說明：一、請一律以「答案卷」作答，作答時不得使用鉛筆，違者該科答案卷不予計分；限用黑色或藍色墨水的筆書寫。
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. In an experimental biological research, what is the function of a controlled experiment?
   A) A carefully recorded result
   B) A repeat of an experiment
   C) An experiment that all variables are kept constant
   D) A group that is designed to contrast with an experimental group with a treatment
   E) An experimental group for testing the variation

2. Charles Darwin proposed which one below in evolutionary biology?
   A) Genetic drift
   B) Gene flow
   C) Natural selection
   D) Mutation
   E) Island biogeography

3. Water is the molecule that makes the life on the earth possible. Which on below did NOT describe its property correctly?
   A) The property of cohesion of the water molecules is due to covalent bonds.
   B) Water molecules are the most abundant molecules on the surface of the Earth.
   C) Water is an excellent solvent of life.
   D) Water has high specific heat thus stabilizes the thermo-dynamics in organisms.
   E) Water molecules are constantly moving in a liquid status.

4. Which kind of cells would have most lysosomes comparing to others listed below?
   A) Ovarian cells
   B) Muscle cells
   C) Pancreatic cells
   D) Red blood cells
   E) White blood cells

5. Passive transport across cell membrane does NOT usually include which one below?
   A) Concentration gradient
   B) The process of osmosis
   C) A semi-permeable membrane
   D) An enzyme that pumps the molecules
   E) Water, as the solvent

6. Which one is the genetic material for eukaryotes?
   A) Ribonucleic acid
   B) Deoxyribonucleic acid
   C) Phospholipids
   D) Carbon dioxides
   E) Cellulose

7. In a cellular respiration, which step produces most ATP? And how many of ATP could be produced in that step?
   A) Oxidative phosphorylation – 32 ATP
   B) Oxidative phosphorylation – 12 ATP
   C) Citric Acid cycle – 12 ATP
   D) Glycolysis – 12 ATP
   E) Glycolysis – 2 ATP

8. Which one below is the INCORRECT statement about fermentation and cellular respiration?
   A) Fermentation is the process of producing ATP without oxygen.
   B) The process of fermentation produces 2 ATP.
   C) The process of cell respiration produces 2 ATP in the step of glycolysis.
   D) The process of cell respiration uses oxygen in the step of oxidative phosphorylation.
   E) The process of alcohol fermentation requires an aerobic environment.

9. Which of the products below are produced in light reactions of photosynthesis, then consumed by Calvin cycle?
   A) ADP and $NADP^+$
   B) CO_2 and O_2
   C) ATP and $NADP^+$
   D) ATP and O_2
   E) ATP and NADPH

10. Why farmers in Taiwan can plant sugarcanes on a dry land (given their type of photosynthesis)?
   A) Because sugarcanes close their stomata on their leaves during the night.
   B) Because the first product of the carbon fixation process of sugarcanes is the carbon compound 3-PGA.
   C) Because sugarcanes are C_4 plants.
   D) Because sugarcanes are CAM plants.
   E) Because sugarcanes maximize photorespiration when in dry condition.

11. When does the DNA replication happen in a cell cycle of a human somatic cell?
   A) First gap of the interphase
   B) S phase of the interphase
   C) Second gap of the interphase
   D) Mitosis
   E) Cytokinesis

12. Which one best define malignant tumors?
   A) The tumors that are abnormally growing within normal tissue.
   B) Malignant tumors only stay in the original site.
   C) Malignant tumors could spread into neighboring tissues and replace normal tissues.
   D) Malignant tumors are usually at the status of metastasis.
   E) Malignant tumors are equivalent to benign tumors.

13. What stage of a cell during meiosis has become haploid?
   A) Anaphase I
   B) Metaphase I
   C) Prophase I
   D) Telophase I
   E) Prophase II

14. For human gametes, how many different possible combinations of chromosomes could be in theses gametes given the diploid number?
    A) 8,388,608
    B) 65,536
    C) 2,048
    D) 1,024
    E) 256

15. Two fruit flies with wild type red eyes crossed and produced offspring as 55 red-eyed males, 53 yellow-eyed males, and 108 red-eyed females. The allele for yellow eyes is
    A) autosomal and dominant
    B) sex-linked and recessive
    C) sex-linked and dominant
    D) autosomal and co-dominant
    E) autosomal and recessive

16. One of the parents carries blood type A and the other carries blood type B. What blood type of children can they possibly have?
    A) A and B
    B) A and AB
    C) B and AB
    D) A, B, AB and O
    E) A, B and O

17. Who has discovered that DNA, instead of protein, is the genetic material using the system of bacteriophages?
    A) Rosalind Franklin
    B) Martha Chase
    C) Time Watson
    D) Russel Wallace
    E) Jason Smith

18. About DNA replication, which one is true?
    A) It is anti-conservation model
    B) It is semi-conservation model
    C) It is complete-conservation model
    D) It is dispersive model
    E) It is a semi-mosaic model

19. 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) Ligase
    B) Polymerase III
    C) Helicase
    D) Topoisomerase
    E) Primase

20. What is NOT a good description or a role of microRNA in controlling gene expression?
    A) microRNA usually form a complex with proteins.
    B) The microRNA-protein complex could bind to a complementary site of mRNA.
    C) The microRNA-protein complex could promote gene expression.
    D) The complex could degrade the mRNA.

