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二、考生應在答案卷上規定範圍內作答，且不得書寫任何與答案無關之文字、符號，違者該科不予計分。

三、答案卷以每人一張為限，不得要求增補；試題與答案卷必須繳回，不得攜出試場。

1. Which one is **NOT** an example of system biology?
 - A) The overall effect of a drug that could lower blood pressure to the whole human body.
 - B) The study of consequences of the water supply level of crops to the essential nutrition of human consumers.
 - C) The study of the DNA molecules and the mechanism of DNA duplication.
 - D) The study of how industrial releasing of CO₂ to atmosphere alter ecosystem and the entire biosphere.
 - E) The study of the effect of changing one variable to the responses of components of an agricultural system.
2. What is **NOT** an emergent property of water molecules that contributed to our Earth's suitability for life?
 - A) The property of cohesion of water molecules.
 - B) Water as an excellent solute for life to use.
 - C) The high specific heat of water.
 - D) Floating of ice on liquid water.
 - E) Water stabilizes the temperature dynamics of environment for life.
3. Which kind of compound is defined by their mirror images of the compounds that have the same numbers of atoms of the same elements but different structure?
 - A) Enantiomers
 - B) Structure isomers
 - C) Cis-isomers
 - D) Trans-isomers
 - E) Isotopes
4. Which one is **NOT** a correct combination of a polysaccharide and its function?
 - A) Starch - Storage polysaccharide
 - B) Cellulose – Structural polysaccharide
 - C) Chitin – Structural polysaccharide
 - D) Glycogen – Storage polysaccharide
 - E) Sucrose – Storage polysaccharides
5. Which one is the genetic material for almost all living organisms?
 - A) Deoxyribonucleic acid
 - B) Ribonucleic acid
 - C) Phospholipids
 - D) Polypeptide
 - E) Carbohydrates

6. Naked human eyes cannot see which of the objects below?
- A) Frog eggs
 - B) *Paramecium*
 - C) Mitochondrion
 - D) Chicken eggs
 - E) Giraffes
7. Which one is **NOT** a valid description about diffusion of particle in cells?
- A) The passive transport of particles depends on diffusion.
 - B) There is no energy investment for cells when passive transport happens.
 - C) When transport across cell membrane, the driving direction of the molecules depends on concentration gradient.
 - D) If the environment of a cell is hypotonic, the size of the cell would enlarge.
 - E) Diffusion across cell membrane never involve transport proteins.
8. For transport of large molecules, such as some proteins or polysaccharides, the most likely way of cell transport is _____.
- A) diffusion
 - B) endocytosis
 - C) facilitated diffusion
 - D) active transport using protein channels
 - E) osmosis
9. In cellular respiration stages, which one is the stage that uses oxygen?
- A) Glycolysis
 - B) Citric acid cycle
 - C) Electron Transport Chain
 - D) Pyruvate oxidation
 - E) Chemiosmosis
10. Where does photosynthesis take place in a plant leaf?
- A) Stomata
 - B) Chloroplasts
 - C) Vein
 - D) Cell wall
 - E) Tracheids
11. In a cell cycle of human (mitosis), which stage is the stage that duplication of chromosomes happens?
- A) Prophase
 - B) Anaphase
 - C) Prometaphase
 - D) Interphase
 - E) Telophase
12. What is a metastasis in cancer development?
- A) The beginning of a cancer development.
 - B) The growing stage of a tumor.
 - C) It is the end stage of begin tumor.
 - D) It is the spreading stage beyond the original site of cancer cells.
 - E) It is the stage of malignant tumor.

13. In meiosis, when do the cells become haploid?
- A) Anaphase I
 - B) Telophase I
 - C) Metaphase I
 - D) Prophase II
 - E) Cytokinesis II
14. What are the three levels of conservation of biodiversity?
- A) Ecosystem diversity, spectacular diversity, genetic diversity.
 - B) Ecosystem diversity, species diversity, genetic diversity.
 - C) Habitat diversity, population diversity, genetic diversity.
 - D) Ecophysics diversity, species diversity, genetic diversity.
 - E) Ecosystem diversity, species diversity, phenotypic diversity.
15. Which one is **NOT** a greenhouse gas that could change the climate patterns?
- A) CH₄
 - B) CO₂
 - C) N₂O
 - D) N₂
 - E) All of them above are greenhouse gases.
16. About DNA replication, which one is true?
- A) It is an anti- dispersive model.
 - B) It is a semi-dispersive model.
 - C) It is a complete-conservation model.
 - D) It is a dispersive model.
 - E) It is a semi-conservation model.
17. The initiation of a DNA replication needs a lot of proteins to work together. Which one is the one that starts the synthesis of the daughter strand?
- A) Primase
 - B) Helicase
 - C) Topoisomerase
 - D) Ligase
 - E) Polymerase I
18. What was Martha Chase's contribution to genetics?
- A) Discovered the A, C, G, T bases in DNA molecule
 - B) Found genetic material is probably in cell but not very sure
 - C) Found that DNA, not protein, is the genetic material
 - D) Found the function of DNA polymerase III
 - E) Found DNA is double helix
19. In mark-recapture technique, if 100 individuals were marked at the first capture; at recapture, there were 10 marked individuals in 100 recaptured individuals, what is the estimated population size?
- A) 100
 - B) 1,000
 - C) 10,000
 - D) 100,000
 - E) 1,000,000

