells.
e. oxidation of red blood cells.

(3.6) Low C reactive protein (CRP) levels indicate:
a. low stress.
b. less likelihood of atherosclerotic plaque.
c. lower risk for heart disease.
d. lower risk for stroke.
e. all of the above.

(3.6) A triglyceride is composed of:
a. three glycerdides.
b. trigonometrical identities.

c. plenty of warm water.
d. long-chain fatty acids.
e. proteinacious molecules.

(3.6) Antioxidants help protect against effects of _____ inside the cell.
a. free radicals
b. pro-oxidants
c. uncle oxidants
d. floating ions
e. solute molecules

(3.6) High C Reactive Protein levels in the blood are associated with:
a. calmness.
b. vitamin C levels.
c. rapid chemical reactions.
d. antioxidant combinations.
e. atherosclerotic plaque.

(3.6) Composting requires:
a. anaerobic digestion.
b. soaking with water.
c. newspapers.
d. constant attention.
e. correct C:N ratio.

(3.7) At normal body pH, proteins are:
a. negatively charged.
b. positively charged.
c. uncharged.
d. supercharged.
e. simply unaware.

(3.7) In order to dissolve readily in water, a molecule should have:
a. carbon bonds.
b. hydrophobia.
c. at least regional electrical polarity.
d. tortuosity.
e. plenty to complain about.

(3.7) As temperature increases, solubilities of most solids, liquids, and gases:
a. increase, increase, increase
b. increase, increase, decrease
c. increase, decrease, decrease
d. decrease, decrease, decrease
e. increase, decrease, increase

(3.7) Even when evaporating, a liquid is still _____ to a certain extent.
a. ruminating
b. pontificating
c. aspirating
d. condensing

e. eulogizing

(3.7) Solutions freeze:
a. at a lower temperature than pure water.
b. over a range of temperature.
c. and concentrate solutes in the unfrozen part.
d. all of the above.
e. none of the above.

(3.7) Amino and carboxyl functional groups change polarity in the presence of hydrogen ions. Thus:
a. they inhabit interstellar space.
b. intracellular proteins can exhibit a net charge.
c. they are said to have mercurial characters.
d. amino and carboxyl groups are nonreactive.
e. they can form nucleic acids at high pH.

(3.7) Gels are important to living things because they:
a. form the internal structure of cells.
b. allow sodium ions to enter the cell by means of a sodium pump.
c. depend on liquid water to transfer complex organic compounds.
d. all of the above.
e. none of the above.

(3.7) The point at which the positive charges on the amino acid molecule exactly balance the negative charges is called the:
a. charge balance point.
b. equal charge point.
c. isoelectric point.
d. electroiso point.
e. isomer point.

(3.7) Proteins at the isoelectric point:
a. are not charged.
b. are minimally soluble.
c. have a net charge.
d. are unaffected by pH.
e. have the same charge as all other molecules.

(3.7) The cytoplasm inside a cell is packed with:
a. proteins and other molecules.
b. gelatin.
c. diatomaceous earth.
d. DNA.
e. care.

(3.7) Proteins trapped inside cell membranes impart:
a. dances with wolves.
b. a net negative internal charge at normal pH.
c. a feeling of stuffiness.
d. collapse of internal structure.

e. a feeling of isolation.

(3.7) The interiors of most cells are electrically negative compared with the interstitial fluid.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(3.8) Protein structure is maintained with the help of _____.
a. actin cytoskeleton
b. isoelectric point
c. molecular adhesion
d. hydrogen bonds
e. oxygen-containing compounds

(3.8) Misfolded proteins:
a. are stored in a safe place.
b. can substitute for other proteins.
c. are usually detected and destroyed or repaired.
d. form new shapes with unique functions.
e. are treated as origami.

(3.8) Chaperone molecules assist polypeptides during:
a. dating.
b. folding.
c. dancing.
d. trading.
e. stuttering.

(3.8) Heat stress proteins help to repair DNA damage due to:
a. heat.
b. chemical damage.
c. mechanical damage.
d. all of the above.
e. none of the above.

(3.8) One genetic repair mechanism involves:
a. heat stress proteins.
b. tiny carpenter elves.
c. Lepidoptera.
d. all of the above.
e. none of the above.

(3.8) Misfolded proteins detected as such are:
a. excluded from the cell.
b. cut into smaller pieces.
c. stored away where they cause no harm.
d. hidden among well-behaved proteins.
e. held back in school.

(3.8) Biomarkers are used as:

a. magic markers.
b. determinators.
c. signs of pill contents.
d. indirect chemical indicators.
e. twitterers.

(3.8) Proteins that are incompletely folded:

a. have no effect on cellular processes.
b. spontaneously disrupt further processing.
c. reject chaperone molecules.
d. can cause disease.
e. must go back through the process.

(3.8) Biomarkers are used to:

a. mark bios.
b. distinguish among different color worms.
c. indicate environmental stress levels.
d. demonstrate when electrophoresis is not valid.
e. teach fishing to the natives.

(3.8) The first stage in protein formation is:

a. hydrogen bonding.
b. amino acid substitution.
c. its unique sequence of amino acids.
d. an α-helix or pleated sheet.
e. folding on itself.

(3.8) Heat shock proteins do all of these but one. Which is *not* a function of heat shock proteins?

a. They can help a person sleep in hot weather.
b. They help fold amino acid chains into proper form.
c. They help dismantle damaged proteins.
d. They are an indication of environmental stress.
e. They help the immune system recognize foreign antigens.

(3.8) Fill in the blanks. _____ is cellular suicide, whereas _____ is cellular assassination.

a. necrosis, apoptosis.
b. apoptosis, necrosis.
c. apoptoblast, necrophilliation.
d. necrophilliation, apoptoblast.
e. death, punishment.

(3.8) Which is *not* a function of heat shock proteins:

a. help fold amino acid chains into proper form.
b. help damage proteins.
c. help escort proteins to combine with other molecules.
d. help immune system recognize foreign antigens.
e. are an indication of environmental stress.

(3.8) Cellular suicide is called _____, and cellular assassination is called _____.

a. necrosis, apoptosis
b. necrotomy, apoptomy
c. apoptosis, necrosis
d. death, killing
e. unfortunate, homicide

(3.8) Crowded conditions within cellular cytoplasm mean that:
a. cells are rigid.
b. it is difficult to identify constituent molecules.
c. chemical reactions proceed more slowly than in a test tube.
d. there is no room for actin cytoskeletons.
e. cell nuclei are squeezed.

(3.8) Prions have the unusual ability to:
a. form alpha helices.
b. cure diseases.
c. fold properly.
d. replicate without RNA or DNA.
e. be ejected from the cell.

(3.8) Because they can replicate without RNA or DNA, prions can possibly be used to:
a. take over the world.
b. form new animals, bacteria, and plants.
c. glue cells together.
d. form cancer tumors.
e. store and transfer information.

(3.8) An alternative to gene therapy is:
a. provide means for cells to fold proteins correctly.
b. alter DNA of somatic cells.
c. correct the genome of germ cells.
d. vaccination to protect against foreign antigens.
e. endocytosis.

(3.9) Enzymes act to:
a. set up organic compounds.
b. stress a molecule to its breaking point.
c. twist a carbon compound in a different way.
d. concentrate reactants locally.
e. be given treats.

(3.9) Enzymes act mainly by:
a. their shapes.
b. their interior charges.
c. themselves.
d. short hops.
e. their agents.

(3.9) Disrupting enzyme shape:
a. makes it ugly.
b. produces a coenzyme.

c. fluoresces.
d. interferes with its function.
e. makes it obese.

(3.9) One characteristic of enzyme action is that a large chemical change is usually:
a. impossible.
b. accompanied by a howling noise.
c. independent of the substrate.
d. brought about in small steps.
e. very rapid.

(3.9) ATP acts like a:
a. source of phosphate.
b. brat.
c. energy liberator.
d. chemical storage battery.
e. extreme energy reactor.

(3.9) The high charge concentration on the ATP molecule adds what to the cell?
a. protein strands.
b. order and structure.
c. positive electrical energy.
d. physicality.
e. identity.

(3.9) All glucose respiration has an anaerobic component.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(3.9) Aerobic respiration of each molecular glucose yields _____ATP, whereas anaerobic respiration yields____ ATP molecules
a. 36, 2
b. 2, 36
c. 2, 4
d. 8, 16
e. 32, 2

(3.9) Which of these is *not* a mechanism by which ATP helps maintain the order and structure of a cell?
a. hydrolysis.
b. phosphorylation.
c. charge density.
d. phosgene.
e. none of the above.

(3.9) Unstructured proteins:
a. are always detrimental to the eukaryotic cell.
b. can regulate enzymatic effectiveness.

c. must be folded correctly.
d. are very common in prokaryotic cells.
e. have no function whatsoever.

(3.10) ATP is:
a. the most energy-rich compound.
b. physically of little influence.
c. a temporary repository of energy in the cell.
d. adenosine tripotasphate.
e. of no consequence in neural impulse transmission.

(3.10) The presence of ATP in primitive forms of life suggests that it has a role in:
a. standard protein formation.
b. communications.
c. higher level formations.
d. PTA.
e. extremophiles

(3.10) The LeChatlier principle states that if a stress is applied to a chemical system, the system adjusts to maintain the stress.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(3.10) Exothermic reactions are less likely to occur in a:
a. hot environment.
b. cold environment.
c. bioreactor.
d. all of the above.
e. none of the above.

(3.10) Crickets chirp more rapidly in cold weather because:
a. metabolism is higher.
b. metabolism is lower.
c. they shiver.
d. none of the above.
e. all of the above.

(3.10) Which of the following molecules are *not* related to a glucose precursor?
a. cellulose
b. starch
c. glycogen
d. lineolic acid
e. chitin

(3.10) What do cud-chewing mammals and termites have in common?
a. They both have six legs.
b. They both communicate with their mouths.
c. They both utilize cellulose-digesting bacteria.

d. They both scamper around at night.
e. They both lie next to cool streams.

(3.11) Free energy expresses the idea that:
a. chemical reactions can occur spontaneously.
b. enzymes in the body don't cost anything.
c. equilibrium is a local concept.
d. living systems find their own food.
e. energy must be liberated in order to be effective.

(3.11) Materials with low surface activity energy are likely to:
a. remain at rest.
b. remain in the body without lipoprotein coating.
c. be unacceptable biomaterials.
d. drop their leaves.
e. attract surface coatings.

(3.11) Enzymes have _____ surface energy.
a. high
b. low
c. improbable
d. all of the above
e. none of the above.

(4.0) As population sample size increases, which of these would be expected to happen?
a. the sample mean would become farther from the population mean.
b. the sample mean would become closer to the population mean.
c. the variability of sample means would increase.
d. none of the above
e. all of the above

(4.1) When one variable is said to be equal to another, what is meant by this?
a. the two must have the same units.
b. the two may have the same magnitudes.
c. the two always have the same symbols.
d. one can always replace the other.
e. neither can be discriminated against.

(4.1) Dimensional analysis:
a. is used to reduce the number of needed experiments.
b. uses dimensional exponents to group variables.
c. can be used to form dimensionless groups.
d. all of the above.
e. none of the above.

(4.1) One difference between iteration and trial-and-error is that:
a. there is a method to iteration that allows it to converge on the correct answer.
b. iteration can be used to solve directly for variable values.
c. trial-and-error methods are never used by engineers.
d. iteration can be used to pick beauty contest winners.

e. iteration is never successful.

(4.1) The reason that probability distributions are used to describe biological properties and responses is that:
a. they can be used to confuse.
b. there is an element of apparent randomness to be dealt with.
c. they make promises exact.
d. probabilities alleviate most difficulties of living things.
e. probabilities are not concentrated at one value.

(4.2) One consequence of organism birth is:
a. learning has not yet taken place.
b. the species is reset close to its original genetic starting point.
c. there has been no opportunity for environment to influence gene expression.
d. university classes will be populated in another 18 years.
e. sexual fertilization has taken place.

(4.2) Chaotic systems are deterministic instead of probabilistic.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(4.2) Chaotic outcomes are:
a. disorganized in nature
b. slow to materialize
c. the result of many choices along the way
d. probable, given the facts
e. epigenetically derived.

(4.2) Many probabilities associated with biological systems are dependent probabilities. That is,
a. their values depend on other variables.
b. they have not yet reached the age of maturity.
c. at least two of them increase at the same time.
d. they depend on growth factors.
e. they don't have to pay income taxes.

(4.2) Two important descriptors of a Normal probability distribution are the:
a. average and mean.
b. mean and nasty.
c. exponent and probability.
d. mean and variance.
e. height and width.

(4.2) Beauty relates to scientific experiments in what way?
a. scientists are beautiful.
b. science can explain beauty.
c. both must balance order and randomness.
d. beautiful paintings are all analyzed scientifically.

e. labs are ugly.

(4.2) Fractals have the same features over a broad range of:
a. philosophies.
b. magnitudes.
c. broken bones.
d. geographical areas.
e. organisms.

(4.2) Chaotic systems are very sensitive to:
a. initial conditions.
b. snide remarks.
c. randomness and probability.
d. statistical analysis.
e. classroom statistics.

(4.2) Statistical procedures are used to:
a. determine exact values of Type I errors.
b. eliminate inaccuracy.
c. guide decisions.
d. eliminate models.
e. obfuscate.

(4.2) Before forming a least-squares equation, it is important to:
a. take a stiff drink.
b. turn on the computer.
c. read statistical texts.
d. graph the data.
e. learn how to do it.

(4.2) The Student's t-test is used to:
a. check differences of means.
b. test Student's t.
c. substitute for coffee.
d. generate numbers.
e. learn how to be a student.

(4.2) Statistics is used to:
a. characterize chaos.
b. separate random from nonrandom events.
c. confuse students.
d. check probability distributions.
e. play the game.

(4.2) What are some confounding experimental effects for which caution needs to be exercised when interpreting statistical results?
a. linked (non-independent) variables.
b. time-dependent effects.
c. learning effects.
d. all of the above.
e. none of the above.

(4.2) The Latin square design is used to:

a. statistically amortize effects.
b. randomize training effects.
c. fabricate colorful Samba clothes.
d. analyze data after the experiment.
e. dance fast.

(4.2) The linear least squares technique is used to produce a:

a. series of sums.
b. balanced curve through thoroughly.
c. graph of statistical variation.
d. mathematical expression from data with a random variation.
e. make small squares.

(4.2) A least squares equation cannot be used reliably to:

a. predict values outside the range of the data.
b. determine the general trend of data.
c. predict the value of dependent variable within the range of the data.
d. produce an empirical model relating the dependent and independent variables.
e. none of the above.

(4.2) Proper application of statistical procedures requires:

a. a calculator.
b. deciding the procedures before the data are seen.
c. graphing the data and then deciding what to do.
d. mathematical models based upon empirical results.
e. someone else who knows what she is doing.

(4.2) Using statistics,

a. random effects can be separated from nonrandom.
b. the result is absolutely certain.
c. group variations can be ignored.
d. drug treatments are found to be irrelevant.
e. smaller sample sizes are preferred to larger ones.

(4.3) Derivatives are used to describe, in mathematical terms:

a. the Lion King.
b. accumulated values.
c. rates of change.
d. fractals.
e. financial values.

(4.3) The unbounded growth of cell population numbers is mathematically described by an unbounded exponential curve. The exponent on the base of Naperian Logorithms in such an equation is:

a. negative.
b. positive.
c. no sign.
d. unbounded.

e. none of the above.

(4.3) Many biological responses conform to:
a. bounded exponential functions.
b. sinusoidal oscillations.
c. limits imposed by exobiology.
d. the normal response.
e. each other.

(4.3) The reason that responses of living things aren't often described by second order differential equations is that:
a. second order equations are hard to solve.
b. living things don't know about second order equations.
c. all second order equations result in sine waves.
d. the resulting periodic responses are not easily controlled.
e. second orders contain too many calories.

(4.4) Two kinds of control system communications in a complex animal organism are:
a. speaking and smelling.
b. transient and steady-state.
c. neural and hormonal.
d. sine and cosine.
e. myelinated and unmyelinated.

(4.4) Communication delays can result in:
a. instability.
b. sloth.
c. impatience.
d. autonomic functions.
e. forgetfulness.

(4.4) Sensory and motor nerves comprise the:
a. somatic nervous system.
b. central nervous system.
c. peripheral nervous system.
d. neuronal nervous system.
e. alternate nervous system.

(4.4) Responses by the sympathetic nervous system can be characterized by:
a. relaxation.
b. full of sympathy.
c. fight or flight.
d. cholinergic.
e. scientists.

(4.4) What is the difference between a nerve and a neuron?
a. there is no difference.
b. a nerve consists of many neurons.
c. they conduct in opposite directions.
d. one is a politically correct name for the other.
e. the placement in the dictionary.

(4.4) The action potential is transmitted across the synapse by means of a:

a. neurotransmitter.
b. postsynaptic potential.
c. autonomic response.
d. euphemism.
e. intracellular cleft.

(4.4) Myelinated neurons conduct:

a. orchestras and sympathies.
b. impulses faster than unmyelinated neurons.
c. present values of sensory inputs.
d. meetings attended by all kinds of neurons.
e. electrons.

(4.4) Neuronal conduction speed can be improved by:

a. rerouting.
b. reducing capacitance and resistance.
c. using non-myelinated neurons.
d. providing excess calcium ions.
e. running faster than the speed of light.

(4.4) Stability of a feedback control system can often be improved by adding:

a. a more solid base upon which to rest.
b. sensitivity to the rate of change of the input signal.
c. integral sensitivity.
d. an open loop.
e. an alcoholic beverage.

(4.4) Artificial neural networks are used to:

a. process information automatically.
b. interpose a hidden layer between input and output.
c. detect lies.
d. improve learning.
e. substitute for real neural networks.

(4.4) To produce a control system that automatically readjusts to changing system dynamics, use:

a. an adaptive control system.
b. a feedforward control system.
c. a open-loop control system.
d. a control knob.
e. the advice of a control engineer.

(4.4) Feedback and feedforward control systems both require:

a. control loops.
b. sensory information.
c. both of the above.
d. one, but not both.
e. neither.

(4.4) All control systems need:

a. feedback or feedforward.
b. proportional sensors.
c. communication system.
d. adaptive control.
e. an operator.

(4.4) Transducers, or biological sensors, change one type of signal into:

a. electrical impulses in the nervous system.
b. chemical signals that circulate as hormones.
c. another type that is more easily manipulated or communicated.
d. second messengers.
e. first messengers/

(4.4) A major impediment to a controlled insulin drug delivery system for diabetics is the unmet need for:

a. a major supply of insulin.
b. a means to implant the system in the pancreas.
c. an energy supply.
d. a reliable and reproducible glucose sensor.
e. enough participants.

(4.4) In addition to the signal level, biological receptors are also often sensitive to:

a. the rate of change of the signal.
b. things said about them.
c. mispronunciation of their names.
d. signal history.
e. their weight and age.

(4.4) A very sensitive receptor type is the:

a. bitter taste receptor.
b. glory be receptor.
c. amplifer receptor.
d. second messenger receptor.
e. first messenger receptor.

(4.4) Connections between a specific molecule and the cell surface are made through:

a. surface irregularities.
b. surface recepticles.
c. ligands.
d. legends.
e. attachment points.

(4.4) When actin and myosin filaments slide past each other:

a. twitching is either fast or slow.
b. the muscle contracts.
c. an accident is avoided.
d. the saccharin shortens.
e. there is no collision.

(4.4) Fast twitch muscle fibers differ from slow twitch fibers in:

a. the size of the motor unit.
b. predominantly using aerobic or anaerobic metabolism.
c. that slow twitch fibers fatigue more rapidly.
d. that fast twitch fibers have more mitochondria.
e. slow twitch fibers don't ever win the race.

