

科目：普通生物學【生科系二年級】

## 一、Single choice (two points for questions #1~#11; three points for Question #12)

1. What type of mutation in the  $\beta$ -globin gene causing sickle-cell anemia in human?
  - A. silent
  - B. frameshift
  - C. nonsense
  - D. missense
  - E. sense
2. All of the following are chemical mutations EXCEPT
  - A. nitrogen mustard.
  - B. X-rays.
  - C. ethyl methanesulfonate.
  - D. hydroxylamine.
  - E. nitrous acid.
3. The processes of transcription and translation are collectively known as
  - A. RNA processing.
  - B. gene duplication.
  - C. protein synthesis.
  - D. DNA synthesis.
  - E. gene expression.
4. Which of the following are products of nonstructural genes, and are therefore never translated?
  - A. transfer RNA
  - B. ribosomal RNA
  - C. messenger RNA
  - D. transfer RNA and ribosomal RNA
  - E. ribosomal RNA and messenger RNA
5. The most common eukaryotic ribosome carries out its function in the
  - A. Golgi apparatus.
  - B. nucleus.
  - C. cytosol.
  - D. mitochondria.
  - E. chloroplast.
6. Which of the following are points of control for gene expression in eukaryotes?
  - A. RNA processing
  - B. translation
  - C. transcription
  - D. post-translational
  - E. All of the choices are correct.

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7. An mRNA that contains the coding sequence for two or more structural genes is called a

- A. polyintronic mRNA.
- B. polyextronic mRNA.
- C. polycistronic mRNA.
- D. polyexpressive mRNA.
- E. polyrepressor mRNA.

8. \_\_\_\_\_ are the building blocks of DNA.

- A. genes
- B. double helices
- C. amino acids
- D. nucleotides
- E. chromosomes

9. What is the complement DNA strand to 5'-ATTCCGGTGA-3'?

- A. 5'-TAAGCCACT-3'
- B. 3'-CGGATTGTC-5'
- C. 5'-CGGATTGTC-3'
- D. 3'-TAAGCCACT-5'
- E. 3'-ATTCCGGTGA-5'

10. Unlike the leading strand, \_\_\_\_\_ are made in replicating the lagging strand of DNA.

- A. primers
- B. nucleases
- C. Okazaki fragments
- D. pyrophosphates
- E. DNA polymerases

11. The mechanism of DNA replication is

- A. conservative.
- B. intermediate.
- C. semiconservative.
- D. dispersive.
- E. complementary.

12. \_\_\_\_\_ attaches DNA sequences at the ends of eukaryotic chromosomes.

- A. Polymerase
- B. Ligase
- C. Telomerase
- D. Topoisomerase
- E. Primase

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二、Answer the following questions

01. Describe how hormones control the metabolism and energy balance in vertebrates. (8 points)
02. What are the three processes involved in urine production? How they are regulated in maintenance of water and salt homeostasis? (8 points)
03. Describe the structure of a human ear and explain the mechanism of hearing and how the ear distinguishes sounds of different frequencies. (9 points)
04. Please explain the evidence that supports the endosymbiotic origin of photosynthetic eukaryotes. (5 points)
05. Describe the major contribution of Charles Darwin to general biology. (5 points)
06. Explain the term "biological species concept", and describe the pros and cons of this concept in term of defining "a species". (7 points)
07. Explain the term "Hardy-Weinberg Principle" and the use of this principle in population genetics. (8 points)
08. Please list the basic structure of (a) a perfect flower (b) ovule (c) pollen grain (d) embryo sac and (e) dicot and monocot seeds. (10 points)
09. (a) Please explain polar transport of auxin and its possible mechanism (b) please give an example of plant physiological response caused by auxin polar transport. (8 points)
10. Seed dormancy can be affected by plant growth regulators (GA, ABA, and cytokinin), light (red light and far-red light), and phytochromes (Pr and Pfr). Please predict the effects (promotion or inhibition on seed germination) of factors mentioned above on lettuce seed dormancy/germination. (7 points)

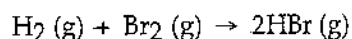
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## 一. 單選題 (每題兩分；共 100 分。答錯不倒扣分數)

1) The  $\Delta E$  of a system that releases 12.4 J of heat and does 4.2 J of work on the surroundings is \_\_\_\_\_ J.

- A) -8.2                      B) 16.6                      C) 4.2                      D) 12.4                      E) -16.6

2) The value of  $\Delta H^\circ$  for the reaction below is -72 kJ. \_\_\_\_\_ kJ of heat are released when 1.0 mol of HBr is formed in this reaction.



- A) 144                      B) -72                      C) 0.44                      D) 36                      E) 72

3) The molar heat capacity of a compound with the formula  $\text{C}_2\text{H}_6\text{SO}$  is 88.0 J/mol-K. The specific heat of this substance is \_\_\_\_\_ J/g-K.

