



2024 Academic Challenge

BIOLOGY TEST – State

Biology Test Production Team

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GENERAL DIRECTIONS

Please read the following instructions carefully. This is a timed test; any instructions from the test supervisor should be followed promptly.

The test supervisor will give instructions for filling in any necessary information on the answer sheet. Most Academic Challenge sites will ask you to indicate your answer to each question by marking an oval that corresponds to the correct answer for that question. One oval should be marked to answer each question. Multiple ovals will automatically be graded as an incorrect answer.

Be sure ovals are marked as  , not  ,  ,  , etc.

If you wish to change an answer, erase your first mark completely before marking your new choice.

You are advised to use your time effectively and to work as rapidly as you can without losing accuracy. Do not waste your time on questions that seem too difficult for you. Go on to the other questions, and then come back to the difficult ones later if time remains.

Time: 40 Minutes Number of Questions: 50

DO NOT OPEN TEST BOOKLET UNTIL YOU ARE TOLD TO DO SO!

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Academic Challenge
Biology Test (State) – 2024

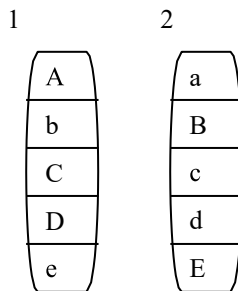
1. In genetic engineering, RFLP is an abbreviation for:
 - a. replication fork ligase polymer
 - b. RNA fingerprinting ligase polymer
 - c. restriction fragment length polymorphism
 - d. RNA frequency ligase polymorphism
 - e. none of the above

2. All of the following are characteristics or associations of dinoflagellates **except**:
 - a. two flagella
 - b. may be bioluminescent
 - c. endosymbiont
 - d. all the same shape
 - e. photosynthetic

3. Which of the following is **not** found in the area of the human body known as the mediastinum?
 - a. gallbladder
 - b. trachea
 - c. thymus gland
 - d. esophagus
 - e. aortic arch

4. Female cats are more likely to be calico because:
 - a. the gene for coat color is found on the autosomes
 - b. the gene for coat color is found on the X chromosomes
 - c. the genotype for coat color is heterozygous
 - d. both b and c
 - e. all of the above

5. Which statement is **incorrect**?
- When comparing the surface area of large cells and small cells with the same shape, large cells have more surface area relative to their volume.
 - Polypeptides are made of amino acids and no membrane surrounds the DNA of prokaryotes.
 - Chloroplasts, mitochondria, lysosomes, and peroxisomes are each bound by a membrane.
 - Microfilaments, microtubules, and intermediate filaments are cytoskeleton components.
 - The smooth endoplasmic reticulum lacks ribosomes and large amounts of smooth endoplasmic reticulum may be found in human liver cells.
6. In the following diagram of two homologous chromosomes, if crossing over occurs once, the resulting chromosomes would most likely have which allele sequences?



Keeping in mind linkage, select the correct allele sequences that would most likely result from a single crossing over between the above chromosomes without mutation:

- chromosome 1 – A, b, C, D, e, and chromosome 2 – a, b, c, d, E
 - chromosome 1 – A, b, c, d, E, and chromosome 2 – a, B, C, D, e
 - chromosome 1 – a, b, C, D, e, and chromosome 2 – a, B, c, D, E
 - chromosome 1 – A, B, C, D, e, and chromosome 2 – a, b, c, d, E
 - chromosome 1 – a, B, C, D, E, and chromosome 2 – A, B, C, D, e
7. The _____ help bend microtubules of cilia and flagella.
- centrioles
 - basal bodies
 - dynein arms
 - plasma membranes
 - contractile vacuoles

8. There are _____ amino acids, and of those, at least _____ are essential.
- 10;2
 - 20;8
 - 22;10
 - 24;12
 - 30;16
9. Which does **not** refer to a region of the pectoral girdle or upper limbs of the human body?
- crural
 - acromial
 - antecubital
 - antebrachial
 - carpal
10. Match the plant structures in **Column A** with their function in **Column B**.

