

1. Which of the following is not a characteristic of bacteria
 - a. Peptidoglycan in the cell wall
 - b. Protein synthesis inhibited by diphtheria toxin
 - c. Protein synthesis inhibited by chloramphenicol
 - d. DNA exists in nucleoids
2. A ribozyme is
 - a. an enzyme that degrades RNA
 - b. involved in synthesizing primers for DNA replication
 - c. required for RNA polymerase activity
 - d. an RNA that has enzymatic activity
3. Which of the following bacterial components is made of DNA?
 - a. ribosomes
 - b. plasmids
 - c. lysosomes
 - d. chromatophores
4. Which is a function of the smooth endoplasmic reticulum?
 - a. modify proteins for export
 - b. synthesize phospholipids
 - c. detoxify drugs
 - d. digest fatty acids
5. 80s ribosomes are assembled in the:
 - a. nucleotide
 - b. nucleoid
 - c. nucleolus
 - d. nuclear lamina
6. A Gram-positive bacterial cell may have:
 - a. two phospholipid bilayers
 - b. two peptidoglycan regions
 - c. LPS
 - d. flagella
7. Which would you not find in a prokaryotic cell?
 - a. spliceosomes
 - b. ribosomal RNA
 - c. RNA primases
 - d. aminoacyl-tRNA synthetases
8. Peripheral membrane proteins are:
 - a. not essential for the cell's existence
 - b. found only on the outer surface of the cell
 - c. attached to biological membranes through interactions with integral membrane proteins
 - d. often found to form pumps that move ions through membranes
9. Which of the following is an example of a protein's secondary structure?
 - a. alpha helixes
 - b. hydrophobic interactions
 - c. amino acid sequence
 - d. nucleotide sequence
10. Which molecule does not contain glucose?
 - a. starch
 - b. cellulose
 - c. sucrose
 - d. fructose
11. The function of the glycogen is:
 - a. provide structure within the cell
 - b. provide structure outside of the cell
 - c. allow movement of the cell
 - d. provide energy storage for the cell
12. Which of the following is NOT a polysaccharide?
 - a. Glycogen
 - b. Starch
 - c. Galactose
 - d. Chitin
13. If an enzyme solution is saturated with substrate, the most effective way to obtain an even faster yield of products is to
 - a. Add more of the enzyme
 - b. Heat the solution to 90 degrees celcius
 - c. Add more substrate
 - d. Add an allosteric inhibitor

14. An enzyme accelerates a metabolic reaction by
- Altering the overall free-energy change for the reaction
 - Making an endergonic reaction occur spontaneously
 - Lowering the activation energy
 - Pushing the reaction away from equilibrium
15. Which of the following is not associated with allosteric regulation of an enzyme's activity?
- A molecule mimics the substrate and competes for the active site
 - A naturally occurring molecule stabilizes a catalytically active conformation
 - Regulatory molecules bind to a site remote from the active site
 - Inhibitor and activator molecules may compete with one another
16. In addition to ATP, what are the end products of glycolysis?
- CO₂ and H₂O
 - CO₂ and pyruvate
 - pyruvate and NADH
 - CO₂, NADH, and FADH₂
17. A scientist purified a protein from animal cells and made fluorescent antibodies to it. When she isolated pieces of the plasma membrane from another batch of animal cells and added the fluorescent antibodies, she could see fluorescence on both sides of the membrane. She tried to isolate the protein from the membranes but could not do so without destroying the membranes. The protein was probably:
- a peripheral protein.
 - a farnesyl-anchored protein.
 - a transmembrane protein.
 - a cytosolic protein.
18. Which statement is FALSE?
- Plant cells undergo plasmolysis when they are placed in a hypertonic solution.
 - The cell wall prevents plant cells from bursting when they are placed in a hypotonic solution.
 - Animal cells shrink in size when they are placed in a hypertonic solution.
 - An animal cell placed in a 1M solution of sucrose, or a 1M solution of isopropanol, will shrink.
19. Which of the following is NOT true of the sodium/potassium pump of animal cells?
- it undergoes conformational changes
 - it uses the energy from ATP
 - it creates a membrane potential
 - it serves as an example of a secondary active transport system
20. Bacteria and Archaea have different
- (a) ribosomes.
 - (b) cell walls.
 - (c) lipids.
 - (d) ALL of the above.
21. Which of the following statements about the mitochondrial electron transport chain is true?
- FADH₂ donates electrons at complex I
 - NADH accepts electrons at complex I
 - protons are pumped into the matrix
 - cyanide prevents electrons from leaving the ETC
22. Which of the following is a correct step in the synthesis of the insulin receptor?
- The signal recognition sequence binds to the translocon.
 - The fully synthesized insulin receptor is fed into the translocon.
 - Translation of the mRNA for insulin receptor begins in the cytosol.
 - The signal sequence is removed by an endoprotease in the cis-Golgi.

