



**The 62<sup>nd</sup> Annual  
Merck State Science Day Competition  
May 22, 2012**

**BIOLOGY**

**Directions:**

**PLEASE DO NOT OPEN THE EXAM BOOKLET UNTIL DIRECTED.**

Be sure to fill in your name on the answer sheet both by printing it in the correct space, and by filling in the corresponding letter in the provided spaces.

**Use a #2 pencil only.**

Carefully erase any errors, and do not make any extraneous marks on the answer sheet. Do NOT use *White-Out* on any portion of the answer sheet.

The test has **120 items** that will be scored. You have **90** minutes in which to answer all the questions.

There is only one correct answer per question. Do not spend too much time on any one question. Do the items you find easier first, and then go back to those you find more difficult or time consuming during the time you have remaining. Your individual score will be computed on the basis of the number of correctly answered items. (There is no penalty for guessing.)

# The Modern Periodic Table of the Elements

1 Hydrogen <b>H</b> 1.01 2.1	2 Beryllium <b>Be</b> 9.01 1.5		3 Lithium <b>Li</b> 6.94 1.0		4 Titanium <b>Ti</b> 47.88 1.5		5 Vanadium <b>V</b> 50.94 1.6		6 Chromium <b>Cr</b> 52.00 1.6		7 Manganese <b>Mn</b> 54.94 1.5		8 Iron <b>Fe</b> 55.85 1.8		9 Cobalt <b>Co</b> 58.93 1.8		10 Nickel <b>Ni</b> 58.69 1.8		11 Copper <b>Cu</b> 63.55 1.9		12 Zinc <b>Zn</b> 65.39 1.6		13 Boron <b>B</b> 10.81 2.0		14 Carbon <b>C</b> 12.01 2.5		15 Nitrogen <b>N</b> 14.01 3.0		16 Oxygen <b>O</b> 16.00 3.5		17 Fluorine <b>F</b> 19.00 4.0		18 Helium <b>He</b> 4.00 ---			
19 Potassium <b>K</b> 39.10 0.8	20 Calcium <b>Ca</b> 40.08 1.0		21 Scandium <b>Sc</b> 44.96 1.3		22 Titanium <b>Ti</b> 47.88 1.5		23 Vanadium <b>V</b> 50.94 1.6		24 Chromium <b>Cr</b> 52.00 1.6		25 Manganese <b>Mn</b> 54.94 1.5		26 Iron <b>Fe</b> 55.85 1.8		27 Cobalt <b>Co</b> 58.93 1.8		28 Nickel <b>Ni</b> 58.69 1.8		29 Copper <b>Cu</b> 63.55 1.9		30 Zinc <b>Zn</b> 65.39 1.6		31 Gallium <b>Ga</b> 69.72 1.6		32 Germanium <b>Ge</b> 72.61 1.8		33 Arsenic <b>As</b> 74.92 2.0		34 Selenium <b>Se</b> 78.96 2.4		35 Bromine <b>Br</b> 79.90 2.8		36 Krypton <b>Kr</b> 83.80 3.0			
37 Rubidium <b>Rb</b> 85.47 0.8	38 Strontium <b>Sr</b> 87.62 1.0		39 Yttrium <b>Y</b> 88.91 1.2		40 Zirconium <b>Zr</b> 91.22 1.4		41 Niobium <b>Nb</b> 92.91 1.6		42 Molybdenum <b>Mo</b> 95.94 1.8		43 Technetium <b>Tc</b> (98) 1.9		44 Ruthenium <b>Ru</b> 101.07 2.2		45 Rhodium <b>Rh</b> 102.91 2.2		46 Palladium <b>Pd</b> 106.42 2.2		47 Silver <b>Ag</b> 107.87 1.9		48 Cadmium <b>Cd</b> 112.41 1.7		49 Indium <b>In</b> 114.82 1.7		50 Tin <b>Sn</b> 118.71 1.8		51 Antimony <b>Sb</b> 121.76 1.9		52 Tellurium <b>Te</b> 127.60 2.1		53 Iodine <b>I</b> 126.90 2.5		54 Xenon <b>Xe</b> 131.29 2.6			
55 Cesium <b>Cs</b> 132.91 0.7	56 Barium <b>Ba</b> 137.33 0.9		57-70 * 89-102 **		71 Lutetium <b>Lu</b> 174.97 1.1		72 Hafnium <b>Hf</b> 178.49 1.3		73 Tantalum <b>Ta</b> 180.95 1.5		74 Tungsten <b>W</b> 183.84 1.7		75 Rhenium <b>Re</b> 186.21 1.9		76 Osmium <b>Os</b> 190.23 2.2		77 Iridium <b>Ir</b> 192.22 2.2		78 Platinum <b>Pt</b> 195.08 2.2		79 Gold <b>Au</b> 196.97 2.4		80 Mercury <b>Hg</b> 200.59 1.9		81 Thallium <b>Tl</b> 204.38 1.8		82 Lead <b>Pb</b> 207.20 1.8		83 Bismuth <b>Bi</b> 208.98 1.9		84 Polonium <b>Po</b> (209) 2.0		85 Astatine <b>At</b> (210) 2.2		86 Radon <b>Rn</b> (222) 2.4	
87 Francium <b>Fr</b> (223) 0.7	88 Radium <b>Ra</b> (226) 0.9		89-102 **		103 Lawrencium <b>Lr</b> (262) ---		104 Rutherfordium <b>Rf</b> (261) ---		105 Dubnium <b>Db</b> (262) ---		106 Seaborgium <b>Sg</b> (263) ---		107 Bohrium <b>Bh</b> (262) ---		108 Hassium <b>Hs</b> (265) ---		109 Meitnerium <b>Mt</b> (266) ---		110 Ununnilium <b>Uun</b> (271) ---		111 Unununium <b>Uuu</b> (272) ---		112 Ununbium <b>Uub</b> (277) ---		113 Ununtrium <b>Uut</b> (284) ---		114 Ununquadium <b>Uuq</b> (289) ---		115 Ununpentium <b>Uup</b> (288) ---		116 Ununhexium <b>Uuh</b> (291) ---		118 Ununoctium <b>Uuo</b> (294) ---			

57 Lanthanum <b>La</b> 138.91 1.1	58 Cerium <b>Ce</b> 140.12 1.1		59 Praseodymium <b>Pr</b> 140.91 1.1		60 Neodymium <b>Nd</b> 144.24 1.1		61 Promethium <b>Pm</b> (145) 1.1		62 Samarium <b>Sm</b> 150.36 1.2		63 Europium <b>Eu</b> 151.97 1.1		64 Gadolinium <b>Gd</b> 157.25 1.2		65 Terbium <b>Tb</b> 158.93 1.1		66 Dysprosium <b>Dy</b> 162.50 1.2		67 Holmium <b>Ho</b> 164.93 1.2		68 Erbium <b>Er</b> 167.26 1.2		69 Thulium <b>Tm</b> 168.93 1.3		70 Ytterbium <b>Yb</b> 173.04 1.1	
89 Actinium <b>Ac</b> (227) 1.1	90 Thorium <b>Th</b> 232.04 1.3		91 Protactinium <b>Pa</b> 231.04 1.5		92 Uranium <b>U</b> 238.03 1.4		93 Neptunium <b>Np</b> (237) 1.4		94 Plutonium <b>Pu</b> (244) 1.3		95 Americium <b>Am</b> (243) 1.3		96 Curium <b>Cm</b> (247) 1.3		97 Berkelium <b>Bk</b> (247) 1.3		98 Californium <b>Cf</b> (251) 1.3		99 Einsteinium <b>Es</b> (252) 1.3		100 Fermium <b>Fm</b> (257) 1.3		101 Mendelevium <b>Md</b> (258) 1.3		102 Nobelium <b>No</b> (259) 1.3	

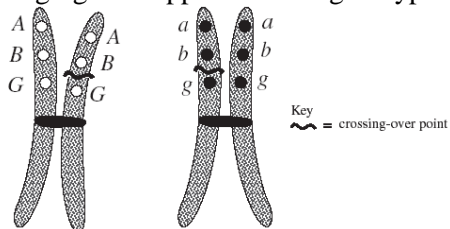
\*lanthanides

\*\*actinides

**Multiple Choice**

Identify the choice that best completes the statement or answers the question and place your selection ON THE ANSWER SHEET..