(4.4) Transmission of a signal from one neuron to the next in the brain occurs in about:
a. 100 fsec
b. 100 psec
c. 100 nsec
d. 100 msec
e. 100 sec

(4.4) The synaptic cleft in the brain is about:
a. 50 fm
b. 50 pm
c. 50 nm
d. 50 mm
e. 50 m

(4.4) The synaptic time delay in brain neurotransmission is:
a. very long; about 0.3 – 100 sec.
b. perpetual; never ending.
c. really cozy; 30 – 50 nm.
d. very short; about 0.3 – 100 msec.
e. planned; configuratively.

(4.4) Knowing that cell membranes have locations that bind with specific molecular shapes:
a. helps students learn about biology.
b. gives something else to worry about.
c. can form the basis for modern drug therapies.
d. is of no value whatsoever.
e. has scientists concerned.

(4.5) Why would living things be expected to optimize the way they do things?
a. optimization decreases efficiency.
b. energy not spent on other things can be used for reproduction.
c. graphing processes may be shallow or deep.
d. there is no survival advantage.
e. that's just the way it is.

(4.5) Which optimum type has the greater penalty for deviations from the optimum point?
a. shallow.
b. deep.
c. suspension.
d. farther away.
e. none of the above.

(4.6) Very sensitive receptors would be expected to:
a. be overwhelming.
b. have careful placement.

c. limit noise.
d. require relatively high energy expenditure.
e. be expensive.

(4.6) The less probable an event is, the more _____it conveys.
a. information
b. chance
c. reality
d. beauty
e. unreality

(4.6) Entropy of a codon is proportional to $\log_2$ (64). Entropy of an amino acid is proportional to:
a. $\log_2$ (64)
b. $\log_2$ (20)
c. $\log_2$ (1)
d. it depends on the length of the amino acid
e. none of the above.

(4.6) Information is directly related to:
a. the number of printed words.
b. order and entropy.
c. the inverse of free energy.
d. chaotic discrimination.
e. who is talking.

(4.6) Stress requires energy to cope. Therefore, less energy will be available during stress to:
a. sleep.
b. process information.
c. play music.
d. smoke correctly.
e. walk or run.

(4.6) The smaller the probability of an event,
a. the smaller is the event.
b. the larger is the source of the event.
c. the better it is.
d. the more stuff it contains.
e. the more information it contains.

(4.6) Microbes in and on the body are often so important that without them the organism:
a. feels clean.
b. cannot function at all.
c. must search them out.
d. cannot thrive.
e. cannot identify its parents.

(4.6) In addition to the genome as a means to store and pass information from one generation to the next,
a. there is no other way to store information needed for subsequent generations.

b. robotic instructions can be used to provide information.
c. saving the genome without changes is of utmost importance.
d. having an alternative means would be nearly impossible.
e. the normal complement of microbes present in and on the body can also pass information in a parallel way.

(4.7) Analog signal processing differs from digital signal processing in that:
a. analog processing always precedes digital processing.
b. meaningful analog information is found between signal extremes whereas digital information is found at the extremes.
c. analog signals are faster than digital signals.
d. meaningful digital information is found between signal extremes whereas analog information is found at the extremes.
e. none of the above.

(4.7) Myelin sheathes around neurons:
a. appear to be grey.
b. allow faster signal conduction speed.
c. convert analog to digital signals.
d. are present in all neurons.
e. surround the dendrites.

(4.7) Different parts of the neuron have different processing functions. One of these is:
a. analog to digital conversion in the axon.
b. analog signal processing in the axon.
c. digital signal processing in the dendrites.
d. analog signal processing in the dendrites.
e. none of the above.

(4.7) Analog signal processing differs from digital signal processing in all *but* the following:
a. all analog information occurs between extreme values.
b. digital signals occupy discrete levels.
c. noise is of less consequence with digital signals compared to analog signals.
d. analog signals that require one channel (pathway) may require many channels if converted into digital form.
e. efficient biological sensors first process signals digitally and then convert the signals to analog form.

(4.7) The neuron itself functions as an analog processor, analog-to-digital converter, and:
a. pulsar.
b. digital signal transmitter.
c. analog signal transmitter.
d. action potential dampener.
e. Brobdingnagian behemoth.

(4.7) Analog signal processing occurs in the neuron_____, whereas digital signal processing occurs in the _____.
a. dendritic tree, axon
b. membrane, nucleus
c. soma, myelin
d. principle component, computer

e. cell body, dendrite

(5.0) Above all else, biology is about biochemicals that can:
a. replicate.
b. exist.
c. capture energy.
d. mimic.
e. possess funny names.

(5.0) What is the primary goal of life?
a. living well.
b. survival and reproduction.
c. domination.
d. cooperation.
e. competition.

(5.0) Counting on living things to remain the same often is:
a. a good bet.
b. a reasonable expectation.
c. an unequivocal response.
d. a mistake.
e. an unintended consequence.

(5.0) Redundancy makes life:
a. ineffective.
b. very robust.
c. duplicitous.
d. relatively formative.
e. very boring.

(5.1) Function of a part of a living system can be inferred from:
a. your neighbor's yard.
b. the form of the part.
c. cytoplasmic turbulence.
d. the rest of the living system.
e. its sale price.

(5.1) If one species has developed an effective survival strategy against predators, then:
a. other species may evolve to appear like that species, even if they do not have the same protective strategy.
b. that species will not evolve.
c. predators of that species will either starve or find other suitable prey.
d. that species will have no limits to its population growth.
e. that species will be able to out-run or out-fly its predators.

(5.2) Dogs have noses and cats have noses. From this we can infer that:
a. their common ancestor probably had a nose.
b. both can get colds.
c. dogs' noses are superior.
d. it is easy to tell their front ends from their hind ends.
e. they smell good.

(5.2) Incremental changes occur in:
- a. evolution.
- b. behavior.
- c. learning.
- d. all of the above.
- e. none of the above.

(5.2) Mitochondral DNA:
- a. comes from the mother.
- b. is the same as nuclear DNA.
- c. is protected from mutation.
- d. all of the above.
- e. none of the above.

(5.2) When new species appear, they are clearly different from older species.
- a. true
- b. false
- c. maybe
- d. all of the above
- e. none of the above

(5.2) Intermediate evolutionary forms were:
- a. easily found in rock strata.
- b. better suited to reproduce than the forms that replaced them.
- c. temporarily better suited to reproduce than the forms they replaced.
- d. able to survive despite large genetic changes.
- e. always found in between prior and later forms.

(5.2) ATP is almost universally used as an energy-storage and transfer molecule. Because living things are constantly changing, it can be inferred that ATP is:
- a. anachronistic.
- b. very ancient.
- c. preventable.
- d. cheap.
- e. related to sports.

(5.2) When breeding for a desired trait in an animal using traditional methods:
- a. genetic material can be ignored.
- b. one can develop the trait even if not originally present.
- c. evolution ceases.
- d. the trait must be present naturally in some form.
- e. the trait must be dominant.

(5.2) Small adaptations are made more easily than:
- a. pie.
- b. large changes.
- c. behavioral changes.
- d. vasoconstriction.
- e. other adaptations.

(5.2) Nasal drift was possible because:
a. a different nasal location was evolutionarily advantageous.
b. the animal had a cold.
c. whales no longer lived on land.
d. the animal had a Roman nose.
e. there were plastic surgeons present.

(5.2) Honeybees can adapt to parasitic mites as long as the mites:
a. have ineffective defenses.
b. go back where they came from.
c. evolve along with the bees.
d. do not kill all the bees.
e. are cooperative.

(5.2) What is *not* a function performed by hemoglobin:
a. it transports oxygen to places where needed.
b. it reduces oxygen toxicity.
c. it helps to acquire oxygen.
d. it forms porhyrins.
e. it binds oxygen and transports it.

(5.2) After cancer cells have been exposed to a chemotherapy drug,
a. they are no longer clean.
b. they can recognize brand names.
c. they can develop dependency.
d. they can develop resistance.
e. they are always all killed.

(5.2) Unless there is a survival or reproductive cost to their retention, vestigial organs:
a. will be retained.
b. will be lost.
c. will shrink.
d. will be rejuvenated.
e. will no longer be vestigial.

(5.2) The difficulty with cancer treatments is that cancer cells surviving the first round of treatment:
a. cannot communicate by quorum sensing.
b. have nowhere else to go.
c. are more difficult to kill.
d. no longer metastasize.
e. face trial by fire.

(5.2) Cancer cells surviving the first round of chemotherapy drugs are:
a. younger.
b. more difficult to kill.
c. pleasantly surprised.
d. unbiased in their reactions.
e. highly regulated.

(5.3) The maximum number of nucleic acid bases in a pair of codons is:

a. 3
b. 6
c. 24
d. 128

(5.3) DNA is the fabricator of proteins.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(5.3) DNA begets RNA; RNA begets proteins; proteins act as:
a. structural building blocks.
b. RNA controllers.
c. DNA regulators.
d. enzymes.
e. all of the above.

(5.3) Because there are 20 common amino acids and 4 nucleotide bases, the minimum number of bases to specify each amino acid is:
a. 1
b. 3
c. 5
d. 10

(5.3) Transfer RNA functions similar to:
a. codons.
b. messenger RNA.
c. a dog finding a thrown stick and returning it.
d. antidepressants.
e. ribosomal RNA.

(5.3) The four genetic bases are CTAG. Of these,
a. C is the most common.
b. C will only combine with G and T with A.
c. it takes all four to form a codon.
d. T cannot appear next to A.
e. all are pyramidines.

(5.3) Proteins are formed in structures called:
a. protein factories.
b. ribosomes.
c. mitochondria.
d. nuclei.
e. lysosomes.

(5.3) "Nothing is ever as simple as it looks." This statement applies to:
a. DNA function.
b. RNA function.
c. protein formation.

d. all of the above.
e. none of the above.

(5.3) Offspring of a completely homozygous parent must all receive the same set of genes from that parent
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(5.3) Dominant and recessive genes are:
a. one very simple case.
b. the same.
c. neither seen in the phenotype.
d. haploid.
e. made by Levi's.

(5.3) Same gene, different expression. Possible?
a. yep
b. nope
c. maybe
d. all of the above
e. none of the above

(5.3) Mutations in genetic material are:
a. entirely random.
b. entirely not random.
c. entirely not occurring.
d. more likely in certain regions of the chromosome than others.
e. of no consequence.

(5.3) RNA interference can be used to:
a. cry "foul!"
b. get in the way of RNA action.
c. influence genetic expression.
d. transform mRNA into iRNA.
e. score unearned runs.

(5.3) PCR can be used to:
a. duplicate genetic material.
b. Play Creative Recordings.
c. destroy RNA.
d. lengthen chromosomes.
e. program CD Roms.

(5.3) Mutations directly change:
a. genetic code.
b. chances to live.
c. eukaryotic RNA.
d. protein function.

e. outlook.

(5.3) Human and animal antibodies are composed of two regions. One is a constant region that links to other body proteins. The other is a variable region that links to:
a. yet other body proteins.
b. the internet.
c. foreign substances.
d. specific polysachharides.
e. specific organelles.

(5.3) Mutations occurring in the variable region of antibodies are:
a. less likely to link to proteins.
b. more likely than in the constant region.
c. normally of no consequence.
d. all of the above.
e. none of the above.

(5.3) Nucleic acid A will only link to nucleic acid T. That means that A will not be located next to C.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(5.3) Nonrandom mutations likely give the organism:
a. a shorter life span.
b. a selective survival and reproductive advantage.
c. some interesting things to talk about.
d. a severe disability.
e. a severe headache.

(5.3) Viruses transfer RNA into a linked host cell to:
a. produce new viruses.
b. be rid of toxic RNA.
c. be able to mutate.
d. kill the host cell.
e. be altruistic.

(5.3) Error-checking and repair for RNA replication is more effective than it is for DNA.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(5.3) A plasmid is:
a. genetic material not part of the chromosome.
b. present in eukaryotic cells.
c. never to be trifled with.
d. responsible for reproduction.

e. the portion of the blood after the cells are removed.

(5.3) You would buy plasmids to:
a. exchange with other plasmid collectors.
b. inject into bacteria.
c. improve a blood bank.
d. duplicate genes already present.
e. corner the market.

(5.3) Autism is especially likely in families of:
a. engineers and physicists.
b. accountants and tax collectors.
c. social workers.
d. circus performers.
e. alcoholics.

(5.3) Damage to DNA is intentionally caused when such damage:
a. can protect the public from Kudzu vines.
b. produces humans interesting to talk to.
c. amuses mad scientists.
d. can sterilize food.
e. has little effect.

(5.3) Cross-breeding and selecting for desired traits has the advantage of:
a. giving time to see if things work out.
b. introducing homogeneity.
c. introducing additional genetic variation.
d. giving breeders something to do.
e. allele-ifying the species.

(5.3) Genes that have no particular advantage to an organism may be retained in the genome if they:
a. mutate spontaneously.
b. confer no particular disadvantage.
c. interfere with survival and reproduction.
d. code for vestigial organs.
e. are on sale.

(5.3) Dominant and recessive genes are:
a. the types of genes.
b. made up of ribonucleic acids.
c. the simplest case of genetic determination.
d. distinguished by different bases.
e. the only possible choice.

(5.3) Gene expression can be influenced by:
a. learning.
b. other genes.
c. environmental conditions.
d. RNA interference.
e. all of the above.

(5.3) A retrovirus:
- a. copies its genetic code from its RNA to the DNA of the host.
- b. infects primarily older people.
- c. cannot be used in gene therapy.
- d. possesses a hard outer coating.
- e. can talk.

(5.3) The Ames test requires:
- a. a microbe unable to survive by itself.
- b. at least 50 questions.
- c. mutaplasticity quotient.
- d. multitiered Petri dishes.
- e. Dr. Ames himself.

(5.3) Genetic variation is useful in order to:
- a. give all organisms the same reproductive advantage.
- b. preserve genetic material from extinct species.
- c. adapt to different environmental conditions.
- d. question senescient beings.
- e. have something to present in class.

(5.3) Chloroplast DNA and mitochondral DNA are the same.
- a. true
- b. false
- c. maybe
- d. all of the above
- e. none of the above

(5.3) Biochips containing cells with DNA, proteins, peptides, or antibodies can be used to:
- a. serve as a condiment.
- b. correlate form with function.
- c. facilitate backgammon games.
- d. form the basis of a biocomputer.
- e. detect target DNA.

(5.3) Epigenetic effects can be felt for:
- a. goodness sake.
- b. many hours.
- c. mechanoreceptors.
- d. many generations.
- e. xenophobics.

(5.3) Methylation of genes in response to environmental factors can be passed down to future generations. This is called:
- a. epigenetics.
- b. exobiotics.
- c. genetic tampering.
- d. neurotransmitting.
- e. RNA interference.

(5.3) _____ _____ cells have paired chromosomes with different alleles on each chromosome.

a. Diploid heterozygous
b. Haploid homozygous
c. Quadraploid omnizygous
d. Uniploid memozygous
e. Paniploid nanozygous

(5.3) Eukaryotic cells have stranded chromosomes with two ends, whereas prokaryotic cells have _____ chromosomes with _____ ends.

a. two, some
b. circular, no
c. helical, two
d. flat, three
e. various, twice as many

(5.3) Each human chromosome, if stretched out, would reach:

a. to the cell wall.
b. from one end to the other.
c. about 2 meters long.
d. out and touch someone.
e. chromosomes can't be stretched out.

(5.3) Mammalian genomes contain some genetic material from:

a. other somatic cells.
b. bacterial infections.
c. their future progeny.
d. viruses.
e. land mites.

(5.3) One problem with agricultural monoculture is the possibility of:

a. monotony.
b. bigamy.
c. too much profit.
d. species extinction.
e. devastating disease.

(5.3) Introns are:

a. plastic appendages.
b. presents for gnomes.
c. instructions for computer programs.
d. noncoding portions of DNA.
e. robotic genomic analyses.

(5.3) The amazing thing about epigenetics is that:

a. they are present at all time.
b. environmentally-caused modifications to the genome can be passed from one generation to the next.
c. they are permanent.
d. the word can be spelled by 55% of the class.
e. without them there could be no genome.

(5.3) Introns are:

a. plastic appendages.
b. presents for gnomes.
c. portions of genomic DNA that do not code for protein formation.
d. autogenic plasmid cycling proteins.
e. gel-like structures within the cell numcleus.

(5.3) The amazing fact about epigenetics is that:

a. the word "epigenetics" includes the shorter word "pig".
b. they were discovered in the early 1900's.
c. epigenetic genes have no effect on their cells.
d. environmentally-caused modifications to the genome can be passed from one generation to the next.
e. people who have epigenetic modifications have no way of knowing which genes have been epigenicized.

(5.3) A DNA molecule can be described as:

a. soft and curly.
b. long and stiff.
c. composed of proteins.
d. never coming when you want it to.
e. having lots of pretty colors.

(5.3) Which is *not* a real type of RNA?

a. messenger RNA (mRNA).
b. transfer RNA (tRNA).
c. epithelial RNA (eRNA).
d. short interfering RNA (siRNA).
e. linear noncoding RNA (lincRNA).

(5.3) Human characteristics are determined to varying degrees by both their genetic code and their environment.

a. true
b. false
c. maybe
d. all of the above
e. none of the above

(5.3) The Hox genes are common to most animals and determine:

a. sex.
b. epigenetic ameliorations.
c. where to live.
d. body configuration.
e. none of the above.

(5.3) DNA strands are not free to arrange themselves haphazardly within the cell nucleus. Instead they:

a. are stacked up like firewood inside the cell nucleus.
b. are arranged cross-wise within the cell.

c. are excluded from the nucleus except when needed.
d. stick out from the cell membrane as ligands.
e. are wound around protein cores to form nucleosomes.

(5.3) Gene expression in the cell is enhanced by:
a. wrapping around histone proteins.
b. methylation.
c. gene deletion.
d. letting DNA strands float freely within the cell nucleus.
e. none of the above.

(5.3) Non-coding RNA differs from coding RNA in that non-coding RNA:
a. is the same as coding RNA.
b. does not serve as a template for protein formation.
c. is not transcribed.
d. is always linear in form.
e. has no effect on epigenetics.

(5.3) Hox genes determine:
a. where an animal is headed.
b. depression of Hix genes.
c. body configuration.
d. twinning.
e. none of the above.

(5.3) Methylation of cytosine in nucleic acids:
a. happens only occasionally.
b. is of no consequence.
c. cannot happen without epigenetic changes in thymine.
d. is the basis for determining the age of human remains.
e. leads to the formation of methyl alcohol.

(5.3) Single-stranded binding protein (SSB) is important for:
a. binding two single DNA strands together.
b. separating DNA strands.
c. determining the proper direction of DNA.
d. inserting histone proteins along a DNA strand.
e. repair of hairpin defects in single-stranded DNA.

(5.4) If two species are to coexist,
a. they must like each other.
b. each must have a different ecological niche.
c. they must form a symbiotic relationship.
d. neither can be aware of the other.
e. there must be a treaty.

(5.4) Evolution by jerks and creeps describes:
a. how evolution contributes to our daily lives.
b. the way conservatives think about evolution.
c. two alternative theories about evolution.
d. the selection process.

e. an open discussion.

(5.4) BU will grow and reproduce to the extent allowed by:
a. the environment.
b. the law.
c. the social system.
d. the rich uncle.
e. the space available.

(5.4) When competition among BU becomes severe:
a. everybody loses.
b. so does altruism.
c. name-calling gets out of hand.
d. selection becomes more critical.
e. there are no winners.