23. Which of the following double-stranded DNA molecules would require the most energy to be separated into single strands (assume all the DNAs have the same overall number of base pairs):
- one which contained 50% G-C base pairs
 - one which contained 25% A-T base pairs
 - one which contained all A on one strand and all T on the other strand
 - one which contained all G on one strand and all C on the other strand
24. Which of the following statements is NOT CORRECT?
- The subunits of DNA and RNA are nucleotides.
 - Nucleotides contain a base linked to the 5' position of deoxyribose or ribose.
 - Nucleotides have a phosphate group attached through a phosphodiester bond.
 - A DNA precursor is deoxyadenosine-5'-triphosphate (dATP), which loses two phosphate groups when synthesis of DNA occurs.
25. The process of synthesizing mRNA along a DNA template is called
- transcription.
 - translation.
 - transformation.
 - replication.
26. Which of the following is a feature of chromatin?
- Chromatin is found in its most condensed form in interphase.
 - Histones are the only proteins found in chromatin.
 - Histone 2A is found in the linker region of chromatin.
 - DNA that is actively being transcribed exists in cells as euchromatin.
27. During DNA lagging strand synthesis, which of the following is NOT CORRECT?
- RNA primers are copied from the DNA template by primase.
 - DNA polymerase III catalyzes the elongation at the growing fork.
 - Each Okazaki fragment is produced in the 5' to 3' direction from its own RNA primer.
 - Each RNA primer is elongated by addition of ribonucleotides to its 5' end.
28. In eukaryotic transcription,
- RNA polymerase I synthesizes transfer RNA.
 - RNA polymerase II synthesizes precursor ribosomal RNA.
 - RNA polymerase II synthesizes messenger RNA.
 - RNA polymerase II binds to the Shine Delgarno sequence.
29. If a triplet in the coding strand of DNA was 5'GAC3', the anticodon that would recognize RNA transcribed from this DNA would be
- 3'CTG5'
 - 3'GUC5'
 - 3'CUG5'
 - 3'GUU3'
30. Binding sites for proteins that regulate transcription in prokaryotes
- are often found upstream of the start of transcription.
 - often contain inverted repeats.
 - are A-T rich.
 - are identical for different transcriptional units.
- 1, 3
 - 1, 2
 - 2, 3, 4
 - 1, 2, 4

31. Which enzyme catalyzes phosphodiester bond formation between two adjacent Okazaki fragments after the primers have been removed and the gap has been filled with appropriate nucleotides?
- DNA polymerase III.
 - DNA polymerase α (alpha).
 - DNA ligase.
 - DNA polymerase I.
32. In a diploid cell in the metaphase of mitosis there are 100 chromatids. The haploid number of chromosomes for this organism would be:
- 200
 - 100
 - 50
 - 25
33. Which statement is CORRECT for the meiotic cell cycle?
- In G1 each chromosome consists of two chromatids.
 - In S phase the chromatids begin to pair.
 - In G2 the sister chromatids are held together by the centromere.
 - In M1 the chromosome number remains the same.
34. In eukaryotes the primary RNA transcript undergoes processing. Which of the following statements concerning RNA processing are correct?
- The multiple adenylate residues, found at the end of mRNA, are coded for by DNA
 - The 3' end of the primary RNA transcript is modified by a 5'- 3' linkage to 7-methylguanylate.
 - Exons in the primary RNA transcript are removed and the mature mRNA contains only intron sequences.
 - There are specific nucleotides found at the exon/intron boundaries that are required for RNA splicing.
 - The primary RNA transcript is cleaved near (about 10-35 nucleotides downstream of) the polyadenylation signal.
- 2,4,5
 - 1,2,4,5
 - 4,5
 - 3,4,5
35. Which of the following steps in the hormone-triggered breakdown of glucose in liver cells involves an amplification of the signal?
- The activation of the receptor by the ligand (hormone).
 - The activation of G protein by the receptor
 - The activation of adenylyl cyclase.
 - The synthesis of cAMP by adenylyl cyclase.
 - The activation of cAMP-dependent protein kinase (cAPK) (=protein kinase A) by cAMP.
 - The activation of glycogen phosphorylase kinase by cAPK.
- 2, 4, 6.
 - 1, 2, 3, 4, 6.
 - 1, 3, 6.
 - 3, 4, 5.