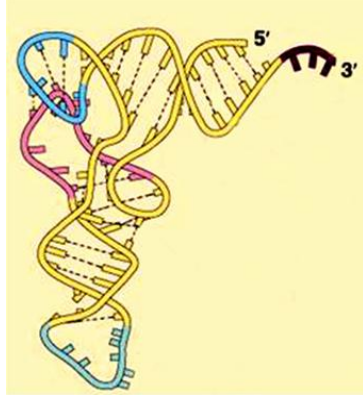
- Which of the following is *not* true concerning biology?
  - Diversity is the result of evolution
  - The behavior of individual organisms is dependent upon their evolutionary history
  - The characteristics of any living organism are under the control of a chemical
  - The diversity of living organisms makes life unpredictable, even using scientific methods
  - All organisms are alike in that their structure and organization arise from matter and energy
- Which of the following descriptions would most likely be used when discussing dynamic equilibrium?
  - response to environmental stimuli
  - limited range of variation
  - rapid energy turnover
  - structural and functional units of life
  - cycle of nutrients
- Four of the five factors listed below affect the rate of an enzymatic reaction. Select the exception.
  - pH
  - temperature
  - concentration of the substrate
  - size of the enzyme
  - pressure
- Genetic equilibrium and allele frequencies are maintained by all of the following *except*;
  - differential survival and reproduction
  - large population interbreeding freely
  - random mating
  - absence of mutations
  - development of isolating mechanisms
- A 'high-energy bond' in ATP
  - is formed when ATP is hydrolyzed to ADP and an inorganic phosphate group
  - is similar to the bonds in glucose molecules; that is why glucose is the primary source of metabolic energy
  - is used to prime other molecules to make a conformational change and react
  - absorbs a large amount of free energy when the phosphate group is attached during hydrolysis
  - all of these
- The diagram below represents one pair of chromosomes during meiosis. Cross-over occurs and the law of segregation applies. What genotypes would you expect to be produced in the gametes?



- ABG; aBG; ABg; abg
- ABG; ABG; abg; abg
- ABG; abG; ABg; abg
- ABG; ABG; ABg; abg

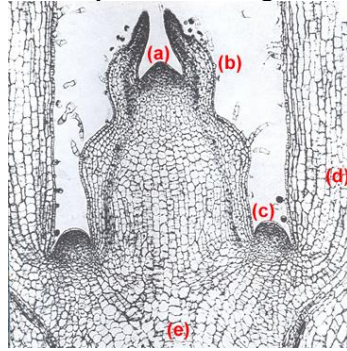
7. At the end of a marathon race, a runner's body is dehydrated. How should the body control the two hormones, ADH and aldosterone, to help re-establish normal water balance?
- A) ADH is released and aldosterone is inhibited
  - B) ADH is inhibited and aldosterone is released
  - C) ADH is released and aldosterone is released
  - D) ADH is inhibited and aldosterone is inhibited

8. The diagram below is most directly involved in which of the following processes?



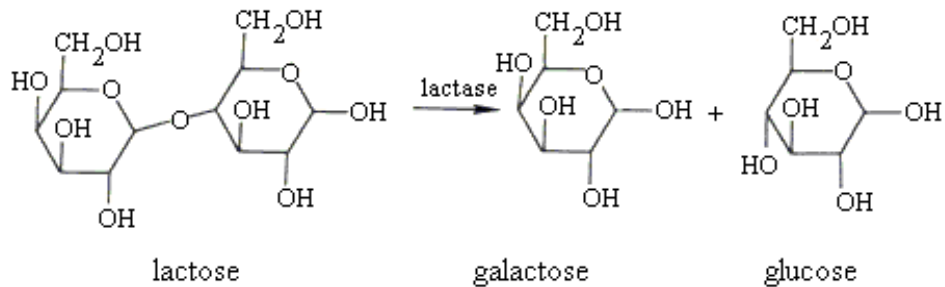
- A) DNA semiconservative replication
  - B) post-translational modification
  - C) pre-mRNA processing to mRNA
  - D) amino acid elongation
  - E) codon-anticodon recognition
9. If a mixture of bacteriophages, some labeled with radioactive sulfur and others labeled with radioactive phosphorus, is placed in a bacterial culture the bacteria will eventually contain
- A) both radioactive sulfur and phosphorus
  - B) radioactive phosphorus only
  - C) radioactive sulfur only
  - D) neither radioactive sulfur nor radioactive phosphorus
  - E) complete viruses with radioactive sulfur coats
10. Acetylation makes genes accessible to transcription by
- A) the acetyl groups attaching to the lysine groups in the histone tails, neutralizing these tails and uncoupling the attachment to the neighboring nucleosomes
  - B) the acetyl groups increase the pH of the nucleus, loosening the histones from the DNA molecule
  - C) the acetyl groups attaching to the sugar-phosphate side chain of the DNA molecule, allowing transcriptional factors access to the promoter regions of the DNA
  - D) the acetyl groups attaching to the lysine groups in the histone tails, promoting condensation of the chromatin
  - E) the acetyl groups binding to the transcriptional factors that then enhance their binding to the chromatin
11. What is the advantage of using DNA microarrays over filter hybridization to screen for single nucleotide mutations?
- A) Whole cells can be used for a DNA template
  - B) PCR is not necessary
  - C) No probes are necessary
  - D) Hundreds of thousands of experiments can be done at the same time
  - E) Microarrays can be read easily