Column A**Column B**

- | | |
|------------------------|---|
| 1. sieve-tube elements | i. transport water and minerals |
| 2. xylem | ii. waxy layer |
| 3. plasmodesmata | iii. conducting cells of phloem |
| 4. cuticle | iv. function to support mature regions of a plant |
| 5. sclerenchyma | v. cytoplasmic channels that allow plant cells to communicate |

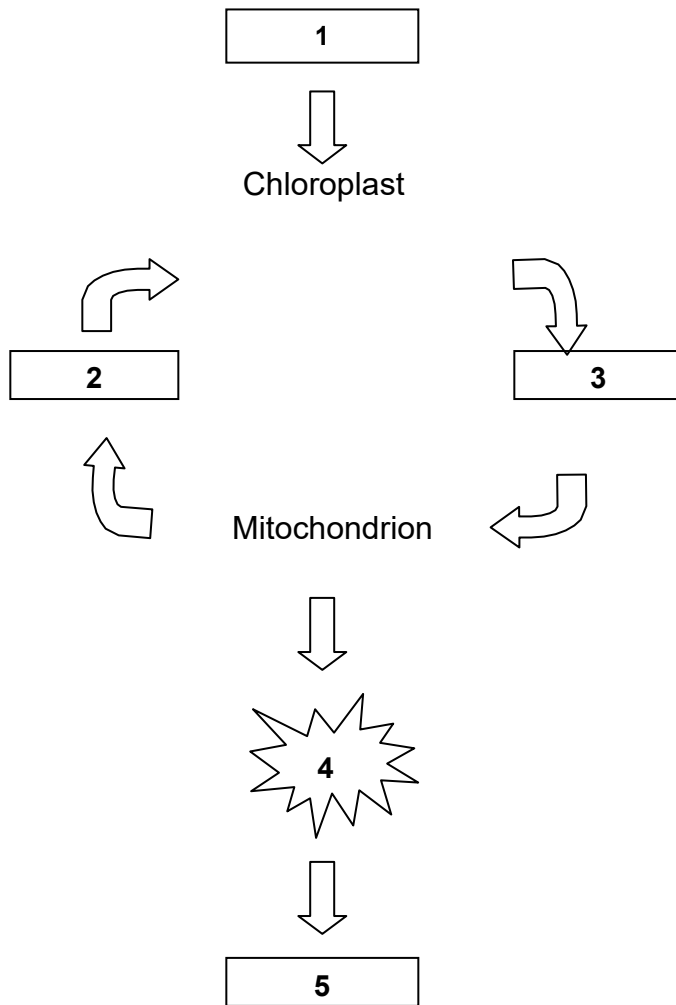
Select the most appropriate matching sequence:

- 1 – v; 2 – iii; 3 – iv; 4 – i; 5 – ii
 - 1 – i; 2 – ii; 3 – iv; 4 – iii; 5 – v
 - 1 – iii; 2 – i; 3 – v; 4 – ii; 5 – iv
 - 1 – iv; 2 – iii; 3 – v; 4 – i; 5 – ii
 - 1 – iii; 2 – i; 3 – iv; 4 – ii; 5 – v
11. Beginning with the ileocecal valve and ending with the anal canal, which is the correct sequence of components of the large intestine in order?
- cecum, transverse colon, descending colon, ascending colon, sigmoid colon, rectum
 - rectum, cecum, ascending colon, sigmoid colon, transverse colon, descending colon
 - descending colon, transverse colon, ascending colon, sigmoid colon, rectum, cecum
 - cecum, ascending colon, transverse colon, descending colon, sigmoid colon, rectum
 - cecum, rectum, transverse colon, sigmoid colon, ascending colon, descending colon

12. Which of the following is **not** an example of a protein?

- a. hemoglobin
- b. an enzyme
- c. cellulose
- d. an antibody
- e. albumin

13. Complete the diagram below, which represents the relationship between the chloroplast and mitochondrion:



Select the most appropriate matching sequence:

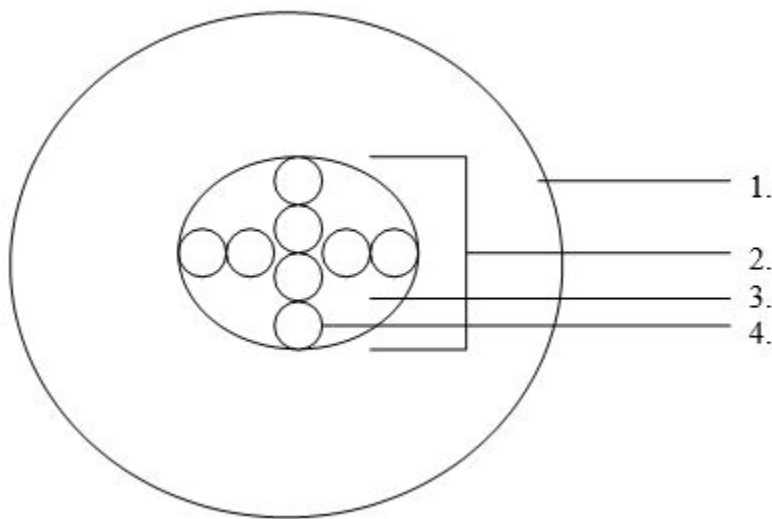
- a. 1 – ATP, 2 – heat energy, 3 – $\text{CO}_2 + \text{H}_2\text{O}$, 4 – sunlight energy, 5 – glucose + O_2
- b. 1 - $\text{CO}_2 + \text{H}_2\text{O}$, 2 – ATP, 3 – sunlight energy, 4 – heat energy, 5 - glucose + O_2
- c. 1 – sunlight energy, 2 - glucose + O_2 , 3 - $\text{CO}_2 + \text{H}_2\text{O}$, 4 – ATP, 5 – heat energy
- d. 1 – sunlight energy, 2 - $\text{CO}_2 + \text{H}_2\text{O}$, 3 - glucose + O_2 , 4 – ATP, 5 – heat energy
- e. 1 - glucose + O_2 , 2 – ATP, 3 – sunlight energy, 4 – heat energy, 5 – $\text{CO}_2 + \text{H}_2\text{O}$

14. NADPH is most closely associated with the:
- a. Krebs cycle
 - b. glycolysis
 - c. formation of lactic acid
 - d. formation of acetyl CoA
 - e. photosynthetic pathways
15. Acids and bases are _____ that release ions when they dissolve in water.
- a. electrolytes
 - b. hydroxyl groups
 - c. phosphate groups
 - d. enzymes
 - e. carbohydrates
16. Which of the following radioactive isotopes would most likely be used to detect remaining thyroid tissue post surgical removal?
- a. phosphorus-32
 - b. cobalt-60
 - c. iodine-131
 - d. carbon-14
 - e. hydrogen-3 or tritium
17. Amniocentesis can be used to determine the chances a fetus may have _____.
- a. Down's syndrome
 - b. Tay-Sachs disease
 - c. Cystic fibrous
 - d. Sickle cell anemia
 - e. all of the above may be indicated from amniocentesis
18. How many kingdoms are in the Domain Eukarya?
- a. 1
 - b. 2
 - c. 3
 - d. 4
 - e. 5
19. Which of the following is **not** found in the cell wall of plants?
- a. lignin
 - b. pectin
 - c. starch
 - d. hemicellulose
 - e. cellulose

20. Which statement is **not** true?

- a. A disaccharide contains two monosaccharides held together by a glycosidic linkage.
- b. Triglycerides are composed of a glycerol and three fatty acids held together by an ester linkage.
- c. Amino acids are the building blocks of proteins that are held together by peptide bonds.
- d. Ribozymes are a type of protein that aid ribosomes during protein synthesis.
- e. Molecular chaperones aid in the folding process of some proteins.

21. Label the cross section of a dicot root.



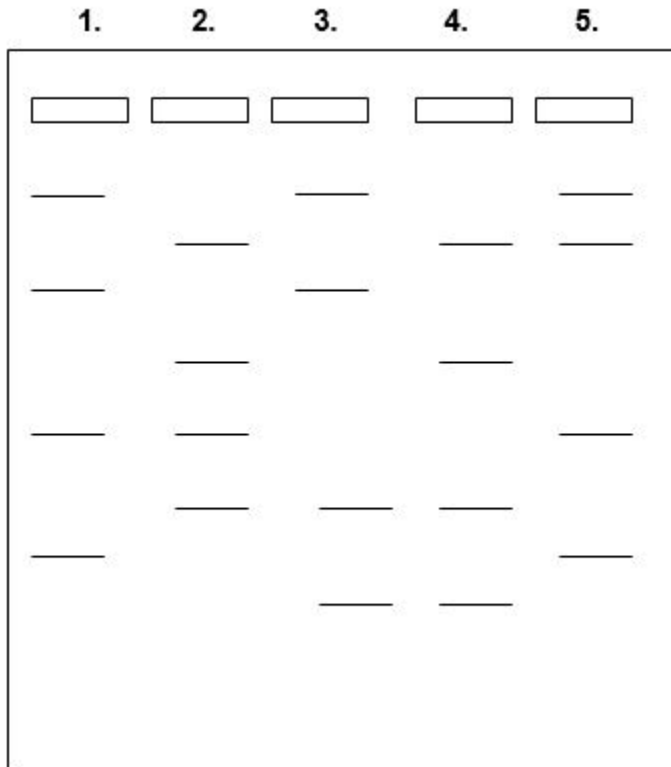
- a. 1 – epidermis; 2 – stele; 3 – phloem; 4 – xylem
- b. 1 – epidermis; 2 – cortex; 3 – xylem; 4 – phloem
- c. 1 – endodermis; 2 – stele; 3 – phloem; 4 – xylem
- d. 1 – cortex; 2 – pericycle; 3 – xylem; 4 – phloem
- e. 1 – endodermis; 2 – cortex; 3 – phloem; 4 – xylem

