

I. Instructions: Choose the best answer for each of the following questions.

1. In what way biology benefits technology?(Model exam,2017)
 - A. Help to investigate information on biomolecules
 - B. Providing detailed information on chemical component of medicinal plants.
 - C. Providing physical devices to gather biological information at all scales of biological organization
 - D. Providing material that used to adapt and develop modern technologies
2. The principle behind biomimicry is that:
 - A. Humans teach animals survival skills
 - B. Technology imitates non-living processes only
 - C. Nature's designs provide blueprints for human innovation
 - D. Natural selection hinders technological progress
3. Substituting animal testing with computer simulations primarily supports which ethical goal?
 - A. Reduction B. Refinement C. Replacement D. Regulation
4. Which application of biology and technology **positively impacts society**?
 - A. Producing biodegradable plastics
 - B. Using harmful biological agents for warfare
 - C. Destroying ecosystems by overharvesting plants
 - D. Conducting unauthorized genetic experiments
5. The field that uses computer algorithms to interpret biological data is:
 - A. Biophysics B. Bioinformatics C. Biogeography D. Biochemistry
6. Which scenario shows misuse of biotechnology?
 - A. Developing drought-resistant crops B. Producing bioweapons
 - B. Synthesizing insulin for diabetics D. Using microbes to produce biofuels
7. Which of the following reflects a responsible integration of biology and technology?
 - A. Creating biodegradable plastics C. Using biological weapons for national defense
 - B. Overharvesting medicinal plants D. Conducting genetic experiments without consent
8. A biologist observes a group of animals and measures their body temperatures across day and night. Which pattern would indicate that the animals are homeothermic?
 - A. Body temperature fluctuates widely with ambient temperature
 - B. Body temperature drops significantly at night to conserve energy

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- C. Body temperature remains relatively stable despite environmental changes
- D. Body temperature raises during activity but falls during rest
9. Which statement best compares the roles of the magnum and uterus in birds?
- A. Magnum secretes albumen; uterus adds the shell
- B. Magnum forms yolk; uterus forms albumen
- C. Magnum forms shell; uterus adds yolk
- D. Both magnum and uterus form albumen
10. Which one of the following **is not** instinctive behavior ?(Model exam,2017)
- A. swimming with dolphin and aquatic animals
- B. opening mouth in chicks when their mother returns to the nest.
- C. honeybees dance when they return to the hive after finding a source of food
- D. blinking when something gets too close to your eye
11. What role do receptors play in the homeostasis process? (Model exam, 2017)
- A. they monitor environmental changes.
- B. they detect stimuli and send information to the brain.
- C. they adjust body conditions back towards the set point.
- D. they regulate the body's response to stimuli.
12. Kidney is one of the main organs responsible for osmoregulation. When the water level in the body is high, how kidneys respond to this change? (Model exam, 2017)
- A. The kidney releases a large amount of hypotonic urine.
- B. The kidney produces a low amount of hypertonic urine.
- C. High volume of water is reabsorbed by the kidneys.
- D. The kidney produce small amount of diluted urine.
13. A desert lizard alternates between basking in the sun and hiding in shade. This behavior represents:
- A. Behavioral thermoregulation C. Physiological thermoregulation
- B. Osmoregulation D. Reflex conditioning
14. What is the key difference between **homeothermic** and **poikilothermic** animals?
- A. Homeotherms maintain constant internal temperature; poikilotherms' body temperature changes with the environment.
- B. Poikilotherms regulate temperature internally, while homeotherms depend on surroundings.

