科目：普通生物【海資系二年級】

選擇題 (每題2分，不倒扣) 共100分 (單選)

1) About 25 of the 92 natural elements are known to be essential to life. Which four of these 25 elements make up approximately 96% of living matter?
A) carbon, hydrogen, nitrogen, oxygen
B) carbon, sodium, chlorine, nitrogen
C) oxygen, hydrogen, calcium, sodium
D) carbon, oxygen, sulfur, calcium
E) carbon, sulfur, phosphorus, hydrogen

2) One liter of a solution of pH 2 has how many more hydrogen ions (H^+) than 1 L of a solution of pH 6?
A) 100,000 times more
B) 400 times more
C) 10,000 times more
D) 4 times more
E) 4,000 times more

3) What is the reason why hydrocarbons are not soluble in water?
A) They exhibit considerable molecular complexity and diversity.
B) They are lighter than water.
C) The majority of their bonds are nonpolar covalent carbon-to-hydrogen linkages.
D) The majority of their bonds are polar covalent carbon to hydrogen linkages.
E) They are hydrophilic.

4) Which of the following are polysaccharides?
A) starch
B) chitin
C) glycogen
D) A and B only
E) A, B, and C

5) Triacylglycerol is a
A) molecule formed from three alcohols by dehydration reactions.
B) protein with tertiary structure.
C) carbohydrate with three sugars joined together by glycosidic linkages.
D) lipid made with three fatty acids and glycerol.
E) lipid that makes up much of the plasma membrane.

6) What limits the resolving power of a light microscope?
A) the shortest wavelength of light used to illuminate the specimen
B) the type of heavy metal or dye that is used to stain the specimen
C) the type of lens used to magnify the object under study
D) the ratio of an object's image to its real size
E) the type of lens that focuses a beam of electrons through the specimen

科目：普通生物【海資系二年級】

7) According to the fluid mosaic model of cell membranes, which of the following is a *true* statement about membrane phospholipids?
   A) They can move laterally along the plane of the membrane.
   B) They have hydrophilic tails in the interior of the membrane.
   C) They occur in an uninterrupted bilayer, with membrane proteins restricted to the surface of the membrane.
   D) They are free to depart from the membrane and dissolve in the surrounding solution.
   E) They frequently flip-flop from one side of the membrane to the other.

8) Which of the following is a characteristic feature of a carrier protein in a plasma membrane?
   A) It exhibits a specificity for a particular type of molecule.
   B) It requires the expenditure of cellular energy to function.
   C) It works against diffusion.
   D) It is a peripheral membrane protein.
   E) It has few, if any, hydrophobic amino acids.

9) Water passes quickly through cell membranes because
   A) water movement is tied to ATP hydrolysis.
   B) it moves through hydrophobic channels.
   C) it is a small, polar, charged molecule.
   D) the bilayer is hydrophilic.
   E) it moves through aquaporins in the membrane.

10) Increasing the substrate concentration in an enzymatic reaction could overcome which of the following?
   A) saturation of the enzyme activity
   B) insufficient cofactors
   C) denaturization of the enzyme
   D) competitive inhibition
   E) allosteric inhibition

11) An enzyme catalyzes a reaction by
   A) lowering the ΔG of a reaction.
   B) increasing the amount of free energy of a reaction.
   C) lowering the energy of activation of a reaction.
   D) supplying the energy to speed up a reaction.
   E) changing the equilibrium of a spontaneous reaction.

12) The ATP made during glycolysis is generated by
   A) substrate-level phosphorylation.
   B) oxidation of NADH to NAD^+.
   C) chemiosmosis.
   D) electron transport.
   E) photophosphorylation.

13) When hydrogen ions are pumped from the mitochondrial matrix across the inner membrane and into the intermembrane space, the result is the

A) formation of ATP.

B) reduction of NAD^+.

C) creation of a proton gradient.

D) lowering of pH in the mitochondrial matrix.

E) restoration of the Na^+/K^+ balance across the membrane.

14) What is the primary function of the Calvin cycle?

