NATIONAL Science Bee

National Championship Biology Exam

Name _____

School

_____

Grade _____

Email address _____

Instructions – Circle the correct answer or leave it blank. Correct answers are worth 2 points. Incorrect answers are worth −1 point. Questions left blank are worth 0 points.

1. Type I diabetes develops when the pancreas does not make enough.
   A. cholesterol.
   B. sucrose.
   C. blood.
   D. insulin.

2. Identify the source below that does NOT contain triglycerides.
   A. olive oil
   B. whale oil
   C. beef fat
   D. diesel oil

3. Identify the difference between a saturated fat and an unsaturated fat.
   A. A saturated fat tends to be a solid at room temperature and generally comes from plants. An unsaturated fat tends to be a liquid at room temperature and comes from warm-blooded animals.
   B. A saturated fat tends to be a liquid at room temperature and generally comes from plants. An unsaturated fat tends to be a solid at room temperature and comes from warm-blooded animals.
   C. A saturated fat tends to be a solid at room temperature and generally comes from warm-blooded animals. An unsaturated fat tends to be a solid at room temperature and comes from plants.
   D. A saturated fat tends to be a solid at room temperature and generally comes from warm-blooded animals. An unsaturated fat tends to be a liquid at room temperature and comes from plants.

4. Which of the following describes a primary protein structure?
   A. protein structure maintained by disulfide linkages
   B. amino acid sequence maintained by peptide bonds
   C. protein chains maintained by interactions of peptide backbones
   D. arrangement of multiple protein subunits

5. Hemoglobin is an example of.
   A. a fibrous protein.
   B. an α-helix.
   C. a globular protein.
   D. a tertiary structure.

6. Collagen is an example of.
   A. a fibrous protein.
   B. an α-helix.
   C. a globular protein.
   D. a tertiary structure.

7. The following is part of a DNA sequence. What is its complementary sequence?

   AGTTCGAGCCT

   A. TCCGAGCTTGA
   B. CAGTCCA
   C. AGGCTCGAACT
   D. TCAAGCTCGGA

8. Identify the most abundant organic substance on earth.
   A. cellulose
   B. fructose
   C. amylopectin
   D. starch

9. Which of the following bond monosaccharide units together into polysaccharides?
   A. ester bonds
   B. glycosidic linkages
   C. disulfide linkages
   D. amine bonds

10. Identify the compound that is NOT an amino acid.
    A. phenylalanine
    B. methionine
    C. histidine

D. guanine

11. The resting membrane potential depends on which of the following?

I. Active transport

II. Selective permeability

III. Differential distribution of ions across the axonal membrane

A. III only
B. I and II only
C. II and III only
D. I, II, and III

12. The Krebs cycle in humans occurs in.
A. mitochondrial matrix
B. inner mitochondrial membrane
C. outer mitochondrial membrane
D. intermembrane

13. A heterotroph.
A. obtains its energy from sunlight, harnessed by pigments
B. obtains its energy by oxidizing organic molecules
C. makes organic molecules from CO2
D. obtains its energy by consuming

14. Regarding meiosis and mitosis, one difference between the two forms of cellular reproduction is that in meiosis.
A. there is one round of cell division, whereas in mitosis there are two rounds of cell division
B. separation of sister chromatids occurs during the second division, whereas in mitosis separation of sister chromatids occurs during the first division
C. chromosomes are replicated during interphase, whereas in mitosis chromosomes are replicated during prophase
D. spindle fibers form during prophase, whereas in mitosis the spindle fibers form during metaphase

15. A feature of amino acids NOT found in carbohydrates is the presence.
A. carbon atoms
B. oxygen atoms
C. nitrogen atoms
D. hydrogen atoms

16. Which of the following is NOT a characteristic of bacteria?
A. Circular double-stranded DNA
B. Membrane-bound cellular organelles
C. Plasma membrane consisting of lipids and proteins
D. Ribosomes that synthesize polypeptides

17. Which of the following best explains why a population is described as the evolutionary unit?
A. Genetic changes can only occur at the population level.
B. The gene pool in a population remains fixed over time.
C. Natural selection affects individuals, not populations.
D. Individuals cannot evolve, but populations can.