(5.4) Genetic material lost to a population,
a. is generally unrecoverable.
b. must be found.
c. is reproduced with time.
d. has no replacement.
e. can be recovered if a large-enough reward is offered.

(5.4) Because of competition and natural selection among living things, living things are continually better adapted to their environments, unless:
a. environmental conditions change.
b. lost genes are spontaneously recovered.
c. humans intervene.
d. evolution reverses.
e. there is no alternative.

(5.4) Because of competition and natural selection among organisms,
a. they all thrive.
b. future generations will become less well adapted.
c. genetic material will live on.
d. competition becomes more keen as time goes by.
e. the price falls rapidly.

(5.4) Darwin's ideas were so revolutionary because:
a. he was the first to describe evolution.
b. he was the first to base evolutionary theory on observations.
c. purpose and meaning were removed from organism interrelationships.
d. his data were observed in the Southern Hemisphere.
e. he became a leader in the revolutionary war.

(5.4) Why are evolutionary "missing links" so hard to find?
a. they are too unattractive to reproduce.
b. they are used for food by more advanced forms.
c. intermediate forms are eventually competitively disadvantaged.
d. they hide among the reeds.
e. no one is paid to find them.

(5.4) The body, it is said, is just:
a. composed of 20 essential elements.
b. meant to reproduce.
c. as ugly as sin.
d. a way for genes to survive another generation.
e. a place to hang clothes.

(5.4) Natural selection cannot happen unless_____ is present.
a. a lawyer
b. biodiversity
c. chocolate
d. a purpose
e. a mortgage

(5.4) Future evolution in humans may involve:
a. manes.
b. memes.
c. mimes.
d. mums.
e. mints.

(5.4) Information storage in living things resides in:
a. gemes and genes.
b. memes and genes.
c. genes and reins.
d. spleens greens.
e. all of the above.

(5.4) Many species of birds best learn their songs when they interact with other birds. This is an example of:
a. adaptive occlusion.
b. memes in action.
c. social perspicacity.
d. randomness in great music.
e. genetic proclivity.

(5.4) Transposons can jump from one place in a chromosome to another. When this happens,
a. a hole is left in its original location.
b. the gene is destroyed.
c. the gene is copied in its original location.
d. other genes jump, too.
e. other genes organize protests.

(5.4) Gamete killer genes exemplify:
a. the competition among individual genes.
b. the best of the world to come.
c. extirpation of all spores.
d. corrective action taken by cellular cytoplasm.
e. mob inheritance.

(5.4) Hamilton's Rule applies to:

a. the cost to benefit ratio of allocating resources to a relative.
b. measurement of Hamilton College graduates.
c. the Island Rule.
d. survival of the fittest.
e. financial dealings.

(5.4) The probable degree of genetic relation between a child and a grandparent is:

a. 1.0
b. 0.5
c. 0.25
d. 0.125
e. 0.122

(5.4) The sanctuary strategy is used to prevent or delay:

a. prisoner arrest.
b. resistance development.
c. Bt corn profits.
d. antibiotic usage.
e. extinction of species.

(5.5) Biological units (BU) can be everything *but*:

a. tissues.
b. populations.
c. microbes.
d. subcellular organelles.
e. all of the above.

(5.5) The cell is surrounded by a _____membrane:

a. momomolecular layer
b. proteinaceous
c. hydrophillic
d. hydrophobic
e. hemodynamic

(5.5) One way that Prokaryotes differ from eukaryotes is that prokaryotes have:

a. mitochondria.
b. plasmids.
c. a cell nucleus.
d. no membrane.
e. chloroplasts.

(5.5) The surface of the cell has special attachment sites called:

a. ports.
b. ligands.
c. knots.
d. lizards.
e. holes.

(5.5) Actin filaments form the _____of cells:

a. cytoskeletons
b. insides

c. membranes
d. nuclei
e. tRNA

(5.5) Cell fusion may be the mechanism to form specialized tissue from:
a. stem cells.
b. cell components.
c. hydrogen.
d. materials with high surface energy.
e. heavy water.

(5.5) Life is more easily described than:
a. found.
b. illustrated.
c. defined.
d. processed.
e. eaten.

(5.5) A definition of life *cannot* help with:
a. legal issues.
b. the limits of biological science.
c. defining differences among BU.
d. classifying entities that have some but not all, characteristics of life.
e. my Facebook page.

(5.5) Autotrophs are those organisms that:
a. do not need energy sources.
b. are primary in the food chain.
c. drive cars.
d. are independent.
e. have blood-borne diseases.

(5.5) Organisms may be classified according to their sources of:
a. light and weight.
b. size and density.
c. talent and ambition.
d. energy and carbon.
e. yin and yang.

(5.5) Of the cells on a human form:
a. most are dead.
b. only 10% are human in origin.
c. nearly 60% are ectoderm.
d. the vast majority are human.
e. some get lost.

(5.5) Trophic levels may be integer or fractional, depending on:
a. temperature of the environment.
b. whether species are terrestrial or aquatic.
c. buttons on an elevator.
d. feeding patterns of higher level organisms.

e. mathematical definition.

(5.5) A genetically-engineered cell exhibiting behaviors vastly different from the line of cells it came from is an example of:
a. teen-age biology.
b. new-age biology.
c. sympathetic biology.
d. symphonic biology.
e. synthetic biology.

(5.5) Of the 10^{14} cells associated with the human body, only 10^{13} of them are:
a. of human origin.
b. without sight.
c. nucleated.
d. bacterial.
e. often late for class.

(5.5) Cell outside membranes have two layers, composed of proteins on the inside and _____ on the outside.
a. hydrophilic lipids
b. proteins
c. moats
d. ligands
e. phospholipids

(5.5) Synthetic genes are meant for:
a. synthetic cells.
b. false eyelashes.
c. production of profitable proteins.
d. everybody with a red car.
e. easing into ecological engineering.

(5.5) Ten percent of all the cells in and on the human body are:
a. dangerous.
b. without nuclei.
c. chimera.
d. of human origin.
e. alert at all times.

(5.6) Biology may seem to be complex, but living things seem to conform to many:
a. unwritten legal constructs.
b. simple rules.
c. other living things.
d. testing procedures.
e. social constraints.

(5.6) Biomaterials are composed of complex interactions among:
a. simple building blocks.
b. populations of like organisms.
c. heterogeneous biomolecules.

d. laws of physics.
e. biological engineers.

(5.6) The complexity of cellular processes comes from:
a. the genomity.
b. RNA interference.
c. the many incremental steps that comprise the entire process.
d. the way the processes are drawn.
e. many variants.

(5.6) Names like *benchwarmer, cheapdate,* and *tiggywinklehedgehog* illustrate what about the naming of genes?
a. the process is rigidly enforced.
b. there are few names that can be used.
c. genes would be much better if these names were not used.
d. fruit flies are the objects of amusement.
e. naming is done freely by imaginative discoverers.

(5.6) Ecological balance in nature can depend upon intricate interrelationships. This can be illustrated by:
a. wolves, elk, aspens, and beavers in Yellowstone Park.
b. antibiotic resistant bacteria.
c. the lack of life on the moon.
d. the way boys look at girls and girls look at boys.
e. the way members of sports teams play together.

(6.0) Why must the entire biological system and its environment be considered when applying engineering to living things?
a. living things are complex and interactive.
b. living things tend to isolate themselves.
c. living things are controlled by DNA.
d. living things act independently.
e. living things have weird relatives.

(6.0) Biological units can represent:
a. people.
b. livers.
c. bee hives.
d. wetland ecosystems.
e. all of the above.

(6.0) The physico-chemical and biological environment for a BU determines:
a. the total response of the BU.
b. a means to study excommunication.
c. the context for BU adaptation.
d. diurnal cycles related to tides.
e. all stochastic biological models.

(6.0) Forms of life found in anoxic, very hot, very cold, or climatically toxic environments are called:
a. crazy.
b. extremophiles.

c. dead.
d. quirks of nature.
e. friends.

(6.0) Biological equilibrium is the same as thermodynamic equilibrium.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.0) Extremophiles are *not*:
a. net energy producers.
b. food sources.
c. sources of biochemicals.
d. all of the above.
e. none of the above.

(6.0) The difference between macroecology and microecology is that:
a. environment is not important for microecology.
b. there is no adaptation.
c. they differ qualitatively.
d. they have different size scales.
e. they are spelled differently.

(6.0) One unintended consequence of suppression of an internal parasite could be:
a. the appearance of other parasites.
b. a very healthy individual.
c. cancer.
d. personality disruption.
e. large medical bills.

(6.1) Water is essential to life because:
a. it is palor.
b. it has a high specific wetness.
c. it can dissolve anything.
d. it has a range of unique physical and chemical properties.
e. it does not freeze in hot weather.

(6.1) Hydrogen bonding in water causes:
a. some water molecules to be like parents and others like children.
b. hydrogen to be trapped.
c. moving water molecules to roll over each other rather than slide by each other.
d. viscosity fluctuation.
e. absolutely nothing.

(6.1) Which is *not* a means for desert animals to conserve water:
a. moving to shady locations.
b. excreting very concentrated urine.
c. drinking more.

d. metabolizing carbohydrate.
e. remaining inactive during the hot day.

(6.1) One way a desert BU can be distinguished from an aquatic BU is that:
a. desert BU cannot swim.
b. the outer covering of an aquatic BU is much more permeable to water.
c. aquatic BU have no words to describe “dry”.
d. aquatic BU have a higher sensitivity to temperature changes.
e. desert BU have different enzyme functions.

(6.1) The outer surface of the skin of animals and the cuticle of plants serve what purpose?
a. they make them look less disgusting.
b. they give a better flavor.
c. they conserve internal moisture.
d. they allow the production of vitamin D.
e. they give space for tattoos.

(6.2) Facultative organisms are capable of:
a. teaching.
b. anaerobic metabolism.
c. producing oxygen.
d. slowing progress.
e. living in residential neighborhoods.

(6.2) Hospital ventilators must be adjusted to supply additional oxygen in cases of:
a. hyperoxia.
b. severe injury.
c. tachycardia.
d. usury.
e. alcoholism.

(6.2) Life at high altitudes cannot be sustained because the amount of oxygen relative to other atmospheric gases decreases with elevation.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.2) If a little oxygen is good for a BU, a lot of oxygen is better.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.2) Oxygen supply in a composting operation can serve two functions. The first is to sustain aerobic metabolism. The other is to:
a. sustain anaerobic metabolism.
b. decrease density.
c. increase nutrient value.

d. remove heat.
e. combine with hydrogen.

(6.2) Organisms that live without oxygen
a. are not able to release the maximum amount of energy in a substrate.
b. are called faculty.
c. are not likely to die in the presence of oxygen.
d. cannot live long.
e. are blue.

(6.2) Of oxygen lack or carbon dioxide presence, to which is the human body more sensitive?
a. oxygen.
b. carbon dioxide.
c. all of the above.
d. none of the above.
e. really, really none of the above.

(6.3) Of the 24 elements essential for life, none are:
a. heavier than iodine.
b. lighter than nickel.
c. chemically active.
d. able to exist in elemental form.
e. happy with their lot.

(6.3) Fats are more concentrated sources of energy than are carbohydrates because:
a. fats contain two hydrogen atoms for each oxygen atom.
b. fats are produced by obese BU.
c. fats have exotic structures.
d. energy also comes from oxidation of hydrogen contained in fats.
e. there is no particular reason.

(6.3) Essential fatty acids are necessary for:
a. cleaning solutions.
b. promoting infertility.
c. proper health.
d. converting nonessential fatty acids.
e. making soap.

(6.3) Vitamins do not supply metabolic energy
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.3) One beneficial result of bacteria growing in the gut is that they synthesize vitamins that can be used by the host. These vitamins are:
a. cheap.
b. ascorbic acid.
c. sources of energy.
d. biochemicals essential for proper metabolism.

e. strongly associated with sports talent.

(6.3) Synthetic growth media for a bioreactor often contain:
a. plenty of water.
b. natural fluids and solutes.
c. alcohol.
d. principal components.
e. no unnatural ingredients.

(6.3) When developing new foods, which of these factors must be taken into account:
a. where it will be eaten.
b. flavor and heat stable nutrition.
c. consumer culture.
d. all of the above.
e. none of the above.

(6.3) The source of the nutrient nitrogen in animals is usually called:
a. popcorn.
b. protein.
c. peptide.
d. prolactin.
e. pemmican.

(6.3) If a man-made element (atomic number 152) were found, it is likely that:
a. it could replace oxygen.
b. it could replace neon.
c. it could replace nitrogen.
d. it would add a lot of weight in BU.
e. it would be pretty, very pretty.

(6.3) If there is an element that plants do not use in their life processes (metabolism), you would expect animals would:
a. require a large amount of that element.
b. not need that element, either.
c. have completely forgotten about it.
d. not require much of that element.
e. eat more plants.

(6.3) Human evolution has been and continues to be influenced by:
a. the clothes we wear.
b. diet.
c. politics.
d. ancestors.
e. personal preferences.

(6.3) Human brains have gotten larger over many generations. This trend has had to be accompanied by:
a. hubris.
b. neural paring.
c. genes to accommodate higher levels of carbohydrate intake.
d. milk drinking.

e. know-it-alls.

(6.3) Lactase is present in most human babies. This enzyme persists into adulthood for humans who:

a. grew up in Asia.
b. tend sheep.
c. prefer not to mature.
d. descended from ancestors who drank milk.
e. insist on keeping it.

(6.3) One compelling reason to believe that dinosaurs could maintain nearly constant body temperatures is that:

a. fossil records still have temperatures that can be extrapolated back to the time when they roamed the Earth.
b. such large dinosaurs could not have cooled much even in freezing temperatures.
c. fermentation of fibrous material in the plants they ate required a fairly constant temperature.
d. modern reptilian descendents are homeothermic.
e. the Earth was always warm and cozy.

(6.3) The types of food that humans eat can be one cause of :

a. RNA interference.
b. human evolution.
c. protein misfolding.
d. telomerase.
e. herbal accommodation.

(6.3) Vitamin D has many more profound effects than once thought. Which of these is *not* a result of sufficient vitamin D?

a. it reduces depression.
b. it aids visual acuity.
c. it reduces cancer risk.
d. it combats stress.
e. it reduces heart attacks.

(6.3) Among environmental pressures pushing human evolution is:

a. the color of flowers.
b. the type of food we eat.
c. beard growth.
d. automobile accidents.
e. long-chain fatty acids.

(6.3) The types of food that humans eat can be one cause of:

a. RNA interference.
b. protein misfolding.
c. human evolution.
d. telomerase.
e. herbal accommodation.

(6.3) Because microbes that digest cellulosic material in the stomachs of cud-chewing animals need a relatively constant temperature in which to operate,

a. large plant-eating dinosaurs were likely warm-blooded.
b. cud-chewing animals are called “ungulates”.
c. those microbes cannot exist outside in the environment.
d. enzymatically-treated cellulose by those microbes is a good indicator of stomach temperature.
e. the microbes must be warm-blooded.

(6.3) Microbes play an important role in digestion for:
a. humans.
b. herbivores.
c. honey bees.
d. termites.
e. all of the above.

(6.3) Large dinosaurs must have eaten at least four tons of plant materials per day.
a. true
b. false
c. maybe
d. none of the above
e. all of the above

(6.4) High levels of carbon dioxide are usually:
a. good for you.
b. toxic.
c. benign.
d. heterozygous.
e. reflective of the amounts of DNA present.

(6.4) Yeasts produce alcohol:
a. as a waste product.
b. to get drunk.
c. by mistake.
d. without carbon.
e. as a relaxation-enhancer.

(6.4) Among the leading contributors to health maintenance are:
a. waste.
b. Jack LaLanne.
c. sanitation.
d. nutration.
e. carbonated beverages.

(6.4) If wastes are not removed:
a. the Dutch will reclaim Manhattan from the English.
b. the BU that produced them will reuse them.
c. increased disease rates are likely.
d. horses will not be found.
e. great piles will grow.

(6.4) Drinking water treated to kill pathogens has nearly eliminated all these diseases *except:*
a. cholera.

b. dental caries.
c. typhoid.
d. dysentery.
e. infectious diarrhea.

(6.5) Removing excess heat from hot organs is one useful function of the:
a. blood.
b. gut.
c. liver.
d. brain.
e. lymph.

(6.5) Cooling of ventilation air by the evaporation of water is proposed as a means to reduce heat stress on animals. Why is this idea counterproductive?
a. it can only reduce air temperature by 2-3ºC maximum.
b. it allows microbes to live in the air.
c. it reduces the ability of the animal to lose heat by panting or sweating.
d. it produces rain.
e. it uses too much water.

(6.5) A more efficient means than convection and evaporation to cool terrestrial animals is often:
a. refrigeration.
b. locomotion.
c. petrification.
d. homogenization.
e. jail them.

(6.5) The best thermal conditions for a BU are found between high temperatures that inactivate their enzymes and temperatures:
a. where leaves drop.
b. at which ice forms.
c. too low to sustain metabolism.
d. that can't be detected.
e. with no degrees.

(6.5) Adaptations of BU to temperature extremes are often useful for:
a. biological engineering designs.
b. prey of the BU.
c. storing food safely.
d. developing odors.
e. certain high schools.

(6.5) Excess heat produced by animals can be removed by evaporation. However, when the air is _____, no further evaporation is possible.
a. saturated
b. cold
c. still
d. polluted
e. gone

(6.5) _____ animals typically seek shelter from cold night time temperatures and then move to bask in the warm morning sun to raise body temperature.

a. Party
b. Small
c. Facultative
d. Ectothermic
e, Warm-blooded

(6.5) The disadvantage of warm body temperatures is that they are close to lethal. The advantage of warm body temperatures is that:

a. air conditioning makes sense.
b. people in hot countries can take afternoon siestas.
c. metabolism is faster than for cooler body temperatures, giving survival and reproduction advantages.
d. bacteria living in digestive tracts are killed.
e. bodies show up better on infrared film.

(6.5) The objective of heat stress indices is to:

a. allow weathermen to sound knowledgeable.
b. determine exactly when it becomes too hot to sleep in class.
c. guide the owners of tanning salons.
d. quantify effects of hot environments.
e. make it illegal to work when it gets too hot.

(6.5) The most consequential effect of cold environmental temperature is:

a. shivering.
b. increased appetite.
c. inattention to detail.
d. numbness.
e. tissue freezing.

(6.6) Heterofermentative organisms can be manipulated to produce different products as they:

a. adapt to different environments.
b. are exploited by unscrupulous individuals.
c. give love and affection.
d. eat candy and drink liquor.
e. release enzymes.

(6.6) Changing environments that require adaptation by BU usually result in:

a. higher growth and reproductive rates.
b. lower growth and reproductive rates.
c. all of the above.
d. none of the above.
e. none of this makes sense.

(6.6) Plants that modify their environments to enhance availability of nutrients are

a. more likely to grow and reproduce.
b. selfish.
c. unusual.
d. expending less energy compared to other species.
e. living in swamps.

(6.6) Adaptation is to evolution as:
- a. science is to engineering.
- b. anecdote is to history.
- c. liver is to onions.
- d. flowers are to leaves.
- e. George is to Washington.

(6.6) Adaptations improve survival, but require _____ that could otherwise be used for _____.
- a. self-control, calmness
- b. ink, writing
- c. knowledge, advantage
- d. resources, reproduction
- e. catalogs, ordering

(6.6) Tolerant strains of bacteria can be selected by:
- a. extremely lethal conditions.
- b. conditions that do not challenge the bacteria.
- c. intermediate conditions that kill some but not all of the bacteria.
- d. providing all their needs.
- e. lottery.

(6.6) Survival of an individual is not as important biologically as survival of:
- a. a group.
- b. specific genes.
- c. environmental stress.
- d. the fittest.
- e. biological models.