A) use NADPH to release carbon dioxide

B) split water and release oxygen

C) transport RuBP out of the chloroplast

D) synthesize simple sugars from carbon dioxide

E) use ATP to release carbon dioxide

15) Which of the following is *false* regarding the bacterial chromosome?

A) It has genes that control binary fission.

B) DNA replication begins at the origin of replication.

C) It is highly folded within the cell.

D) It consists of a single, circular DNA molecule.

E) Its centromeres uncouple during metaphase of mitosis.

16) What is the name of enzymes that control the activities of other proteins by phosphorylating them?

A) chromatin

B) ATPases

C) protein kinases

D) kinases

E) cyclins

17) How do the two members of a pair of homologous chromosomes differ from each other?

A) their staining patterns

B) their length

C) the precise sequence of the DNA within each of the chromosomes

D) the identity and relative position of the genes present on each of the chromosomes

E) the position of the centromere within each of the chromosomes

18) Independent assortment of chromosomes is a result of

A) the relatively small degree of homology shared by the X and Y chromosomes.

B) the random and independent way in which each pair of homologous chromosomes lines up at the metaphase plate during meiosis I.

C) the random nature of the fertilization of ova by sperm.

D) the random distribution of the sister chromatids to the two daughter cells during anaphase II.

E) all of the above

19) Given the parents *AABBCc* × *AabbCc*, assume simple dominance and independent assortment. What proportion of the progeny will be expected to phenotypically resemble the first parent?

A) 1/8　　B) 3/8　　C) 1　　D) 1/4　　E) 3/4

20) Two plants are crossed, resulting in offspring with a 3:1 ratio for a particular trait. This suggests
A) that a blending of traits has occurred.
B) that each offspring has the same alleles.
C) incomplete dominance.
D) that the parents were true-breeding for contrasting traits.
E) that the parents were both heterozygous.

21) What does a frequency of recombination of 50% indicate?
A) The two genes likely are located on different chromosomes.
B) All of the offspring have combinations of traits that match one of the two parents.
C) Abnormal meiosis has occurred.
D) Independent assortment is hindered.
E) The genes are located on sex chromosomes.

22) What is the mechanism for the production of genetic recombinants?
A) crossing over and independent assortment
B) deletions and duplications during meiosis
C) methylation of cytosine
D) nondisjunction
E) X inactivation

23) What are the coding segments of a stretch of eukaryotic DNA called?
A) exons
B) introns
C) codons
D) replicons
E) transposons

24) There are 61 mRNA codons that specify an amino acid, but only 45 tRNAs. This is best explained by the fact that
A) the rules for base pairing between the third base of a codon and tRNA are flexible.
B) some tRNAs have anticodons that recognize two or more different codons.
C) many codons are never used, so the tRNAs that recognize them are dispensable.
D) A and B only
E) A, B, and C

25) What is the most abundant type of RNA?
A) hnRNA
B) mRNA
C) pre-mRNA
D) rRNA
E) tRNA

26) Viruses with single-stranded RNA that acts as a template for DNA synthesis are known as
A) viroids.
B) proviruses.
C) retroviruses.
D) lytic phages.
E) bacteriophages.

27) In a nucleosome, what is the DNA wrapped around?
A) nucleolus protein
B) polymerase molecules
C) histones
D) ribosomes
E) mRNA

28) Approximately what proportion of the DNA in the human genome codes for proteins or functional RNA?
A) 32% B) 83% C) 13% D) 2% E) 46%

29) Two potential devices that eukaryotic cells use to regulate transcription are DNA _____ and histone _____.
A) amplification; acetylation
B) methylation; acetylation
C) amplification; methylation
D) acetylation; methylation
E) methylation; amplification

30) In both eukaryotes and prokaryotes, gene expression is primarily regulated at the level of
A) mRNA splicing.
B) transcription.
C) translation.
D) mRNA stability.
E) protein stability.