E) The complex could block the translation.

21. What description below about human genome is INCORRECT?
A) The size of a human genome is about 10 billion base pairs.
B) The proportion of exons in a human genome is about 1.5 %.
C) There are about 21,000 genes in a human genome.
D) The first human genome project was completed in the early 2000's.
E) About 40 % of the human genome are related to transposable elements.

22. About Okazaki fragments, which one is NOT true?
A) They are in lagging strand.
B) DNA ligase joints them together when the synthesis is finished.
C) They are multiple fragments that are synthesizing from 5' to 3'.
D) They are only elongated by DNA polymerase I.
E) DNA polymerase III plays a role in forming these fragments.

23. In evolutionary biology, what is the meaning of homologies?
A) The characters that convergently evolved into the same function.
B) The characters that only observed in one species in a species complex.
C) The characters that play a functional role in adaptation.
D) The characters that were derived from common ancestor.
E) The characters that caused radiation of the descendent species.

24. There are 320 individuals in genotype *WW*, 160 individuals in genotype *Ww*, and 20 individuals in genotype *ww* in a Hardy-Weinberg equilibrium population. What would be the expected allele frequence of *W* and *w* in the 100^{th} generation after this current generation?
A) W =0.8 and w=0.2
B) W =0.9 and w=0.1
C) W =0.7 and w=0.3
D) W =0.6 and w=0.4
E) W =0.5 and w=0.5

25. What would be the mechanism that would NOT drive the genetic differentiation and diversification of populations?
A) Genetic drift
B) Sexual selection
C) Natural selection
D) Mutation
E) Gene flow

26. Two islands separated due to an earthquake. The population of a lizard species was divided into two populations on these two islands and eventually speciated. What kind of speciation is this?
A) Parapatric speciation
B) Sympatric speciation
C) Allopatric speciation
D) Peripatric speciation
E) Phyletic speciation

27. Which of the following would not constitute reproductive isolation between individuals in the same species?
A) Habitat specialization
B) Temporal mismatch of reproductive times

C) Coexisting on one geographic area
D) Displacements of courtship rituals among individuals
E) Geographic barrier between populations

28. Which of the following descriptions is NOT true for adaptive radiation?
A) It usually involves key innovation of character.
B) It usually requires filling of lineages to different ecological roles.
C) It can be observed in regional geographic area.
D) It does not require change of speciation rates.
E) It could happen in a sympatric condition.

29. Systematics is _____.
A) the evolutionary relationships between organisms
B) the science of “reconstructing” the evolutionary history and relationships among organisms
C) A sub-discipline of phylogenetics
D) the same as cladistics
E) the science using mostly genomic data to distinguish species

30. In the evolution of plants and fungal diversity, which one below is NOT true?
A) Green algae are the sister group of land plants.
B) Amoebozoans is the unicellular group that is sister to the big group included fungi and animals.
C) Land plants can be divided into vascular plants and nonvascular plants.
D) Seed plants include gymnosperms and angiosperms.
E) Fungi are more closely related to land plants than animals.

31. Which of the following group of arthropods is the most closely related group to insects?
A) Spiders
B) Crustaceans
C) Horseshoe crabs
D) Myriapods
E) Trilobites

32. Which one below is NOT correct for the taxonomic unit Vertebrates?
A) Echinodermata is the sister group of Vertebrates.
B) All vertebrates evolved from a common ancestor.
C) Vertebrates all have a backbone.
D) Tetrapods are the Vertebrates that could live on dry lands.
E) Amniotes include Reptiles and Mammals.

33. Insects are the most successful group of animals. In insects, the life history of which group does not go through complete metamorphosis?
A) Beetles
B) Butterflies
C) Mosquitos
D) Fruit flies
E) Grasshoppers

34. Animals could modify their behaviors through learning. Which one below is NOT a good description about learning in animals?
A) Spatial learning increases the fitness of animals by storing useful landscape and environmental information in memory.
B) Associative learning is experience based, which does not require any prior information.