(6.6) Which is a means used by camels and cacti to become adapted to dry conditions:
- a. reducing evaporative water loss.
- b. maintaining body temperature constant.
- c. maintaining a thin layer of surface insulation.
- d. turning their sides to the sun.
- e. all of the above.

(6.6) Cardiac hypertrophy develops in order to:
- a. reduce cardiac oxygen consumption.
- b. pump blood more efficiently.
- c. receive an award for the best heart.
- d. deliver blood at high pressure.
- e. be a better lover.

(6.6) Brightly colored insects capture the attention of birds who would eat them. Why do brightly colored insects persist?
- a. they are good at hiding.
- b. they are faster than predator birds.
- c. they usually contain toxins.
- d. birds are color blind.
- e. they have no fear.

(6.6) Brighter light generally results in taller plants.

a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.6) "Like mother, like daughter" is true not only because of genes passed from mother to child, but also because of:

a. the fetal environment.
b. birthday presents.
c. the mother's hobbies.
d. home cooking.
e. individual clothing choices.

(6.6) The hygiene hypothesis speculates that allergies later in life develop because of:

a. exposure to modern pesticides.
b. unchallenged immune systems early in life.
c. obesity and smoking.
d. hexadecimal system.
e. scientific method.

(6.6) Women with a male twin are less likely than women with a female twin to do what?

a. celebrate birthdays.
b. eat rare hamburgers.
c. marry and have children.
d. wear jewelry.
e. read maps well.

(6.7) Humans, giraffes, and termites have each:

a. the same number of legs.
b. similar genetic codes.
c. significantly modified their environments.
d. colorful livers.
e. had their fifteen minutes of fame.

(6.7) Without giraffes and other herbivorous animals, the African savanna would probably be:

a. more wooded.
b. more lonely.
c. more grassy.
d. more extensive.
e. more barren.

(6.7) Air conditioning has been used extensively by:

a. Monarch butterflies.
b. honeybees.
c. cacti.
d. dogs and cats.
e. palm trees.

(6.7) Why is it important to protect other worlds from contamination with Earthly life forms? Because Earthly life forms:

a. could be killed on other worlds.
b. cannot be completely sterilized.
c. are weird.
d. are very competitive.
e. are carbon based.

(6.7) Insulin is necessary to regulate glucose uptake of cells within the _____but not in the _____.

a. muscles, kidney
b. fat tissue, eye
c. red blood cells, intestinal lining
d. liver, muscles
e. dermis, brain

(6.7) Hormones act to modify the environments of other tissues and organs.

a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.7) Food in the digestive system is:

a. catabolized before it is quantized.
b. strictly not inside the body.
c. unaffected by pH.
d. regulated by hormones.
e. free of toxins.

(6.7) BU not only adapt to their environments, but also:

a. produce offspring that harm the environment.
b. fix those things that are wrong.
c. modify their environments to their own purposes.
d. draw conclusions.
e. go their own way.

(6.7) The Gaia Theory pertains to:

a. happiness and prosperity.
b. sexual orientation of males.
c. twenty-four hour days.
d. a balance of the whole Earth's biosphere.
e. anti-response to dark and drizzly days.

(6.8) BU adapted to extremely harsh environments would be expected to:

a. remain in place.
b. barely survive.
c. reproduce slowly.
d. put on weight.
e. be hard to get along with.

(6.8) Most useful bioreactor products are produced during the _____phase of the growth cycle.

a. lag
b. growth
c. stationary
d. death
e. exponential

(6.8) Rapidly growing plant tissues usually contain less _____ than slowly growing tissues.

a. water
b. toxin
c. energy
d. air
e. biomass

(6.8) Conditional survival strategies allow:

a. plants to move to new locations.
b. you to quit your job.
c. insect phenotypes to change at will.
d. response to be related to the type of challenge.
e. an absolute level of eproduction.

(6.8) If it is attempted to breed a rare species, it would be best to:

a. find at least two adults.
b. minimize the degree of adaptation required of that species.
c. put them in a zoo.
d. give them a warm place to live.
e. put them in a cozy place.

(6.8) Chemicals regurgitated by army worms feeding on a corn plant activate plant genes to produce toxins and summon insect predators. Which of the following can be said about this response:

a. this is an example of feedback control.
b. plants more than animals need to depend more on toxic chemicals because. They can't move to avoid predators.
c. army worms that feed extensively on corn plants will probably eventually develop a defense against the toxins.
d. the corn plants will not be able to set as much seed as they would have without the army worm attack.
e. all of the above.

(6.9) When the environment cannot be controlled to the satisfaction of BU, if possible, they will:

a. complain.
b. plan.
c. congregate.
d. move.
e. regurgitate.

(6.9) Cancer cells metastasizing is an example of:

a. reverse Polish notation.
b. BU moving to friendlier environments.
c. genetic mutation.
d. hybridization.
e. being run out of town.

(6.9) Which of the following is *not* used to promote species preservation:
a. larger rather than smaller reserves.
b. dividing the reserve into many smaller areas.
c. grouping smaller reserves equidistantly from each other.
d. connecting smaller reserves with corridors.
e. making reserves round or square rather than long and narrow.

(6.9) Conditions that favor species extinction also favor:
a. species formation.
b. species reproduction.
c. sterilization.
d. epistemology.
e. cinnamon flavoring.

(6.9) Extinction and preservation require opposite conditions. Extinction normally takes place with
a. isolation.
b. larger areas.
c. coevolution.
d. migration.
e. the opposite of intinction.

(6.10) Adaptability favors:
a. stress.
b. status quo.
c. survival.
d. superiority.
e. all of the above.

(6.10) The essential difference between adaptation and evolution is:
a. adaptation means change, but evolution means modification.
b. adaptation reduces growth and reproduction, but evolution enhances them.
c. the way they are spelled.
d. adaptation requires genetic mutation, but evolution does not.
e. how they are considered by biologists.

(6.10) Some genetic diseases, such as sickle-cell anemia, Tay-Sachs disease, and diabetes persist because they once gave their carriers a:
a. headache.
b. reproductive advantage.
c. lot to think about.
d. tribal influence.
e. reason to live.

(6.10) Genetic evolution normally requires genetic variation and

a. coevolution constant.
b. constant environment.
c. isolation.
d. RNA interpretation.
e. a reason to live.

(6.10) Evolution is always a long, constant process.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.10) Most genetic diseases are relatively rare because they:
a. are caused by recessive genes.
b. don't occur very often.
c. give a survival disadvantage.
d. persist surreptitiously.
e. do not know any better.

(6.10) Without high selection pressure,
a. genetic changes are not likely to be felt.
b. personal space becomes smaller.
c. humans won't notice.
d. evolution accelerates.
e. comedians will no longer be funny.

(6.10) Bats find their insect prey by echo-location. It might, therefore, be expected that:
a. bats would be blind.
b. bats would emit low-frequency signals.
c. insects would develop a defense.
d. insects would become extinct.
e. bats would be well-fed.

(6.10) "Swarm intelligence" is the term given to a group of BU, each acting according to simple rules, but which enables the group to act and react in sophisticated ways. This is an example of:
a. the blind leading the blind.
b. coevolution.
c. evolution favoring a group rather than an individual.
d. cooperation among individuals leading to hegemony.
e. a misuse of the word "intelligence".

(6.10) Payment to salmon fishermen was changed from a piece rate to a weight basis, and this resulted in a long decline in average body weight of salmon. This is an example of:
a. overzealous fisherman.
b. a gradual change in environmental pressure.
c. malnutrition among salmon.
d. an unintended consequence.
e. salmon with a difference.

(6.10) Evolutionary principles can be used to improve upon a product design: which is *not* a step in this process?

a. determine what the final product will look like.
b. determine performance specifications.
c. make random changes.
d. measure performances of changed prototypes.
e. discard all prototypes that do not improve performance.

(6.10) The essential difference between adaptation and evolution is that:

a. adaptation reduces growth and reproduction; evolution increases both.
b. adaptation enhances growth and reproduction; evolution has not effect.
c. adaptation enhances growth and reproduction; so does evolution.
d. adaptation reduces both growth and reproduction, the same for evolution.
e. none of the above.

(6.10) Adaptation to a different environment uses resources that otherwise could be used for:

a. drinking and carousing.
b. growth and reproduction.
c. spatial interpretation.
d. memes and genes.
e. environmental sensing.

(6.10) Isolation of a population is required if a new species is to form. This isolation can occur:

a. spatially, planetarily, or phrenologically.
b. scientifically, technologically, or chemically.
c. spatially, morphologically, or behaviorally.
d. reverently, quietly, or shushally.
e. boisterously, pandemically, or sycophantly.

(6.10) Producing strains of microbes with desirable characteristics can be accomplished by genetic engineering, or by:

a. wishing for them to change.
b. studying them intently.
c. closing up their little minds.
d. subjecting them to environmental pressures.
e. teaching them new skills.

(6.11) Aggression promotes survival and reproductive success except when:

a. individuals are left alone.
b. aggression becomes extreme.
c. birds sing their songs.
d. crowding undermines social order.
e. survival doesn't happen that way.

(6.11) The complexity of human social interactions makes it difficult to determine:

a. effects of crowding.
b. social evolution.
c. group ecology.
d. passive aggression.
e. active nonaggression.

(6.11) Which of the following does *not* have higher risk for effects of crowding:
- a. males.
- b. females at home.
- c. first born.
- d. children over ten.
- e. first-born males over ten.

(6.11) You would expect residents to help other residents in need more in:
- a. wealthier neighborhoods.
- b. more crowded neighborhoods.
- c. integrated neighborhoods.
- d. less crowded neighborhoods.
- e. plenary neighborhoods.

(6.11) Intruding into personal space is:
- a. a way to make a person feel at ease.
- b. a sign of submission.
- c. an aggressive act.
- d. polarity-driven.
- e. a way to make someone talk.

(6.11) Space requirements for animals need to be larger for:
- a. females.
- b. caterpillars.
- c. males.
- d. children.
- e. donkeys.

(6.11) Perception of personal space is *not* influenced by:
- a. location inside or outside.
- b. lighting.
- c. defensibility.
- d. direction.
- e. gender.

(6.11) The study of personal interactions at school is called:
- a. normality checking.
- b. small group ecology.
- c. bullying.
- d. friendly persuasion.
- e. class morale.

(6.11) Sensory overload may occur in humans of any age. What brings on this condition?
- a. whistling “Dixie” in the dark.
- b. talking softly to another person.
- c. Formosa ham.
- d. a combination of many kinds of stimuli.
- e. school buses.

(6.11) One thing a biological engineer might want to avoid in designing an enclosed space for humans is sensory overload. Which of these are to be avoided?

a. music that can be made louder or softer by the listener.
b. closable curtains on windows.
c. faucets that can be turned off.
d. furniture bolted in place.
e. noise-canceling ear phones.

(6.11) Confinement spaces for animals must allow the animals to:
a. get up, move around, and perform normal bodily functions.
b. be able to interact with their offspring.
c. have the space all to themselves.
d. be stress-free.
e. yodel.

(6.11) High population densities encourage more virulent forms of disease
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.11) Crowding of the same kinds of plants or animals makes them more vulnerable to:
a. robbery.
b. disease.
c. predation.
d. tourism.
e. criticism.

(6.11) The balance between resources and needs leads to a natural population density called the :
a. resource response.
b. density division.
c. carrying capacity.
d. population quotient.
e. economic balance.

(6.11) Stress, aggressive behavior, extreme passivity, and social aberrations, are just some of the symptoms of:
a. Dr. Johnson.
b. crowding.
c. road rage.
d. airport security.
e. GenX.

(6.11) The Germans have a lot of it, Mediterranean peoples have a little, and the English are in between
a. air.
b. body hair.
c. personal space.
d. speech accent.
e. chutzpah.

(6.12) Toxins usually interfere with:

a. nuclear reactions.
b. metabolic processes.
c. xenobiotics.
d. digital participation.
e. drinking coffee.

(6.12) Which of these is *not* a class of biotransformations available to deal with toxic substances?
a. oxidation.
b. reductation.
c. degradation.
d. conjugation.
e. none of the above.

(6.12) The difference between a life-saving medicine and a deadly poison is often merely a question of:
a. regulatory definition.
b. who's asking.
c. painstaking manufacture.
d. dosage.
e. prescription.

(6.12) One question of extreme interest is whether there is a safe dose for a toxin. The reason for this is:
a. no safe dose means that the toxin must be eliminated completely.
b. a safe dose can be included in all food additives.
c. that it provides work for unemployed scientists.
d. panic will ensue.
e. arsenic prefers old lace.

(6.12) Responses to a mutagenic compound are:
a. nothing to be concerned about.
b. a balance between damage and repair processes.
c. always fatal.
d. passed from one generation to the next.
e. to be avoided.

(6.12) Toxin effects often depend on:
a. strain of lab mice and stress level.
b. dosage level and sterilization.
c. method of administration and species tested.
d. damage to DNA, RNA, and CNN.
e. revisionist propaganda.

(6.12) People can die from ingestion of too much:
a. nutrients.
b. water.
c. aspirin.
d. all of the above.
e. none of the above.

(6.12) In regions where there are higher levels of grazing pressure, there is usually:
a. more intense selection pressure for plants with chemical defenses.
b. found faster growing plants.
c. sunlight that reaches the ground and is wasted.
d. larger herbivores.
e. very tall grasses.

(6.12) Toxins to which BU have been exposed over many generations can often be accommodated better than new environmental toxins. The reason for this is that:
a. principally one of definition.
b. individuals especially sensitive to the older toxins have been killed by them.
c.. new environmental toxins are made by humans.
d. there are no biomarkers for new toxins.
e. toxins lose their toxicity over time.

(6.12) Toxin sensitivity has been found to vary with:
a. time of exposure.
b. gastric acidity.
c. drug manufacturer.
d. foot size.
e. environmentalists' point of view.

(6.12) Which is *not* a mechanism used by microbes to counteract antibiotics:
a. membrane exclusion.
b. pumping out of the cell.
c. detoxification.
d. maintain metabolic pathways.
e. none of the above.

(6.12) High blood lipid levels can promote:
a. clean arteries.
b. postprandial ventriloquism.
c. elevated blood levels of environmental solvents.
d. synthesis of toxic proteins.
e. low triglycerides.

(6.12) DDT and estrogen mimics are examples of:
a. endocrine disrupters.
b. hormonal attributes.
c. toxic biphenols.
d. concentrated hormesis.
e. other compounds.

(6.12) Prenatal exposure to intrauterine sex hormones determines:
a. characteristic sexual responses after birth.
b. sex of the offspring..
c. endocrine disruption.
d. personality of the mother.
e. chimera.

(6.12) Larger molecular size always means:

a. larger mass.
b. overabundance.
c. less toxicity.
d. higher toxicity.
e. no toxicity.

(6.12) LD_{50} means
a. 50 people Lie Down.
b. 50% of species will become extinct.
c. the dose of a toxic substance will kill 50% of those taking it.
d. 50 seconds are required for death..
e. there are 50 products from Lipid Disintergration.

(6.12) Some nutrients overstimulate organisms and the organisms die.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.12) One of the most harmful ecological effects of toxins is that they:
a. concentrate as they move up through trophic levels.
b. kill Kentucky foals.
c. seem to be innocuous until they have their effect.
d. are used as protection by other species.
e. act more strongly on organisms at lower trophic levels.

(6.12) Cyanide is present in larger or smaller amounts in many plants. Why is cyanide toxic to animals?
a. it changes the color of blood to bright red.
b. it interferes with protein synthesis.
c. it locks up ATP.
d. it has structure often mistaken for sucrose.
e. it interferes with carbohydrate metabolism.

(6.12) Once flushed down the drain, medicines, drugs, and hormones are:
a. totally removed from the ecosystem.
b. no longer of concern.
c. often returned to sources of drinking water.
d. made ineffective.
e. all degraded into elemental form.

(6.12) Larger molecules are less toxic than smaller molecules because:
a. they are fixed in place.
b. they cannot pass as easily through permeable membranes.
c. they are more difficult to accelerate in the blood.
d. they are mistaken for similar molecules.
e. they have tails that move from side to side.

(6.13) Cells respond to shear stresses by:
a. distorting.

b. growing differently.
c. dying.
d. all of the above.
e. none of the above.

(6.13) Stem cells grown on very soft surfaces become:
a. nerve.
b. muscle
c. bone.
d. fat.
e. pluripotent.

(6.13) Materials suspended in moving fluids will be deposited if:
a. rate of shear increases.
b. the flow velocity decreases.
c. thrombi form.
d. postage is not paid on time.
e. they cannot float.

(6.13) One major detriment of blood thrombi is:
a. they cut off oxygen supply to regions downstream.
b. the clot incorporated detritus.
c. clotted blood cannot clot again.
d. erythrocytes cannot pass them.
e. they can be reabsorbed eventually.

(6.13) Many early biomaterials were sensed as foreign by the body's immune system, and they were covered with clot-like depositions. It can be said from this that surface free energies of these biomaterials before the depositions were:
a. low.
b. high.
c. in the middle.
d. all of the above.
e. none of the above.

(6.13) When atheroschlerotic plaque forms, flow accelerates, and:
a. washes away the plaque.
b. increases hydrostatic pressure.
c. more plaque forms.
d. regions of proteins form.
e. counteracts effects of the plaque.

(6.13) Small round structures are usually capable of resisting larger internal pressures.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.13) Small spheres are capable of resisting larger surface forces.
a. true

b. false
c. maybe
d. all of the above
e. none of the above

(6.13) Bone strength is enhanced by:
a. eating.
b. sleep.
c. walking.
d. relaxing.
e. muscule formation.

(6.13) Seaweed bends but mollusks resist ocean currents. Of the two, the one needing stronger walls is:
a. seaweed.
b. mollusk.
c. neither
d. all of the above
e. none of the above

(6.13) When is optimization not incorporated in biological systems?
a. when they forget about it.
b. when it saves energy.
c. when they are complex.
d. when it does not incur a survival advantage.
e. when there is a less-optimum approach.

(6.13) Two organisms that were formed separately from different lineages but that have similar forms and functions are examples of:
a. identical twins.
b. convergent evolution.
c. attraction of opposites.
d. parenthetic expression.
e. divergent evolution.

(6.13) Cell injury depends on shear stress.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.13) Blood clots will form in:
a. artificial limbs.
b. intracellular spaces.
c. regions of stagnant blood flow.
d. mitochondria.
e. neural tissue.

(6.13) Better than flat surfaces upon which to grow human stem cells are:
a. agar plates.

b. stem cell gardens.
c. bioreactors containing liquids.
d. three-dimensional mattresses.
e. three-dimensional matrices.

(6.13) The strongest wood is:
a. dense, mature, and dry.
b. light and airy.
c. poplar.
d. grown without physical stress.
e. found at the local lumber yard.

(6.13) Accelerations of human bodies can cause tissue damage and:
a. variation of mildness.
b. severe discomfort.
c. forces beyond belief.
d. paleological remembrances.
e. methylation of RNA.

(6.13) The tissue most affected by acceleration and vibration is:
a. liver.
b. brain.
c. blood.
d. skin,
e. bone.

(6.13) Why is a woodpecker like a football or soccer player?
a. both have red uniforms.
b. both play their hearts out.
c. both use their feet to steady themselves.
d. both are subject to head injury.
e. both are paid exactly what they are worth.

(6.13) Sports engineers concern themselves with:
a. playing as well as they can.
b. finding the best ways to thwart adversary defenses.
c. avoiding rules and regulations.
d. telecasting sports events.
e. making play safer or performance better.

(6.14) The benefits of each biological form, function, and action must:
a. be expected.
b. have unintended consequences.
c. outweigh the costs.
d. be allometric.
e. not be detrimental.