31) Yeast artificial chromosomes contain which of the following elements?
A) telomeres
B) origin of replication
C) centromere
D) both A and B
E) A, B, and C

32) What would be the best technique for determining the evolutionary relationships among several closely related species, each of which still contains living members?
A) DNA or RNA analysis
B) comparative embryology
C) examining the fossil record
D) comparative anatomy
E) comparison of homologous structures

33) All of the following are criteria for maintaining Hardy-Weinberg equilibrium involving two alleles *except*
A) the frequency of all genotypes must be equal.
B) gene flow from other populations must be zero.
C) matings must be random.
D) populations must be large.
E) there should be no natural selection.

科目：普通生物【海資系二年級】

34) In a Hardy-Weinberg population with two alleles, *A* and *a*, that are in equilibrium, the frequency of allele *a* is 0.7. What is the percentage of the population that is heterozygous for this allele?

A) 3　B) 42　C) 9　D) 21　E) 30

35) The first genetic material was most likely a(n)

A) DNA oligonucleotide.
B) protein.
C) RNA polymer.
D) DNA polymer.
E) protein enzyme.

36) Which gas was probably *least* abundant in Earth's early atmosphere?

A) CH_4　B) H_2O　C) CO　D) NH_3　E) O_2

37) What are the cells in a sponge that are primarily responsible for trapping food particles from circulating water?

A) pore cells (porocytes)
B) mesohyl cells
C) choanocytes
D) amoebocytes
E) epidermal cells

38) What kind of data should probably have the greatest impact on animal taxonomy in the coming decades?

A) similarities in metabolic pathways
B) fossil evidence
C) nucleotide sequences of homologous genes
D) the number and size of chromosomes within nuclei
E) comparative morphology of living species

39) Corals are most closely related to which group?

A) freshwater hydras
B) barnacles
C) sponges
D) jellies
E) sea anemones

40) An increase in which of the following parameters is most important in the evolution of specialized exchange surfaces such as the linings of the lungs or intestines?

A) body thickness
B) volume of component cells
C) number of cell layers
D) metabolic rate of component cells
E) surface area

41) Animals require certain basic amino acids in their diet. An amino acid that is referred to as nonessential would be best described as one that
A) is not used by the animal in biosynthesis.
B) is not found in many proteins.
C) must be ingested in the diet.
D) can be made by the animal's body from other substances.
E) is less important than an essential amino acid.

42) Which of the following is *not* a function of plasma proteins in humans?
A) oxygen transport
B) transport of water-insoluble lipids
C) maintenance of blood osmotic pressure
D) blood clotting
E) immune responses

43) Which action below is affected by an antihistamine?
A) phatocytosis of antigens
B) blood vessel dilation
C) MHC presentation by macrophages
D) clonal selection by antigens
E) the secondary immune response

44) Each indication below is a clinical characteristic of inflammation *except*
A) redness.
B) decreased temperature.
C) increased blood flow.
D) edema.
E) pain.

45) The clonal selection theory implies that
A) antigens activate specific lymphocytes.
B) only certain cells can produce interferon.
C) the body selects which antigens it will respond to.
D) brothers and sisters have similar immune responses.
E) a B cell has multiple types of antigen receptors.

46) The MHC is important in
A) identifying cancer cells.
B) recognizing parasitic pathogens.
C) identifying bacterial pathogens.
D) distinguishing self from nonself.
E) both A and D

47) CD4 and CD8 are proteins
A) present on the surface of natural killer (NK) cells.
B) that are T-independent antigens.
C) that are on the surface of antigen-presenting cells where they enhance B cell activity.
D) that are present on the surface of T cells where they enhance cellular interaction.
E) secreted by antigen-presenting cells.

科目：普通生物【海資系二年級】

48) Naturally acquired passive immunity would involve the

A) injection of antibodies.

B) injection of vaccine.

C) placental transfer of antibodies.

D) absorption of pathogens through mucous membranes.

E) ingestion of interferon.

49) Which of these ecosystems accounts for the largest amount of Earth's net primary productivity?