18. The endocrine system maintains homeostasis using many feedback mechanisms. Which of the following is an example of positive feedback?
A. Infant suckling causes a mother's brain to release oxytocin, which in turn stimulates milk production.
B. An enzyme is allosterically inhibited by the product of the reaction it catalyzes.
C. When ATP is abundant the rate of glycolysis decreases.
D. When blood sugar levels decrease to normal after a meal, insulin is no longer secreted.

19. A scientist carries out a cross between two guinea pigs, both of which have black coats. Black hair coat is dominant over white hair coat. Three quarters of the offspring have black coats, and one quarter have white coats. The genotypes of the parents were most likely.
A. bb × bb
B. Bb × Bb
C. Bb × bb
D. BB × Bb

20. All of the following play a role in morphogenesis EXCEPT.
A. apoptosis
B. homeotic genes
C. operons
D. inductive effects

21. A dog is following the scent of a jackrabbit. Which of the following accurately describes how the dog's brain integrates information for smell?
    A. Chemoreceptors in the brain send impulses for smell in the nasal cavity.
    B. Chemoreceptors cells in the nasal cavity send impulses to the appropriate area of the brain.
    C. Chemoreceptors on epithelial cells of the tongue send hormones to the appropriate area of the brain.
    D. Receptors originating in the nose send action potentials to the motor regions of the brain.

22. If ATP breakdown (hydrolysis) is inhibited, which of the following types of movement across cell membranes is also inhibited?
    A. Movement of oxygen into a cell
    B. Movement of water through aquaporins
    C. Passage of a solute against its concentration gradient
    D. Facilitated diffusion of a permeable substance

23. Which of the following questions is most relevant to understanding the Calvin cycle?
    A. How does chlorophyll capture light?
    B. How is ATP used in the formation of 3-carbon carbohydrates?
    C. How is NADP+ reduced to NADPH?
    D. How is ATP produced in chemiosmosis?

24. Rosalind Franklin's x-ray diffraction images taken in the 1950s most directly support which of the following claims about DNA?
    A. The ratios of base pairs are constant
    B. The nucleotide sequence determines genetic information
    C. The two strands of DNA are antiparallel
    D. The basic molecular structure is a helix

25. Scientists have found that the existing populations of a certain species of amphibian are small in number, lacking in genetic diversity, and separated from each other by wide areas of dry land. Which of the following human actions is most likely to improve the long-term survival of the amphibians?
    A. Cloning the largest individuals to counteract the effects of aggressive predation
    B. Reducing the population size by one-fifth to decrease competition for limited resources
    C. Constructing a dam and irrigation system to control flooding
    D. Building ponds in the areas of dry land to promote interbreeding between the separated populations

26. If chemical signals in the cytoplasm control the progression of a cell to the M phase of the cell cycle, the fusion of a cell in G1 with a cell in early M phase would most likely result in the.
    A. replication of chromosomes only in the G1 cell
    B. exiting of both cells from the cell cycle and into the G0 phase
    C. condensation of chromatin in preparation of nuclear division in both cells
    D. transfer of organelles from G1 cell to the cell in the M phase

27. Villi and microvilli are present in the small intestine and aid in reabsorption by
    A. increasing the surface area of the small intestine
    B. decreasing the surface area of the small intestine
    C. making the small intestine more hydrophilic
    D. making the small intestine more hydrophobic

28. Which of the following does NOT take place in the small intestine?
    A. Pancreatic lipase breaks down fats to fatty acids and glycerol.
    B. Pepsin breaks down proteins into amino acids.
    C. Pancreatic amylase breaks down carbohydrates into simple sugars.
    D. Bile emulsifies fats into smaller fat particles.

29. In animal cells, which of the following represents the most likely pathway that a secretory protein takes as it is synthesized in a cell?
    A. Plasma membrane–Golgi apparatus–ribosome–secretory vesicle–rough ER
    B. Ribosome–Golgi apparatus–rough ER–secretory vesicle–plasma membrane
    C. Plasma membrane–Golgi apparatus–ribosome–secretory vesicle–rough ER
    D. Ribosome–rough ER–Golgi apparatus–secretory vesicle–plasma membrane

30. All of the following statements are correct regarding alleles EXCEPT.

A. alleles are alternative forms of the same gene
B. alleles are found on corresponding loci of homologous chromosomes
C. a gene can have more than two alleles
D. an individual with two identical alleles is said to be heterozygous with respect to that gene