(6.14) The energy cost of walking has two components:
a. that both increase with speed.
b. that both decrease with speed.
c. of which one increases and one decreases with speed.

d. that have no relation to speed.
e. none of the above.

(6.14) The power of walking has been found to be a minimum at:
a. normal walking speed.
b. all speeds.
c. all costs.
d. the highest walking speed possible.
e. galloping speed.

(6.14) Human walking is energy intensive because:
a. walking cannot be expected to happen without energy expenditure.
b. the body mass rises and falls with each stride.
c. walking in a straight line requires inefficient control.
d. the path of the hips does not relate to walking speed.
e. there is friction.

(6.14) Centipedes walk just as efficiently as humans
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.14) Riding a bicycle is more efficient energetically than walking because:
a. riding is faster.
b. the body mass does not rise and fall when riding.
c. riding requires development of balance.
d. bikes are lighter these days.
e. you can pass walkers.

(6.14) The transition from walking to running occurs when:
a. escaping tigers.
b. running requires more energy.
c. walking is too slow.
d. running is more efficient.
e. it feels unnatural.

(6.14) If humans walked on all four limbs, then they might:
a. gallop at high speeds.
b. look like horses.
c. remove heat by walking faster.
d. need higher doorways.
e. wear out their knees.

(6.14) Breathing during exertion is:
a. dominated by resistance.
b. a result of compliance.
c. optimized to save energy.
d. performed at frequencies that do not vary.
e. too difficult to maintain.

(6.14) Optimization is especially useful to an organism because it:

a. requires careful control of responses.
b. encourages insects to fly into spider webs.
c. allows animals to go for long periods of time without eating.
d. saves energy for survival and reproduction.
e. makes the organism isolated.

(6.14) Optimization in BU:

a. is achieved by trial and error.
b. is dependent upon feedback.
c. conserves resources.
d. all of the above.
e. none of the above.

(6.14) Conservation of scarce resources in nature includes:

a. genetic material.
b. endangered species.
c. carbon.
d. iron.
e. decimation of resources.

(6.14) The variation of breathing frequency about some average value demonstrates:

a. redundancy.
b. an element of trial and error.
c. biological culpability.
d. precise optimization.
e. survival mechanisms.

(6.14) Which biological functions appear to be optimized?

a. locomotion.
b. breathing.
c. hunting seals.
d. heart rate.
e. all of the above

(6.14) The presence of nonoptimum genes in a population probably means that:

a. the penalty for maintaining the presence of these genes is not too high.
b. somebody made a mistake.
c. there is a narrow optimum with a high penalty for deviations form the optimum point.
d. without looking, genes were recovered from past individuals.
e. this has nothing to do with regulation of respiratory rate, walking speed, or blood pressure.

(6.15) Without epinephrine in the body, what would be expected?

a. the person would remain calm.
b. there would be less post-traumatic stress disorder.
c. digestion would operate at resting levels.
d. none of the above a, b, c.
e. all of the above a, b, c.

(6.15) Extirpation improves BU survival in the heat.

a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.15) After being caught sleeping in this class, you can declare that you weren't sleeping, you were just in a natural state of:

a. torpor.
b. ecstasy.
c. estivation.
d. proportion.
e. estimation.

(6.15) Which of the following is *not* an altered state with a survival advantage?

a. torpor.
b. hibernation.
c. estivation.
d. abjection.
e. induction.

(6.15) An insect in the state of torpor produces no metabolic wastes.

a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.15) Bacteria that form endospores are usually:

a. benign.
b. dangerous.
c. found in envelopes.
d. prohibitively expensive.
e. without hope.

(6.15) Endospores are the means by which bacteria sometimes reproduce.

a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.15) A plant is just a means to make another:

a. seed.
b. flower.
c. leaf.
d. root system.
e. attempt at new life.

(6.15) The response to hemorrhage demonstrates that the entire organism is willing to survive by sacrifice of:

a. substructure.
b. blood.
c. time.
d. fluids
e. enemies.

.

(6.16) Cells in the body improve their survival by accepting:

a. symbiosis.
b. limits on their independence.
c. close neighbors.
d. reversed charges.
e. gigs.

(6.16) When two or more unrelated species change over time to become more and more mutually dependent, it is called:

a. coeducation.
b. coevolution.
c. inclusion.
d. specialization.
e. dependency.

(6.16) Which of these is *not* an example of cooperation among BU?

a. coevolution.
b. social insect colonization.
c. symbiosis.
d. pathogenicity.
e. mutual dependence.

(6.16) Flowers meant to attract insects are most likely to be:

a. brightly colored.
b. intensely flavored.
c. strongly scented.
d. smoothly textured.
e. centrally located.

(6.16) The difference between symbiosis and coevolution is that:

a. symbiotic organisms combine physically.
b. coevolution involves lichens.
c. symbiosis includes two different species.
d. coevolution involves both sexes.
e. coeducation involves mutually-dependent pedantic concepts.

(6.16) It is speculated that both mitochondria and chloroplasts:

a. are recent additions to higher-level cells.
b. are included together within all cells.
c. are dependent upon eukaryotic DNA to replicate.
d. were once independent prokaryotes.
e. are nonfunctional.

(6.16) Species that have coevolved:
a. cannot be separated.
b. are mutually dependent.
c. look the same.
d. have the same function.
e. are inseparable.

(6.16) Plants seem to exhibit either one of these two reproductive strategies:
a. scatter seeds upon the ground or in the air.
b. lead, follow, or get out of the way.
c. widely scatter many pollen grains or attract pollinators to deliver pollen to target flowers.
d. reproduce before they die or after they die.
e. bar hop or surf the internet.

(6.16) Colors and smells of flowers can indicate:
a. the type of pollinator.
b. interest by fluorists.
c. the temperature.
d. penalties for picking them.
e. their genus and species.

(6.16) Biofilms are especially hard to destroy because of:
a. anti-censorship laws.
b. cooperation among bacteria.
c. rapid reproduction.
d. planetary guidelines.
e. their heritage.

(6.16) What types of animals are normally found in groups?
a. loners.
b. predators and prey.
c. those that optimize resource utilization.
d. aquatic.
e. big, fat ones.

(6.16) If a poison for one species is a food for a second species, then:
a. the survival of the first species can be enhanced.
b. both will taste better.
c. the first will go to the other for help.
d. nothing will happen.
e. the second species can shop at a second-hand store.

(6.16) Groups that confer significant survival advantage to their members usually:
a. require a high cost of membership.
b. remain undeterred from their aims.
c. are found only in nature.
d. are antievolutionary.
e. are related to the Mafia.

(6.16) Probiotics are microbes that often assist by:

a. turning professional.
b. conferring advantages later in life.
c. streptococci.
d. competitive inhibition.
e. doing odd jobs.

(6.16) Chimera are distinguished by:
a. ringing sounds.
b. cells with different functions.
c. shimmering cells.
d. cells with completely different DNA.
e. cells frantically attempting to organize.

(6.16) Interspecies mating:
a. can not occur.
b. can result in chimera.
c. produces haploid germ cells.
d. requires human intervention.
e. occurs discreetly.

(6.16) According to the Multilevel Selection (MLS) theory of evolution, evolution operates:
a. as robustly as possible.
b. on cells that are also organisms.
c. sequentially at all levels of hierarchical organization.
d. with a different mechanism at each level.
e. in parallel universes simultaneously.

(6.16) Information legacies to transfer biological information from one generation to the next do *not* include:
a. ATP.
b. genes.
c. memes.
d. microbiome.
e. prions.

(6.16) One difference between apoptosis and necrosis is that:
a. one of them is spelled incorrectly.
b. apoptosis releases beneficial chemicals into the environment; necrosis releases toxins.
c. apoptosis is cellular murder, whereas necrosis is cellular suicide.
d. apoptosis can occur randomly, but necrosis cannot.
e. there is a reward for necrotic killers.

(6.16) Insulin can be produced by the:
a. brain.
b. liver.
c. intestine.
d. adipose tissue.
e. blood.

(6.17) Competition among BU is common when:

a. negotiations break down.
b. friendship is absent.
c. resources are finite.
d. some BU demonstrate weakness.
e. both open at rival malls.

(6.17) Competition among BU can lead to:
a. defensive mechanisms.
b. energy expenditures.
c. species elimination.
d. all of the above.
e. none of the above.

(6.17) The struggle between plants and herbivores leads to:
a. plants that grow fast and animals that grow slowly.
b. plants that produce toxins and herbivores immune to them.
c. plenty of heartache.
d. fisticuffs.
e. new laws of nature.

(6.17) Which of the following are most likely to kill their hosts or victims?
a. predators.
b. parasites.
c. pathogens.
d. pickles.
e. pastors.

(6.17) Biological control of unwanted species is preferable to chemical control because biological control is usually:
a. highly specific.
b. harmful to the environment.
c. not dependent on human intervention.
d. completed quickly.
e. economically prohibitive.

(6.17) Parasites do best when:
a. they kill their hosts.
b. their hosts thrive.
c. they are able to come and go.
d. are particularly virulent.
e. they have had a little too much to drink.

(6.17) Fever is a host reaction to:
a. gain sympathy.
b. require medicines.
c. mobilize defenses.
d. prepare pathogens.
e. let mom know that it is sick.

(6.17) The Red Queen Principle: “it takes all the running you can do just to keep in the same place” illustrates the fact of:

a. limited running speed.
b. treadmill training.
c. the result of competition and death.
d. mutual evolution by pathogens and hosts.
e. Alice's upbringing.

(6.17) Competition among BU can sometimes be used by Biological Engineers as a:
a. certain example of selection pressures.
b. method to achieve design goals.
c. means to predict all biological outcomes.
d. participant in the Game of Life.
e. way to eliminate all pathogens.

(6.17) The Red Queen Principle: "it takes all the running you can do just to keep in the same place" is the same as saying:
a. taller trees beget taller giraffes.
b. run until you drop.
c. do not expect donuts if you are a bad cop.
d. put on a happy face.
e. you can't win at the game of life.

(6.17) Examples of BU that exploit other BU are:
a. parasites.
b. pathogens.
c. herbivores.
d. predators.
e. all of the above.

(6.17) Defenses against disease include:
a. diarrhea.
b. fever.
c. runny nose.
d. vomiting.
e. all of the above.

(6.17) Some plants eliminate competitors by:
a. emitting poisonous chemicals.
b. using microbes as assassins.
c. over-feeding them.
d. pulling them out of the ground.
e. stretching them thin.

(6.17) *Mycoplasmas* are an example of:
a. muscle tissue.
b. independently-living organisms.
c. blood types.
d. an organism becoming simpler rather than more complex than its forebears.
e. predators.

(6.17) *Mycoplasmas* are a good starting point for synthetic biology because:
a. they are freely floating.

b. they can be grown in a test tube without much support.
c. they have large genomes with many places to change genes.
d. they cannot talk back.
e. they have very simple genomes.

(6.17) Usually more dangerous than gram positive bacteria are:
a. gram negative bacteria.
b. no bacteria.
c. electrolysis.
d. epigenetic changes.
e. karma dogs.

(6.17) Over time, parasites adapt to become less:
a. unfamiliar.
b. resourceful.
c. damaging.
d. pluripotent.
e. bashful.

(6.18) Bacteria normally reproduce asexually. They can, however, exchange genetic material by the process of:
a. transformation.
b. conjugation.
c. transducktation.
d. transpiration.
e. parthenogenesis.

(6.18) In general, to reduce the rate of microbial reproduction, require the microbe to:
a. increase its trophic level.
b. attend to competition and unfavorable environments.
c. exchange bacterial genes.
d. line up in a straight line.
e. do pushups.

(6.18) One possible danger of genetically-modified organisms is that they can:
a. be pathogenic.
b. be introduced outside of the laboratory.
c. lose their identities.
d. donate genetic materials to others.
e. replace Walmarts.

(6.18) The p53 "guardian angel of the genome" gene has the opposite effects from:
a. an oncogene.
b. a pathogen.
c. an Ethernet.
d. the p57 "Heinz" gene.
e. the p52 ½ "devil" gene.

(6.18) Freely floating somatal cells will not divide until they:
a. become transcripted.
b. anchor.

c. let someone know.
d. take elementary mathematics.
e. find an private location.

(6.18) Crowding somatal cells stops them from:
a. metabolizing.
b. wandering.
c. reproducing.
d. pandering.
e. getting on the train.

(6.18) Telomeres function as:
a. measures of genetic reproductive success.
b. expendable labels at the ends of genetic strands.
c. communication devices among somatal cells.
d. segments of bacterial genes.
e. replace cable TV.

(6.18) Without telomerase, germ cells and cancer cells would:
a. be replaced by somatal cells.
b. need to combine with other cell types.
c. only divide a finite number of times.
d. each have no function.
e. not get to know each other.

(6.18) Human telomeres seem to be conserved longer for:
a. those performing very vigorous exercise.
b. a sedentary life style.
c. marathon runners.
d. those who drink at least three glasses of water each day.
e. engaging in moderate exercise.

(6.18) The germ cells (also called gametes) have _____as many chromosomes as somatal cells.
a. one-half
b. the same
c. twice
d. two times
e. nearly

(6.18) Sexual reproduction is energy wasteful, but confers:
a. environmental stability.
b. survival advantages.
c. points of discussion.
d. intense interest.
e. a raison d'etre.

(6.18) The more competitive sex is usually the one:
a. with the lesser resource investment in reproduction.
b. with most interest in the offspring.
c. with no sex hormones.

d. resorting to subterfuge.
e. participating in more ship-board romances.

(6.18) The sex that is more selective of its mate is:
a. the sex with the highest investment in the offspring.
b. the sex with the better vision.
c. female.
d. hermaphroditic at least part of the time.
e. too picky.

(6.18) External fertilization requires the release of _____male gametes compared to internal fertilization.
a. more
b. the same number of
c. less
d. all of the above
e. nonr of the above.

(6.18) Hermaphroditic qualities develop where there is:
a. use of the Greek language and alphabet.
b. something weird going on.
c. limited opportunity to meet a member of the opposite sex.
d. crowding.
e. a bar district.

(6.18) Sequential hermaphroditism often confers male characteristics upon:
a. estrogen emulators.
b. the largest individual.
c. a few selected by chance.
d. mutated genomes.
e. portraits of famous women.

(6.18) Plants are capable of:
a. vegetative reproduction.
b. semiperfect flowers.
c. hermaphrodism.
d. conversation.
e. many wonderful things.

(6.18) Communication among BU requires:
a. pheromones.
b. receptors to sense the signals.
c. memory.
d. good speaking ability.
e. mouths to speak.

(6.18) HeLa cells are unusual because they are:
a. illegal.
b. unusually robust and prolific.
c. derived from cancer.
d. widely known.

e. pristine

(6.19) Sensing is the first step in:
a. communication.
b. feed forward control.
c. cellular structure.
d. playground activities.
e. paying your taxes.

(6.19) Communication is sensation that invites response.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.19) Courtship rituals are intended to communicate:
a. desire, coordination, and fulfillment.
b. odd behavior that has no meaning to other species.
c. pheromone release into the environment.
d. availability, fertility, and synchrony.
e. come-hither looks.

(6.19) Humans often choose mates with physical attributes similar to their own.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.19) Vocal sounds are used by many species to convey information to others. Which is *not* an example of this:
a. dogs growling.
b. pigs squealing.
c. bees buzzing.
d. all of the above.
e. none of the above.

(6.19) High-pitched sounds carry farther than low-pitched sounds.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.19) Which of the following are remembered the longest?
a. pictures.
b. words.
c. odors.
d. touches.
e. indiscretions.

(6.19) Chemical communication is used by:
- a. insects.
- b. plants.
- c. body organs.
- d. all of the above.
- e. none of the above.

(6.19) Bacteria in a biofilm take no action in the presence of autoinducers until:
- a. the wine has reached its time.
- b. RNA interferes.
- c. a threshold is reached.
- d. the leader says to move.
- e. they see the whites of their enemies' eyes.

(6.19) Which imaging method indicates regions of high and low metabolism?
- a. MRI.
- b. CT.
- c. endoscopy.
- d. PET.
- e. Kodak.

(6.19) Ultrasonic imaging depends on:
- a. reflection of a wave at tissue interfaces.
- b. the transit time of a wave traveling through tissue.
- c. piezoelectric transducers.
- d. all of the above.
- e. none of the above.

(6.19) Discrimination of a large variation of signal choices from a limited number of sensors requires:
- a. imagination.
- b. broad spectrum sensors.
- c. Young's modulus.
- d. very selective sensors.
- e. paying close attention.

(6.19) Perception of added stimulus intensity depends on the:
- a. absolute level of sensation.
- b. sensors used.
- c. magnitude of the stimulus already present.
- d. frequency.
- e. month of the year.

(6.19) Weber's Law states that the perception of an added stimulus:
- a. depends upon selectivity of the sensors.
- b. has no relation to stimulus order.
- c. has a threshold.
- d. is a fraction of the stimulus already present.
- e. is a joke.

(6.19) fMRI, or functional magnetic resonance imaging, can be used to detect tissue metabolism because of:

a. the way it detects things.
b. a large magnetic field around each tissue.
c. nuclear effects.
d. counting used tissues.
e. differential magnetic susceptibility of oxyhemoglobin and deoxyhemoglobin.

(6.19) Which of theses imaging methods would be used for seeing beneath the skin surface without ionizing radiation?

a. Fluorescence Spectroscopy
b. Near Infrared Spectroscopy
c. Ultrasonic Imaging.
d. Functional Magnetic Resonance Imaging
e. All of the above.

(6.19) Which of these imaging methods form images from reflections at tissue interfaces?

a. fMRI and DTI.
b. Endoscope and Fluorescence Spectroscopy.
c. Ultrasound and Optical Coherence Tomography.
d. CT and MRI.
e. PET and NIRS.

(6.19) Although Electron Tomography gives images with high resolution, its major disadvantage is that:

a. it competes with ultrasound.
b. the sample has to be placed in a vacuum.
c. it cannot identify specific organic chemicals.
d. its images are inverted.
e. it is difficult to find enough electrons to run the machine.

(6.19) Chemical communication is common among:

a. microbes
b. body organs and tissues.
c. insects.
d. trees.
e. all of the above.

(6.19) ATP does *not* function as:

a. energy storage molecule.
b. DNA precursor.
c. communicator substance.
d. high charge density physical attractor molecule.
e. intermediate energy molecule.

(6.19) Chemical communication among microbes living in close proximity is called:

a. odor response.
b. pheromone response.
c. toxic warfare.
d. plenipotentiary communication.

e. quorum sensing.

(6.19) ATP can function as a communicator substance, high charge density physical attraction molecule, and energy storage molecule.

a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.19) Chemical communication among BU includes:

a. quorum sensing in bacteria.
b. pheromones among insects.
c. hormones among body organs.
d. emissions from nearby plants.
e. all of the above.

(6.19) A difference between quorum sensing and other chemical communications among microbes is that:

a. quorum sensing can only happen with a single species.
b. cholera microbes cannot use quorum sensing.
c. with quorum sensing, a chemical threshold value must be reached before any response is observed.
d. the autoinducers have a large effect on larger animals.
e. biofilms can use either, but are particularly sensitive to depressive quorum sensing chemicals.

(6.19) Prairie dogs and vervet monkeys are among animals that seem to have:

a. tan coats.
b. imaginations.
c. plenty of food.
d. specialized language.
e. no enemies.

(6.19) Microbes can communicate among themselves to reduce:

a. interpersonal distances.
b. misunderstandings.
c. density.
d. environmental noise.
e. antibiotic susceptibility.

