



**Harvard Undergraduate Science Olympiad India
2024 Open Round
Biology (7th-8th Grade) Exam
ANSWER KEY**

Format of Biology Section: The Biology section will contain only single-select multiple choice questions with 4-5 answer choices each. The section will have 40 multiple choice questions.

Scoring: Each correct answer will give you 1 point. You will lose 0.25 points for an incorrect answer. You will receive 0 points for a question left blank.

Allowed Materials:

You must bring:

- #2 pencil
- Eraser

You are allowed:

- Non-programmable, non-graphing calculator
- Wrist-watch (not a smart watch)

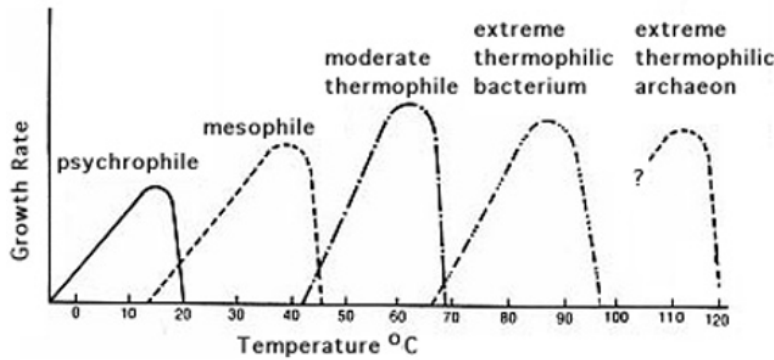
You may not bring

- Smart watch
- Books or notes
- Electronic devices

Cell Biology:

1. Which of the following choices denotes the movement of water across a selectively permeable membrane to balance solute concentration?
 - A. diffusion
 - B. osmosis**
 - C. facilitated transport
 - D. endocytosis
2. Which of the following choices correctly describes the products of the light-dependent reactions?
 - A. NADPH, ATP, and O₂**
 - B. NADPH, ATP, and glucose
 - C. NADP⁺, ADP, and O₂
 - D. NADP⁺, ATP, and glucose
3. Which of the following is the most accurate equation representing cellular respiration?
 - A. $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{Sugar} + \text{O}_2$
 - B. $\text{Sugar} + \text{CO}_2 \rightarrow \text{O}_2 + \text{H}_2\text{O}$
 - C. $\text{Sugar} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$**
 - D. $\text{Sugar} + \text{O}_2 + \text{H}_2\text{O} \rightarrow \text{CO}_2$
4. Meiosis is a process in which the daughter cells are genetically different from parent cells. In which phase of meiosis do the sister chromatids separate and move chromosomes to opposite poles of the cell?
 - A. anaphase I
 - B. anaphase II**
 - C. metaphase I
 - D. metaphase II

5. Extremophiles are bacteria that can exist in extreme conditions. The extremophiles in the diagram below can survive specific temperature ranges. Based on the diagram, if a culture of bacterial extremophiles grew at around 77° F, which extremophile would it most likely be?



- A. Psychrophile
- B. Extreme thermophilic bacterium
- C. Mesophile
- D. Moderate thermophile

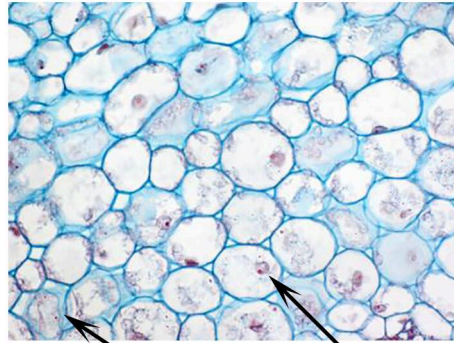
Plant Anatomy & Physiology:

6. Transpiration is the process where water is released by plants through openings in the leaves. Which of the following correctly describes how transpiration occurs?
- A. Water moves to the leaves through xylem and out the plant through stomata
 - B. Water moves to the leaves through xylem and out the plant through meristems
 - C. Water moves to the leaves through phloem and out the plant through stomata
 - D. Water moves to the leaves through phloem and out the plant through meristems
 - E. None of the above
7. Which of the following nutrients is NOT a plant macronutrient?
- A. Phosphorus
 - B. Potassium
 - C. Chloride
 - D. Nitrogen
8. Which of the following is NOT associated with asexual reproduction in plants?
- A. Budding
 - B. Fragmentation
 - C. Pollination
 - D. Vegetative propagation
 - E. None of the above

9. Which of the following plant tissues has the lowest rate of O₂ consumption?

- A. Collenchyma
- B. Parenchyma
- C. Phloem
- D. Sclerenchyma
- E. Xylem

10. Based on the structure of the plant tissue shown in the image below, what is the most likely function of this tissue?



