



**ENGINEERING  
AT ILLINOIS**

## 2017 Academic Challenge

### BIOLOGY TEST – SECTIONAL

– This Test Consists of 50 Questions –

#### **Biology Test Production Team**

Donna Ford, John A. Logan College – Author/Team Leader

Julie Littrell, Kaskaskia College – Author

Keith Krapf, John A. Logan College – Reviewer

Sahid L. Rosado Lausell, WYSE – Coordinator of Test Production

#### 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 \*\*\***

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

©2017 Worldwide Youth in Science and Engineering

“WYSE”, “Worldwide Youth in Science and Engineering” and the “WYSE Design” are service marks of and this work is Copyright ©2017 by the Board of Trustees of the University of Illinois at Urbana – Champaign.  
All rights reserved.



WYSE – Academic Challenge  
Biology Test (Sectional) – 2017

1. Select the most appropriate path for the production of recombinant DNA.
  - a. plasmid, DNA ligase, restriction enzyme, amplification
  - b. DNA ligase, plasmid, restriction enzyme, amplification
  - c. amplification, DNA ligase, restriction enzyme, plasmid
  - d. plasmid, restriction enzyme, DNA ligase, amplification
  - e. restriction enzyme, amplification, restriction enzyme, plasmid

2. Match the disease in **Column A** with the microbe that causes it in **Column B**.

**Column A**

1. Diphtheria
2. Tetanus
3. Gangrene
4. Whooping cough – Pertussis
5. Rubella

**Column B**

- a. *Clostridium tetani*
- b. *Bordetella pertussis*
- c. *Corynebacterium diphtheriae*
- d. Togaviridea
- e. *Clostridium perfringens*

- |          |       |       |       |       |
|----------|-------|-------|-------|-------|
| a. 1 – c | 2 – e | 3 – a | 4 – b | 5 – d |
| b. 1 – c | 2 – a | 3 – e | 4 – b | 5 – d |
| c. 1 – b | 2 – d | 3 – c | 4 – e | 5 – a |
| d. 1 – e | 2 – c | 3 – b | 4 – a | 5 – d |
| e. 1 – d | 2 – a | 3 – e | 4 – b | 5 – c |

3. Which of the following ocean zones is the deepest?
  - a. abyssal zone
  - b. intertidal zone
  - c. bathyal zone
  - d. oceanic providence
  - e. hadal zone

4. Using the information in the Table below, which is a derived trait for Class Crustacea?

Taxa	Characteristic
Domain Eukarya	Cells with nuclei
Kingdom Animalia	Heterotrophs, cells without cell walls
Phylum Arthropoda	Exoskeleton made of chitin
Class Crustacea	Two compound eyes, two pair of antennae
Order Decapoda	Five pair of legs

- a. no cell walls
- b. five pair of walking legs
- c. two pair of antennae
- d. exoskeleton made of chitin
- e. All of the above are derived traits for Class Crustacea.

5. Which type of microscope would be best to use while dissecting a small animal?
- Compound
  - Confocal
  - Stereomicroscope
  - Transmission electron microscope
  - Scanning electron microscope
6. Orchids and cacti are examples of \_\_\_\_.
- C<sub>3</sub> plants
  - C<sub>4</sub> plants
  - CAM plants
  - Bryophytes
  - Fern allies
7. The human skeleton is composed of \_\_\_\_ bones.
- 196
  - 198
  - 200
  - 206
  - 213
8. Which of the following is associated with meiosis?
- asexual reproduction
  - homologous chromosomes
  - sexual reproduction
  - Both a and b are correct.
  - Both b and c are correct.
9. In fruit flies, eye color is X-linked. Red eyes X<sup>R</sup> is dominant to white eyes X<sup>r</sup>. What would be the genotypes for the following: white eyed male and a red eyed female, who had both red and white eyed male and female offspring?