20. In the case of human malaria, which one is the definitive hosts?
- A) *Anopheles*
 - B) *Homo sapiens*
 - C) *Plagiorhynchus*
 - D) *Drosophila*
 - E) *Plasmodium*
21. Gregor used parent generation seeds that have yellow-round phenotype (genotype *YYRR*) to cross with the parent generation seeds that have green-wrinkled phenotype (genotype *yyrr*). Then he crossed their F1 seeds to generate F2 seeds. Given the gene encodes color and the gene encodes shape of the seeds are independent assorted, what is the expected phenotypic ratio of the F2 seeds (Yellow-Round: Green-Round: Yellow-Wrinkled: Green-Wrinkled)?
- A) 9:3:3:1
 - B) 1:2:2:1
 - C) 2:3:3:2
 - D) 4:1:1:4
 - E) 1:4:4:1
22. Which description is incorrect about the viruses that infect bacteria?
- A) They named phages.
 - B) They inject their genetic material in the bacterial cells.
 - C) They replicate within their host cells.
 - D) They could use either lytic cycles or lysogenic cycles to reproduce.
 - E) They all eventually break the host cells and kill the host cells.
23. We learned that gene expressed through transcription and translation. Which one below would involve in translation of a eukaryotic cell?
- A) Ribosome
 - B) DNA template
 - C) RNA polymerase
 - D) Promoter
 - E) Spliceosome
24. In between of transcription and translation in a gene expression of an eukaryotic cell, there is a step called RNA processing. Which one below is INCORRECT?
- A) It adds poly-A tail in this step.
 - B) It cuts out introns in this step.
 - C) The exons remain in the final product.
 - D) It adds a 5'-cap in this step.
 - E) The final product of this step is rRNA.
25. Which description below is correct about miRNA?
- A) They are originally short RNA sequences.
 - B) An enzyme call Tricer trims the original form of miRNA.
 - C) The trimmed product is double-stranded RNA.
 - D) The trimmed products are stable thus could be used directly for next steps.
 - E) If a miRNA sequence is completely complementary with an mRNA, the translation steps would be blocked and the mRNA would not degrade.

26. About the Human Genome Project (HGP), which one below is **NOT** true?
- A) The results of HGP showed that most of the human genome does not consist of genes.
 - B) There are about three billion base pairs of nucleotides in a human genome.
 - C) There are about 21,000 genes in a human genome.
 - D) HGP began in 1990.
 - E) The first HGP was done by whole-genome shotgun method.
27. A Hardy-Weinberg equilibrium population would **NOT** show which property below?
- A) The population would not have genetic drift.
 - B) The population would not have mutation
 - C) The allele frequencies do not change through time.
 - D) Natural selection would work in the gene pool of this population.
 - E) The individuals mate randomly within this population.
28. Which one below would lead to speciation?
- A) The individuals in this species mate randomly.
 - B) The gene flow exists among the populations in a species.
 - C) The females cannot recognize males from sister species.
 - D) There is geographic barrier between two populations thus the exchanges of individuals were blocked.
 - E) The population size is small.
29. Which one is the correct sequence of the origins of organisms on earth?
- A) Prokaryotes, multicellular eukaryotes, vascular plants, small invertebrates, single-celled eukaryotes.
 - B) Single-celled eukaryotes, prokaryotes, multicellular eukaryotes, vascular plants, small invertebrates.
 - C) Prokaryotes, single-celled eukaryotes, multicellular eukaryotes, small invertebrates, vascular plants.
 - D) Prokaryotes, single-celled eukaryotes, vascular plants, multicellular eukaryotes, small invertebrates.
 - E) Single-celled eukaryotes, prokaryotes, multicellular eukaryotes, vascular plants, small invertebrates.
30. Which one below is the most likely organism that evolved into chloroplast through the process of endosymbiosis?
- A) Cyanobacterium
 - B) Green alga
 - C) *E. coli*
 - D) Red alga
 - E) *Euglena*
31. Where does meiosis take place in an angiosperm?
- A) Seeds
 - B) Fruits
 - C) Ovule
 - D) Style
 - E) Stigma
32. What is **NOT** a shared character among vertebrates (the Phylum Chordata)? Note that some characters may disappear in some developmental stages.
- A) Notochord
 - B) Ventral heart
 - C) Pharyngeal slits
 - D) Post-anal tail
 - E) Ventral nerve cord