A) tropical rain forest

B) salt marsh

C) open ocean

D) savanna

E) tundra

50) In the nitrogen cycle, the bacteria that replenish the atmosphere with N_2 are

A) methanogenic protozoans.

B) denitrifying bacteria.

C) nitrifying bacteria.

D) nitrogen-fixing bacteria.

E) *Rhizobium* bacteria.

科目：普通化學【海資系二年級】

選擇題（均為單選，每題4分，答錯倒扣1分，未作答則不計分亦不倒扣。）

1. Which sample of the following compounds contains both ionic and covalent bonds?
(A) H_2O (B) CH_3Cl (C) C_2H_5OH (D) $NaNO_3$ (E) NH_2OH

2. In which of the following molecules does hydrogen have an oxidation state of -1?
(A) H_2O (B) NH_3 (C) CaH_2 (D) CH_4 (E) H_2

3. If the solubility of BaF_2 is equal to χ, which of the following expressions is equal to the solubility product, K_{sp}, for BaF_2?
(A) χ^2 (B) $2\chi^2$ (C) χ^3 (D) $2\chi^3$ (E) $4\chi^3$

4. The volume of a liquid is to be measured. Which of the following cylindrical flasks would take the most accurate measurement?
(A) A flask with 1 ml gradations and a diameter of 1 cm.
(B) A flask with 1 ml gradations and a diameter of 3 cm.
(C) A flask with 5 ml gradations and a diameter of 1 cm.
(D) A flask with 5 ml gradations and a diameter of 3 cm.
(E) A flask with 10 ml gradations and a diameter of 1 cm.

5. An acid solution of unknown concentration is to be titrated with a standardized hydroxide solution that will be released from a buret. The buret should be rinsed with
(A) hot distilled water.
(B) distilled water at room temperature.
(C) a sample of the unknown acid solution.
(D) a sample of the hydroxide solution.
(E) a neutral salt solution.

6. Which of the groups below is (are) listed in order from lowest to highest melting point?
I. KI, LiF, BeO
II. F_2, Cl_2, Br_2
III. K, Na, Li
(A) I only (B) I and II only (C) I and III only (D) II and III only (E) I, II and III

7. How many liters of distilled water must be added to 1 liter of an aqueous solution of HCl with a pH of 1 in order to create a solution with a pH of 2?
(A) 0.1 L (B) 0.9 L (C) 2 L (D) 9 L (E) 100 L

科目：普通化學【海資系二年級】

8. The concentrations of which of the following species will be increased when HCl is added to a solution of CH_3COOH in water?
   I. H^+
   II. CH_3COO^-
   III. CH_3COOH
   (A) I only (B) I and II only (C) I and III only (D) II and III only (E) I,II, and III

9. Which of the following can function as both a both a Brønsted-Lowry acid and Brønsted-Lowry base?
   (A) HCl (B) H_2SO_4 (C) HSO_3^- (D) SO_4^{2-} (E) H^+

10. Which of the following salts will produce a solution with a pH of greater than 7 when placed in distilled water?
    (A) NaCN (B) KCl(C) $NaNO_3$ (D) NH_4NO_3 (E) KI

11. A 0.1-molar solution of which of the following acids will be the best conductor of electricity?
    (A) CH_3COOH (B) H_2CO_3 (C) H_2S (D) HF (E) HNO_3

12. Which of the following aqueous solutions has the highest boiling point?
    (A) 0.1 *m* NaOH (B) 0.1 *m* HF (C) 0.1 *m* Na_2SO_4 (D) 0.1 *m* CH_3COOK (E) 0.1 *m* NH_4NO_3

13. What is the boiling point of a 2 *m* solution of NaCl in water? (The boiling point elevation constant, k_b, for water is 0.5℃/*m*)
    (A) 100℃ (B) 101℃ (C) 102℃ (D) 103℃ (E) 104℃