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- C. Homeotherms are found only in water, while poikilotherms are land-dwellers.
D. Poikilotherms always live in warm environments
15. What happens to the surface area-to-volume ratio as an animal's size increases?
A. It decreases, leading to slower heat loss C. It increases, causing faster heat loss
B. It remains constant regardless of size D. It increases along with daily food requirements
16. When a chimpanzee stacks boxes to reach a banana hanging overhead, which learning type is shown?
A. Insight learning (problem-solving through reasoning) C. Classical conditioning
B. Habituation D. Sensitization
17. What is the role of insulin in homeostasis?
A. To increase blood glucose levels C. To decrease blood glucose levels
B. To regulate body temperature D. To control blood pressure
18. Which hormone is released when blood glucose levels are too low?
A. Insulin B. Glucagon C. Adrenaline D. Cortisol
19. Compare the K_m values of two enzymes: Enzyme A has a K_m of 2 mM, and Enzyme B has a K_m of 10 mM. Which statement is true?
A. Enzyme B has a higher affinity for the substrate
B. Enzyme A reaches V_{max} faster than Enzyme B
C. Enzyme A has a higher affinity for the substrate
D. Enzyme B is more efficient at low substrate concentrations
20. Which of the following describes the 'Induced Fit' model of enzyme-substrate interaction?
A. The enzyme's active site molds its shape to bind the substrate more precisely upon contact.
B. The enzyme and substrate bind only via covalent bonds.
C. The substrate acts as a key that perfectly fits into a rigid enzyme lock.
D. The substrate changes its chemical identity before entering the active site.
21. During which phase of the cell cycle does DNA replication occur?
A. M Phase B. G1 Phase C. G2 Phase D. S Phase
22. Which of the following is the primary role of an enzyme in a biochemical reaction?
A. To increase the activation energy C. To act as a permanent reactant
B. To lower the activation energy D. To change the final equilibrium of the product
23. In the structural classification of enzymes, the non-protein organic part that is loosely attached to the apo-enzyme is called:
A. A prosthetic group B. A co-enzyme C. A metal ion activator D. A holo-enzyme

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24. The "Lock and Key" model of enzyme action suggests that:
- A. The enzyme is flexible and changes shape
 - B. The active site is a rigid structure complementary to the substrate
 - C. The substrate changes shape to fit the enzyme
 - D. Enzymes can bind to any substrate
25. The process of copying a gene's DNA sequence into a sequence of RNA is called:
- A. Translation
 - B. Replication
 - C. Transcription
 - D. Transformation
26. Which one of the following is true about enzymes? (Model exam,2017)
- A. Enzymes consumed in the reaction they catalyzed.
 - B. Enzymes increase the rate by increasing activation energy.
 - C. Enzymes are highly specific for their substrates.
 - D. Enzymes can function in wide range of temperature and pH.
27. What is the quaternary structure of protein? (Model exam,2017)
- A. The folding pattern of the polypeptide chain.
 - B. The interaction between subunits.
 - C. The three-dimensional shape.
 - D. The sequence of amino acids
28. What is the key feature of the lock and key model of enzyme-substrate interaction? (Model exam, 2017)
- A. Enzyme active sites fill-in with a substrate to interact through covalent interactions.
 - B. The enzyme changes shape to better fit the substrate after binding.
 - C. The substrate fits perfectly into the enzyme's active site from the start.
 - D. The enzyme does not bind to the substrate at all until the reaction is complete.
29. Which of the following occurs during Prophase I of meiosis but NOT during prophase of mitosis?
- A. Chromosomes condense
 - B. Synapsis and crossing over
 - C. The nuclear envelope breaks down
 - D. Spindle fibers form
30. How does a competitive inhibitor affect enzyme activity?
- A. By binding to the allosteric site
 - B. By permanently denaturing the enzyme
 - C. By competing with the substrate for the active site
 - D. By increasing the V_{max} of the reaction

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31. What is the effect of increasing substrate concentration on a reaction controlled by a non-competitive inhibitor?
- A. The inhibition is completely overcome
 - B. The rate of reaction remains low because V_{max} is reduced
 - C. The inhibitor is pushed out of the active site
 - D. The K_m value decreases significantly
32. In the production of beer, why is the 'malting' process essential?
- A. To kill bacteria in the grain
 - B. To activate enzymes like amylase to break down starch into sugars
 - C. To add flavor to the barley
 - D. To increase the alcohol content directly
33. Which level of protein structure is most directly determined by the sequence of codons in mRNA?
- A. Primary
 - B. Secondary
 - C. Tertiary
 - D. Quaternary
34. In the context of the Ethiopian leather industry, why are proteases and lipases used in "bating"?
- A. To color the leather
 - B. To make the leather waterproof
 - C. To remove non-collagenous proteins and fats to make leather soft and pliable
 - D. To speed up the drying process
35. Which observation would best support the "Induced Fit" theory over the "Lock and Key" theory?
- A. An enzyme binds to only one substrate
 - B. X-ray crystallography shows the enzyme shape changes when the substrate binds
 - C. The reaction rate increases with temperature
 - D. The enzyme remains unchanged after the reaction
36. Evaluate the relationship between the surface area to volume ratio and cell size.
- A. Larger cells have a higher ratio, making them more efficient
 - B. Smaller cells have a higher ratio, allowing for more efficient nutrient exchange
 - C. The ratio stays the same regardless of cell size
 - D. Cells grow larger to decrease their surface area

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37. If you were to design a laundry detergent to remove blood stains (protein), which enzyme would be the most critical ingredient?