Male parent	Female parent	Red eyed male offspring	White eyed male offspring	Red eyed female offspring	White eyed female offspring
a. X <sup>r</sup> Y	X <sup>r</sup> X <sup>r</sup>	X <sup>R</sup> Y	X <sup>r</sup> Y	X <sup>R</sup> X <sup>R</sup>	X <sup>r</sup> X <sup>r</sup>
b. X <sup>R</sup> Y	X <sup>R</sup> X <sup>r</sup>	X <sup>R</sup> Y	X <sup>r</sup> Y	X <sup>R</sup> X <sup>r</sup>	X <sup>r</sup> X <sup>r</sup>
c. X <sup>r</sup> Y	X <sup>R</sup> X <sup>r</sup>	X <sup>R</sup> Y	X <sup>r</sup> Y	X <sup>R</sup> X <sup>r</sup>	X <sup>r</sup> X <sup>r</sup>
d. X <sup>R</sup> Y	X <sup>r</sup> X <sup>r</sup>	X <sup>r</sup> Y	X <sup>R</sup> Y	X <sup>r</sup> X <sup>r</sup>	X <sup>R</sup> X <sup>R</sup>
e. X <sup>r</sup> Y	X <sup>R</sup> X <sup>R</sup>	X <sup>R</sup> Y	X <sup>r</sup> Y	X <sup>R</sup> X <sup>R</sup>	X <sup>R</sup> X <sup>r</sup>

10. Which of the following is an **incorrect** association?
- Mendel – taxonomy
  - Franklin – DNA
  - Morgan – fruit fly
  - Fleming – penicillin
  - All of the above are incorrect associations.

11. The structural formula for methane is \_\_\_\_\_.

a. CH<sub>4</sub>

b.  $\begin{array}{c} \text{H} \\ \text{H} : \text{C} : \text{H} \\ \text{H} \end{array}$

c.  $\begin{array}{c} \text{H} \\ | \\ \text{H} - \text{C} - \text{H} \\ | \\ \text{H} \end{array}$

d. H = C = C = H

e. H -- C – H

12. Given the following DNA strand, determine the amino acid sequence that it codes.

Codon	AUG	CUC	GAG	CCC	UUU	AAA	UAC	GGG
Amino acid	Met	Leu	Glu	Pro	Phe	Lys	Tyr	Gly

**TAC GGG AAA GAG CTC**

a. Met Pro Phe Leu Glu

b. Tyr Gly Lys Glu Leu

c. Met Tyr Pro Phe Glu

d. Tyr Met Lys Glu Leu

e. Gly Pro Phe Leu Glu

13. Match the terms in **Column A** with their definitions in **Column B**.

**Column A**

1. Biotic factors
2. Abiotic factors
3. Ecotone
4. Ecosystem
5. Population

**Column B**

- a. transition between two ecosystems
- b. community and ecosystem
- c. amount of rainfall, soil type
- d. all the members of same species in an area
- e. competition, disease

- |          |       |       |       |       |
|----------|-------|-------|-------|-------|
| a. 1 – c | 2 – e | 3 – b | 4 – d | 5 – a |
| b. 1 – e | 2 – c | 3 – a | 4 – b | 5 – d |
| c. 1 – d | 2 – a | 3 – b | 4 – c | 5 – e |
| d. 1 – e | 2 – b | 3 – a | 4 – c | 5 – d |
| e. 1 – a | 2 – e | 3 – b | 4 – d | 5 – c |

14. Which of the following does **not** take place during Prophase I?
- crossing over
  - chromatids separate
  - nuclear envelope breaks apart
  - spindles start to form
  - homologous chromosomes form tetrads
15. Which of the following reactions do **not** produce ATP?
- glycolysis
  - non cyclic photophosphorylation
  - citric acid cycle
  - chemiosmosis
  - All of the above reactions produce ATP.
16. \_\_\_\_ water molecule(s) are taken out when a triglyceride is synthesized.
- Zero
  - One
  - Two
  - Three
  - Four
17. Which of the following is **not** associated with Kingdom Fungi?
- cell wall – chitin
  - digest externally
  - reproduce by spores
  - hyphae
  - autotrophs
18. In angiosperms, the endosperm is formed when \_\_\_\_.
- a sperm cell fertilizes two polar bodies
  - a sperm cell fertilizes the ovule
  - a seed absorbs water
  - a plant embryo breaks through the seed coat
  - pollen reaches the stigma
19. Which is **not** a correct association?
- ester linkage – phospholipid
  - phosphodiester linkage – RNA
  - glycosidic linkage – starch
  - covalent bonds – table salt
  - peptide bonds – proteins