36. In the cAMP second messenger system,
- the ligand binds to a G protein.
 - Gs-GTP activates adenylate cyclase.
 - protein kinase A phosphorylates IP₃ receptors.
 - cAMP activates phospholipase C.
37. Insulin is released by pancreatic β -cells to reduce blood glucose levels. Insulin binds to the insulin receptor on fat and muscle cells and activates the insulin signaling pathway. Which ONE of the following events occurs during insulin signaling?
- Insulin binds to a G protein-coupled receptor and causes an increase in cytosolic Ca^{2+} levels.
 - GLUT2 transporters are phosphorylated and activated.
 - Intracellular vesicles containing GLUT4 fuse with the plasma membrane.
 - Glycogen synthase kinase-3 phosphorylates and activates glycogen synthase.
38. If you know that a region of double-stranded DNA has a content of 60% G/C base pairs and 40% A/T base pairs, then what is the ratio of purines to pyrimidines in the DNA?
- 60:40
 - 40:60
 - 50:50
 - 20:80
39. Which of the following mutations would you expect to have the most disastrous effect on the product of a protein coding gene?
- A deletion of one base pair near the middle of the coding sequence
 - A change of one A-T base pair near the end of the gene to a G-C base pair
 - A deletion of three base pairs near the beginning of the gene
 - A change of one G-C base pair near the beginning of the gene to an A-T base pair
40. Which of the following statements concerning RNA are correct?
- RNA is synthesized in the 3' to 5' direction.
 - RNA contains ribose.
 - The following nitrogenous bases are found in RNA: uracil, adenine, cytosine, guanine.
 - In eukaryotes the 5' end of the primary RNA transcript is modified.
 - If the sequence of the DNA template strand is 3'AAA TCG CCC 5', then the sequence of the RNA transcript is 5' UUU AGC GGG 3'.
- 1,2,3,4,5
 - 2,3,4,5
 - 1,2,4,5
 - 1,2,3,4
41. Mitochondria and chloroplasts are thought to be bacteria that invaded ancestral eukaryotic cells. Which of the following observations support this idea?
- The genomes of the subcellular organelles code for prokaryotic like ribosomal RNAs.
 - Promoter sequences in the genome of subcellular organelles are similar to bacteria.
 - The genomes of subcellular organelles are single-stranded.
 - Translation of subcellular organelle mRNAs is inhibited by antibiotics.
 - Subcellular organelle DNA is packaged with histones.
- 1, 2, 3, 5
 - 1, 3, 4
 - 1, 2, 4
 - 2, 3, 5