Cytoplasm

Nucleus

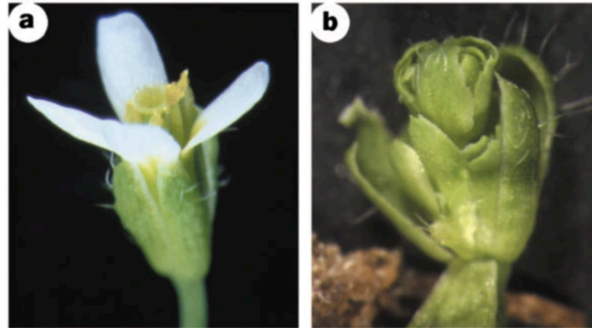
Credit: University of Florida

- A. Photosynthesis and metabolism
- B. Flexible support during plant growth
- C. Rigid support in mature plant tissues
- D. Transport of sugars and other nutrients
- E. Transport of water and minerals

11. Which of the following processes will increase the transpiration rate of plants?

- A. Increase in humidity
- B. Increase in temperature
- C. More wind
- D. Closure of stomata
- E. None of the above

12. In the figure below, (a) shows a wild-type flower while (b) shows a mutant flower. What floral organ is overexpressed in (b)?



Credit: Pelaz et al., 2000

- A. Carpals
- B. Petals
- C. Sepals
- D. Stamens

Animal Anatomy & Physiology:

13. Also called folate, this vitamin can be used to treat anemia and are given to pregnant women. It helps promote brain and nerve function and is found in leafy green such as spinach or broccoli. What is this vitamin?

- A. K
- B. B3
- C. B9
- D. B12

14. Which of the following blood types is considered the universal acceptor?

- A. AB+
- B. AB-
- C. O-
- D. O+

15. The body uses many defenses to fight off pathogens including bacteria, viruses, or even organic molecules. The innate defenses are methods of defense that are non-specific to foreign invaders. Which of the following is NOT part of the innate immune system?

- A. complement proteins
- B. humoral response
- C. phagocytosis
- D. cytokines

16. During a respiratory cycle, air moves into and out of the lungs due to action of the diaphragm and changes in pressure. Which of the following is true during inhalation?
- A. The diaphragm contracts and pressure in the lungs decrease
 - B. The diaphragm contracts and pressure in the lungs increase
 - C. The diaphragm relaxes and pressure in the lungs decrease
 - D. The diaphragm relaxes and pressure in the lungs increase
 - E. None of the above
17. Cartilage is a type of connective tissue with varied functions in the body. Which of the following is NOT a location in the human body where cartilage is found?
- A. In the soft parts of the outer ear
 - B. On the ends of bones in joints
 - C. In the hard parts of the fingernails
 - D. Around the trachea (windpipe)
 - E. Surrounding the nares (nostrils)
18. During inflammation, white blood cells travel to the site of inflammation by squeezing through the intact walls of the capillaries. What is the term that refers to the passage of white blood cells through the blood vessel wall?
- A. chemotaxis
 - B. diapedesis
 - C. leukocyte extravasation
 - D. leukocyte transmigration
19. What brain region is responsible for controlling vital rhythms such as breathing and heart rate?
- A. Cerebellum
 - B. Cerebrum
 - C. Medulla oblongata
 - D. Spinal cord
20. Which of the following glands is matched incorrectly to a hormone it produces?
- A. Anterior pituitary- antidiuretic hormone
 - B. Ovaries- estrogen
 - C. Posterior pituitary- oxytocin
 - D. Thyroid- calcitonin