20. In pea plants, tall plants (T) are dominant to short plants (t), round seeds (R) are dominant to wrinkled seeds (r), and yellow seeds (Y) are dominant to green seeds (y). What phenotypes could be produced by the following genotypes: ttRRyy and TtRrYY?
- tall, round, green; short, round, green; tall, round, green; tall, wrinkled, yellow; short, wrinkled, yellow
  - tall, round, yellow; short, round yellow
  - tall, round, green; short, round, green
  - tall, wrinkled, yellow; short, wrinkled, green
  - only tall, round, yellow
21. In a \_\_\_\_ mutation only one amino acid changes.
- nonsense
  - frameshift
  - missense
  - silent
  - neutral
22. \_\_\_\_ are to grasshoppers as \_\_\_\_ are to crayfish.
- Malpighian tubules; green glands
  - Malpighian tubules; digestive glands
  - Nephridia; Malpighian tubules
  - Nephridia; green glands
  - Kidneys; Malpighian tubules
23. Using the Hardy-Weinberg equation, determine the frequency of the dominant allele in a population where 16% express the recessive phenotype.
- 0.84
  - 0.60
  - 0.48
  - 0.40
  - 0.16
24. High fructose syrup would be a/an \_\_\_\_.
- amino acid
  - protein
  - lipid
  - carbohydrate
  - nucleic acid
25. An organism that would move towards light and against gravity, would be described as \_\_\_\_.
- geotaxic negative and phototaxic positive
  - thigmotaxic negative and phototaxic positive
  - geotaxic positive and thigmotaxic positive
  - chemotaxic positive and geotaxic negative
  - geotaxic positive and phototaxic negative

26. Carl Woese \_\_\_\_.
- used rRNA to classify organisms into three Domains
  - determined how DNA replicated
  - genetically engineered the first human protein in a bacterium
  - proposed the Endosymbiosis theory
  - proposed a five Kingdom system
27. Which of the following cell parts do **not** have a plasma membrane?
- mitochondrion
  - Golgi complex
  - chloroplast
  - ribosome
  - All of the above have plasma membranes.
28. Fill in the following table with the missing information.

Symbol	Number of protons	Number of neutrons	Atomic weight	Valence shell electrons
C	i.	6	12	4
O	8	8	ii.	iii.
Na	11	iv.	23	1

- i – 12      ii – 16      iii – 8      iv – 11
- i – 6      ii – 16      iii – 8      iv – 12
- i – 4      ii – 8      iii – 4      iv – 23
- i – 6      ii – 6      iii – 6      iv – 12
- i – 6      ii – 16      iii – 6      iv – 12

29. Match the descriptions from **Column A** with the most appropriate term in **Column B**.

**Column A**

- the study of proteins in a genome
- used to detect antibodies or proteins
- used to diagnose genetic disorders
- temperature cycler

**Column B**

- Southern blotting
- PCR
- Western blotting
- Proteomic

- 1 – c      2 – a      3 – b      4 – d
- 1 – b      2 – c      3 – a      4 – d
- 1 – a      2 – c      3 – d      4 – b
- 1 – d      2 – c      3 – a      4 – b
- 1 – a      2 – c      3 – b      4 – d