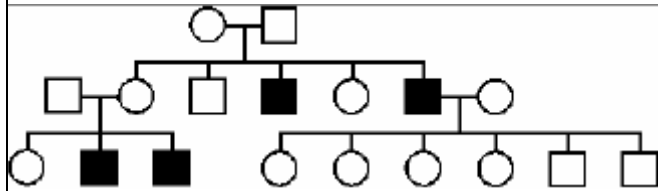
42. How many amino acids would be in the protein encoded by a gene with the sequence 3' TACCCGGATTCA 5'?
- 1
 - 2
 - 4
 - 6
43. You wish to construct a plasmid that will express green fluorescent protein (GFP) as a reporter gene in *E. coli*. Which of the following sequence elements would you add to your plasmid?
1. An origin of DNA replication.
 2. A multiple cloning site.
 3. An inducible promoter.
 4. A host chromosome integration site.
 5. A transcription termination site at the end of the GFP ORF.
- 1, 2, 3, 5
 - 2, 3, 5
 - 3, 5
 - 1, 4
44. Which one of the following techniques is used to demonstrate the presence of DNase-sensitive sites in euchromatin?
- Automated DNA sequencing.
 - Southern blot analysis.
 - Northern blot analysis.
 - DNA fingerprinting.
45. When the polymerase chain reaction (PCR) is used, it is convenient to make a "master mix" of common reagents that will be dispensed into each sample of DNA to be amplified. The key ingredients of this master mix are:
- buffer, deoxyribonucleotides (4 types), DNA primers, heat-stable DNA polymerase.
 - buffer, deoxyribonucleotides (4 types), RNA primers, heat-stable RNA polymerase.
 - restriction buffer, restriction enzyme, water, double-stranded DNA.
 - buffer, dideoxyribonucleotides (4 types), deoxyribonucleotides (4 types), heat-stable DNA polymerase, fluorescent primers.
46. DNA replication in prokaryotes requires
- primase to make small primers containing deoxyribonucleotides.
 - DNA polymerase III to join Okazaki fragments.
 - helicase to keep single strands of DNA separated.
 - DNA polymerase I to cut out primers and fill in gaps in the lagging strand.
47. The following codons code for arginine—CGU, CGA, CGC, and AGA. What is the minimum number of tRNAs required to recognize all these codons?
- 1
 - 2
 - 3
 - 4
48. The purpose of a Northern blot is to determine if a group of cells
- have RNA.
 - have DNA.
 - express RNA that codes for a specific protein.
 - have the gene for a specific protein.
49. Cyclic AMP (cAMP)
- binds to allolactose.
 - interacts with the α -subunits of RNA polymerase.
 - binds to the operator sequence of the lac operon.
 - is at low concentration when glucose is present.
50. Penicillin is an effective antibiotic because it:
- inhibits bacterial protein synthesis but not eukaryotic protein synthesis
 - inhibits bacterial cell wall synthesis
 - inhibits unique electron transport chain components found in only in bacteria
 - inhibits ion transport through the bacterial plasma membrane

51. Which if the following statements are correct about gram-negative bacteria?
- penicillins are effective antibiotics to use against them
 - they often possess an outer membrane containing toxic lipopolysaccharides
 - their cell walls have more peptidoglycan than do gram-positive bacteria
 - they are easily killed with detergents
52. All electron transport chains require
- NAD^+ or NADP^+ to be the terminal electron acceptors.
 - Electron carriers to be arranged from low to high electronegativity.
 - ATP hydrolysis to supply the energy for electron flow.
 - Electrons to enter the chain associated with stable compounds.
53. A key role of fermentation in overall metabolism is to
- Increase NADH synthesis for oxidative phosphorylation.
 - Increase O_2 concentration for electron transport.
 - Synthesize extra ATP.
 - Regenerate NAD^+ in the cytosol.
54. In an aerobic prokaryotic cell, the molecules of the respiratory chain should be located in the
- cytosol
 - cristae
 - cell wall
 - plasma membrane
55. The fermentation of glucose to ethanol
- Results in the evolution of 2CO_2 .
 - Results in the net production of 2 ATP and 2 NADH.
 - Does not evolve CO_2 .
 - Results in the net production of 4 ATP.
56. Anaerobic respiration occurs when
- O_2 runs low in the cell
 - Fermentation occurs
 - a terminal electron acceptor other than O_2 is used
 - electrons are donated to the electron transport chain from FADH_2
57. A mutation caused an unknown structural change in the Fe-containing protein component of the ETC. Although the proteins were still found to be in the cytoplasmic membrane as usual, oxidative phosphorylation was completely inhibited. Predict the mechanism(s) of how the mutation shut down the ETC.
- Electrons would be unable to channel through the ETC, and therefore no oxidative phosphorylation would occur
 - A proton gradient would not be established, therefore no transition of energy between the nutrient and the production of ATP
 - Both the establishment of a proton gradient and electron movement through the ETC would not happen.
 - None of the above.
58. Bacterial flagella cause bacteria to move by
- whipping
 - vibrating
 - rotating
 - waving
59. The operator region of an associated operon
- codes for the synthesis of a repressor
 - is a nucleotide sequence of DNA that binds an active regulatory protein
 - binds RNA polymerase at the beginning of transcription of an operon
 - is a nucleotide sequence of an RNA molecule which is not translated into protein
60. What effect would the addition of lactose have on a repressed *lac* operon?
- The operator site on the operon would move.
 - It would reinforce the repression of that gene.
 - The *lac* operon would be transcribed.
 - It would have no effect whatsoever.