12. What is the most appropriate description of the region labeled 'a' shown below?



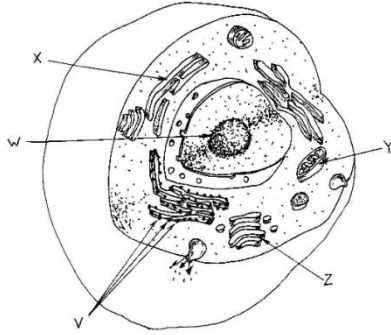
- A) the axillary bud that is the site for apical dominance  
B) the developing vascular tissue that will give rise to the xylem and phloem  
C) the leaf primordia that will give rise to the new leaves  
D) the flower bud that will differentiate into the carpels and stamens  
E) the apical meristem that is comprised of actively, undifferentiated cells
13. As a marine biologist, a student brings you a newly found organism that has the following characteristics: bilateral symmetry, radial and determinate cleavage, blastopore develops into the mouth, and it has a trochophore larva form. Which is the best classification of this organism?  
A) a starfish  
B) a brachiopod  
C) a nematode  
D) a ctenophora  
E) both b and c are possible
14. Which of the following is *not* an ancestral characteristic of land plants that connects them morphologically and molecularly to the charophytes?  
A) peroxisome enzymes that help minimize the loss of organic products resulting from photorespiration  
B) rings of cellulose-synthesizing proteins in the plasma membrane  
C) presence of a durable polymer called sporopollenin  
D) formation of a phragmoplast  
E) ultrasound structure of the flagellated sperm
15. Which of the following is *not* a typical event associated with cell signaling?  
A) activation of G-proteins by exchanging GTP for GDP  
B) production of the second messengers cAMP and IP3  
C) activation of protein kinases  
D) release of calcium ions from cell membranes  
E) stimulation of apoptosis
16. Estrogen and testosterone are steroid hormones, and most likely bind to  
A) cytoplasmic receptors  
B) G-protein linked membrane receptor  
C) enzyme linked membrane receptor  
D) membrane ion channel  
E) all of the above are possible
17. Tree seedlings in a nursery are displaying the following foliar symptoms: the old leaves near the bottom of each seedling are turning yellowish between the vein while the vein region remain green; the younger leaves look normal; the soil pH is 5.5. What is the likely cause of these symptoms?  
A) aluminum toxicity because of low pH  
B) deficiency of sulfur caused by acid precipitation  
C) toxicity of acids of acid rain  
D) magnesium deficiency caused by low soil magnesium levels  
E) calcium deficiency caused by increased leaching losses

18. In a developmental study of a nematode worm, the positions of two embryonic cells (designated A and B) are switched. Cell A typically develops into the worm's pharynx, and cell B typically develops into the worm's metanephridium. However, after the switch, descendants of cell B form the pharynx. Which of the following statements regarding the nematode's development best explains these results?
- Different cells of the nematodes receive different sets of genes
  - The nematode undergoes position-dependent cellular interactions
  - Development in the nematode is invariant
  - Embryogenesis in the nematode is mainly determined by individual cells
  - None of the above are acceptable explanations
19. Using the diagram below, choose the best explanation of this reaction.



- it is the complete equation for dehydration synthesis
  - it requires the input of a water molecule and demonstrates dehydration synthesis
  - it requires the product of a water molecule and demonstrates hydrolysis
  - it requires the input of a water molecule and demonstrates hydrolysis
  - it is an example of an anabolic reaction which is necessary for the products to be used for cellular respiration
20. Vasoconstriction of which of the following vessels will most effectively reduce fat absorption from the small intestine into the bloodstream?
- lacteals inside intestinal villi of the small intestine
  - capillaries in the smooth muscle of the small intestine
  - lacteals in the peritoneum around the small intestine
  - capillaries in the peritoneum around the small intestine
  - capillaries inside the intestinal villi of the small intestine
21. Production of which of the following hormones will be inhibited by the administration of dietary calcium to prevent osteoporosis?
- growth hormone
  - calcitonin
  - thyroid hormone
  - parathyroid hormone
  - glucagon

22. In the diagram below, structure labeled Z would best be described as:



- A) organelle for primary structure of proteins
  - B) storage organelle for mRNA nucleotides
  - C) organelle that modifies, stores and routes non-cellulose carbohydrates
  - D) organelle that receives materials on the trans face and secretes products from the cis face
  - E) organelle with an electron transport system embedded in the inner wall
23. Under which condition would you expect the mitochondrial proton gradient to be highest and therefore ATP synthesis to proceed?
- A) pyruvate (present); oxygen (present); ATP levels (high)
  - B) pyruvate (present); oxygen (present); ATP levels (low)
  - C) pyruvate (present); oxygen (absent); ATP levels (high)
  - D) pyruvate (absent) oxygen (present); ATP levels (low)
  - E) pyruvate (absent); oxygen (absent); ATP levels (high)
24. What occurs as electrons flow down the electron transport chain of the mitochondria assuming normal conditions?
- A) NADH and FADH<sub>2</sub> are oxidized
  - B) the pH of the matrix increases
  - C) the electrons decrease free energy
  - D) an electrochemical gradient is formed
  - E) all of the above occur
25. An acetylcholinesterase inhibitor increases nasal secretions in a human because it
- A) blocks acetylcholinesterase release from parasympathetic nerve endings
  - B) blocks acetylcholinesterase response at acetylcholine receptors
  - C) increases parasympathetic activity at acetylcholine receptors
  - D) decreases parasympathetic activity at acetylcholine receptors
  - E) increases acetylcholine activity within the presynaptic cleft of the nasal cells
26. Carbon dioxide is passed into a solution of bromthymol blue indicator until the acid solution turns yellow. A sprig of elodea is then placed into this solution. After a few hours in the sunlight, the yellow solution turns blue again. The purpose of this experiment is to show that
- A) oxygen is given off during photosynthesis
  - B) carbon dioxide is used during photosynthesis
  - C) carbon dioxide is given off as a by-product of photosynthesis
  - D) bromthymol blue changes to bromthymol yellow under acid conditions
  - E) chlorophyll acting as a photocatalyst is necessary for photosynthesis

27. Dichlorophenolindophenol (DPIP) is a blue dye that is discolored when it is reduced. After being mixed with DPIP, which of the following would show the greatest change in color from blue to clear?
- A) isolated chloroplasts in the light
  - B) isolated chloroplasts in the dark
  - C) chlorophyll extract in the dark
  - D) boiled chloroplasts in the light
  - E) boiled chloroplasts in the dark
28. In a mesophyll cell of a leaf, the synthesis of ATP occurs in which of the following?
- 1. ribosomes
  - 2. mitochondria
  - 3. chloroplasts
- A) 1 only
  - B) 2 only
  - C) 3 only
  - D) 2 and 3 only
  - E) 1, 2, and 3
29. Which of the following adult tissues would be labeled as a result of labeling the ectoderm with vital dyes in a vertebrate embryo
- 1. skeletal muscle
  - 2. pituitary gland, adrenal medulla
  - 3. dermis of skin
- A) I only
  - B) II only
  - C) III only
  - D) I and II, but not III
  - E) II and III, but not I
30. Which of the following is *not* part of the gene-for-gene recognition in a plant disease resistance response?
- A) cells remote from the infection site convert methylsalicylic acid to salicylic acid which induces production of PR proteins and aids in resistance to pathogen attack
  - B) R-Avr recognition stimulates production of phytoalexins
  - C) PR proteins act as part of the SAR (systemic acquired resistance) in that they are specific to the type of pathogen
  - D) the HR (hypersensitive response) initially causes cell and tissue death near the infection site
  - E) none of the above: all are involved in the gene-for-gene recognition defense mechanism
31. The significance of oocyte polarity is that
- A) cell systems near the anterior end of an organism are aligned differently from cell systems at the posterior end
  - B) it results in the formation of the gray crescent
  - C) it produces differently pigmented regions in the egg
  - D) cytoplasmic determinates (substances) located at one end of the other zygote differ from the cytoplasmic determinates located at the other end
  - E) all of the above
32. Which of the following is *not* true of apoptosis?
- A) the formation of the human hand is an example
  - B) it involves cell self-destruction
  - C) it is known as programmed cell death
  - D) it sculpts body parts
  - E) it primarily eliminates old, diseased cells