31. Once a plasmid has incorporated specific genes, such as the gene coding for the antibiotic ampicillin, into its genome, the plasmid may be cloned by.
    A. inserting it into a virus to generate multiple copies
    B. treating it with a restriction enzyme in order to cut the molecule into small pieces
    C. inserting it into a suitable bacterium in order to produce multiple copies
    D. running it on a gel electrophoresis in order to determine the size of the gene of interest

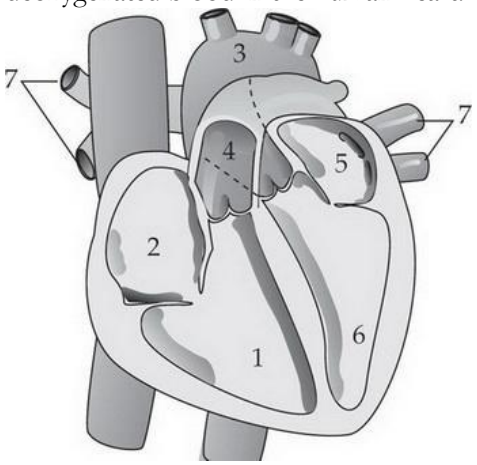
32. Although mutations occur at a regular and predictable rate, which of the following statements is the LEAST likely reason the frequency of mutation appears to be low?
    A. Some mutations produce alleles that are recessive and may not be expressed.
    B. Some undesirable phenotypic traits may be prevented from reproducing.
    C. Some mutations cause such drastic phenotypic changes that they are removed from the gene pool.
    D. The predictable rate of mutation results in ongoing variability in a gene pool.

33. Which of the following adaptive features would least likely be found in an animal living in a hot arid environment?
    A. Long loops of Henle to maximize water reabsorption
    B. Storage of water in fatty tissues
    C. Large ears to aid in heat dispersion
    D. Short loops of Henle to maximize water secretion

34. Which of the following best accounts for the ability of legumes to grow well in nitrogen-poor soils?
    A. These plants make their own proteins.
    B. These plants have a mutualistic relationship with nitrogen-fixing bacteria.
    C. These plants are capable of directly converting nitrogen gas into nitrates.
    D. These plants do not require nitrogen to make plant proteins.

35. Which of the following is most correct concerning cell differentiation in vertebrates?
    A. Cells in different tissues contain different sets of genes, leading to structural and functional differences.
    B. Differences in the timing and expression levels of different genes leads to structural and functional differences.
    C. Differences in the reading frame of mRNA leads to structural and functional differences.
    D. Differences between tissues result from spontaneous morphogenesis.

36. Question below refers to the diagram below. Which of the following chambers or vessels carry deoxygenated blood in the human heart?



    A. 4 only
    B. 1 & 2 only
    C. 5 only
    D. 1, 2, and 4

37. In chick embryos, the extraembryonic membrane that provides nourishment to the fetus is the.
    A. amnion
    B. chorion
    C. placenta
    D. egg yolk

38. Some strains of viruses can change normal mammalian cells into cancer cells in vitro. This transformation of the mammalian cell is usually associated with the.

A. formation of a pilus between the mammalian cell and the virus
B. incorporation of the viral genome into the mammalian cell's nuclear DNA
C. conversion of the host's genome into the viral DNA
D. release of spores into the mammalian cell

39. The major difference between cartilage and bone is that cartilage.
A. is a part of the skeletal system
B. is composed of collagen and salts
C. lacks blood vessels and nerves
D. secretes a matrix

40. Crossing-over occurs during which of the following phases in meiosis?
A. Prophase I
B. B. Metaphase I
C. C. Anaphase I
D. D. Prophase II

41. Which of the following about meiosis is NOT true?
A. Meiosis produces two haploid gametes.
B. Homologous chromosomes join during synapsis.
C. Sister chromatids separate during meiosis I.
D. Crossing-over increases genetic variation in gametes.

42. A plant grows in the opposite direction of the gravitational force. This is an example of.
A. positive thigmotropism
B. negative phototropism
C. positive phototropism
D. negative gravitropism

43. In most ecosystems, net primary productivity is important because it represents the.
A. energy available to producers
B. total solar energy converted to chemical energy by producers
C. biomass of all producers
D. energy available to heterotrophs

44. Hawkmoths are insects that are similar in appearance and behavior to hummingbirds. Which of the following is LEAST valid?
A. These organisms are examples of convergent evolution.
B. These organisms were subjected to similar environmental conditions.
C. These organisms are genetically related to each other.
D. These organisms have analogous structures.