61. Which of the following statements about the bacterial chromosome are TRUE?
- (1) It is a single circular molecule in the bacterial cytoplasm.
 - (2) It carries between 100-500 genes depending on the bacterial genus.
 - (3) It possesses one strand which serves as the template strand for all genes during transcription.
 - (4) Its length is commonly expressed in millimeters.
- (a) 1, 3
(b) 3 only
(c) 2,3 and 4
(d) 2, 3
62. Which of the following is true?
- a. Mutations always change the phenotype but not the genotype
 - b. Mutations always change the genotype and may or may not change the phenotype
 - c. Mutations always change the genotype and the phenotype
 - d. Mutations change the genotype but not the phenotype
63. Plasmids are directly transferred between bacterial cells by:
- a. transduction
 - b. conjugation
 - c. transformation
 - d. sigma factors
64. A microbiology student, Elisa, performs the following protocol:
1. exposes a sample of lactose pos E.coli to 30 sec of low intensity UV radiation
 2. recovers the surviving E.coli by growing them on LB media, at 37°C for 24 hours.
 3. plates some of the E.coli onto MacConkey agar. MacConkey agar is a differential medium containing lactose, peptone and protease peptone (among other things) and any lactose utilizing colonies will appear red. Those that don't will appear white.
- Which steps did Elisa use in her isolation of lactose-negative mutants?
- a. mutagenesis, outgrowth, selection
 - b. mutagenesis, outgrowth, screening
 - c. mutagenesis, outgrowth, selection and screening
 - d. mutagenesis, selection, screening
65. Phosphorylation cascades involving a series of protein kinases are useful for cellular signal transduction because
- a) They are species specific
 - b) They always lead to the same cellular response
 - c) They amplify the original signal many fold
 - d) They counter the harmful effects of phosphatases
66. What IS THE CORRECT ORDER of the following steps in signal transduction?
- 1) Initiation of intracellular signalling pathway(s).
 - 2) Transport of the signal to target cell.
 - 3) Binding of the signal to receptor on target cell, activation of receptor.
 - 4) Termination of cellular response.
 - 5) Synthesis and release of signalling molecule by signalling cell.
 - 6) Changes in cellular function, metabolism or development.
- a. 2, 5, 3, 1, 4, 6
b. 3, 1, 5, 2, 6, 4
c. 3, 1, 4, 5, 2, 6
d. 5, 2, 3, 1, 6, 4

67. When the product of one gene modifies the phenotypic express produced by a second gene, this is referred to as:
- dominance
 - co-dominance
 - Mendelian genetics
 - epistasis
68. Using Mendel's flower color (purple is dominant, white is recessive) and stem length (long is dominant, short is recessive), if two dihybrid plants are crossed, what is the probability that the progeny will be short with purple flowers?
- 3/4
 - 1/4
 - 9/16
 - 3/16
69. The immediate energy source that drives ATP synthesis during oxidative phosphorylation is
- the oxidation of glucose and other organic compounds.
 - the flow of electrons down the electron transport chain.
 - the affinity of oxygen for electrons.
 - a difference of H^+ concentration on opposite sides of the inner mitochondrial membrane.
70. The final electron acceptor of the electron transport chain that functions in oxidative phosphorylation is
- oxygen
 - water
 - NAD^+
 - Pyruvate
71. A Western blot is best described by which of the following statements?
- A multi-step method to detect a specific protein in its natural subcellular location.
 - A multi-step method using 2 different antibodies to detect a specific protein in a complex mixture.
 - A multi-step method using a DNA probe to detect the expression of a specific gene in a complex mixture.
 - A multi-step method for assaying the expression of a specific gene in its natural subcellular location.