(6.19) Why should a biological engineer understand the importance of the touch sense when designing a new object?

a. The way the object feels affects its acceptability.
b. Touch can make even the most inept design acceptable.
c. Feeling is one way to design a good product.
d. Warm objects are preferred over cool objects.
e. Without touch, there would be no objects.

(6.19) Pheromones are chemicals that:

a. affect mating.

b. affect behavior.
c. are not easily detectable.
d. are effective in very dilute concentrations.
e. all of the above.

(6.20) If not for receptor adaptation, we would be inundated with:
a. uncoordinated motions.
b. ever-present stimuli.
c. others demanding our attention.
d. redundant signals.
e. requests for favors.

(6.20) Without anticipation, ecological systems develop:
a. predator-prey cycles.
b. slow receptors.
c. a questioning attitude.
d. ennui.
e. balance.

(6.20) Conditioning is a learning process that transforms feedback control into:
a. feed forward control.
b. a reflex.
c. open loop control.
d. ventilation.
e. homeostasis.

(6.20) Neural plasticity allows lost functions to be learned by:
a. the school of lost art.
b. elements of the peripheral nervous system.
c. humoral communications.
d. new neuronal pathways.
e. hard knocks.

(6.20) The cellular production of useful biochemicals in economic quantities can be helped by:
a. manual manipulation.
b. recombinant RNA.
c. metabolic engineering.
d. inverted bioreactors.
e. technological troglodytes.

(6.20) Antibodies are often called by the name:
a. complementary proteins.
b. cytoplaomic reticula.
c. dual link enzymes.
d. immunoglobulins
e. ephemera.

(6.20) Antibodies have two ends. The first binds to _____and the second binds to_____.
a. antigens, other immune defenses
b. cytokines, interferons
c. DNA, RNA

d. the heart, the soul
e. plenum, plena

(6.20) Which of these is *not* a function performed by the immune system:
a. ingesting.
b. labeling.
c. binding.
d. supporting.
e. neutralizing.

(6.20) Invader cells can enter the body through:
a. intercellular clefts.
b. microbial channels.
c. seminal vesicles.
d. input/output ports.
e. ligands.

(6.20) Two animals with vastly different Major Histocompatibility Complex (MHC) genes cannot be used for xenografts. Xenografts use:
a. tissues from the same species.
b. tissues from other species.
c. tissues from the same animal.
d. none of the above.
e. all of the above.

(6.20) Dysfunctional immune systems are explained by the:
a. rational reasoning.
b. problematic professor.
c. hygiene hypothesis.
d. factual forum.
e. semantic scientist.

(6.20) With antagonistic action,
a. two muscle groups assist each other.
b. hormonal responses are less precise.
c. bar room brawls break out.
d. the difference between two opposing actions yields a reaction.
e. no one is safe.

(6.20) An advantage of dead zone is that it:
a. promotes limited instability.
b. saves energy.
c. is quiet.
d. is precise.
e. is not alive.

(6.20) If a particular type of antigen is to be bound, one would use _____antibodies.
a. independent.
b. monoclonal.
c. polyclonal.
d. offset.

e. anticlonal.

(6.20) The threshold for unacceptable delay between signal sensing and control action for a prosthesis falls within _____sec.
a. 0.01 – 0.05
b. 0.05 – 0.1
c. 0.1 – 0.5
d. 0.5 – 1.0
e. 1.0 - 5.0

(6.20) Sensors in the body are usually sensitive to:
a. adequate stimulus.
b. rate of change of the signal.
c. signal level.
d. all of the above.
e. none of the above.

(6.20) Open loop control is _____ than closed loop control.
a. more stable
b. slower
c. more automatic
d. faster
e. more dynamic

(6.20) More precise control can be achieved with:
a. antagonistic action.
b. open loop.
c. second messenger sensors.
d. optimization.
e. dictatorial agonists

(6.20) One big challenge in biomedical technology is how to:
a. transform autographs into allographs.
b. produce excelgraphs.
c. make xenographs acceptable to the recipient.
d. reassemble scattergraphs.
e. reproduce Xeroxes.

(6.20) An example of a diurnal cycle is the response of:
a. aquatic organisms to the tides.
b. estrus cycle of animals.
c. glucose regulation in exercise.
d. deciduous trees to the seasons.
e. thermoreceptors to temperature.

(6.20) Which of the following is *not* a characteristic of biological control:
a. rate sensitivity.
b. feedback.
c. absolute precision.
d. time delays.
e. redundancy.

(6.20) Antibodies:

a. link with antigens.
b. are different at each end.
c. mark invading species.
d. can shroud the antigen and neutralize it.
e. all of the above.

(6.20) Antagonistic action:

a. gets you kicked out of class.
b. results in exquisite control.
c. improves control efficiency.
d. is antithetical to torpor.
e. cannot happen without permission.

(6.20) Proper development of the immune system requires:

a. repeated exposure to antigens that trigger allergic reactions.
b. early exposure to a wide range of beneficial microbes.
c. production of the antibody IgE.
d. stimulation of effector T cell production.
e. none of the above.

(6.20) Adult mammals cannot gain immunity from ingested antibodies, as can newborn infant mammals because:

a. they snub their noses at another's antibodies.
b. their digestive systems contain protease enzymes that newborn infants do not.
c. adult antibodies are different from newborn infant antibodies.
d. adult immune systems are as fully developed.
e. none of the above.

(6.21) Senescence begins shortly after:

a. maturity is reached.
b. 8 o'clock in the morning.
c. the BU dies.
d. stability is lost.
e. birth.

(6.21) If birth is the act of BU regeneration, then an example of this would be:

a. microbes invading the body.
b. transforming a stem cell into a specific tissue cell.
c. the first day of class.
d. a prisoner leaving the penitentiary.
e. tying a bow tie.

(6.21) Succession in an ecological community is an example of:

a. regeneration.
b. senescence.
c. extirpation.
d. maturation.
e. the blind leading the blind.

(6.21) Pioneer plant species would be expected to:
a. be the first to colonize a disturbed area.
b. located wherever planted by Jonathon Chapman.
c. be clothed in furs and skins.
d. colonize new planets.
e. be carried in Conestoga wagons.

(6.21) The best description for the life stage represented by stem cells used to form new tissue is:
a. regeneration.
b. senescence.
c. extirpation.
d. maturation.
e. pontification.

(6.21) Decline of physical and mental capacity to meet the challenges of life is called:
a. regeneration.
b. senescence.
c. extirpation.
d. maturation.
e. pontification.

(6.21) Ending human reproduction approximately in midlife may have reproductive advantages by:
a. increasing survival chances of offspring.
b. decreasing competition among the elderly.
c. making more resources available for the elderly.
d. proving the worth of the individual.
e. giving membership in AARP.

(6.21) One possible reason that women live longer than men is that:
a. natural selection has favored male competition over longevity.
b. women are more deserving.
c. men have evolved to operate the remote for a limited time.
d. men don't ask directions, and so get lost a lot.
e. men drink too much beer.

(6.21) Which is *not* an example of an annual biological cycle?
a. migration of wildebeests.
b. growth of human leg bones.
c. microbial reproduction.
d. skin production of vitamin D.
e. leaf cycles of deciduous plants.

(6.21) Phases of the moon affect living things through:
a. inspirational concepts.
b. its effect on the sun.
c. its "tic".
d. tides and light.
e. werewolves.

(6.21) Diurnal variation of deep body temperature probably originates in the _____of the brain.
a. planetary system.
b. cortex callosum.
c. limbic system.
d. cerebellar cruciate.
e. medulary median.

(6.21) Plants maintain a diurnal cycle of enzymatic activity even in the absence of:
a. xylem.
b. light.
c. roots.
d. heat.
e. phloem.

(6.21) Increased accident incidence and poor performance can be attributed to:
a. eating apples.
b. sleeping late.
c. rush hour traffic.
d. disruption of diurnal schedule.
e. bumble gene.

(6.21) The efficacy and toxicity of medicines can vary:
a. according to the pharmacist.
b. throughout the day.
c. without fail.
d. when using best manufacturing practices.
e. from bottle to bottle.

(6.21) Human cycles of sleeping and body temperature, are 24 hours long when:
a. charted by computer.
b. entrained by daily light and activity cycles.
c. allowed to run freely.
d. measured in a movie marathon.
e. travelling through space.

(6.21) Every atom in our bodies:
a. has likely been part of someone else before.
b. becomes waste with time.
c. moves faster than the rest.
d. jumps between simultaneous energy levels.
e. has been identified.

(6.21) Nutrient cycles are responsible for:
a. plenty of unnecessary moving around.
b. movement of nutrients along certain pathways.
c. efficient reuse of nutrients.
d. all of the above.
e. none of the above.

(6.21) Which of these functions does *not* occur during sleep?
a. conscious awareness enhancement.

b. kidney blood purification.
c. energy store replenishment.
d. metabolic toxin removal.
e. nervous system remodeling.

(6.21) A consequence of natural cycles is that:
a. diurnal differences can never be ignored.
b. peanut plants can grow from peanut butter.
c. genetic expression has no consequence.
d. living things are always changing.
e. Schwinn cells can grow.

(6.21) Biological rhythms occur on all time scales. Diurnal rhythms occur every:
a. 5 seconds or so.
b. hour.
c. month.
d. year.
e. day.

(6.21) Effectiveness of _____ vary throughout the day.
a. food, drink, and rest
b. medicines, drugs, and pesticides
c. music, art, and dance
d. genetics, proteomics, and telomeres
e. wants, needs, and haves

(6.21) Biological rhythms occur on:
a. purpose.
b. at least two people.
c. many different time scales.
d. a daily basis.
e. only selected individuals.

(6.21) According to the comprehensive concept of aging, the p53 gene:
a. plays no role in aging.
b. guards the gene pool.
c. cavorts with the p52 and p54 genes.
d. indirectly controls mitochondrial activity.
e. sticks cholesterol to the insides of arteries.

(6.21) When telomeres shorten too much:
a. they produce cells that are too tight.
b. they suppress p53 gene activity.
c. no free radicals can survive.
d. melatonin has free rein.
e. p53 gene activity decreases mitochondrial activity.

(6.21) Free radicals, mitochondria, p53 gene activity, and telomeres: these are all related to:
a. aging, senescence, and cell death.
b. cellular function in healthy adults.
c. the way of reproduction.
d. myelin coating of nerve cells.

e. cellular membrane ligands.

(6.21) Mammalian eyes have three photosensitivities. These are:
a. rods, cods, and clods.
b. rods, cones, and nonvisual photoreceptors.
c. nonvisual photoreceptors, flashes, and f-stops.
d. sun, moon, and stars.
e. bioluminescences, biophotonics, and biomemories.

(6.22) Satisfying all physical needs of a BU does not always lead to a successful design. In addition the _____ needs of the BU should be satisfied.
a. egoistic and idiom
b. nutrient and metabolic
c. emotional and intellectual
d. brother and sister
e. white and black

(6.22) Emotions are usually _____events that relate the state of equilibrium of an organism.
a. touchy-feely
b. chemically mediated
c. easily defined
d. manufactured
e. present plopping

(6.22) Emotion at a very basic level can even be seen in:
a. penitentiaries.
b. primitive BU.
c. guts.
d. placid individuals.
e. igneous rocks.

(6.22) Emotion in higher-order animals is initiated and coordinated in the _____system of the brain.
a. limbic
b. lumbar
c. cognitive
d. parietal
e. illusory

(6.22) Panic is a dangerous condition that arises when the individual feels:
a. superior to others.
b. pretty stupid.
c. a sense of worthlessness.
d. out of control.
e. out of touch.

(6.22) Cognition of external events is controlled by:
a. two-way mirrors.
b. olfactory sense.
c. emotional state.

d. flash memory.
e. neural plasticity.

(6.22) Emotion arises, not only in the brain, but also in the:
a. central nervous system.
b. endocrine system.
c. feet.
d. heart.
e. spine.

(6.22) Emotions can be learned.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.22) It has been speculated that the essence of our personality, who we think we are, is determined by:
a. personality models.
b. the neocortex.
c. the areas of the brain responsible for awareness.
d. more primitive parts of the brain.
e. other people.

(6.22) It appears as if some animals can understand and communicate in human vocal language. Among these are:
a. dogs and fleas.
b. cats and dogs.
c. apes and birds.
d. cattle and horses.
e. mice and rats.

(6.22) Among the most difficult to understand of animal characteristics is:
a. communications.
b. hunger.
c. self-awareness.
d. maternal love.
e. galloping.

(6.22) Personality affects health, and health affects:
a. wealth.
b. personality.
c. exam scores.
d. foot size.
e. all of the above.

(6.22) Of the different types of neurotransmitters, _____is associated with pleasure:
a. epinephrine
b. acetylcholine
c. serotonin

d. dopamine
e. ATP

(6.22) Someone you are talking to turns away slightly and crosses his arms. Seeing this, you should:
a. assume that he is feeling friendly toward you.
b. press harder to reach agreement.
c. change the subject and adopt a more conciliatory tone.
d. discuss personal issues with him.
e. turn away.

(6.22) Designs of enclosures for juvenile animals or humans should always promote playfulness. Without play, juveniles are likely to become:
a. dull and listless.
b. adventuresome and curious.
c. overly aggressive.
d. domicile.
e. barundi

(6.22) Intelligence is directly related to the number of neurons in the brain.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.22) Brain grey matter and white matter are both:
a. distributed evenly in the brain.
b. capable of the same performance.
c. composed of neurons.
d. desiccated when wet.
e. easily changed.

(6.22) The CNS white matter contains:
a. myelin.
b. pigment.
c. melatonin.
d. axonal bleach.
e. chloroplasts.

(6.22) "Use it or lose it" applies to:
a. DNA and RNA.
b. emotional maturity and neurotransmitters.
c. muscle and kidney tissue.
d. muscle tissue and brain power.
e. money.

(6.22) Learning is related to knowledge already possessed similarly to the way the smallest detectable stimulus difference is determined by:
a. genes.
b. the Island Rule.

c. Young's Principle.
d. Weber's Law.
e. the Peter Principle.

(6.22) The Maslow hierarchy prioritizes human:
a. motivation.
b. emotion.
c. disposition.
d. palpitation.
e. locomotion.

(6.22) According to Maslow, lower level needs will be of less concern if they have been habitually satisfied for some time. This implies the presence of a kind of:
a. inertia.
b. resistance.
c. capacity.
d. flow source.
e. schooling.

(6.22) Where there are interfaces between humans and machines, there will be need for:
a. bandages.
b. operators.
c. psychologists.
d. human factors engineers.
e. pretty lights.

(6.22) Expectations of human behavior in response to environmental conditions related to technology is called:
a. productivity goading.
b. human factors.
c. environmental engineering.
d. terrorism.
e. small group ecology.

(6.22) Proper layout of a control panel would be expected to be related to:
a. cultural habits.
b. artistic discretion.
c. plenary session.
d. political activities of the panelists.
e. space available.

(6.22) Many accidents, including deaths, arise when:
a. 100% quality assurance fails.
b. computers cannot be programmed correctly.
c. humans are part of the control loop.
d. pristine conditions no longer exist.
e. they are least expected.

(6.22) Human health, according to Clyde Hertzman, is dependent mainly upon:
a. socioeconomic infrastructure.
b. biomedical engineering.

c. survival and reproduction.
d. avoiding illness.
e. wealth.

(6.22) Animals at lower social levels have:
a. fewer cares.
b. more stress.
c. crowding problems.
d. big appetites.
e. less DNA.

(6.22) Social egalitarianism benefits:
a. allocation of resources among dominant individuals.
b. survival of the fittest.
c. all individuals.
d. the least fit individuals.
e. the genome.

(6.22) Which of these is *not* a sign of body-mind interaction:
a. petted animals have lower blood pressure.
b. pregnant mothers with infections have more schizophrenic children.
c. long delays between action and result are perceived as unrelated.
d. tapping the knee results in leg jerk.
e. regular exercise improves memory.

(6.22) In order to make biofeedback work, an autonomous action must be made:
a. apparent to the person.
b. controllable with medical technology.
c. constant and immovable.
d. tonomic.
e. before the thought occurs.

(6.22) About half of people given inactive medicines will improve. This result is given the name:
a. placer effect.
b. placebo effect.
c. Pluto affect.
d. promise effect.
e. parliamentary effect.

(6.22) Biological engineers must be aware of psychology, sociology, economics, art, political science, literature, and music because:
a. they keep teachers of these subjects employed.
b. they interconnect various regions of the brain.
c. they all form parts of the overall environment for living things.
d. they are intellectually stimulating.
e. they need to be distinguished from nerds.

(6.22) Knowledge of natural tendencies can lead to better designs involving living things than can:
a. any computer models.
b. knowledge of unnatural tendencies.

c. wild goosses.
d. brute force impositions.
e. open-loop control.

(6.22) Emotions are probably:
a. related to survival.
b. unnecessary in a technical world.
c. not related to mating.
d. undesirable.
e. full of waste.

(6.22) The ability to learn is:
a. unnecessary to survival.
b. confined to humans.
c. widespread in the animal kingdom.
d. able to be ignored in a biological system design.
e. irrelevant.

(6.22) Human factors engineering combines behavioral responses with physical configurations.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(6.22) Which of these is *not* a factor to consider in a design involving biological systems?
a. maintenance of social infrastructure.
b. learning and intellectual stimulation.
c. emotional responses and sensory stimulation.
d. space requirements.
e. none of the above.

(6.22) According to Maslow, the need for _____ must be satisfied before _____.
a. esteem, social acceptance
b. security, love
c. love, security
d. food, drink
e. drink, food

(6.22) Animals with the highest positions in their societies:
a. have less stressful and longer lives.
b. are targets of assassination.
c. live short but sweet lives.
d. nurture others in their group.
e. are nattily attired.

(6.22) The left hemisphere of the human brain perceives detail of a visual stimulus whereas the right hemisphere perceives general structure.
a. true
b. false
c. maybe
d. all of the above

e. none of the above

(6.22) The blood-brain barrier:
a. keeps blood out of the brain.
b. normally protects the brain from outside chemical influences.
c. is unaffected by bacterial endotoxins or adrenaline.
d. separates the brain from the rest of the body.
e. all of the above.

(6.22) Conventional cancer treatments target:
a. all relocated cells.
b. strange cells.
c. immune system cells.
d. fast growing cells.
e. hair follicles.

(6.22) The ability to learn is a consequence of:
a. mothers' protections.
b. the challenges of siblings.
c. fathers' encouragements.
d. aunts and uncles influences.
e. improved adaptation to the environment.

(6.22) Tactile vibration of a driver's car seat is one way engineers hope to avoid:
a. driver sensory overload.
b. lead in drivers' butts.
c adding another idiot light to the car's dash.
d. radar collision avoidance systems.
e. driver education.

(6.23) All parts of a complex organism do not die at the same time, nor is there a huge difference between:
a. those parts still living and those dead.
b. those just dead and those long dead.
c. chemical compositions of living and dead matter.
d. funeral parlors.
e. zombies and students.

(6.23) Defining death is important legally. Why is it also important to a biological engineer:
a. clinically-dead people can be taken immediately off life support.
b. it can help to determine worthwhile medical projects.
c. the engineer can know for sure if she/he is alive or not.
d. mathematical modeling of a dead being is simpler than modeling of a live being.
e. biomedical engineers can become lawyers if they can't make it as engineers.

(6.23) Sterilization of food requires:
a. absolutely no viable microorganisms remaining.
b. reducing food nutritive content below levels required for microbe survival.
c. reducing the probability of microbe survival to a very small level.
d. reproductive counseling.
e. someone who knows how.

(6.23) Cryogenic preservation is used with:
a. baker's yeast.
b. human kidneys.
c. flower seeds.
d. cattle sperm.
e. expired baseball heros.