45. Which of the following describes a symbiotic relationship?
A. A tapeworm feeds off of its host's nutrients causing the host to lose large amounts of weight.
B. Certain plants grow on trees in order to gain access to sunlight, not affecting the tree.
C. Remora fish eat parasites off of sharks; the sharks stay free of parasites, and the remora fish are protected from predators.
D. Meerkats sound alarm calls to warn other meerkats of predators.

46. Destruction of all beta cells in the pancreas will cause which of the following to occur?
A. Glucagon secretion will stop and blood glucose levels will increase.
B. Glucagon secretion will stop and blood glucose levels will decrease.
C. Glucagon secretion will stop and digestive enzymes will be secreted.
D. Insulin secretion will stop and blood glucose levels will increase.

47. All of the following are stimulated by the sympathetic nervous system EXCEPT
A. dilation of the pupil of the eye
B. constriction of blood vessels
C. increased secretion of the sweat glands
D. increased peristalsis in the gastrointestinal tract

48. The calypso orchid, Calypso bulbosa, grows in close association with mycorrhizae fungi. The fungi penetrate the roots of the flower and take advantage of the plant's food resources. The fungi concentrate rare minerals, such as phosphates, in the roots and make them readily accessible to the orchid. This situation is an example of
A. parasitism
B. commensalism
C. mutualism
D. endosymbiosis

49. Which of the following are characteristics of both bacteria and fungi?
A. Cell wall, DNA, and plasma membrane
B. Nucleus, organelles, and unicellularity

C. Plasma membrane, multicellularity, and Golgi apparatus
D. Cell wall, unicellularity, and mitochondria

50. A sustained decrease in circulating Ca2+ levels might be caused by decreased levels of which of the following substances?
    A. Growth hormone
    B. Parathyroid hormone
    C. Thyroid hormone
    D. Calcitonin

51. The synthesis of new proteins necessary for lactose utilization by the bacterium E. coli using the lac operon is regulated
    A. by the synthesis of additional ribosomes
    B. at the transcription stage
    C. at the translation stage
    D. by differential replication of the DNA that codes for lactose-utilizing mechanisms

52. Which of the following statements about trypsin is NOT true?
    A. It is an organic compound made of proteins.
    B. It is a catalyst that alters the rate of a reaction.
    C. It is operative over a wide pH range.
    D. The rate of catalysis is affected by the concentration of substrate.

53. A change in a neuron membrane potential from +50 millivolts to -70 millivolts is considered
    A. depolarization
    B. repolarization
    C. hyperpolarization
    D. an action potential

54. The energy given up by electrons as they move through the electron transport chain is used to
    A. break down glucose
    B. make glucose
    C. produce ATP
    D. make NADH

55. If a photosynthesizing plant began to release 18 O2 instead of normal oxygen, one could most reasonably conclude that the plant had been supplied with.
    A. H2O containing radioactive oxygen
    B. CO2 containing radioactive oxygen
    C. C6H12O6 containing radioactive oxygen
    D. NO2 containing radioactive oxygen

56. Chemical substances released by organisms that elicit a physiological or behavioral response in other members of the same species are known as.
    A. auxins
    B. hormones
    C. pheromones
    D. enzymes

57. The sliding action in the myofibril of skeletal muscle contraction requires which of the following?

    I. Ca2+
    II. ATP
    III. Actin

    A. I only
    B. II only
    C. II and III
    D. I, II, and III

58. Which of the following organisms in this population are secondary consumers?
    A. Sharks
    B. Mackerels
    C. Herrings
    D. Small crustaceans

59. A nerve impulse requires the release of neurotransmitters at the axonal bulb of a presynaptic neuron. Which of the following best explains the purpose of neurotransmitters, such as acetylcholine?
    A. They speed up the nerve conduction in a neuron.
    B. They open the sodium channels in the axonal membrane.
    C. They excite or inhibit the postsynaptic neuron.
    D. They open the potassium channels in the axonal membrane.