72. Which would you not find in a prokaryotic cell?
- spliceosomes
 - ribosomal RNA
 - RNA primases
 - aminoacyl-tRNA synthetases
73. Which of the following is not an effect of epinephrine binding to its receptor?
- cAMP activates protein kinase A.
 - Protein kinase A phosphorylates glycogen phosphorylase kinase.
 - Inhibitory protein is phosphorylated by protein kinase A.
 - Glycogen synthetase is activated.
74. In *Drosophila* the recessive alleles for brown and scarlet eyes (of two independent genes) interact so that $bw/bw;st/st$ is white. If a pure-breeding brown is crossed to a pure-breeding scarlet, what proportion of the F_2 will be white?
- 1/16
 - 1/4
 - 7/16
 - 3/4
75. The following pedigree depicts the inheritance of a rare hereditary disease affecting muscles:



- What is the most likely mode of inheritance of this disease?
- Autosomal dominant
 - Autosomal recessive
 - X-linked dominant
 - X-linked recessive

76. A couple are both heterozygous for two autosomal recessive diseases: cystic fibrosis (CF) and phenylketonuria (PKU). What is the probability that their first child will have either CF or PKU?
- 0
 - $\frac{1}{4}$
 - $\frac{1}{2}$
 - $\frac{1}{16}$

77. A man whose mother had cystic fibrosis (autosomal recessive) marries a phenotypically normal woman from outside the family, and the couple consider having a child. If the frequency of cystic fibrosis heterozygotes (carriers) in the general population is 1 in 25, what is the chance that the first child will have cystic fibrosis?
- $\frac{1}{2500}$
 - $\frac{1}{625}$
 - $\frac{1}{200}$
 - $\frac{1}{100}$

78. A couple has a female child with Tay Sachs disease, and three unaffected children. Neither parent nor any of the four biological grandparents of the affected child has had the disease. The most likely genetic explanation is that Tay Sachs disease is inherited as a(n) ...
- autosomal dominant
 - autosomal recessive
 - X-linked dominant
 - X-linked recessive

79. The following pedigree shows the inheritance of attached earlobes (black) and unattached earlobes (white). Both alternative phenotypes are quite common in human populations. If the phenotypes are determined by alleles of one gene, then attached earlobes are inherited as a(n) ...



- autosomal dominant
- autosomal recessive
- X-linked dominant
- X-linked recessive

80. What are the possible blood types of the offspring of a cross between individuals that are type AB and type O?
- A or B
 - AB or O
 - AB
 - A, B or AB

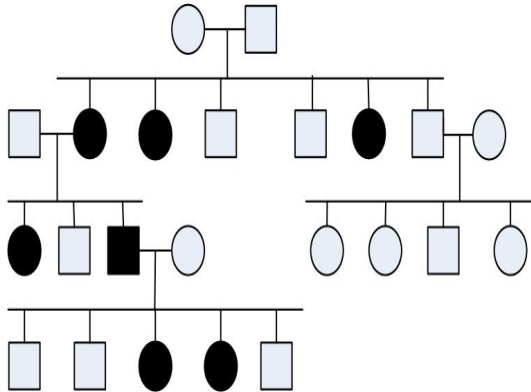
81. A female from a stock of true-breeding, rough-winged *Drosophila*, when mated with a true-breeding, wild type male, yielded all rough-winged flies. The F_1 females were backcrossed to the wild type males. The results of this cross were males and females that were all rough-winged. You would predict such an outcome for the cross, if the rough-winged trait is
- due to an autosomal dominant
 - due to a sex-linked dominant
 - due to a sex-linked recessive
 - due wholly to a defect of mitochondrial DNA, i.e. cytoplasmic inheritance

82. Sex-influenced traits are those that:
- are determined by the genes on the X chromosome
 - are determined by the genes on the Y chromosomes
 - are determined by the genes on either the X or Y chromosome
 - show up in both sexes, but their expression may differ between the two sexes because of hormonal differences

83. Sickle-cell anaemia is controlled by two incompletely dominant alleles. In a population of 100 individuals, if the percentage of individuals with the sickle-cell trait is 20% and there are no individuals with sickle-cell anaemia, what is the frequency of the S allele in the population?
- 0 (as individuals with the S allele always die).
 - 0.01
 - 0.05
 - 0.10