22. The burning of fossil fuels produces mainly _____ and _____ oxides, which are damaging to our environment.

- a. sulfur; hydrogen
- b. sulfur; nitrogen
- c. carbon; sulfur
- d. nitrogen; hydrogen
- e. none of the above

23. In Mendel's experiments, he crossed plants having yellow seeds with plants having wrinkled green seeds. **R** represents the dominant allele round, **r** represents the recessive allele wrinkled, **Y** represents the dominant allele yellow, and **y** represents the recessive allele green. If he wished to determine whether a plant was homozygous dominant for both traits or heterozygous dominant for both traits, what would he use for his testcross?
- a. RrYy
 - b. RRyy
 - c. Rryy
 - d. both a and c
 - e. none of the above
24. Which organic compounds have the greatest potential to be used for fishing line, surgical thread, and bullet proof vests?
- a. carbohydrates
 - b. lipids
 - c. proteins
 - d. nucleic acids
 - e. none of the above
25. Which is **not** a method by which bacteria can transfer DNA?
- a. transduction
 - b. conjugation
 - c. transformation
 - d. binary fission
 - e. both b and d
26. Which of the following is **not** a prezygotic barrier?
- a. hybrid inviability
 - b. temporal isolation
 - c. gametic isolation
 - d. habitat isolation
 - e. mechanical isolation
27. Which of the following is **not** a characteristic of Phylum Annelida?
- a. segmentation
 - b. pseudocoelom
 - c. closed circulatory system
 - d. metanephridia
 - e. ventral nerve cord

28. Observe the following gel that contains sample 1 from Dad, sample 2 from Mom, and samples 3, 4, and 5 from children with unknown parents. Which could be the child or children of the parents in wells 1 and 2?



- 3, 4, and 5
- 3 and 4 only
- 3 only
- 4 only
- 5 only

29. Which statement is **true**?

- The light dependent reactions of photosynthesis occur within the thylakoids of the grana.
- The electron transport chain or system for cellular respiration is located in the matrix of the mitochondrion.
- NADPH is produced primarily in the light independent reactions of photosynthesis.
- Carbon dioxide fixation is most important during cellular respiration within the cristae.
- ATP is produced in the ribosome prior to photosynthesis.

30. Which of the following is **not** a characteristic of cnidarians?
- a. two definite tissues
 - b. spicules
 - c. gastrovascular cavity
 - d. tentacles
 - e. stinging cells
31. Which of the following examples is not palindromic?
- a. 5' – AACGTT – 3' 3' – TTGCAA – 5'
 - b. 5' – CCATGG – 3' 3' – GGTACC – 5'
 - c. 5' – CATACT – 3' 3' – GTATGA – 5'
 - d. 5' – CATATG – 3' 3' – GTATAC – 5'
 - e. 5' – GAGCTC – 3' 3' – CTCGAG – 5'
32. If 20% of a DNA molecule is composed of adenine, what percent will be guanine?
- a. 15%
 - b. 20%
 - c. 30%
 - d. 40%
 - e. 50%
33. Biofilm is most closely associated with which of the following organisms?
- a. viruses
 - b. protista
 - c. bacteria
 - d. plants
 - e. fungi
34. Which of the following is a three-dimensional alpha helix, beta sheet structure/system made up of more than one polypeptide?
- a. primary
 - b. secondary
 - c. tertiary
 - d. quaternary
 - e. both a and b
35. Which is **not** a reservoir animal for the following diseases?
- a. Leprosy – armadillo
 - b. Lymes Disease – deer
 - c. Hanta virus – mice
 - d. Plague – prairie dogs
 - e. Giardiasis – fish