14. Which of the following is the most likely electron configuration of a sulfur atom in its ground state?
    (A) $1s^2 2s^2 2p^6$ (B) $1s^2 2s^2 2p^6 3s^2 3p^2$ (C) $1s^2 2s^2 2p^6 3s^2 3p^4$ (D) $1s^2 2s^2 2p^6 3s^2 3p^6$
    (E) $1s^2 2s^2 2p^6 3s^2 3p^5 4s^1$

15. A molecule whose central atom has d^2sp^3 hybridization can have which of the following shapes?
    I. tetrahedral
    II. square pyramidal
    III. square planar
    (A) I only (B) III only (C) I and II only (D) II and III only (E) I, II and III

16. Which of the following could be the quantum numbers (n, l, m_l, m_s) for the valence electron with the greatest energy in a phosphorous atom in ground state?
    (A) 2, 0, 0, 1/2 (B) 2, 0, 1, 1/2 (C) 2, 1, 0, 1/2 (D) 3, 1, 1, 1/2 (E) 3, 2, 1, 1/2

17. Which of the following is true of a substance in equilibrium in the liquid phase?
(A) Its temperature must be less than 100℃
(B) Its temperature must be greater than 0℃
(C) Its temperature must be lower than that of the surrounding atmosphere
(D) Its vapor pressure must be greater than the pressure of the surrounding atmosphere
(E) Its vapor pressure must be lower than the pressure of the surrounding atmosphere.

18. Which of the following processes can occur when the temperature of a substance is increased at constant pressure?
I. Sublimation
II. Melting
III. Boiling
(A) I only (B) II only (C) I and II only (D) II and III only (E) I, II and III

19. A gaseous mixture of oxygen and nitrogen is maintained at a constant temperature. Which of the following MUST be true regarding the two gases?
(A) Their average kinetic energies will be the same.
(B) Their average molecular speeds will be the same.
(C) Their partial pressures will be the same.
(D) Their total masses will be the same.
(E) Their densities will be the same.

20. Which of the following sets of gases would be most difficult to separate if the method of gaseous effusion is used?
(A) O_2 and CO_2 (B) N_2 and C_2H_4 (C) H_2 and CH_4 (D) He and Ne (E) O_2 and He

21. $$POCl_3\ (l) \rightarrow POCl_3\ (g)$$
For the reaction above, $\triangle H$ is 50 kilojoules per mole and $\triangle S$ is 100 joules per mole. What is the boiling point of $POCl_3$? (Assume that $\triangle H$ and $\triangle S$ remain constant with changing temperature.)
(A) 0.5 K (B) 2 K (C) 50 K (D) 200 K (E) 500 K

22. When pure sodium is placed in an atmosphere of chlorine gas, the following spontaneous reaction occurs.
$2Na_{(s)} + Cl_{2(g)} \rightarrow 2NaCl_{(s)}$
Which of the following statements is true about the reaction?
I. $\triangle S > 0$
II. $\triangle H < 0$
III. $\triangle G > 0$
(A) I only (B) II only (C) I and II only (D) II and III only (E) I, II and III

科目：普通化學【海資系二年級】

23. Which of the following is true under any conditions for a reaction that is spontaneous at any temperature?
(A) $\triangle G$, $\triangle S$, and $\triangle H$ are all positive
(B) $\triangle G$, $\triangle S$, and $\triangle H$ are all negative
(C) $\triangle G$ and $\triangle S$ are negative, and $\triangle H$ is positive
(D) $\triangle G$ and $\triangle S$ are positive, and $\triangle H$ is negative
(E) $\triangle G$ and $\triangle H$ are negative, and $\triangle S$ is positive

24. A $^{214}_{84}Po$ nuclide emits two alpha particles and two beta (β^-) particles. The resulting nuclide is (A) $^{210}_{82}Pb$ (B) $^{210}_{83}Bi$ (C) $^{210}_{84}Po$ (D) $^{206}_{82}Pb$ (E) $^{206}_{84}Po$

25. Strontium-90 decays through the emission of beta particles. It has a half-life of 29 years. How long does it take for 80% of a sample of strontium-90 to decay?
(A) 9.3 years (B) 21 years (C) 38 years (D) 67 years (E) 96 years