84. Which process in the nephron is *least* selective?
- secretion
 - reabsorption
 - active transport
 - filtration

85. In the following pedigree, the indicated trait is most likely caused by what type of allele?

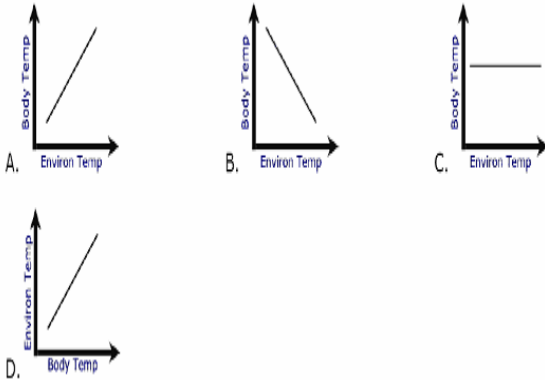


- Autosomal recessive
 - Autosomal dominant
 - X-linked recessive
 - X-linked dominant
86. Which of the following is the best definition of evolution?
- a change in the phenotypic makeup of a population
 - a change in the genetic makeup of a population
 - a change in the environmental conditions
 - a change in the genotypic makeup of an individual
87. Gene frequencies in a gene pool may shift randomly and by chance. This is called
- genetic drift
 - gene flow
 - adaptive radiation
 - artificial selection

88. Which of the following statements is FALSE?
- The formation of a platelet plug is only the beginning of clotting.
 - Arteries and veins are classified by the direction in which they carry blood and not by whether the blood they carry is highly oxygenated or not.
 - Human serum contains no proteins.
 - People living at very high altitudes have higher [EPO] because of the lower O₂ content in the air they breathe.
89. What would you predict if you treat a whole muscle with acetylcholine esterase inhibitors?
- The muscle never contracts
 - The muscle never relaxes.
 - The muscle contracts for about 100msec, then relaxes and then contracts again, repeating this cycle many times.
 - a or b, depending on the state of the muscle before the treatment.
90. Which of the following is an example of an electric synapse?
- The synapse between sensory and motor neurons in a simple reflex circuit.
 - The gap junctions between cardiomyocytes.
 - The activation of nerve impulses in our fingertips in the case of an electric shock.
 - The triggering of APs in photosensitive rods in the mammalian retina by light.
91. The process of gluconeogenesis can be described as:
- The conversion of glucose to glycogen
 - The breakdown of glucose to pyruvate
 - The synthesis of glucose from non-glucose molecules
 - The formation of glycogen from glucose
92. Growth hormone and insulin act:
- Together to promote glucose storage
 - Antagonistically to increase and decrease plasma glucose levels, respectively
 - Antagonistically to decrease and increase plasma glucose levels, respectively
 - Together to promote glycogenesis

93. The secretion of ANF from the heart increases:
- Blood flow by increasing heart rate
 - Insulin secretion from the pancreas
 - Glomerular filtration rate in the kidney
 - Synthesis of aldosterone in the adrenal gland
94. The actions of parathyroid hormone are antagonistic to:
- Calcitonin
 - Npy
 - Insulin
 - The thyroid hormones
95. Which of the following four components of the blood are important for clotting?
- calcium, vitamin K, albumin, globulin
 - calcium, heparin, prothrombin, fibrinogen
 - calcium, prothrombin, fibrinogen, platelets
 - calcium, prothrombin, platelets, vitamin A
96. Place the structures in the order that blood returning to the heart from the body would pass through them.
- right ventricle
 - left atrium
 - right atrium
 - pulmonary artery
 - left ventricle
 - pulmonary vein
- 2-5-4-6-3-1
 - 2-5-6-4-3-1
 - 3-1-4-6-2-5
 - 1-3-6-4-5-2
97. What is the channel or means by which end-products of carbohydrates are delivered to the vertebrate liver?
- Lacteals
 - Pancreatic duct.
 - Direct diffusion into the liver.
 - Hepatic portal vein.
98. What is the most important factor necessary for establishing the resting membrane potential?
- Excitation by neurotransmitters.
 - Sodium ions leaking through the semipermeable membrane into the cell.
 - The tendency of potassium ions to diffuse out of the cell through the semipermeable cell membrane.
 - The tendency of calcium ions to diffuse out of the semipermeable cell membrane.
99. What is the principal reason why men do not have menopause?
- The germinal epithelium of their seminiferous tubules is self regenerating.
 - Men are provided with far more germ cells at birth than women.
 - Men because of their usual larger body size store sufficient androgens in their body to last an average life span.
 - Men store sufficient sperms in their seminal vesicles to last a normal life span.
100. A decrease in the pH of human blood caused by exercise would
- decrease breathing rate.
 - increase heart rate.
 - decrease the amount of O₂ unloaded from hemoglobin.
 - decrease cardiac output.
101. List the stages of embryological development in their proper order from early to late.
- Zygote, Blastula, Morula, Gastrula
 - Zygote, Morula, Blastula, Gastrula
 - Zygote, Morula, Gastrula, Blastula
 - Zygote, Blastula, Gastrula, Morula
102. Your friend has just taken a big bite of a ham sandwich garnished with butter and lettuce. Which of the following statements is correct?
- Ham only is digested in the mouth.
 - Bread and butter only are digested in the mouth.
 - Bread only is digested in the mouth.
 - All components of lettuce cells are digested either in the mouth or in the stomach.