C) Imprinting is an innate behavior of offspring to remember their parents, which is build-in genetically and not a type learning.
D) Offspring observe parents and learn the ways to solve problems. This is a type of social learning.
E) Learning skill could be genetic or acquired.

35. What is NOT a negative consequence of invasive predatory species to an ecosystem?
A) Drive local population to extirpation.
B) Change the role of a local species in a food web.
C) Decrease local species richness.
D) Increase the local species diversity.
E) Cause local species extinction.

36. When doing a life table of a human population to describe the demographic changes, which variable is often used to measure the changes between classes through time?
A) Age classes
B) Gender classes
C) Race classes
D) Morphological classes
E) Body weight classes

37. Which one below is NOT a major threat to biodiversity?
A) Habitat loss
B) Invasive species
C) Overharvesting
D) Pollution
E) Annual climate fluctuation

38. Which of the interactions below is NOT a mutualism?
A) Bees and the plants that they pollinate
B) Cows and their grass land
C) Chloroplast and plant cells
D) Mitochondria and animal cells
E) Cooperation of hunting gang of wolves

39. In epithelial tissues (the lining tissues), which one is unlikely a correct match of a tissue and where it may locate?
A) Simple squamous epithelium – air sacs of lungs
B) Simple cuboidal epithelium – tubes in kidney
C) Stratified squamous epithelium – sweat gland
D) Simple columnar epithelium – intestines
E) Stratified squamous epithelium – vagina

40. Which enzyme below CANNOT digest the molecules listed next to it?
A) Pancreatic amylase – Polysaccharides
B) Trypsin – Polypeptides
C) Nucleases – DNA
D) Lipase – Fat globules
E) Maltase – Maltose

41. When under holding your breath, which cue from your body that your brain would pick up to change your breathing rate?
A) Heart beating rate

B) pH value in blood that changed by CO_2 concentration
C) Raising level of O_2
D) Partial pressure of CO_2 in your lung
E) Partial pressure of O_2 in your lung

42. How does hemoglobin stabilize the pH value in human blood?
A) It carries CO_2 to the lung.
B) It carries O_2 to the blood.
C) It binds H^+ in blood when pH values lowered.
D) It binds carbonate ions in blood.
E) It releases H^+ to blood when pH values changed.

43. Myocardial infarction is the results of____.
A) the rupture of arteries in lungs
B) the blockage of arteries in brain
C) the damage of limb arteries
D) the high level of C-reactive protein responding to inflammation
E) the damage of coronary arteries

44. For the process of the activation of a helper T cell, pick a WRONG step below.
A) the antigen independently binds to the binding site of the helper T cell
B) a macrophage encounters the antigen
C) the self protein binds to the antigen
D) the antigen-self protein complex migrates to the surface of macrophage
E) the antigen-self protein complex binds to the T cell receptor

45. Antihistamines allow short term relief of allergy based on which reason below?
A) They form a complex of the effector B cells.
B) They stop the formation of B cells.
C) They deactivate the allergens.
D) They interfere the histamine's action.
E) They attach to the mast cells.

46. In osmoregulation of freshwater fish and marine fish, which statement is correct?
A) Only freshwater fish gain salt ions from food.
B) Only freshwater fish excrete ions from gills.
C) Only marine fish uptake ions from gills.
D) Only marine fish excrete ions from kidney.
E) Only freshwater fish uptake ions from gills.

47. Which description of the reabsorption and secretion in human kidney below is INCORRECT?
A) The initial filtrate in Bowman's capsule include H_2O, H^+, HCO_3^-, urea and nutrients.
B) In the proximal tubule, nutrients, salt, HCO3-, and H2O are reabsorbed. No secretion.
C) In the loop of Henle, salt and H2O are reabsorbed. No secretion.
D) In the distal tubule, salt, HCO3-, and H2O are reabsorbed. Secretion takes place.
E) In the collecting duct, salt, urea and H_2O are reabsorbed. No secretion.

48. Pancreatic hormones regulate blood glucose level. In the statements below, which one is correct?
A) Alpha cells in pancreas release insulin into the blood.
B) Insulin stimulates only liver cells to take up glucose.
C) When the level of blood glucose drops, it diminished the alpha cells.
D) If the regulation of insulin is disordered and thus blood glucose is elevated, this is called

hyperglycemia.

E) Type I diabetes is caused by the defective insulin signaling.

49. A woman has experienced several miscarriages due to the low level of a hormone that causes the breakdown of the uterus lining (similar to menstruation). Which hormone could be the insufficient one?

A) LH (luteinizing hormone)
B) FSH (follicle-stimulating hormone)
C) Oxytocin
D) Prolactin
E) Insulin

50. In a skeletal muscle contraction, which is would be shortened during contraction?

A) Z-line
B) Thick filaments
C) Sarcomere
D) Thin filaments
E) Dark band