33. Four of the five actions listed below are true of testosterone. Select the exception.

- A) produced by spermatogonia cells
- B) stimulates spermatogenesis
- C) necessary for growth and function of the male reproductive tract
- D) assists in the control of sexual behavior
- E) promotes secondary sexual characteristics

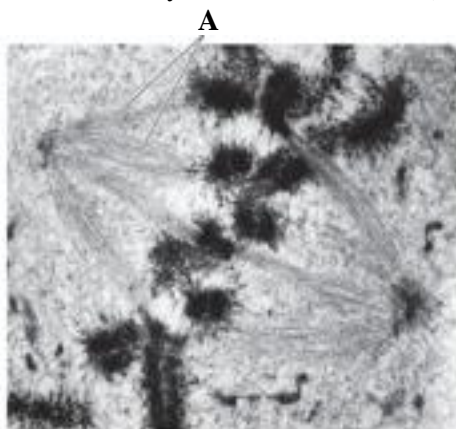
34. Which of the following describes a fixed action pattern (FAP)?

- A) a human infant mimics facial expressions of a nearby adult
- B) a male fruit fly waves his wings at a female fruit fly
- C) a European cuckoo hatchling pushes the host bird's egg out of the nest
- D) a baby garter snake captures and eats a slug
- E) all of these are examples of a fixed action pattern

35. Which of the following is *not* associated with an ecosystem service?

- A) purification of our air and water
- B) detoxify and decompose waste products
- C) protection of our watersheds and windbelts
- D) very costly to the budget of towns and cities
- E) related to biodiversity

36. Which cell structure is indicated by the two leader lines (directly below A)?

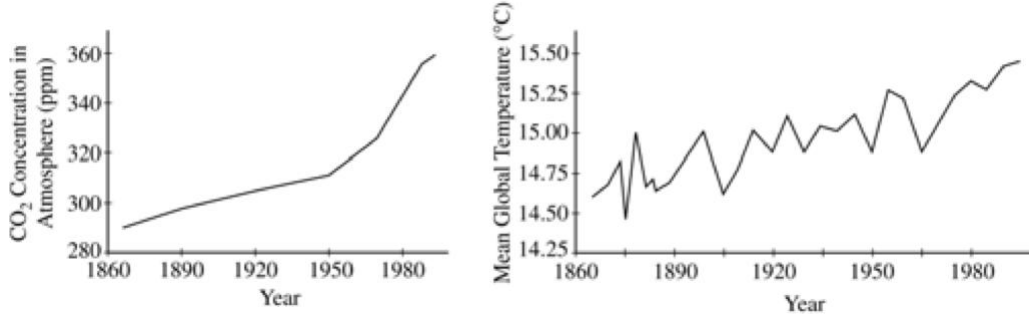


- A) nonkinetochore microtubules
- B) kinetochore microtubules
- C) kinetochore microfilaments
- D) chromatids
- E) centrioles

37. When an animal cell is at the G<sub>2</sub> checkpoint ;

- A) CdK component is being recycled and the cyclin is at the highest level
- B) cyclin begins to be degraded, terminating the M phase
- C) cyclin combines with CdK, producing MPF which phosphorylates a variety of proteins
- D) is known as the 'restriction point' and if bypassed will begin DNA semi-conservative replication
- E) the cell has exited the cell cycle and has switched into a nondividing state

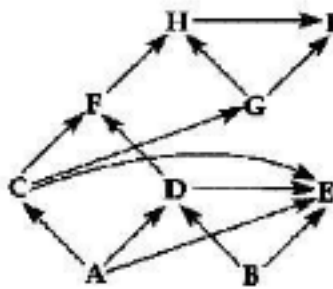
38. The graphs below show the changes in CO<sub>2</sub> concentration and mean global temperatures. What can be concluded by these two sets of data?



- A) there is a direct cause-effect relationship between the atmospheric CO<sub>2</sub> increase and global temperature increase  
 B) there is an inverse relationship between the atmospheric CO<sub>2</sub> levels and the rise in mean global temperatures  
 C) there is a positive correlation between the atmospheric CO<sub>2</sub> levels and the increase in global temperatures  
 D) this provides evidence of an impending ice age  
 E) no relationship between the two can be inferred
39. Eutrophication is associated with all of the following characteristics of a lake *except*;  
 A) decrease in depth  
 B) limited transparency  
 C) increased abundance of anaerobic decomposers  
 D) abundant phytoplankton  
 E) abundant oxygen at all levels
40. Fire in the dry shrublands does not kill the small bushy plants most likely due to;  
 A) these plants have a tough protective outer periderm  
 B) their leaves are generally very thick and retain water  
 C) they can resprout from the root crowns  
 D) the fires burn the taller plants and remain as crown fires that do not reach ground level  
 E) the root apical meristematic tissue respond to wound secondary messengers and mitotic division occur quickly for the shoot regrowth
41. Which of the following is *not* true of genetic switches?  
 A) They allow different structures to evolve within an individual organism  
 B) They determine when and where a gene is turned on or off  
 C) They control how a molecular tool kit is used  
 D) They integrate positional information in an embryo  
 E) A single switch controls each gene
42. Sickle cell trait is often used to demonstrate heterozygosity advantage in certain populations. If 9% of a given population is born with sickle cell anemia, what percent of this population would be expected to have sickle cell trait?  
 A) 91%  
 B) 49%  
 C) 42%  
 D) 21%  
 E) not enough information is provided

43. Short tandem repeats (STRs) are often beneficial in forensic science. Which of the following does *not* contribute to this use?
- A) STRs can easily be amplified by the use of PCR so multiple copies may be analyzed in numerous experiments
  - B) The small size (2-6 bp) of the STRs make better candidates for analysis when compared to a gene coding for a specific protein
  - C) STRs tend to be highly variable, so this increases the effectiveness for human identification purposes
  - D) An individual inherits two copies of an STR from each parent, which may or may not be of equal size, so the analysis of the fragment is reduced compared to other regions of the DNA
  - E) none of the above: all are applicable for the use of STRs in forensic science

44. The diagram below depicts a food web.



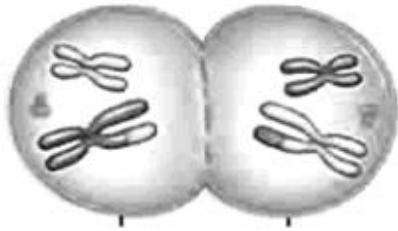
Using this web, the combine biomass of C + D would most likely be

- A) less than the biomass of E
  - B) less than the biomass of H
  - C) less than the biomass of A + B
  - D) equal to the biomass of H
  - E) greater than the biomass of A + B
45. In conservation biology, species-area curves for the taxa make it possible to predict all of the following *except*;
- A) how the size of an area relates to species richness
  - B) the area that a keystone species will occupy
  - C) how sampling larger habitats will affect the number of species sampled
  - D) how many species occur on islands of different sizes
  - E) how the loss of a certain area of habitat is likely to affect biodiversity
46. Given a population that contains genetic variation, what is the correct sequence of the following events when applying the influence of natural selection?
1. Environmental change occurs
  2. A new selection pressure occurs
  3. Differential reproduction occurs
  4. Allele frequencies within the population change
- A) 1, 3, 2, 4
  - B) 1, 2, 4, 3
  - C) 1, 2, 3, 4
  - D) 2, 1, 3, 4
  - E) 2, 1, 4, 3
47. In which of the following habitats would you expect to find the largest number of *k*-selected individuals?
- A) the rainforest of Brazil
  - B) south Florida after a hurricane
  - C) a newly emergent volcanic island
  - D) the constantly shifting sands of the Sahara desert
  - E) a recently abandoned field in Iowa