36. Which of the following animals have an open circulatory system?

- a. perch
- b. lancet
- c. crayfish
- d. hagfish
- e. shark

37. Match the tissues in **Column A** with the components or cell types in **Column B**.

Column A

- 1. connective
- 2. epithelial
- 3. muscle
- 4. nervous

Column B

- a. dendrite
- b. smooth
- c. blood
- d. adipose
- e. squamous
- f. cardiac
- g. axon

Select the correct matching sequence

- a. 1 – c, d; 2 – a, e; 3 – b, f; 4 – g
- b. 1 – e, g; 2 – c, d; 3 – b, f; 4 – a
- c. 1 – c, d; 2 – e; 3 – b, f; 4 – a, g
- d. 1 – c; 2 – d, e; 3 – a, b; 4 – f, g
- e. 1 – c, d; 2 – b, e; 3 – f; 4 – a, g

38. Match the ECG wave in **Column A** with the correct definition in

Column B. Column A

- 1. P wave
- 2. QRS wave
- 3. T wave

Column B

- i. repolarization of ventricles
- ii. depolarization of ventricles
- iii. depolarization of atria

Select the correct matching sequence.

- a. 1 – i; 2 – iii; 3 – ii
- b. 1 – iii; 2 – ii; 3 – i
- c. 1 – iii; 2 – i; 3 – ii
- d. 1 – i; 2 – ii; 3 – iii
- e. 1 – ii; 2 – iii; 3 – i

39. Homeotherm refers to____, while poikilotherm refers to_____.

- a. body temperature from the environment; body temperature remaining the same
- b. body temperature remaining the same; body temperature maintained from metabolism
- c. body temperature maintained from metabolism; body temperature remaining the same
- d. body temperature remaining the same; body temperature depending on the environment
- e. body temperature from the environment; body temperature maintained from metabolism

40. Which vaccine type does **not** match with the organism it helps protect against?
- a. live, attenuated vaccine – mumps
 - b. toxoid – tetanus
 - c. conjugated vaccine – *Haemophilus influenzae* type B
 - d. subunit vaccine – hepatitis B
 - e. DNA vaccine – diphtheria
41. The gametophyte generation of ferns is called the_____.
- a. gemmule
 - b. fronds
 - c. prothallus
 - d. protoneum
 - e. rhizoid
42. Mutualism is an important relationship between many organisms. Which of the following is **not** a mutualistic relationship?
- a. mycorrhize – roots and fungi
 - b. lichen – fungi and algae
 - c. termite and *Trichonympha*
 - d. cow gut and methanogen
 - e. cow birds putting their eggs into another bird's nest
43. Which of the following statements is **not** true?
- a. The total magnification of a microscope using an ocular with a 10X lens and an objective of 45X would be 450X.
 - b. If a scientist was using an electron microscope, the organism would need to be living.
 - c. As the power of the microscope increases, the need for light also increases.
 - d. While using the 100X objective, the oil added stops the light from refracting as the power increases.
 - e. The rheostat knob is used to control light.
44. If a molecule has a molecular formula of C_2H_2 , there will be a_____.
- a. single bond between the carbon atoms
 - b. double bond between the carbon atoms
 - c. double bond between the carbon and hydrogen atoms
 - d. triple bond between the carbon atoms
 - e. None of the above answers are correct.
45. _____ is the wall of a ripen ovary.
- a. Seed coat
 - b. Pericarp
 - c. Peduncle
 - d. Receptacle
 - e. Lenticel

46. If an organism's genotype is $X^rY Aa$, which of the following could **not** be a possible gamete.
- X^rA
 - Ya
 - YA
 - $X^R a$
 - $X^r a$
47. Many factors affect population size. _____ factors have a greater affect when the population size is large.
- Biotic
 - Abiotic
 - Density – independent
 - Climate
 - none of the above
48. DNA _____.
- has the code for proteins
 - replicates during the S phase of interphase
 - strands run antiparallel
 - is transcribed forming mRNA
 - all of the answers are correct
49. Chlorophyll is a pigment that _____.
- emits 2 electrons when excited by light
 - absorbs green light
 - is found only in plants
 - is used during the light-independent reaction
 - has iron in the center of the molecule
50. The expected genotype ratio for a dihybrid test cross is _____.
- 9 : 3 : 3 : 1
 - 1 : 2 : 1
 - 3 : 1
 - 1 : 1 : 1 : 1
 - 1 : 1

Scratch Paper