21. Which of the following correctly describes the flow of blood through the cardiovascular system?
- A. Right atrium→ bicuspid valve→ right ventricle→ lungs→ left atrium→ mitral valve→ left ventricle
 - B. Right atrium→ mitral valve→ right ventricle→ lungs→ left atrium→ bicuspid valve→ left ventricle
 - C. Left atrium→ bicuspid valve→ left ventricle→ lungs→ right atrium→ mitral valve→ right ventricle
 - D. Left atrium→ mitral valve→ left ventricle→ lungs→ right atrium→ bicuspid valve→ right ventricle
22. The material that passes into the small intestine from the stomach is known as chyme, containing hydrochloric acid and partly digested food. After entering the small intestine, chyme mixes with pancreatic juice to further digest food. Which of the following is NOT found in pancreatic juice?
- A. carboxypeptidase
 - B. trypsinogen
 - C. pepsinogen
 - D. phospholipase
23. Which of the following is a function of smooth muscle?
- I. Controlling the resistance of blood vessels
 - II. Moving food through the small intestine
 - III. Moving blood through large veins
 - IV. Producing a pulse
- A. III only
 - B. I and III only
 - C. I and II only
 - D. II, III, and IV only
 - E. II, II, III, and IV only
24. Which of the following organs is NOT part of the excretory system?
- I. Lungs
 - II. Pancreas
 - III. Kidneys
 - IV. Sweat glands
- A. II only
 - B. I and II only
 - C. I and IV only
 - D. I, II, and IV only
 - E. I, II, III, and IV only

25. In a series of experiments in 1923, Roger Hubbard and Samuel Munford found that urine pH increased in those who had eaten a standard meal. In patients who could not secrete stomach acid, no increase in pH occurred. Based on these findings, which of the following is a reasonable conclusion?
- A. Secretion of acid by the stomach causes bicarbonate levels to decrease in the blood, leading to an increase in blood pH.
 - B. Secretion of acid by the stomach causes bicarbonate levels to increase in the blood, leading to an increase in blood pH.
 - C. Secretion of acid by the stomach causes bicarbonate levels to decrease in the blood, leading to a decrease in blood pH.
 - D. Secretion of acid by the stomach causes bicarbonate levels to increase in the blood, leading to a decrease in blood pH.
 - E. None of the above
26. Grey and white matter compose the brain and spinal cord. Grey matter consists primarily of neuron cell bodies while white matter consists primarily of neuron axons. Which of the following is TRUE regarding the organization of grey and white matter in the spinal cord and brain?
- A. Grey matter is surrounded by white matter in the spinal cord and brain
 - B. White matter is surrounded by grey matter in the spinal cord and brain
 - C. Grey matter is surrounded by white matter in the spinal cord and white matter is surrounded by grey matter in the brain
 - D. White matter is surrounded by grey matter in the spinal cord and grey matter is surrounded by white matter in the brain
 - E. None of the above
27. An irregular heartbeat caused by chaotic and irregular electrical signals in the upper parts of the heart is known as which of the following rhythms? It can result in poor blood flow, along with dizziness, fatigue and weakness.
- A. atrial fibrillation
 - B. heart block
 - C. sinus tachycardia
 - D. sinus bradycardia
 - E. ventricular fibrillation

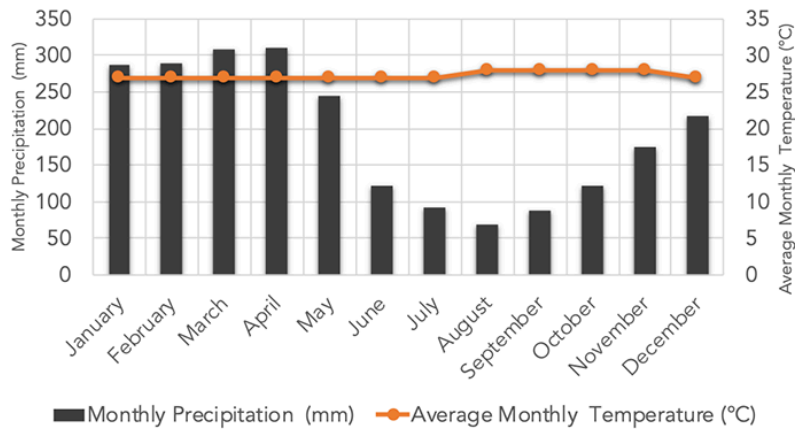
Ecology:

28. Interspecific interactions are interactions among different species. These interactions can be represented by a “/” notation. For example, a predator-prey interaction can be represented by a +/- notation. Which of the following correctly matches the interspecific interaction with its “/” notation?

- I. Commensalism (+/+)
- II. Mutualism (+/0)
- III. Parasitism (+/-)

- A. II only
- B. III only**
- C. I and III only
- D. I and II only
- E. I, II, and III

29. Climographs measure average rainfall and temperature in a location over the year. The climograph below most likely represents which biome?