48. Heat shock proteins were originally described as proteins produced in response to heat stress. Some of these proteins are now known to act as;
- GTP-ase activating proteins
  - proteases that degrade ubiquitin-tagged proteins
  - ionophores that dissipate  $H^+$  gradients
  - protein-tyrosine kinases
  - molecular chaperones that regulate protein folding
49. All of the following processes occur in the mitochondria of mammalian cells *except*;
- protein synthesis
  - DNA synthesis
  - beta oxidation of fatty acids
  - fatty acid biosynthesis
  - citric acid cycle
50. Resource partitioning would be most likely to occur between;
- sympatric populations of species with similar ecological niches
  - sympatric populations of a predator and its prey
  - sympatric populations of a flowering plant and its specialized insect pollinator
  - allopatric populations of species with similar ecological niches
  - allopatric population of the same animal species
51. The major function of the Casparian strip of the plant root is to;
- serve as a site for the storage of excess sugars in the form of starch
  - initiate lateral root growth
  - control the movement of materials into the vascular cylinder of the root
  - control the movement between the symplastic and alloplastic root from the root hairs through the ground tissue of the root
  - allow for expansion of the vascular cambium as the root grows laterally
52. During respiration, NADH donates two electrons to the carrier known as ubiquinone. When this occurs, ubiquinone
- becomes oxidized
  - pumps protons across the inner mitochondrial membrane
  - passes the electrons directly to oxygen which is then reduced to  $H_2O$
  - A and B, but not C
  - A, B, and C
53. All of the following statements regarding nature reserves are true *except*;
- A single large reserve is always better than several smaller reserves with the same total area
  - Constructing several smaller reserves may be better than a single large reserve with the same total area
  - The increase of edge-adapted species can have a positive or negative effect on biodiversity
  - Disease can be a problem in reserves that contain connection corridors between them
  - Edges of nature reserves frequently have their own biological communities
54. Which of the following examples below best describes Batesian mimicry?
- the praying mantis that resembles a twig
  - a kingsnake to a coral snake
  - butterfly that resembles a leaf
  - a fawn with fur coloring that camouflages it in the forest environment
  - a snapping turtle that uses its tongue to mimic a worm, thus attracting fish
55. With few exceptions, most of the food chains studied by ecologists have a maximum of how many links?
- 2
  - 3
  - 5
  - 10
  - 15

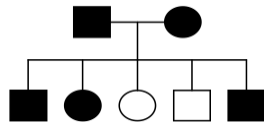
56. Elephants are not the most common species in African grasslands. The grasslands contain scattered woody plants, but their numbers are limited by the elephants. In studies where the elephants have been removed, the grasslands are converted to forests or shrublands that support fewer species than the previous grasslands. Elephants can be defined as what type of species in this community?
- A) dominant  
 B) top herbivore  
 C) secondary consumer  
 D) indicator  
 E) keystone
57. Introduced species can have important effects on biological communities by
- A) displacing native species  
 B) preying on native species  
 C) competing with native species for resources  
 D) reducing biodiversity  
 E) all of the above can occur
58. Which one molecule could provide the energy source, the carbon source, and the electron source for a chemoheterotroph?
- A) sulfur dioxide  
 B) methane  
 C) carbon dioxide  
 D) glucose  
 E) ATP
59. Vector transmission is not responsible for;
- A) influenza  
 B) Lyme disease  
 C) Chagas disease  
 D) malaria  
 E) dengue
60. Assume a cloning vector contains an antibiotic resistance gene and an appropriate restriction enzyme recognition site in the LacZ site. The gene of interest, if inserted, will
- A) inactivate the antibiotic resistance gene  
 B) activate the antibiotic resistance gene  
 C) inactivate the beta-galactosidase gene  
 D) activate the beta-galactosidase gene  
 E) have no effect on either the beta-galactosidase gene or the ampicillin resistance gene
61. Which of the following is *not* a method used to create plants with a human gene?
- A) use of *Agrobacterium tumefaciens* and the Ti plasmid  
 B) use of a gene gun  
 C) growth of plants from genetically modified cells  
 D) injecting the human egg nuclei into an enucleated megaspore mother cell of a plant  
 E) use of electroporation following the creation of protoplasts
62. A unicellular alga with cell walls containing pectin and silica is isolated from coastal waters. It is capable of photosynthesis and stores oil for energy. This alga is most likely a;
- A) dinoflagellate  
 B) diatom  
 C) foraminiferan  
 D) red alga  
 E) choanoflagellate

63. There is a group of small fish living in a lake with a sandy bottom. The majority of fish are light brown, with the others being approximately 10% mottled and 10% dark brown. A construction company dumps several loads of gravel in the bottom of the lake, giving it a mottled appearance. Assuming random mating, what would be predicted for the future populations' coloration?
- A) due to disruptive selection, the light brown would decrease while the mottled and dark brown will both increase
- B) due to directional selection, the dark brown may be eliminated; a decrease in light brown; an increase in mottled coloration
- C) due to stabilizing selection, the mottled will be favored; increasing their coloration, while decreasing both the light and dark brown coloration
- D) due to natural selection, the ratios will not change
- E) there is no way to predict evolutionary changes
64. The following diagram would best be described as being in which phase during division?



- A) late telophase of mitosis
- B) late telophase II of meiosis
- C) prometaphase of meiosis I
- D) late telophase I of meiosis
- E) prometaphase of meiosis II
65. If anaerobic pathways follow glycolysis;
- A) the two NADH molecules produced during glycolysis will be used to reduce pyruvate to either lactate or ethanol and  $\text{CO}_2$  (depending on the organism)
- B)  $\text{CO}_2$  will be one of the products as pyruvate is converted to lactate
- C) ATP will be required to convert pyruvate to either lactate or ethanol and  $\text{CO}_2$
- D) oxidative phosphorylation occurs either on the plasma membrane or on derivatives of the plasma membrane
- E) none of the above will occur
66. Which of the following statements is correct?
- A) In aerobic respiration, ATP is released in the first phase of glycolysis
- B) The process of fermentation is restricted to obligate anaerobic organisms
- C) Glucose has more energy than fructose bisphosphate
- D) Glycolysis occurs free in the mitochondrial matrix
- E) Enzymes lower the activation energy for each step in the chemical reactions in respiration
67. As a biochemist, a student brings to you a newly discovered plant that is a potential food crop. This crop is targeted to be grown in the Midwest, where the summers may be very hot and dry. Which of the following would most likely be beneficial to test for first to determine the potential of this new plant?
- A) the presence of RuBP carboxylase/oxygenase
- B) the increase in production of oxaloacetic acid throughout the evening and early morning hours
- C) the presence of PEP-carboxylase
- D) the presence of malate in the mesophyll cells
- E) the amount of abscisic acid produce during drought conditions