103. Which of the following graphs best represents a typical response of a thermoregulator to changes in environmental temperature?.



- A) A
- B) B
- C) C
- D) D

104. In the vertebrate body, fine adjustment of water reabsorption works through the action of antidiuretic hormone (ADH) on the _____ which _____ its permeability to H₂O.

- A. proximal convoluted tubule; decreases
- B. proximal convoluted tubule; increases
- C. descending loop of Henle; decreases
- D. collecting duct; increases

105. B cells and T cells detect foreign protein (antigens) and respond to this new infection. Which of the following statements is not correct with respect to how B cells and T cells detect this infection?

- A. Memory cells induce specific B and T cells to reproduce more of themselves.
- B. Antigens may be carried by foreign cells to areas that house B and T cells.
- C. B cells and T cells constantly roam the body looking for foreign antigens.
- D. Antigens may be carried in the blood to areas that house B and T cells.

106. Skeletal muscles are directly stimulated by neurons of the _____ nervous system.

- A. Parasympathetic motor
- B. Sympathetic motor
- C. Visceral
- D. Peripheral motor

107. In a resting neuron, the resting membrane potential is -70 mv and the threshold is -50 mv. In this cell, an action potential may be initiated by

- A. opening K⁺ gates to cause a hyperpolarization of 15 mv
- B. closing Na⁺ gates to cause a depolarization of 25 mv
- C. opening Na⁺ gates to cause a depolarization of 25 mv
- D. opening Na⁺ gates to cause a depolarization of 15 mv

108. An excitatory synapse between two neurons

- A. could later become an inhibitory synapse depending on the actual signal sent to that axon terminal.
- B. is an electrical signal directly passed between neurons where they touch each other.
- C. usually causes a contraction in a muscle cell.
- D. may or may not initiate an action potential in the postsynaptic neuron.

109. As a sarcomere contracts,

- A. the two Z lines slide past each other.
- B. the length of the I band remains constant
- C. the length of the M line shortens.
- D. the length of the A band remains constant.

110. What is the proper sequence of events as a muscle cell contracts?
1. Sarcoplasmic reticulum releases Ca^{++}
 2. Depolarization of the muscle cell membrane
 3. Tropomyosin reveals active sites on actin filaments
 4. Troponin binds to tropomyosin
 5. Myosin heads attach to actin and move one notch
- A. 4, 1, 2, 3, 5
B. 2, 4, 1, 5, 3
C. 2, 1, 4, 3, 5
D. 1, 2, 3, 4, 5
111. *Thyroid Stimulating Hormone* (TSH) and *Adrenocorticotrophic Hormone* (ACTH) are produced in the _____ and have _____ as their target tissues.
- A. endocrine glands; specific body tissues
B. anterior pituitary; posterior pituitary
C. anterior pituitary; endocrine glands
D. hypothalamus; posterior pituitary
112. A hormone may exhibit very exact target specificity because
- A. it is carried by the blood directly to its target tissue and nowhere else in the body.
B. it travels throughout the entire body but only target cells have receptors specific for that hormone.
C. each body cell has only one receptor and responds only to one hormone.
D. releasing factors from the hypothalamus activate target tissues to be receptive to the hormone.
113. What is responsible for the rapid spread of action potential throughout a skeletal muscle fibre?
- A. The release of calcium ions into sarcoplasm by the sarcoplasmic reticulum.
B. The ATP activation of myosin.
C. The sliding action of actin and myosin filaments.
D. The temporal summation of motor units.
114. The largest (in size and weight) living autotrophic organisms belong to which Kingdom?
- a) Plantae
b) Animalia
c) Fungi
d) Stramenopila
115. Which of the following are NOT synapomorphies of Chordates?
- a. pharyngeal gill slits and vertebrae
b. post-anal tail and notochord
c. notochord and pharyngeal gill slits
d. dorsal, hollow nerve cord and post-anal tail