(6.23) Biological knowledge can be used to determine the exact time of death by:
a. knowing stages of decomposition.
b. carbon dating.
c. which microbes colonize the human body.
d. looking at a clock.
e. checking mitochondrial DNA.

(6.23) Reliability curves do *not* show:
a. high initial failure rates.
b. a long period of low failure rates.
c. older things fail at increasing rates.
d. a continued exponential failure rate with age.
e. expected failure rates.

(6.23) The death rate for humans:
a. becomes 100% over a long-enough time span.
b. is highest early in life.
c. is randomly high and low.
d. has no relation to age.
e. looks like a light bulb.

(6.23) The failure curve for humans and other living things can be illustrated by a model composed of:
a. the follies of youth.
b. redundant faulty components.
c. chaotic mathematical equations.
d. life insurance executives.
e. pretty parts.

(6.23) Without death, which of these would be unnecessary?
a. bodies.
b. food.
c. genes.
d. emotions.
e. a good suit.

(6.23) Death in humans can be legally declared with the appearance of:
a. the absence of breathing.
b. loss of consciousness.
c. lack of a heart beat.
d. no electroencephalographic activity.
e. all of the above.

(6.23) Microbial death is usually difficult to assure, and is only done so on a _____ basis.
a. probability
b. possible

c. confident
d. random
e. protein- folding

(7.0) Scaling relations are used to:
a. extend knowledge about one creature to another.
b. remove physical or chemical limitations.
c. determine the heredity of particular fish.
d. exercise quantitative skills.
e. test memory skills.

(7.0) One difference between an engineering design and a complete guess is that the engineering design:
a. incorporates hardware and software.
b. usually incorporates quantitative predictions.
c. is made by engineers.
d. cannot be used by living things.
e. requires an engineering degree.

(7.1) Scaling factors
a. can be used to reduce overcrowding.
b. can be used to estimate the needs of new species.
c. are important for a biological engineer to know.
d. all of the above.
e. none of the above.

(7.1) Allometric relations only exist when there is:
a. a large extended family of allomets.
b. external pressure for modification.
c. similarity of structure and function.
d. complete dissimilarity.
e. equations to describe them.

(7.1) Allometric relations seem to be a product of:
a. excess capacity.
b. Lever Brothers.
c. evolutionary pressure.
d. uneconomical design.
e. flirting.

(7.1) Scale-invariant features of biological tissues include:
a. tissue configuration.
b. limb size.
c. bending moment.
d. tissue strength.
e. body weight.

(7.1) Allometric relationships are related to evolutionary principles through:
a. utilizing resources selfishly.
b. avoiding physical constraints.
c. giving extra functional capacity.
d. survival of the biggest.

e. optimizing benefit/cost ratios.

(7.2) Use of dimensionless numbers can:
a. improve the efficiency of experimental biology.
b. make measurements unnecessary.
c. allow living things to rearrange themselves.
d. separate component variables.
e. impress nonengineers.

(7.3) If you knew a person's height, knowing what else would enable you to calculate the height of the person's naval?
a. Silver anniversary.
b. Bronze ruler.
c. Golden rule.
d. Golden ratio.
e. Birth date.

(7.3) A partial Fibonacci number set is:
a. … 0, 1, 2, 3, 5 …
b. … 0, 0, 1, 1, 2 …
c. … 5, 8, 13, 21, 34 …
d. … 21, 34, 55, 88, 143 …
e. … 103, 204, 305, 406 …

(7.3) Which of these can *not* be said about the Golden Ratio?
a. it is calculated as ratios of time or length segments.
b. it is related to the sequence of Fibonacci numbers.
c. it describes plant growth and leaf spacing.
d. it has a solid theoretical basis.
e. it is useful in biology.

(7.3) The Golden Ratio results in:
a. Bermuda Triangle.
b. a model for biological description.
c. more money for the lower limb.
d. exponential responses.
e. fractalization.

(7.4) Heart rates are faster for:
a. larger animals.
b. smaller animals.
c. zombies.
d. students answering this question.
e. plants.

(7.4) The lifetime of an organism
a. cannot be statistically estimated.
b. preferentially circumvents autographs.
c. increases as body mass increases.
d. lasts longer.
e. has no relation to the average.

(7.4) Patterns that are repeated at different scales are said to have _____ scaling.
- a. fractal
- b. fraction
- c. similarity
- d. redundant
- e. fish

(7.4) Fractal scaling results mathematically in:
- a. exponential functions.
- b. power-law functions.
- c. logarithmic functions.
- d. linear functions.
- e. digital filtering.

(7.4) Fractal properties have been observed in:
- a. tree trunk growth.
- b. cultural Venn diagrams.
- c. neural electrical activity.
- d. parent-child relationships.
- e. iron ore.

(7.4) The main reason behind the scaling relationship of body size and mass is that:
- a. body proportions remain the same.
- b. the compositions of all bodies is the same.
- c. mass and size are measurements of the same thing.
- d. body density falls within a narrow range.
- e. the professor says so.

(7.4) Body surface area is scaled with:
- a. L^2
- b. L^3
- c. L^4
- d. L^1
- e. LL

(7.4) Body surface area is related to body mass to the _____ power.
- a. 3/4
- b. 2/3
- c. 1/3
- d. 7/8
- e. 1.75

(7.4) Dimensions of various body parts should only be proportional for _____creatures.
- a. histologically unambiguous
- b. evolutionarily contiguous
- c. morphologically homologous
- d. phrenologically pronounced
- e. phastasmagorically ostracized.

(7.4) Femur lengths of primates and ungulates would be expected to follow the same scaling relationships.

a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.4) Scaling relationships for plants are most usefully related to:
a. plant mass.
b. root system.
c. tree height.
d. trunk diameter.
e. leaf area.

(7.4) Body temperature for warm-blooded animals varies inversely with body mass.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.4) Birds have a higher body temperature than mammals.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.4) If birds have higher body temperatures than mammals, what conclusion can be made?
a. their enzymes are generally optimized for higher temperatures.
b. their nucleic acids are less stable.
c. their blood has higher viscosity.
d. they have more mitochondria.
e. they frequent hotter locales.

(7.4) The fact that mammalian body temperatures are nearly identical means that:
a. metabolic rates are all nearly the same.
b. metabolic rates and surface areas are proportional.
c. metabolic rates per unit body mass are higher for larger animals.
d. surface to volume ratios are smaller for smaller animals.
e. they all are closely related.

(7.4) Basal metabolic rate is due to:
a. reproduction.
b. muscular activity.
c. life-sustaining processes.
d. ingestion of food.
e. movement.

(7.4) Over 27 orders of magnitude, basal metabolic rate depends upon mass to the ____power.
a. -1/2
b. 1/4

c. 2/3
d. ¾
e. 1.75

(7.4) Basal metabolic rate is:
a. directly related to maximum oxygen uptake.
b. the lowest rate of metabolism to sustain life.
c. the metabolic rate of herbs.
d. inversely related to size.
e. always high.

(7.4) Femur lengths of primates and ungulates would be expected to follow the same scaling relationships.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.4) Body temperature for warm-blooded animals varies inversely with body mass.
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(7.4) Birds have a higher body temperature than mammals.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.4) Basal oxygen consumption is needed to support:
a. resting metabolic needs.
b. cardiac output.
c. body temperature increases.
d. nonliving tissue.
e. basal herbal tissue.

(7.4) Maximum oxygen consumption:
a. is greater for smaller animals.
b. limits aerobic metabolism.
c. is related to mass to the 1.2 power.
d. determines running speed.
e. bears no relation to anything.

(7.4) Oxygen consumption is:
a. higher for higher metabolic rates.
b. inconsequential for plants.
c. plentiful among homeotherms.

d. related to chloroplast structure.
e. used to reduce carbon dioxide to carbon.

(7.4) Larger animals have larger hearts and higher heart rates.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.4) Cross-sectional areas of smaller blood vessels (including capillaries) are larger for larger animals.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.4) Cross-sectional areas of larger blood vessels are the same for all animals.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.4) Compared to smaller animals, larger animals have:
a. greater aortic blood velocities.
b. lower maximum oxygen uptakes.
c. a greater number of smaller vessels.
d. lower body temperature.
e. larger trunk diameter.

(7.4) Capillaries in larger animals are the same size as capillaries in smaller animals.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.4) The lifetime number of heartbeats is:
a. greater for larger mammals.
b. the same for all mammals.
c. smaller for larger mammals.
d. not predictable.
e. depends on love life.

(7.4) Total metabolic energy per unit mass is:
a. greater for larger mammals.
b. the same for all mammals.
c. smaller for larger mammals.
d. not predictable.

e. has no meaning.

(7.4) If mass (m) is proportional to the cube of significant length (L), then area is proportional to:

a. L
b. $m^{1/2}$
c. $m^{2/3}$
d. $L^{2/3}$
e. $m^{3/4}$

(7.4) Two different species are homologous if they have:

a. been shaken to disperse fat globules.
b. five fingers and toes.
c. scaly skin.
d. the same relative structure and proportions.
e. plenty of analogous apparitions.

(7.4) Smaller birds have higher-pitched calls. Higher pitches (higher frequencies) do not carry as far as lower pitches. Thus it is not surprising that smaller birds:

a. have fewer offspring.
b. live longer lives.
c. defend smaller territories.
d. have fewer friends.
e. carry grudges.

(7.4) Alveolar size is:

a. larger than the size of veins.
b. the same as other neurons.
c. smaller to sustain higher metabolism.
d. related to running speed.
e. not important for diffusion of oxygen and carbon dioxide.

(7.4) Oxygen consumption of the liver is:

a. relatively small.
b. unrelated to body mass.
c. nearly the same in all animals.
d. lost to the environment through homologous mechanisms.
e. one of the highest of all the organs in the body.

(7.4) Two similar animals are compared and one has twice the mass as the other. The heart and lungs of the smaller animal are _____ the sizes of the heart and lungs of the larger animal.

a. one quarter
b. two thirds
c. four fifths
d. one half
e. twice

(7.4) Animals with higher heart rates also have :

a. higher respiration rates.
b. larger heart sizes.

c. larger body sizes.
d. higher basal metabolic rates.
e. larger feet.

(7.4) If people say someone is "big hearted," that implies that the person is:
a. protruding at the chest.
b. denser than average.
c. big all over.
d. filled with blood.
e. sparsely populated with capillaries.

(7.4) Animals with higher basal metabolic rates also have:
a. higher respiration rates.
b. larger heart sizes.
c. higher heart rates.
d. larger diameter capillaries.
e. more aortas.

(7.4) Larger animals have more capillaries than smaller animals because:
a. larger animals have more aortas.
b. capillary size and placement depend on diffusion limits.
c. they have more blood to fill them.
d. their capillaries are smaller.
e. resources to form more capillaries insignificant.

(7.4) Animals with higher metabolic rates need more efficient diffusion of gases in the lung. This leads to:
a. smaller alveoli.
b. slower respiration rates.
c. pleurapotency.
d. larger lungs.
e. static electricity.

(7.4) Animals with higher power disspated in the lungs also have:
a. higher body temperatures.
b. lower body temperatures.
c. ineffective metabolism.
d. larger lungs.
e. smaller lungs.

(7.4) The most effortless walk involves:
a. longer legs.
b. walking very slowly.
c. freely swinging legs.
d. not paying attention.
e. holding hands.

(7.4) The reason that animals with longer legs do not have inherently faster running speeds is that:
a. running speed is inversely proportional to leg length.
b. the efficiency of walking and running is the same.

c. all the legs are not the same size.
d. longer legs are harder to coordinate.
e. running speed also depends on muscle mass.

(7.4) Greater acceleration due to gravity allows faster natural (ballistic) walking
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.4) The number of steps per unit time (stride rate) for mammals is higher for mammals with:
a. higher population density.
b. larger hearts.
c. higher respiration rates.
d. larger tidal volumes.
e. greater amounts of hemoglobin.

(7.4) Smaller animals walk effortlessly with a speed _____larger animals.
a. faster than
b. the same as
c. slower than
d. all over
e. comparable to

(7.4) The relationship between size and running speed is different from the relationship between size and walking speed because:
a. walking and running are different.
b. running is like jumping along.
c. walking is non-ballistic.
d. running involves more muscular effort.
e. the body center of mass does not rise and lower in running.

(7.4) Animals that walk at a faster speed also have:
a. larger hearts.
b. faster running speeds.
c. faster heart rates.
d. shorter life spans.
e. higher respiration rates.

(7.4) Maximum running speed for quadrapeds:
a. is slower for longer legs.
b. does not depend on leg length.
c. is faster for longer legs.
d. is faster for shorter legs.
e. is just as fast as it needs to be.

(7.4) Ballistic walking would be _____on the moon compared to Earth.
a. faster
b. the same

c. slower
d. easier
e. farther away

(7.4) Times for growth, sexual maturity, reproduction, and lifespan are generally shorter for:
a. probiotics.
b. eukaryotes.
c. drug users.
d. smaller organisms.
e. stem cells.

(7.4) Animals with longer lifetimes also have:
a. longer generation times.
b. more offspring.
c. higher stride rates.
d. higher heart rates.
e. faster respiration rates.

(7.4) Animals that live longer usually have:
a. faster walking speeds.
b. smaller hearts.
c. more rapid heart rates.
d. smaller basal metabolic rates.
e. more to eat.

(7.4) The amount of solid waste produced by an animal depends exclusively on the amount of food fed.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.4) Which of these does *not* increase required amount of food intake for an animal:
a. animal size.
b. cold environmental temperature.
c. physical injury.
d. food quality.
e. none of the above.

(7.4) Larger birds sing songs of:
a. greater passion.
b. lower pitch.
c. mournful woe.
d. greater intricacy.
e. better listening.

(7.4) Metabolic rate and body temperature:
a. both depend on body mass.
b. vary greatly with genotype.
c. vary throughout the 24-hour day.

d. all of the above.
e. none of the above.

(7.4) Animals twice as massive have brains twice as massive.

a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.4) If the kidney clearance of a certain molecule is measured, what else must be known in order to calculate the concentration of that molecule in bodily fluid?

a. sizes and number of kidneys.
b. mass rate of excretion of the molecule.
c. pH of body fluid.
d. efficiency of the kidney.
e. source of the molecule.

(7.4) If the speed of walking is proportional to the square root of leg length then speed of walking would be expected to vary with body mass to what power?

a. ½
b. 1/3
c. ¼
d. 1/6
e. 1/8

(7.4) Heart rate for smaller mammals is faster than heart rate for larger mammals. Thus, over the entire lifetime of the animal,

a. the smaller mammal's heart rate would beat twice as many times as the larger mammal's heart.
b. the larger mammal's heart would beat faster than the smaller mammal's heart.
c. the total number of heart beats for both would equal three times the number of heart beats for the smaller animal.
d. the larger mammal's heart would beat twice as many times as the smaller mammal's heart.
e. the total number of heart beats would be the same for both larger and smaller mammals.

(7.4) The Reynolds number is given as $\mathrm{Re} = \frac{dvp}{\mu}$. If a direct measure of diameter cannot be obtained, what could be an alternate form for the Reynold's number?

a. $\mathrm{Re} = \frac{m^{1/2} vp}{\mu}$

b. $\mathrm{Re} = \frac{m^{1/4} vp}{\mu}$

c. $\mathrm{Re} = \frac{m^{1/3} vp}{\mu}$

d. $\mathrm{Re} = m^3 \mathrm{vp}/\mu$

e. $\mathrm{Re}= \frac{m^2 vp}{\mu}$

(7.4) Which of these plant types is the most photosynthetically efficient?
a. C1
b. C2
c. C3
d. C4
e. C5

(7.4) Fractal organization in biology extends from:
a. a to z.
b. chromosomes to flocking birds.
c. mountains to molehills.
d. respiration to breathing.
e. Sunday to Tuesday.

(7.4) A lion and a house cat drink water side-by-side. What would you observe?
a. The lion would finish the water and he would finish the cat.
b. Both would drink the same amount of water, but the cat would explode.
c. The lion would lap water slower than would the cat.
d. The cat would prefer to drink while the lion wasn't looking.
e. Nothing. Who wants to waste time watching felines drink?

(7.4) A structural constraint that would limit the size of King Kong would be:
a. The strength of his muscles.
b. The size of his head in relation to his body.
c. The elasticity of his tendons.
d. The strength of his bones.
e. The size of the camera used to take his picture.

(7.4) Animals with larger hearts,
a. are more amorous.
b. have larger capillaries.
c. eat faster.
d. run much faster than animals with smaller hearts.
e. shake water off themselves slower.

(7.5) Which of these is *not* a reason for predicting organ masses:
a. dosages of directed drugs.
b. cooling isolated organs.
c. planning a banquet for Hannibal Lechter.
d. calculation of amounts of specific biochemicals.
e. matching organ donors to recipients.

(7.5) Animals twice as massive have brains twice as massive.
a. true
b. false
c. maybe
d. all of the above

e. none of the above

(7.5) An animal with a larger thyroid gland would also be expected to have larger:
a. brain.
b. liver.
c. adrenal gland.
d. kidney.
e. all of the above.

(7.5) Food ingested by larger animals is expected to take longer to be expelled as waste compared to food ingested by smaller animals. One reason for this is that the intestines of larger animals are larger. Another is:
a. larger animals chew for longer periods of time.
b. intestinal peristalsis for larger animals is slower.
c. it just seems longer.
d. it takes longer for digestive enzymes to work.
e. larger animals eat longer food.

(7.5) Animals with larger amounts of hemoglobin also have larger amounts of myoglobin.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.6) The number of species in a grassland ecosystem is related to the area of that system by:
a. a random variable.
b. the mean and standard deviation.
c. an inverse relationship.
d. a power-law relationship.
e. dumb luck.

(7.6) Population doubling times for birds are:
a. able to be calculated with utmost precision.
b. almost impossible.
c. directly proportional to $(\text{mass})^{1/2}$.
d. nearly three times as long as for mammals.
e. dependent on the number of eggs laid.

(7.6) The range of a species is related to the population of that species by:
a. a random variable.
b. the mean and standard deviation.
c. a power-law relationship.
d. an inverse relationship.
e. KFC.

(7.6) Larger flocks of birds usually mean larger populations. Thus, also,
a. larger flocks are more concentrated.
b. the species range is larger for larger populations.
c. the birds are from the United Kingdom.
d. food supplies are more abundant.

e. birds don't fly alone.

(7.6) Larger animals live further apart.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.6) The population density of animals with larger amounts of hemoglobin is:
a. less.
b. the same.
c. greater.
d. can't tell.
e. won't tell.

(7.6) The relative population densities for different groups of animals all of the same size, beginning with the lowest density is:
a. birds, mammals, crabs.
b. mammals, birds, crabs.
c. crabs, birds, mammals.
d. crabs, mammals, birds.
e. all of the above.

(7.6) The density of herbivore populations depends on the availability of light.
a. true
b. false
c. maybe
d. all of the above
e. none of the above

(7.6) Larger animals require:
a. friendly neighbors.
b. more plants to eat.
c. longer times to increase population numbers.
d. higher densities.
e. forgiveness.

(8.1) A biological engineering creation must, above all, consider:
a. the entire system.
b. details of the biological unit.
c. physics.
d. survival and reproduction.
e. cost.

(8.1) Living things are never:
a. quite as they are expected to be.
b. self-contained.
c. redundant.
d. competitive.
e. soft.

(8.1) Living things strive to:
- a. comply with environmental constraints.
- b. contribute to harmonious relationships.
- c. dominate their physical, chemical, and biological environments.
- d. move to friendlier environments.
- e. control their tempers.

(8.1) Reductionist tendencies lead to:
- a. shrinking thoughts.
- b. prevention of expansionism.
- c. penalties across the board.
- d. focus on smaller and more fundamental issues.
- e. consideration of the entire system.