68. An incompletely dominant gene controls the color of chickens so that  $BB$  produces black,  $Bb$  produces a slate-gray color called blue, and  $bb$  produces splashed white. A second gene controls comb shape, with the dominant gene  $R$  producing a rose comb and  $r$  producing a single comb. If a pure-breeding, black chicken with a rose comb is mated to a splashed white chicken with a single comb, in the  $F_2$  generation, what fraction of the offspring will be blue with rose comb?  
 A) 9/16      B) 3/8      C) 3/16      D) 1/16      E) 0/16
69. *Arabidopsis thaliana* is advantageous for plant genetic research because  
 A) it is a close relative of corn and the results from this species can be applied to problems with corn  
 B) the cells are relatively difficult to transform with foreign DNA, but once accomplished, can be used to create a plant with a particular mutation that then yields important information about the gene's normal functions  
 C) it's genome is relatively large, therefore many genes can be identified to determine the blueprints for plant development, a major goal of systems biology  
 D) it is a small plant with a small genome size which can be raised inexpensively  
 E) it is the only plant with HOX genes that can be compared to the animal kingdom
70. Which of the following pairs is *mismatched* between the organism and digestive tract?  
 A) hookworm: incomplete digestive tract      D) tapeworm: no digestive tract  
 B) fluke: incomplete digestive tract      E) pinworm: complete digestive tract  
 C) roundworm: complete digestive tract
71. Which of the following is not matched correctly with its mode of motility?  
 A) Rhizopoda -- pseudopods      D) Archaezoa -- flagella  
 B) Ciliophora -- cilia      E) Apicomplexa -- nonmotile  
 C) Euglenozoa -- pseudopods
72. A hemoflagellate protozoa that is transmitted by the Triatoma of a 'kissing' bug is;  
 A) *Trypanosoma cruzi*      D) *Plasmodium vivax*  
 B) *Entamoeba histolytica*      E) *Trypanosoma brucei gambiense*  
 C) *Giardia lamblia*
73. In a lichen:  
 A) the mycobiont is responsible for the reduction of  $CO_2$  to carbohydrates  
 B) the mycobiont appears to make the plasma membrane of the photobiont partner more permeable  
 C) only the photosynthetic partner benefits from the association  
 D) the mycobiont appears to provide sugars for the photosynthetic partner  
 E) the photobiont appears to produce the hyphae to the mycobiont for absorption of sugars
74. Using the pedigree below, which of the following is the mode of inheritance and likely genotypes of the parents?



- A) autosomal: both parents are homozygous recessive  
 B) autosomal: both parents are homozygous dominant  
 C) autosomal: both parents are heterozygous  
 D) sex-linked: the father is recessive and the mother is homozygous recessive  
 E) sex-linked: the father is dominant and the mother is heterozygous

75. As a mycologist, your assignment is to locate living members of the phylum Glomeromycota. Where would be the best place to do the research?
- A) on the foot of a person with athlete's foot
  - B) growing on rocks in harsh conditions
  - C) the kidneys of mammals
  - D) in stagnant freshwater ponds
  - E) the roots of vascular plants
76. As a research assistant, you are studying mitotic divisions in various organisms. You identify an organism that maintains its nucleus during cell division with microtubules passing through the nucleus inside cytoplasmic tunnels. The organism most likely belongs to which group?
- A) archeobacteria
  - B) eubacteria
  - C) dinoflagellates
  - D) diatoms and some yeast
  - E) coenocytic fungi
77. A closer look at the relationship between dominance and phenotype now indicates that the observed dominant/recessive relationship of alleles depends on the level at which we examine the phenotype. An example of this is with Tay-Sachs disease. Which of the following is the best relationship between the gene and level to which it is studied?
- A) recessive: organismal level
  - B) codominant: biochemical level
  - C) incomplete dominant: molecular level
  - D) dominant: organismal level
  - E) sex-linked: organismal level
78. All of the following can contribute to density-dependent regulation of populations except;
- A) intraspecific competition for nutrients
  - B) interspecific competition for space
  - C) herbivory
  - D) annual temperature increases
  - E) predation
79. Humoral immunity is characterized by all of the following *except*:
- A) binding of antibodies to antigens activates the complement system and pore formation
  - B) secretion of antibodies by plasma cells
  - C) cytokines secreted by helper T cells which activate B cells
  - D) opsonization allows for increased phagocytosis of the antigens
  - E) cytotoxic T cells secrete perforin molecules that trigger apoptosis of the infected cell
80. Sources of new genetic variation include all of the following *except*:
- A) exon shuffling
  - B) horizontal gene transfer
  - C) apomixis
  - D) changes in microsatellites
  - E) heterochrony
81. Place the following events of evolution in the proper sequence from the earliest to the most recent.
1. origin of cyanobacteria
  2. origin of multicellular eukaryotes
  3. origin of fungal-plant symbiosis
  4. origin of land plants
  5. origin of diplomonads
- A) 1, 2, 3, 4, 5
  - B) 1, 5, 2, 3, 4
  - C) 1, 5, 2, 4, 3
  - D) 5, 1, 2, 4, 3
  - E) 5, 1, 2, 3, 4

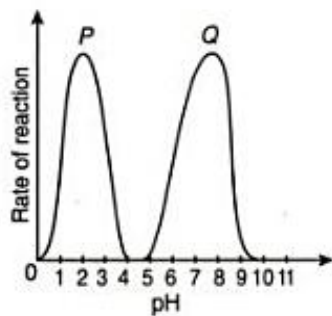


82. When the acetylcholine is released into the junction between the motor neuron and a skeletal muscle, it then binds to a sodium channel, which opens this channel. This regulatory mechanism is described as;
- a voltage-gated potassium channel
  - a ligand-gated sodium channel
  - a voltage-gated sodium channel
  - a second-messenger-gated sodium channel
  - an inhibitory postsynaptic potential
83. Which of the following processes leads to the formation of polytene chromosomes?
- recombination between adjacent chromosome segments
  - nondisjunction of chromatids during meiosis II
  - sister chromatid cross-over and exchange
  - repeated replication without the separation of chromatids
  - inactivation of one chromosome of each homologous pair
84. Which of the following is the genomic composition of guanosine from a circular double stranded DNA genome that has 21% adenosine?
- guanosine = 10.5%
  - guanosine = 21 %
  - guanosine = 29 %
  - guanosine = 58%
  - not enough information is provided
85. Retrotransposons include which of the following characteristics?
- They replicate themselves through an RNA intermediate.
  - They may contain introns.
  - They utilize reverse transcriptase for replication.
- 1 only
  - 3 only
  - 1 and 3
  - 2 and 3
  - 1, 2, and 3
86. The ability of a desert rodent's kidney to form highly concentrated urine is largely due to;
- long loops of Henle that pass through tissues to increase salt concentrations
  - distal convoluted tubules that are impermeable to water
  - the ability of cells lining the proximal convoluted tubule to absorb water
  - a high glomerular filtration rate
  - the production of a high sodium ultrafiltrate in the glomerulus
87. You are studying cellular slime molds, and notice that in one study plot there is the aggregation of myxamoebas. This was most likely initiated by;
- a high pH
  - uptake of chloride ions
  - low light intensities
  - elevated temperature
  - secretion of cyclic ATP
88. Plant species A has a diploid number of 10 while species B has a diploid number of 14. An allotetraploid derived as a hybrid between these two species would most likely result in:
- $2n = 24$ ; sterile
  - $2n = 12$ ; fertile
  - $2n = 19$ ; sterile
  - $2n = 17$ ; sterile
  - $2n = 24$ ; fertile