33. Which one is the most successful group in Arthropods in terms of the number of species?
- A) Insects
 - B) Chelicerates
 - C) Millipedes
 - D) Crustaceans
 - E) Centipedes
34. Which pair of epithelial tissue-human body part is **NOT** a correct match?
- A) Simple squamous epithelium – air sacs of lung
 - B) Pseudostratified columnar epithelium – skin of the ear canal
 - C) Stratified squamous epithelium – lining of esophagus
 - D) Simple cuboidal epithelium – tube of the kidney
 - E) Simple columnar epithelium – lining of intestines
35. Which combination of digestion enzyme and its target carbohydrates is **NOT** correctly matched?
- A) Pancreatic amylase – polysaccharides
 - B) Trypsin – polypeptides
 - C) Chymotrypsin – polysaccharides
 - D) Nucleases – DNA
 - E) Bile salts – fat globules
36. About gas transportation in human blood, which one below is a correct description?
- A) O_2 is transported in blood via bounding to hemocyanin.
 - B) Hemoglobin is the CO_2 carrier in human blood.
 - C) O_2 is transported in plasma.
 - D) CO_2 is transported in red blood cells.
 - E) CO_2 is transported in blood as bicarbonate ions.
37. What is the correct sequence of electrical events in a heartbeat?
- A) SA node, atria, AV node, specialized muscle fibers, apex, ventricles.
 - B) SA node, atria, AV node, apex, specialized muscle fibers, ventricles.
 - C) Atria, SA node, AV node, specialized muscle fibers, apex, ventricles.
 - D) SA node, AV node, atria, specialized muscle fibers, apex, ventricles.
 - E) SA node, atria, specialized muscle fibers, AV node, apex, ventricles.
38. Antihistamine can relief an allergic reaction of human body because antihistamines block the histamine's action and ____.
- A) reduce the number of effector B cells.
 - B) prevent the generation of antibodies.
 - C) prevent the inflammatory reaction due to histamines.
 - D) stimulate the production of antibodies.
 - E) prevent antigens from binding to antibodies.
39. Which one below is **NOT** a role of urinary system in human body?
- A) Filtration
 - B) Reabsorption
 - C) Secretion
 - D) Excrement
 - E) Excretion

40. Diabetes is a common endocrine disorder in humans. Which one below is **NOT** true?
- A) It is a symptom of the body's inability to produce or use insulin.
 - B) It causes hyperglycemia.
 - C) Type I diabetes refers to the lack of insulin in blood.
 - D) Type II diabetes refers to the hyperreaction of insulin receptors in cells.
 - E) Type I and Type II diabetes both cause elevated glucose level in blood.
41. The human female reproductive cycle is a complex process. Which one below does **NOT** correctly correspond the hormone level to an even in ovarian cycle?
- A) FSH – stimulates follicle to grow.
 - B) LH peaks – triggers ovulation.
 - C) Estrogen peaks – causes LH surge.
 - D) Oxytocin increases – thickening of endometrium.
 - E) Decrease of progesterone/Estrogen – menstruation begins
42. After fertilization, a frog embryo would start its development. In which stage that the embryo would develop blastocoel?
- A) Fertilization
 - B) Cleavage
 - C) Gastrulation
 - D) Organ formation
 - E) Metamorphosis
43. For Schwann cells in a motor neuron, which description below is incorrect?
- A) They locate on dendrites of a neuron.
 - B) Myelin sheath is the insulating material for Schwann cells.
 - C) In between Schwann cells, there is node of Ranvier.
 - D) Schwann cells speed up the transmission of signals.
 - E) Schwann cells do not cover the synaptic terminals.
44. A nerve signal begins as a change of membrane potential occurred. Which one below is invalid about the change of membrane potential?
- A) Before the change, the resting potential is maintained by the sodium-potassium pumps.
 - B) Once the nerve was excited, more potassium channels opened, and more sodium channels closed thus the membrane potential changed.
 - C) The changes of ion concentrations after the excitement of nerve, it causes the depolarization across inside and outside of the membrane.
 - D) To see depolarization happens, the stimulation needs to reach a threshold.
 - E) Finally, the membrane repolarized into a status that interior of cell is more negatively charged.
45. Which one below does **NOT** involve in the hearing of a human?
- A) Outer ear
 - B) Eardrum
 - C) Hammer
 - D) Semicircular canals
 - E) Organ of Corti

46. In a filament sliding model of a muscle fiber, which one below would shorten during a muscle contraction?
- A) Dark band
 - B) Sarcomere
 - C) Myosin
 - D) Actin
 - E) Z line
47. Which of the form of interaction between two species resulted in increase of fitness of both parties?
- A) Mutualism
 - B) Predation
 - C) Parasitism
 - D) Herbivory
 - E) Commensalism
48. The equation of a population growth with limited resource is $G = rN(K-N)/K$, in which G stands for the growth rate of a population, r is the per capita rate of increase, N is the population size at a particular time, and K is the carrying capacity, or the maximum population size. If the term $(K-N)/K=1$, the model of this population growth is called _____.
- A) logistic model
 - B) lognormal model
 - C) intrinsic model
 - D) exponential model
 - E) limited model
49. Which one below is the largest unit within which gene flow can occur based on the biological species concept?
- A) Cohort
 - B) Species
 - C) Population
 - D) Genus
 - E) Class
50. In a forensic scene, the DNA profile that a police officer uses as the evidence to identify the crime is based on _____.
- A) The DNA sequences of a particular gene.
 - B) The presence of an expressed gene.
 - C) The order of genes on a chromosome.
 - D) The genotype frequency
 - E) The presence of different fragment sizes of DNA