30. Bacteria use their \_\_\_\_\_ for cellular respiration.
- mitochondrion
  - ribosome
  - nucleoid
  - plasma membrane
  - storage vesicle
31. The end result of glycolysis is \_\_\_\_\_.
- citric acid
  - lactic acid
  - pyruvic acid
  - carbon monoxide
  - None of the above is the end result of glycolysis.
32. This genetic disorder can be described as a transport membrane protein that does not transport the chloride ion properly.
- Phenylketonuria
  - Galactosemia
  - Cystic fibrosis
  - Huntington disease
  - Marfan syndrome
33. A noncompetitive inhibitor attaches to the \_\_\_\_\_ of an enzyme.
- allosteric site
  - catalytic site
  - active site
  - substrate site
  - competitive site
34. In eukaryotes, there are \_\_\_\_\_ ATP produced after aerobic cellular respiration.
- 2
  - 4
  - 20
  - 32
  - 36
35. Which is **not** true about hydrogen?
- If hydrogen loses an electron it becomes a positive ion.
  - If hydrogen loses an electron it is a proton.
  - The greater the concentration of hydrogen ions the more alkaline the solution.
  - Hydrogen has one valence shell electron.
  - Hydrogen is found in all organic molecules.

36. The tibia articulates with the \_\_\_\_\_.  
a. cuboid  
b. calcaneus  
c. talus  
d. cuneiform  
e. None of the above are correct.
37. Anions are formed by which of the following reactions?  
a. oxidation  
b. reduction  
c. hydrolysis  
d. condensation  
e. None of the above are correct.
38. Which of the following is true?  
a. Enzymes are shape specific and made of amino acids.  
b. Activation energy increases in the presence of a catalyst.  
c. Hydrolysis reactions are catabolic.  
d. Both a and b are correct.  
e. Both a and c are correct.
39. pH 7.35-7.45 would best represent?  
a. human blood  
b. human urine  
c. human stomach juices  
d. baking soda  
e. None of the above are true.
40. Which structure or chemical does **not** provide support to plants?  
a. cellulose  
b. central vacuole  
c. lignin  
d. hemicellulose  
e. pectin
41. Which of the following is associated with cellular respiration?  
a. NADP  
b. FAD  
c. non-cyclic pathway  
d. Photosystem I  
e. Photosystem II

42. In Labrador retrievers, black fur is dominant (B) to brown fur (b). Pigmentation is dominant (E) to no pigmentation (e). To produce a yellow Labrador retriever, the dog must have the recessive genotype for no pigmentation. Determine the phenotype ratio of offspring, from two black Labrador retrievers both with genotypes BbEe.
- 3:1
  - 1:2:1
  - 1:1:1:1
  - 9:3:3:1
  - 9:4:3
43. Which Protista is **not** matched correctly to its mode of locomotion?
- Euglena* – flagella
  - Amoeba* – pseudopods
  - Paramecium* – cilia
  - Trypanosoma* – pseudopods
  - Dinoflagellates – flagella
44. Which fruit type is **not** correctly matched to the plant?
- Legumes – beans
  - Berry – grape
  - Pome – apple
  - Pepo – orange
  - Drupe – cherry
45. Which mouth part is **not** correctly matched to the animal where it would be found?
- radula – snail
  - mandibles – grasshopper
  - vomerine teeth – frog
  - chelicera – spider
  - Aristotle lantern – sea anemone
46. The promoter region is \_\_\_\_.
- upstream from the coding region on the DNA molecule
  - the area RNA polymerase will bind to on the DNA molecule
  - the area where the enhancer binds to on the DNA molecule
  - Both a and b are correct.
  - Both a and c are correct.
47. \_\_\_\_ is made of glucose and fructose.
- Lactose
  - Maltose
  - Sucrose
  - Galactose
  - None of the above are correct.

48. Which is **not** correctly matched to the bacterial type?
- a. Lipopolysaccharide – Gram negative
  - b. have teichoic acid – Gram positive
  - c. stain magenta/pink – Gram negative
  - d. stain purple – Gram positive
  - e. have a thick layer of peptidoglycan – Gram negative
49. Sickle – cell anemia is \_\_\_\_.
- a. caused by a point mutation which causes one amino acid to be changed
  - b. caused by a missing protein pump
  - c. the result of a transport protein not working properly
  - d. caused by a missing digestive enzyme
  - e. caused by extra sequences of DNA
50. Which is **not** a type of root?
- a. adventitious root
  - b. tap root
  - c. fibrous root
  - d. axillary root
  - e. tuberous root