89. The current hypothesis suggests that there are critical factors that contribute to the evolution of semelparity versus iteroparity. Which of the following does *not* fit the models?
- A) Semelparity will be favored where the survival rate of offspring is low.
  - B) Iteroparity may be favored in more dependable environments, where adults are more likely to survive to breed again.
  - C) Salmon eventually return to the freshwater streams to spawn, producing thousands of eggs in a single reproductive opportunity before it dies - this supports the iteroparity hypothesis.
  - D) The agave, or 'century plant' grows in arid climate with poor soils and demonstrates semelparity.
  - E) Some lizards produce a few large, nutrient-containing eggs annually beginning in their second year of life that supports the iteroparity hypothesis.
90. Which of the following is a *false* statement about skeletal muscle contractions?
- A) A single action potential at the neuromuscular junction is sufficient to cause a muscle to twitch
  - B) Once maximum muscle tension is achieved, no ATP is required to maintain that level of tension
  - C) An action potential in the muscle cell activates contraction by releasing  $\text{Ca}^{2+}$  into the sarcoplasm
  - D) The tension generated by a muscle can be varied by controlling how many of its motor units are active
  - E) Summation of twitches leads to a graded increase in the tension that can be generated by a single muscle fiber
91. Which of the following statements describing the effects of stress is *false*?
- A) stressful stimuli cause the hypothalamus to activate the adrenal medulla via nerve impulses
  - B) epinephrine and norepinephrine released from the renal medulla increase blood pressure and breathing rate
  - C) mineralocorticoids released from the adrenal cortex trigger proteins and fats to be broken down and then converted to glucose, which leads to an increase in blood glucose levels
  - D) the adrenal cortex responds to endocrine signals, which cause the hypothalamus to secrete a releasing hormone that stimulates the anterior pituitary gland to release ACTH
  - E) the release of aldosterone in response to severe stress may lead to hypertension
92. The cortical reaction of sea urchin eggs directly functions in
- A) the production of a fast block to polyspermy
  - B) the formation of a fertilization envelope
  - C) the generation of an electrical impulse by the egg
  - D) the fusion of the egg and sperm nuclei
  - E) the release of hydrolytic enzymes from the sperm
93. The neocortex of mammals is involved in \_\_\_\_\_ and is homologous to the \_\_\_\_\_ of birds.
- A) circadian rhythms . . . suprachiasmatic nuclei
  - B) vision . . . optic lobes
  - C) parenting behavior . . . the thalamus
  - D) cognition . . . the pallium
  - E) flight . . . cerebellum

94. Which of the following is the best example of environmental remediation?
- A) Introducing the bacterium *Shewanella oneidensis* into an area that has high levels of uranium, in which the bacterium converts the uranium to insoluble forms
  - B) Decreasing the annual volume of sewage flowing into a stream by one half
  - C) Restoring an open-pit mine by first grading the site to reestablish a gentle slope, and then spreading topsoil when the slope is in place
  - D) Planting nitrogen-fixing plants such as lupines in an alpine ecosystem of the western United States to raise the nitrogen concentrations in soils disturbed by mining and other activities.
  - E) Adding mycorrhizal symbionts to a tall-grass prairie in Minnesota to enhance recovery of native species
95. Sulfolobus, an extreme thermophilic archaean, uses \_\_\_\_ as an energy source and is similar to \_\_\_\_ archaeans in respiration.
- A) hydrogen sulfide. . . methanogenic
  - B) light. . . halophilic
  - C) sulfur. . . methanogenic
  - D) hydrogen gas. . . halophilic
  - E) methane. . . thermoacidophilic
96. Four of the five organisms listed below belong to the same monophyletic group. Select the exception.
- A) *Amoeba proteus*
  - B) euglenoids
  - C) plasmodial slime molds
  - D) cellular slime molds
  - E) *Entamoeba histolytica*
97. Four of the five choices listed below are related to a common fungal group. Select the exception.
- A) asci
  - B) zygomycetes
  - C) Rhizopus
  - D) zygosporangium
  - E) spores
98. Which of the following is *not* a correct statement about the Cambrian period?
- A) animals started a great adaptive radiation
  - B) all major groups of animals originated in the seas
  - C) changes in land masses, climate and sea levels limited animal evolution
  - D) coevolution of predators and prey and of parasites and hosts was a factor in animal evolution
  - E) the atmospheric level of oxygen was higher than current atmospheric level
99. In vertebrate evolution, the appearance of the vertebral column led most directly to development of
- A) limbs such as arms and legs
  - B) sense organs and the nervous system
  - C) more efficient respiratory systems
  - D) jaws
  - E) bipedalism

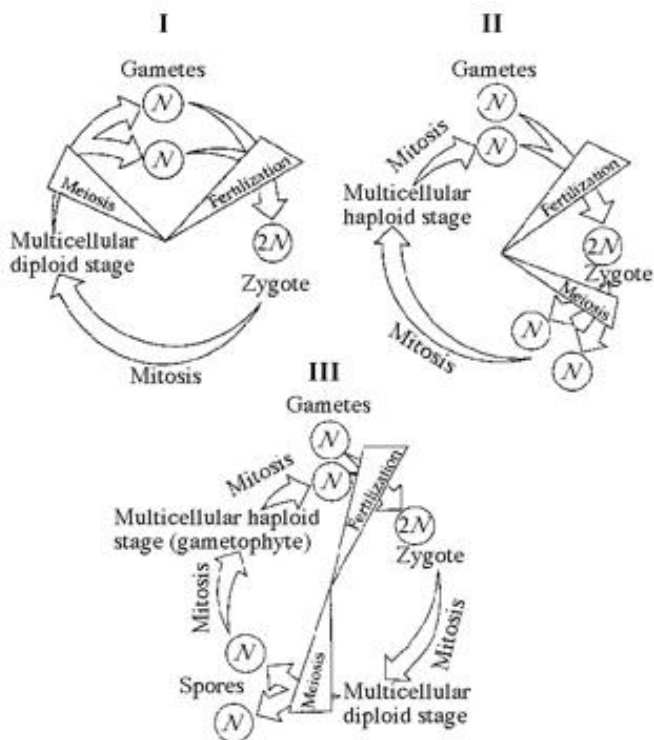
100. The following diagram shows the rate of two enzyme-controlled reactions in the human body.



Which is *not* true about enzymes P and Q?

- A) P is pepsin; Q is trypsin
- B) P has an optimum pH of 2.0; Q has an optimum pH of 7.8
- C) P has an inactive form secreted in the stomach; then becomes active in low pH  
Q is secreted by the pancreas in an inactive form; then transported to the duodenum
- D) P is part of the gastric juices; Q is part of the bile
- E) P will drive hydrolysis of proteins; Q will drive hydrolysis of proteins

Use the diagram below to answer questions #101, 102 and 103.