- A. Amylase B. Lipase C. Protease D. Cellulase

38. Which type of inhibition is likely occurring if a molecule that inhibits an enzyme's activity binds to an enzyme active site? (Model exam,2017)

- A. Non-competitive inhibition C. Competitive inhibition
B. Activator inhibition D. Substrate inhibition

39. Consider the following chemical reactions below.

A. $HR_2 + A \xrightarrow{E} H + AR_2$

B. $\text{Ethanol} + \text{NAD}^+ \xrightarrow{F} \text{Acetaldehyde} + \text{NADH} + \text{H}^+$

Based on the above chemical reactions „A“ and „B“, in which classes of enzymes does enzyme “E” and “F” can be grouped respectively? (Model exam,2017)

- A. Oxidoreductases and Transferase C. Hydrolases and Lyases
B. Lyases and Hydrolases D. Transferases and Oxidoreductases

40. What role do betaglucanase enzymes play in industrial process? (Model exam,2017)

A. In biofuel industry, breakdown cellulose into sugars and ferment to produce cellulosic ethanol.

B. In dairy industry, hydrolyses protein in the manufacture of cheese.

C. In food processing, clarify fruit juices.

D. In brewing industry, improve beer filtration.

41. If a protein consists of 150 amino acids, what is the minimum number of nucleotides in the mRNA coding region?

- A. 50 B. 150 C. 300 D. 450

42. A cell in G2 phase has double the amount of DNA compared to a cell in G1. Why?

- A. It has absorbed DNA from the environment
B. DNA replication occurred during the S phase
C. The cell has already divided
D. Chromosomes have been lost

43. If a woman with blood type O marries a man with blood type AB, what are the possible blood types of their children?

- A. A and B C. AB and O
B. A, B, and O D. Only AB

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44. Why is meiosis I referred to as the "reduction division" while meiosis II is the "equational division"?

- A. Meiosis I separates sister chromatids; Meiosis II separates homologs
- B. Meiosis I reduces the number of chromosomes from diploid to haploid; Meiosis II maintains it
- C. Meiosis I doubles the DNA; Meiosis II halves it
- D. Meiosis I occurs in somatic cells; Meiosis II in germ cells

45. A scientist treats a cell with a chemical that prevents spindle fiber formation. Evaluate which stage of mitosis will be most directly affected.

- A. Prophase
- B. Metaphase (chromosomes cannot align)
- C. S-phase
- D. G1 phase

46. Contrast the end products of Mitosis and Meiosis.

- A. Mitosis: 2 haploid cells; Meiosis: 4 diploid cells
- B. Mitosis: 2 diploid cells; Meiosis: 4 haploid cells
- C. Mitosis: 4 haploid cells; Meiosis: 2 diploid cells
- D. Mitosis: 2 identical cells; Meiosis: 2 non-identical cells

47. Suppose the amino acid coding region in a mRNA is 1200 nucleotides long, how long is the protein in terms of amino acid number?

- A. 1200 amino acids
- B. 400 amino acids
- C. 600 amino acids
- D. 300 amino acids

48. Mendel's Law of Independent Assortment states that: (Model exam, 2017)

- A. Alleles for different genes segregate independently during gamete formation.
- B. Alleles for the same gene segregate independently during gamete formation.
- C. Alleles for the same gene segregate together during gamete formation.
- D. Alleles for different genes segregate together during gamete formation.

44. In incomplete dominance: (Model exam, 2017)

- A. One allele is completely dominant over the other.
- B. There are more than two alleles for a particular gene.
- C. Both alleles are expressed equally.
- D. Neither allele is completely dominant over the other

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49. How do vertebrates and invertebrates primarily differ?(Model exam,2017)
- A. many vertebrates are soft bodied, while invertebrates do not.
 - B. vertebrates are cold blooded, while invertebrates are warm-blooded.
 - C. invertebrates have more complex and specialized organ, while vertebrates do not.
 - D. vertebrates have vertebral column, while invertebrates do not.
50. The phenomena in which heterozygote lack the dominant and recessive relationship, and each allele is capable of some degree of phenotypic expression referred to as:
- A. Complete dominance C. Incomplete dominance
 - B. Co-dominance D. Full dominance