(8.1) The systems perspective for utilizing living things:
- a. unifies fundamental knowledge with global knowledge.
- b. sees everything.
- c. eschews reductionism.
- d. happens no matter how hard we try.
- e. colors everything with the same broad brush.

(8.1) A systems model of biology would begin with:
- a. subcellular contributions.
- b. a shallow but broad approach.
- c. the law of diminishing returns.
- d. the genetic code wholly determining responses.
- e. computer models.

(8.1) Population dynamics models incorporate five basic principles. Which of these is *not* one of them?
- a. cooperation.
- b. competition.
- c. linear causality.
- d. limits.
- e. none of the above.

(8.2) A cloned individual has exactly the same genetic material as the donor of the somatic source cell.
- a. true
- b. false
- c. maybe
- d. all of the above
- e. none of the above

(8.2) When living things are an integral part of an engineering design,
- a. the engineer can utilize their complexity.
- b. there are many approximations to make.
- c. the living things will die.
- d. calculus will be used to find the integral.
- e. the engineer will find a way to introduce information theory.

(8.2) Using a DNA strand as an input tape, translating the DNA sequence into an output DNA sequence, and then selecting the most useful results, results in:
a. lots of extra DNA.
b. a biological computer.
c. unique solutions to genetic problems.
d. a gooey mess.
e. RNA interference.

(8.2) Bioreactors designed as organs are examples of:
a. biomimetics.
b. biological system inadvertently affected.
c. in vitro manipulation.
d. fractal manipulations.
e. man-machine interfaces.

(8.2) Bioremediation:
a. utilizes biological organisms to solve the problem.
b. cannot clean up pollutants.
c. allows politicians to take credit for the work of engineers.
d. controls medical solutions.
e. solves all problems.

(8.2) Studying ant behavior helps craft solutions for:
a. making social policies.
b. improving business operations.
c. decision making.
d. educational issues.
e. all of the above.

(8.2) A similarity between ecological engineering and biological engineering is that they both:
a. are mutually exclusive.
b. usually consider humans as special species.
c. are technically soft fields.
d. are related to biological utilization in the context of their total surroundings.
e. admire each other.

(8.2) Digital ants can be used to:
a. detect computer security threats.
b. swarm to bit picnics.
c. take a byte out of crime.
d. form digital ant nests.
e. put faulty electronic circuits back together.

(8.2) Corn containing higher than normal levels of lysine and tomatoes containing vaccines are examples of
a. imagination gone wild.
b. genetically-modified organisms.
c. frankenfoods.
d. transgenic fahrfurnugen.
e. what is wrong with modern technology.

(8.2) Cloning of animals requires that

a. animals be born free.
b. males are not involved in the process of fertilization.
c. telomeres become rejuvenated.
d. the nucleus of a somatic cell is implanted into an egg cell.
e. clones are exactly like their progenitors.

(8.2) Before genetically-altered microbes were used from which to extract insulin, most insulin for human use was obtained from:
a. other humans.
b. swine.
c. snakes.
d. cows.
e. any place we could get it.

(8.2) Which of these is *not* a requirement for materials to be implanted in the human body?
a. non-toxic.
b. fat-free.
c. strong.
d. inert.
e. reliable.

(8.2) Introducing a gene into a patient receiving gene therapy requires a suitable:
a. autograph.
b. thrombus.
c. vector.
d. composition.
e. insurance company.

(8.2) One difference between ecological engineering and biological engineering is:
a. the usual scale of biology considered.
b. ecological engineering ignores genetic differences.
c. humans are not part of the ecological engineering scheme.
d. biological engineers don't get as muddy.
e. ecological engineers dine alone.

(8.2) When living things themselves are used as the solution to an engineering problem, the result is an example of:
a. hydried systems.
b. bionics.
c. biotechnology.
d. exploitation.
e. mad scientists at work.

(8.2) Hybrid systems is another name for:
a. bonecs.
b. gasoline-efficient cars.
c. bionics.
d. genetic crosses.
e. anything involving biology and engineering.

(8.2) Which of these is *not* an example of a hybrid system:
a. bioremediation of pollutants by microbes.

b. dolphins exploring dangerous underwater sites.
c. honeybees monitoring dispersed chemicals.
d. galvanometers measuring neuronal discharge.
e. Priuses.

(8.2) Using rats to carry video cameras to locate human survivors in building rubble is an example of:
a. hybrid systems.
b. biotechnology.
c. biomimetics.
d. biomedical engineering.
e. wishful thinking.

(8.2) Using earthworms to disburse soil amendments is an example of:
a. biotechnology.
b. hybrid systems.
c. biomimetics.
d. biomedical engineering.
e. wishful thinking.

(8.2) Using *Bacillus thuringiensis* as a natural pesticide is an example of:
a. biomedical engineering.
b. biotechnology.
c. hybrid systems.
d. biomimetics.
e. biosolutions engineering.

(8.2) Using biological organisms to remove pollutants from the environment is called:
a. biomedical engineering.
b. bioromination.
c. bioremediation.
d. biotechnology.
e. none of the above.

(8.2) Using natural populations for bioremediation has the advantage that they are:
a. adapted and robust.
b. cheap and ineffective.
c. genetically altered.
d. unchanged by pollutants.
e. wild and carefree.

(8.2) Petroleum-based environmental pollutants are a good source of:
a. protein.
b. energy.
c. micronutrients.
d. hydrophilic compounds.
e. gasoline.

(8.2) Environmental engineers who use microbes to bioremediate petroleum-based pollutants must usually supply:
a. energy, water, and air.

b. sterilizable containers.
c. protein, phosphorus, and micronutrients.
d. suitable employment.
e. stable environment.

(8.2) Using plants to remove unwanted substances from the soil is called:
a. phytoexploitation.
b. leaf mining.
c. petiolar progress.
d. phytoremediation.
e. pyroremediation.

(8.2) When rain falls on asphalt parking lots, the runoff water carries with it:
a. pollutants.
b. ducks.
c. assorted automobile parts.
d. plenty of mud.
e. car keys.

(8.2) Rain gardens:
a. grow rain showers.
b. filter pollutants from runoff.
c. are populated with water lilies.
d. must be carefully tended to remove weeds.
e. are not useful.

(8.2) Trees can act as barriers to:
a. lumbermen.
b. squirrels.
c. sound.
d. pleasant living.
e. squirrels.

(8.2) Bacterial DNA can be used as the basis of:
a. defibrillators.
b. bacterial de-linkers.
c. resting metabolism.
d. genetic computers.
e. eukaryotic DNA.

(8.2) A Turing machine is a simple:
a. computer.
b. DNA strand.
c. automobile.
d. rotating thing.
e. convertible.

(8.2) A DNA computer would normally operate in:
a. a binary.
b. base 4.
c. isolation.

d. acidic solution.
e. an imaginative mind.

(8.2) If a single DNA strand represents the input data, and the complementary DNA strand represents the output, then DNA polymerase represents the:
a. local mechanism.
b. probability of success.
c. translation instructions.
d. toe nail.
e. end of the process.

(8.2) Imitating a biomaterial or function is called:
a. biomedical engineering.
b. biotechnology.
c. bionics.
d. biomimetics.
e. bioimitation.

(8.2) Copying spider silk to produce strong cables is an example of:
a. biomimetics.
b. hybrid systems.
c. biotechnology.
d. biomedical engineering.
e. biosilkery.

(8.2) *Swarm intelligence* is the term used to describe the coordination of a group of individuals. Which of these is *not* an example of swarm intelligence:
a. a flock of migrating geese.
b. ants in a colony.
c. a school of swimming fish.
d. humans commuting to work.
e. swallows flying to San Juan Capistrano.

(8.2) Looking inside the brain for evidence of thoughts, memories, and recognition sounds like science fiction, but really is the domain of:
a. Dr. Faustus.
b. the Peabody Conservatory.
c. neural engineering.
d. scan interviews.
e. brain science.

(8.2) Positron Emission Tomography employs radioactive tracers to image:
a. radioactive drugs.
b. computer interrupt times.
c. liver position.
d. brain activity.
e. protein disruption.

(8.2) Information known by the subject forms distinctly different _____compared to irrelevant information.
a. event related potentials

b. positron emission tomography images
c. musical scores
d. verbal utterances
e. x-rays.

(8.2) Complex, self-organizing systems operate very much like ecosystems, according to:
a. Rand Corporation.
b. complexity theory.
c. ecological engineers.
d. television sources.
e. fortune tellers.

(8.2) Studying how ants organize themselves to obtain food leads to:
a. scraps of food to eat.
b. squinting eye sight.
c. efficient managerial algorithms.
d. familiarity with ants.
e. a path to a picnic.

(8.2) Foraging theory is an example of:
a. biomedical engineering.
b. biotechnology.
c. hybrid systems.
d. biomimetics.
e. harvesting acumen.

(8.2) Foraging theory is based upon:
a. cost to benefit ratios.
b. cows eating grass.
c. computer operation.
d. maximum likelihood estimation.
e. retail therapy.

(8.2) Wildlife ecology, group ecology, and internet ecology all rest upon:
a. ecological engineering.
b. interactions among players and environment.
c. planar wetlands.
d. tautology.
e. good textbooks.

(8.2) Before a new gene can be inserted in DNA:
a. the new gene must be found.
b. the DNA must be cut by resuscitation enzymes.
c. the DNA must be isolated.
d. items b and c.
e. none of the above.

(8.2) Genetically-modified organisms are antibiotic resistant to some degree.
a. true
b. false
c. maybe

d. all of the above
e. none of the above

(8.2) A vector used to introduce a therapeutic gene must:
a. have both magnitude and direction specified.
b. be repulsed by the target cell.
c. have an impenetrable outer coat.
d. be benign.
e. available most of the time.

(8.2) RNA interference and _____have the same effects.
a. antisense DNA
b. down field blocking
c. cross-checking
d. plywood figures
e. umpire error

(8.2) Inserting a BT gene into plants protects them from:
a. BB genes.
b. butterfly and moth caterpillars.
c. prototype emissions.
d. growth and reproduction.
e. BT dieases.

(8.2) A benefit of genetically modified plants is:
a. improved protection against human exploitation.
b. they are less expensive.
c. reduced pesticide use.
d. improved leaf area.
e. they are cute.

(8.2) Genetically-modified organisms are an example of:
a. biomimetics.
b. hybrid systems.
c. biomedical engineering.
d. biotechnology.
e. biogeomes.

(8.2) Genetically-modified organisms have been produced to produce pesticides, nutrients, drugs, and:
a. be exact duplicates.
b. lithosensor systems.
c. generate sticky goo.
d. organic foods.
e. cosmetics.

(8.2) Green fluorescent protein is used to:
a. cause proteins to glow in ordinary light.
b. visualize the presence of biochemicals.
c. make everything turn green.
d. color fluorescent Irish symbols.

e. instill a sense of ecology.

(8.2) Green fluorescent protein can be used to:
a. kill corals.
b. distinguish among different colors.
c. mark the location of specific proteins.
d. produce a line of fluorescent bulbs.
e. harvest seaweed.

(8.2) Biomedical engineering is usually characterized by the application of physical devices to:
a. wrists and ankles.
b. the living and nonliving.
c. spectral intensity.
d. humans or animals.
e. lizard guts.

(8.2) The initial attempt at a biomedical engineering design is usually:
a. based on fundamental principles.
b. the final design.
c. highly empirical.
d. easily accomplished.
e. done by amateurs.

(8.2) Subsequent to the initial prototype, a biomedical engineering design is usually:
a. based on fundamental principles.
b. highly empirical.
c. the final design.
d. easily accomplished.
e. unacceptable.

(8.2) Compared to the original organs, replacement organs are usually:
a. genetically-modified.
b. poorly understood.
c. less robust.
d. phantasmagorical.
e. exact replicas.

(8.2) Which of these is likely to have the lowest risk of rejection:
a. pentagraft.
b. xenograft.
c. allograft.
d. autograft.
e. autograph.

(8.2) Taking liver cells from a pig to inject into a human is an example of:
a. xenograft.
b. pentagraft.
c. allograft.
d. autograft.
e. autograph.

(8.2) A blood transfusion from one person to another is an example of a:

a. xenograft.
b. allograft.
c. pentagraft.
d. autograft.
e. autograph.

(8.2) Materials used in medical devices are usually:

a. not suited for their use.
b. better than natural tissue..
c. hydrophobically water soluble.
d. inexpensive compared to device costs.
e. neither high nor low surface energy.

(8.2) The artificial kidney was initially developed in secret during:

a. World War II.
b. a ban on kidney work.
c. a divorce hearing.
d. an automobile parts convention.
e. a Los Vegas strip show.

(8.2) The first artificial heart:

a. was a left ventricle assist device.
b. was invented by the inventor of the artificial kidney.
c. was electrically powered.
d. fluttered whenever a robot was in view.
e. had no valves.

(8.2) Which of these is *not* an artificial organ used or under development:

a. artificial blood.
b. artificial lungs.
c. artificial brain parts.
d. artificial ears.
e. none of the above.

(8.2) Tissue engineering is the manipulation of living cells to:

a. form a better Kleenex.
b. line bioreactors.
c. propagate for generations.
d. replace original tissues.
e. form improved HeLa cells.

(8.2) A tissue engineering scaffold is used to:

a. support cells while they form an organ.
b. supply cells to other organs.
c. remain in place while healing occurs.
d. prevent deterioration of natural organs.
e. paint high cell walls.

(8.2) Human activities sometimes disturb natural conditions. In that case, the biological engineer may be called upon to:

a. put the conditions back as they were.
b. minimize biological impact.
c. write a statement justifying the actions.
d. give sympathy.
e. give the eulogy.

(8.2) Sometimes human activities promote the growth and reproduction of certain species. The biological engineer may be called upon to:
a. eliminate all other species.
b. promote satisfaction.
c. limit population growth.
d. turn off the lights.
e. spend government money.

(8.2) When resources are all obtained locally, waste is disposed locally, and energy sources are renewable, then the system is said to be:
a. idealistic.
b. small-scale.
c. preventable.
d. sustainable.
e. economical.

(8.2) Hearing aids that equally amplify all sounds are usually unsatisfactory because:
a. speech is perceived based on formants.
b. barking dogs can become annoying.
c. sensory overload can result.
d. the human voice needs anti-grating filters.
e. they make a sound like the ocean waves.

(8.2) Biomimetical principles are the basis for:
a. new materials.
b. controls.
c. complex adaptive organizations.
d. all of the above.
e. none of the above.

(8.2) Phytoremediation can be used to
a. correct bad vision in a dog.
b. remove excess nutrients from the soil.
c. grow bacteria from sterile growth medium.
d. replace scarce nutrients in a pond.
e. replace phytos in the environment.

(8.2) The artificial heart is an example of a biological engineering effort where:
a. first principles are used to design new products.
b. nothing new can be learned from the effort.
c. a living system is the recipient of the design.
d. color is important.
e. the project ad to be restarted.

(8.2) Dredging a shipping channel for commercial reasons can:
a. lower the ocean level.

b. inadvertently harm living things.
c. increase the rate of evolution.
d. uncover hidden treasure.
e. result in reliability theory.

(8.2) Cottonwood trees are good for phytoremediation because:
a. they hide rabbits and deer.
b. they grow fast and can be genetically modified.
c. they are native to many candidate locations.
d. they primarily use phytostabilization.
e. they cannot reproduce.

(8.2) Which of these is *not* a useful way to deliver DNA into a target cell?
a. tying cell membrane ligands together.
b. using transfection reagents and endocytosis.
c. with electroporation.
d. virus vectors.
e. biolistics.

(8.2) Of the common means to introduce DNA into a cell, biolistics is:
a. the most robust.
b. usually used only with plant cells.
c. used with virus vectors.
d. plenty good enough.
e. the slowest method.

(8.2) Bioleaching uses bacteria to:
a. hold tightly to the skin.
b. *Thiobacillus ferrooxidans.*
c. extract metal ore.
d. pan for gold.
e. digest blood.

(8.2) Extraction of metals from low-grade ores can be accomplished with special microbes. This is an example of:
a. hybrid systems.
b. biotechnology.
c. biomedical engineering.
d. bioremediation.
e. biomimetics.

(8.2) Controlling insects, so-called "cyborg beetles", for use in surveillance, is an example of:
a. biomimetics
b. biotechnology.
c. biomedical engineering.
d. bioremediation.
e. hybrid systems.

(8.3) A completed design incorporating all known design objectives
a. requires at most 5 years of effort.
b. is a realistic expectation for biological engineers.
c. describes the artificial heart.

d. doesn't exist.
e. was made many years ago.

(8.3) Old designs and new designs have what in common?
a. they both require blueprints.
b. both have used computer aided design.
c. improvements can be made in both.
d. they are appreciated.
e. both have symbiosis.

(8.3) The submarine built for two incorporated several types of biological engineering considerations. Which of these is *not* a consideration?
a. human factors engineering.
b. life support.
c. biomimetical arms.
d. Weber-Fechner law.
e. the environment.

(8.3) The evolution of living things and human made products follow similar paths. Which of these is *not* associated with bioevolution or product evolution?
a. each depends upon entirely random processes.
b. each incremental version is better adapted to use.
c. both usually begin as rather crude.
d. the survival of both depends upon competitive advantage.
e. constant improvemwent is expected.

(8.3) Bacterial flagella can be harnessed as:
a. nanosliders.
b. tiny hairs that wiggle back and forth.
c. motors powered by ATP.
d. whips and chains.
e. pull tiny wagons.

(8.3) Bionanotechnology can be used to form semiconductor circuits that:
a. produce tiny computers.
b. give off very small amounts of heat.
c. kill viruses.
d. assemble themselves.
e. have no connections.

(8.3) Feeding systems for cows require a good deal of knowledge about the cows. Which of these is *not* a relevant cow characteristic:
a. cows eat the same way each time they feed.
b. cattle facing each other are in an aggressive posture.
c. head down position releases more saliva.
d. cows like to eat in groups.
e. cows fight over feed.

(8.4) Above all, when considering biological processes, a biological engineer must:
a. make sure he or she is legally covered.

b. limit consideration to the biological unit involved.
c. have a thorough knowledge of genetics.
d. read about the history of the process.
e. consider the entire system, including the environment.

(8.4) When designing a system for use by humans,
a. psychology can be ignored.
b. the engineer can always use the same system on rats.
c. appearance of the system can be critical to its acceptance.
d. the engineer can require the human to adapt to the system requirements.
e. make it as cheaply as possible.

(8.4) Which is *not* an opportunity for biological engineers:
a. working in the patent office.
b. working for an insurance company.
c. teaching about science, mathematics, or engineering.
d. working for a medical device manufacturer.
e. none of the above.

(8.4) Valuable information for the redesign of a device to be used to solve a problem involving biological units should come from what sources?
a. users of a previous model of the device.
b. manufacturers of competing devices.
c. newly graduated biological engineers.
d. know-it-alls.
e. none of the above.

(8.4) Success is achieved by:
a. accomplishing tasks.
b. appreciating beauty.
c. expecting to give and receive the best.
d. all of the above.
e. none of the above.

(8.4) Living an inspirational life is:
a. reserved for the clergy.
b. a measure of success.
c. a perfect poem.
d. the trust of pure women.
e. cannot be attained.

(8.4) Dénouement is the:
a. passage of time.
b. greeting.
c. final outcome of a literary work.
d. final blessing.
e. French word for kitty-cat.

(8.4) When facing a new design challenge, biological engineers should first
a. check to see if a similar problem has been solved biologically by living things.

b. try genetic engineering.
c. turn to ecologists for the answer.
d. have in mind a means to control living organisms to force them to produce what is required.
e. ask mom what she would do about it.