60. During a dive, a Weddell seal's blood flow to the abdominal organs is shut off and oxygen-rich blood is diverted to the eyes, brain, and spinal cord. Which of the following is the most likely reason for this adaptation?
    A. To increase the number of red blood cells in the nervous system
    B. To increase the amount of oxygen reaching the skeletomuscular system
    C. To increase the amount of oxygen reaching the central nervous system
    D. To increase the oxygen concentration in the lungs

61. In general, animal cells differ from plant cells in that animal cells have

A. a cell wall made of cellulose
B. lysosomes
C. large vacuoles that store water
D. centrioles within centrosomes

62. A chemical agent is found to denature all enzymes in the synaptic cleft. What effect will this agent have on acetylcholine?
    A. Acetylcholine will not be released from the presynaptic membrane.
    B. Acetylcholine will not bind to receptor proteins on the postsynaptic membrane.
    C. Acetylcholine will not diffuse across the cleft to the postsynaptic membrane.
    D. Acetylcholine will not be degraded in the synaptic cleft.

63. The liver is a vital organ that performs all of the following functions EXCEPT
    A. storing amino acids that were absorbed in the capillaries of the small intestine
    B. detoxifying harmful substances such as alcohol or certain drugs
    C. synthesizing bile salts that emulsify lipids
    D. breaking down peptides into amino acids

64. Hemoglobin is a molecule that binds to both O2 and CO2. There is an allosteric relationship between the concentrations of O2 and CO2. Hemoglobin's affinity for O2
    A. decreases as blood pH decreases
    B. increases as H+ concentration increases
    C. increases in exercising muscle tissue
    D. decreases as CO2 concentration decreases

65. In humans, fertilization normally occurs in the
    A. ovary
    B. fallopian tube
    C. uterus
    D. placenta

66. The development of an egg without fertilization is known as
    A. meiosis
    B. parthenogenesis
    C. embryogenesis
    D. vegetative propagation

67. All of the following are examples of hydrolysis EXCEPT
    A. conversion of fats to fatty acids and glycerol
    B. conversion of proteins to amino acids
    C. conversion of starch to simple sugars
    D. conversion of pyruvic acid to acetyl CoA

68. In cells, which of the following can catalyze reactions involving hydrogen peroxide, provide cellular energy, and make proteins, in that order?
    A. Peroxisomes, mitochondria, and ribosomes
    B. Peroxisomes, mitochondria, and lysosomes
    C. Peroxisomes, mitochondria, and Golgi apparatus
    D. Lysosomes, chloroplasts, and ribosomes

69. The primary site of glucose reabsorption is the
    A. glomerulus
    B. proximal convoluted tubule
    C. loop of Henle
    D. collecting duct

70. All of the following statements are true EXCEPT
    A. thyroxine increases the rate of metabolism
    B. insulin decreases storage of glycogen
    C. vasopressin stimulates water reabsorption in the kidney
    D. epinephrine increases blood sugar levels and heart rate

71. Metafemale syndrome, a disorder in which a female has an extra X chromosome, is the result of nondisjunction. The failure in oogenesis that could produce this would occur in
    A. metaphase I
    B. metaphase II
    C. telophase I
    D. anaphase II

72. In plants, the tendency of climbing vines to twine their tendrils around a trellis is called
    A. thigmotropism
    B. hydrotropism
    C. phototropism
    D. geotropism

73. When a retrovirus inserted its DNA into the middle of a bacterial gene, it altered the normal reading frame by one base pair. This type of mutation is called
    A. duplication
    B. translocation
    C. inversion
    D. frameshift mutation

74. High levels of estrogen from maturing follicles inhibit the release of gonadotropin releasing hormone (GnRH). Which of the following endocrine glands produces GnRH?
    A. Anterior pituitary
    B. Posterior pituitary
    C. Hypothalamus
    D. Pineal gland

75. The principle inorganic compound found in living things is
    A. carbon
    B. oxygen
    C. water
    D. glucose

Biology Answer Key:

1) D
2) D
3) D
4) B
5) C
6) A
7) D
8) A
9) B
10) D
11) D
12) A
13) B
14) B
15) C
16) B
17) D
18) A
19) B
20) C
21) B
22) C
23) B
24) D
25) D
26) C
27) A
28) B
29) D
30) D
31) C
32) D
33) D
34) B
35) B
36) D
37) D
38) C
39) C
40) A
41) C
42) D
43) D
44) C
45) C
46) D
47) D
48) C
49) A
50) B
51) B
52) C
53) B
54) C
55) A
56) C
57) D
58) C
59) C
60) C
61) D
62) D
63) D
64) A
65) B
66) B
67) D
68) A
69) B
70) B
71) D
72) A
73) D
74) C
75) C