101. In a life cycle such as shown in part III of the above diagram, if the zygote's chromosome number is 10, which of the following will be true?
- A) The sporophyte's chromosome number per cell is 5 and the gametophyte's is 10
  - B) The sporophyte's chromosome number per cell is 10 and the gametophyte's is 5
  - C) The sporophyte and gametophyte each have 10 chromosomes per cell
  - D) The sporophyte and gametophyte each have 5 chromosomes per cell
  - E) The sporophyte and gametophyte each have 20 chromosomes per cell





111. In cells, which of the following can catalyze reactions involving hydrogen peroxide, make proteins, and provide cellular energy, in that order?
- lysosomes, ribosomes, and chloroplasts
  - smooth endoplasmic reticulum, ribosomes, and mitochondria
  - peroxisomes, ribosomes, and mitochondria
  - peroxisomes, lysosomes, and mitochondria
  - peroxisomes, Golgi apparatus, and mitochondria

For questions #112, 113 & 114 refer to the following chart and information below:

The original sequence of a short polypeptide chain is:

**MET - PRO - LEU - ALA - ARG**

	U	C	A	G
U	UUU = phe UUC = phe UUA = leu UUG = leu	UCU = ser UCC = ser UCA = ser UCG = ser	UAU = tyr UAC = tyr UAA = stop UAG = stop	UGU = cys UGC = cys UGA = stop UGG = trp
C	CUU = leu CUC = leu CUA = leu CUG = leu	CCU = pro CCC = pro CCA = pro CCG = pro	CAU = his CAC = his CAA = gln CAG = gln	CGU = arg CGC = arg CGA = arg CGG = arg
A	AUU = ile AUC = ile AUA = ile AUG = met	ACU = thr ACC = thr ACA = thr ACG = thr	AAU = asn AAC = asn AAA = lys AAG = lys	AGU = ser AGC = ser AGA = arg AGG = arg
G	GUU = val GUC = val GUA = val GUG = val	GCU = ala GCC = ala GCA = ala GCG = ala	GAU = asp GAC = asp GAA = glu GAG = glu	GGU = gly GGC = gly GGA = gly GGG = gly

112. Which of the following DNA strands would serve as a template for the amino acid sequence shown above?
- 3' - ATGCGACCAGCACGT - 5'
  - 3' - AUGCCACUAGCACGU - 5'
  - 3' - TACGGTGATCGTGCA - 5'
  - 3' - UACGGUGAUCGUGCA - 5'
  - 3' - TGCACGATCACCGTA - 5'
113. If a mutation occurs in which uracil is deleted from the messenger RNA after methionine is translated, which of the following represents the resulting amino acid sequence? (use code from question 112)
- serine - histidine - serine - threonine
  - methionine - proline - glutamine - histidine
  - methionine - proline - leucine - alanine - arginine
  - methionine - proline - alanine - arginine - arginine
  - methionine - proline - glutamine - arginine

114. The mRNA above was found to be much shorter than the original mRNA synthesized in the nucleus. Which of the following is *not* true concerning this observation?
- A) In this particular protein, the excision of introns from the pre-mRNA resulted in this shortened sequence
  - B) In this particular protein, the excision of exons from the pre-mRNA resulted in this shortened sequence
  - C) This is only one way that this particular sequence could have been produced, as alternative splicing yields evidence for DNA's unique packaging
  - D) Spliceosomes and ribozymes were used in the processing of this particular pre-mRNA
  - E) None of the above are false statements: all are true statements
115. Why is proteomics important in the systems biology approach?
- A) The interactions of networks of proteins are central to the functioning of cells and organisms.
  - B) Comparing the proteins produced by a normal allele and the allele associated with a disease can help improve treatments.
  - C) The three-dimensional structure of a protein can be used to predict its function.
  - D) Determining the proteins expressed in a cell identifies the genes more accurately than can be done through genomics.
  - E) This bioinformatics field allows for the mathematical modeling of biological systems.
116. Which of the following approaches would be most useful in tracing human evolution?
- A) evo-devo and the comparison of developmental genes in plants and animals
  - B) metagenomics and proteomics
  - C) systems biology and the use of 'knock-out' experiments
  - D) analysis of single nucleotide polymorphisms and copy-number variants across individuals from the same and different populations
  - E) All of the above make important contributions to the study of human evolution

**For questions #117, 118, 119 & 120, choose from the following scientists to match with their contribution to biology.**

- |                       |                       |
|-----------------------|-----------------------|
| 1. Hershey - Chase    | 5. Erwin Chargaff     |
| 2. Barbara McClintock | 6. Alfred Wallace     |
| 3. George Beadle      | 7. Gould - Eldredge   |
| 4. Thomas Hunt Morgan | 8. Frederick Griffith |

117. By means of X-ray irradiation of the mold *Neurospora crassa* and screening of mutants, showed that mutants induced in genes corresponded to alterations in specific enzymes. This led to the acceptance of the one gene - one enzyme theory at the time.
- A) 1                      B) 3                      C) 4                      D) 5                      E) 8
118. Biochemist(s) whose experiments provided crucial information allowing Watson, Crick and Wilkins to elucidate the double helix structure of DNA: the molecular structure must correspond to the base-pair ruling.
- A) 1                      B) 2                      C) 4                      D) 5                      E) 8
119. Revised the concept that evolution occurred only by gradualism by introducing and providing overwhelming evidence for the punctuated-equilibria theory.
- A) 2                      B) 4                      C) 5                      D) 6                      E) 7
120. Elucidated the connection between meiosis and genetic segregation with the work done with *Drosophila* - gave rise to gene-linkage maps
- A) 1                      B) 3                      C) 4                      D) 6                      E) 8





**Merck State Science Day 2012  
Answer Section**

**BIOLOGY**

**MULTIPLE CHOICE**

- |       |       |        |
|-------|-------|--------|
| 1. D  | 40. C | 80. C  |
| 2. B  | 41. E | 81. B  |
| 3. D  | 42. C | 82. B  |
| 4. A  | 43. D | 83. D  |
| 5. C  | 44. C | 84. C  |
| 6. C  | 45. B | 85. E  |
| 7. C  | 46. C | 86. A  |
| 8. E  | 47. A | 87. D  |
| 9. B  | 48. E | 88. E  |
| 10. A | 49. D | 89. C  |
| 11. D | 50. A | 90. B  |
| 12. E | 51. C | 91. C  |
| 13. B | 52. B | 92. E  |
| 14. C | 53. A | 93. D  |
| 15. E | 54. B | 94. A  |
| 16. A | 55. C | 95. C  |
| 17. D | 56. E | 96. B  |
| 18. B | 57. E | 97. A  |
| 19. D | 58. D | 98. C  |
| 20. A | 59. A | 99. D  |
| 21. D | 60. C | 100. D |
| 22. C | 61. D | 101. B |
| 23. B | 62. B | 102. B |
| 24. E | 63. B | 103. E |
| 25. C | 64. D | 104. D |
| 26. B | 65. A | 105. A |
| 27. A | 66. E | 106. C |
| 28. D | 67. C | 107. B |
| 29. B | 68. B | 108. D |
| 30. C | 69. D | 109. D |
| 31. D | 70. A | 110. E |
| 32. E | 71. C | 111. C |
| 33. A | 72. A | 112. C |
| 34. E | 73. B | 113. B |
| 35. D | 74. C | 114. B |
| 36. B | 75. E | 115. A |
| 37. C | 76. C | 116. D |
| 38. C | 77. A | 117. B |
| 39. E | 78. D | 118. D |
|       | 79. E | 119. E |
|       |       | 120. C |