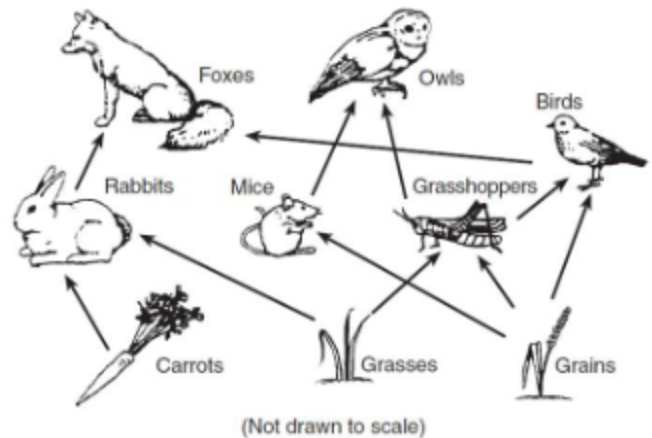


Credit: NASA

- A. Desert
- B. Savannah
- C. Temperate forest
- D. Tropical rainforest**
- E. Tundra

30. Examine the food web at right. What would most likely occur if the local bird population went extinct?

- A. the population of owls would decrease
- B. the population of grasses would decrease
- C. the population of foxes would increase
- D. the population of carrots would increase
- E. None of the above



31. Which of the following is NOT considered an abiotic factor in an ecosystem?

- A. Decomposers
- B. Humidity
- C. Soil
- D. Temperature

Biosystematics:

32. Which of the following characteristics is NOT found in common between amphibians, mammals, and reptiles?

- A. Are tetrapods
- B. Have limbs with digits
- C. Originated from a common ancestor
- D. Possess amnion

33. Which of the following correctly orders the hierarchy of classification?

- A. Domain, kingdom, class, family, phylum, order, genus, species
- B. Domain, kingdom, phylum, class, order, family, genus, species
- C. Domain, phylum, kingdom, class, order, genus, family, species
- D. Kingdom, domain, class, phylum, family, order, genus, species
- E. Kingdom, domain, phylum, family, class, genus, order, species

34. Which of the following kingdoms uses binary fission to produce new cells?

- I. Animalia
- II. Monera
- III. Plantae
- IV. Protista

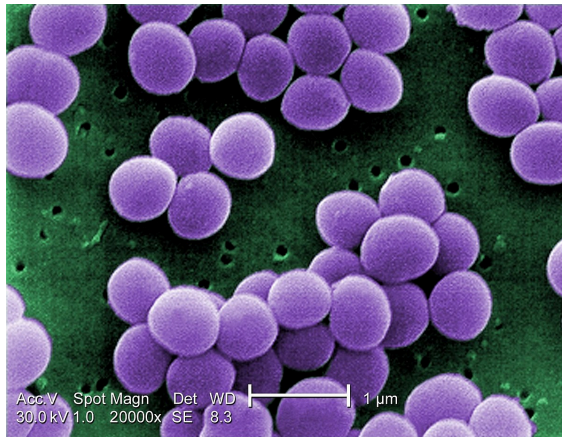
- A. III only
- B. IV only
- C. II and IV only
- D. II, III, and IV only
- E. I, II, and III only

35. Which of the following are vertebrate classes?

- I. Arthropoda
- II. Aves
- III. Chondrichthyes
- IV. Nematoda

- A. I only
- B. II and III only
- C. I and IV only
- D. II, III, and IV only
- E. I, II, III, and IV

36. Which of the following best describes the shape of the bacteria shown below?



Credit: Wikipedia

- A. Diplococcus
- B. Streptobacillus
- C. Streptococcus
- D. Staphylococcus

Biology Applications:

37. Which of the following processes does NOT rely on bacteria?
- A. Making beer
 - B. Making bread**
 - C. Making cheese
 - D. Making yogurt
38. Which of the following illnesses is a vector-borne disease?
- A. Ebola
 - B. Lyme disease**
 - C. Smallpox
 - D. Tuberculosis
 - E. None of the above
39. Which of the following diseases does NOT have vaccine prevention?
- A. Dengue fever**
 - B. Meningococcal disease
 - C. Polio
 - D. Smallpox
 - E. None of the above
40. Yeast are fungi that use fermentation to aid in food processes such as making wine. Which of the following correctly describes the products of yeast fermentation?
- A. Ethanol and carbon dioxide**
 - B. Carbon dioxide only
 - C. Lactic acid and carbon dioxide
 - D. Pyruvate and ethanol
 - E. Pyruvate and lactic acid