

Biology & Biotechnology: Second-round sample problems

I. Is the following true or false?

Each question is worth 1 point

1. Cyanobacteria, microscopic animals (protozoa), microscopic algae and microscopic fungi are prokaryotes.

Answer: False

2. Reflexes are complex congenital stereotypical forms of behavior that occur in response to environmental changes.

Answer: False

3. Totipotency is the ability of plant cells to express the genetic information of an entire organism.

Answer: True

4. Four hundred primary spermatocytes form 800 spermatozoa after meiosis.

Answer: False

5. Embryonic stem cells are the product of cleavage of the 16-cell zygote.

Answer: False

6. R-strategists have small sizes and short life span.

Answer: True

7. The monomer units of DNA are nucleotides consisting of deoxyribose, phosphoric acid residue and nitrogenous bases. In the DNA double helix, A-U or G-C pairs function as a bridge between strands.

Answer: False

8. In humans, albinism is an autosomal recessive trait.

Answer: True

9. The essential amino acids include valine, leucine, isoleucine, lysine, methionine, threonine, tryptophan and phenylalanine.

Answer: True

10. Amino acids are the pepsin reaction product.

Answer: False

II. Choose the correct answer

Each question is worth 2 points

1. The functions of lymph do not include:

A. the return of electrolytes, proteins and water from the intercellular space into the bloodstream

B. communication between organs and tissues

C. the collection of red blood cell tissue

D. oxygen transfer from the lungs to body tissues

Answer: D

2. Acid precipitation is principally caused by:

- A. SO_2
- B. N_2
- C. NO
- D. CO_2

Answer: A

3. Reversible changes in phytocenoses do not include:

- A. fluctuations
- B. successions
- C. seasonal changes in the appearance
- D. seasonal changes in flora

Answer: B

4. How many gamete types are there in an organism of the genotype AaBbCC ?

- A. 4
- B. 2
- C. 8
- D. 6

Answer: A

5. Which protein structure corresponds to the helically twisted chain of amino acid molecules?

- A. primary
- B. secondary
- C. tertiary
- D. quaternary

Answer: B

6. A man with hemophilia marries a female who is normal (all her ancestors were normal too). Their normal daughter marries a normal man. What is the probability that the couple will have a child with hemophilia?

- A. 12.5%
- B. 25%
- C. 50%
- D. 75%

Answer: B

7. The type of chemical bond that occurs when two cysteine molecules combine and plays an important role in forming the secondary structure of proteins:

- A. Ionic
- B. Covalent
- C. Hydrogen

D. Disulfide

Answer: D

8. Tall plants were crossed with low plants. In the first generation (F_1), all plants are medium-sized. In the second generation (F_2), 25% of the plants were tall; 50%, medium-sized; 25%, low. This is an example of:

- A. complete dominance
- B. overdominance
- C. co-dominance
- D. incomplete dominance

Answer: D

9. Secondary metabolites accumulate in the microbial culture during:

- 1. the lag phase
- 2. the linear growth stage
- 3. the exponential phase
- 4. the stationary phase and cell death phase

Answer: D

10. Glucagon is produced by:

- A. the pancreas
- B. the adrenal cortex
- C. the pituitary gland
- D. the epiphysis

Answer: A

III. Match the data from the two columns

Each question is worth 1 point

1. Match the taxonomic ranks (left) to the taxon names (right) for the common bean

Taxonomic rank	Taxon name
1. <i>Regnum</i> (kingdom)	A. Fabales
2. Division	B. Phaseolus
4. <i>Ordo</i> (order)	C. Plantae
5. <i>Familia</i> (family)	D. Magnoliophyta (Angiospermae)
6. Genus	E. Fabaceae
7. Species	G. <i>Phaseolus vulgaris</i> L.

Answer: 1 – C, 2 – D, 3 – A, 4 – E, 5 – B, 6 – F

2. Match the organisms in the left column to the food chain links in the right column

Organism	Food chain links
1. Barley, spruce, purple sulfur bacteria	A. Primary consumers
2. Wolf, fox, lion	B. Decomposer
3. <i>Bacillus subtilis</i>	C. Producer
4. Deer, wild boar, hare	D. Secondary consumers

Answer: 1 – C, 2 – D, 3 – B, 4 – A

3. Match the enzymes in the left column to the substrates in the right column

Enzyme	Substrate
1. Catechol-O-methyl transferase	A. fructose 1,6-bisphosphate
2. Catalase	B. noradrenaline
3. Restriction enzyme	C. hydrogen peroxide
4. Aldolase	D. DNA

Answer: 1 – B, 2 – C, 3 – D, 4 – A

IV. Choose the most appropriate option for each gap

Select only correct statements

Each question is worth 1 point

1. Ferns are an ancient group of ... ¹⁾ plants, most of which are ... ²⁾. Usually ... ³⁾ and ... ⁴⁾ develop on the ventral surface of gametophytes of homosporous ferns. Fronds, the leaves of ferns, carry ... ⁵⁾.

- A. sporous
- B. sporangia
- C. homosporous
- D. archeogonia
- E. antheridia

Answer: 1 – A, 2 – C, 3 – D or E, 4 – D or E, 5 – B

2. Most organic compounds are characterized by¹⁾. Dextrorotatory isomers are indicated by the letter²⁾, and levorotatory isomers are indicated by the letter.....³⁾. Molecules of nucleic acids contain only⁴⁾, whereas protein molecules contain only⁵⁾

- A. L-isomers
- B. optical isomerism
- C. D
- D. D-isomers
- E. L

Answer: 1 – B, 2 – C, 3 – E, 4 – D, 5 – A

V. Solve the problem

Each question is worth 5 points

ONE CLICK TO OPEN ALL DOORS

1. *Drosophila* has a dominant gene for red eyes and a recessive gene for white eyes on the X chromosomes. A white-eyed female bred with a red-eyed male. What eye color will males and females have in the first and second generation?

Answer: In the F₁-generation, all the females will have red eyes and all the males, white. In the F₂-generation, half of the females and half of the males will be red-eyed and the other half, white-eyed.

2. A criterion for classifying a substance as biologically active is its ability to affect physiological processes at concentrations of 10^{-7} - 10^{-6} mol/kg of live weight. Substance A (molar mass 183) has a significant physiological effect on the animal at a concentration of 1000 $\mu\text{g}/\text{kg}$ of body weight. Substance B (molar mass 23) affects physiological processes at a concentration of 2.3 mg/g of weight. Which of the two substances can be classified as biologically active using this criterion? Support your answer with calculations.

Answer: Substance A