- A) 1.13                      B) 4.89                      C)  $6.88 \times 10^3$                       D) 88.0                      E) -88.0

4) Objects can possess energy as \_\_\_\_\_.

- (a) endothermic energy  
(b) potential energy  
(c) kinetic energy

- A) a only                      B) b only                      C) c only                      D) b and c                      E) a and c

5) Which one of the following is an exothermic process?

- A) boiling soup  
B) water evaporating  
C) ice melting  
D) condensation of water vapor  
E) Ammonium thiocyanate and barium hydroxide are mixed at 25°C: the temperature drops.

6) The number 0.00430 has \_\_\_\_\_ significant figures.

- A) 6                      B) 4                      C) 2                      D) 5                      E) 3

7) The correct answer (reported to the proper number of significant figures) to the following is \_\_\_\_\_.

$$6.3 \times 3.25 = \underline{\hspace{2cm}}$$

- A) 20.48                      B) 20.5                      C) 21                      D) 20.475                      E) 20.

8) The law of constant composition applies to \_\_\_\_\_.

- A) solutions  
B) solids  
C) homogeneous mixtures  
D) heterogeneous mixtures  
E) compounds

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- 9) For which of the following can the composition vary?
- A) pure substance
  - B) element
  - C) homogeneous mixture
  - D) heterogeneous mixture
  - E) both homogeneous and heterogeneous mixtures
- 10) Which one of the following is not an intensive property?
- A) temperature
  - B) melting point
  - C) mass
  - D) boiling point
  - E) density
- 11) The correct name for  $K_2S$  is \_\_\_\_\_.
- A) potassium sulfate
  - B) dipotassium sulfate
  - C) potassium sulfide
  - D) potassium disulfide
  - E) potassium bisulfide
- 12) Calcium forms an ion with a charge of \_\_\_\_\_.
- A) 0
  - B) -2
  - C) +2
  - D) -1
  - E) +1
- 13) Cathode rays are \_\_\_\_\_.
- A) protons
  - B) neutrons
  - C) atoms
  - D) x-rays
  - E) electrons
- 14) Different isotopes of a particular element contain the same number of \_\_\_\_\_.
- A) protons and neutrons
  - B) protons
  - C) subatomic particles
  - D) neutrons
  - E) protons, neutrons, and electrons
- 15) Which one of the following does not occur as diatomic molecules in elemental form?
- A) hydrogen
  - B) oxygen
  - C) bromine
  - D) nitrogen
  - E) sulfur
- 16) When the following equation is balanced, the coefficients are \_\_\_\_\_.
- $$Al(NO_3)_3 + Na_2S \rightarrow Al_2S_3 + NaNO_3$$
- A) 4, 6, 3, 2
  - B) 2, 1, 3, 2
  - C) 2, 3, 2, 3
  - D) 2, 3, 1, 6
  - E) 1, 1, 1, 1

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- 17) The balanced equation for the decomposition of sodium azide is \_\_\_\_\_.
- A)  $\text{NaN}_3 (\text{s}) \rightarrow \text{Na} (\text{s}) + \text{N}_2 (\text{g})$   
B)  $2\text{NaN}_3 (\text{s}) \rightarrow 2\text{Na} (\text{s}) + 2\text{N}_2 (\text{g})$   
C)  $2\text{NaN}_3 (\text{s}) \rightarrow \text{Na}_2 (\text{s}) + 3\text{N}_2 (\text{g})$   
D)  $2\text{NaN}_3 (\text{s}) \rightarrow 2\text{Na} (\text{s}) + 3\text{N}_2 (\text{g})$   
E)  $\text{NaN}_3 (\text{s}) \rightarrow \text{Na} (\text{s}) + \text{N}_2 (\text{g}) + \text{N} (\text{g})$
- 18) What is the empirical formula of a compound that contains 27.0% S, 13.4% O, and 59.6% Cl by mass?
- A)  $\text{SOCl}_2$       B)  $\text{SO}_2\text{Cl}$       C)  $\text{ClSO}_4$       D)  $\text{SOCl}$       E)  $\text{S}_2\text{OCl}$
- 19) The mass % of H in methane ( $\text{CH}_4$ ) is \_\_\_\_\_.
- A) 25.13      B) 4.032      C) 92.26      D) 7.743      E) 74.87
- 20) A strong electrolyte is one that \_\_\_\_\_ completely in solution.
- A) disappears      B) decomposes      C) ionizes      D) reacts
- 21) When  $\text{H}_2\text{SO}_4$  is neutralized by  $\text{NaOH}$  in aqueous solution, the net ionic equation is \_\_\_\_\_.
- A)  $\text{SO}_4^{2-} (\text{aq}) + 2\text{Na}^+ (\text{aq}) \rightarrow \text{Na}_2\text{SO}_4 (\text{s})$   
B)  $\text{SO}_4^{2-} (\text{aq}) + 2\text{Na}^+ (\text{aq}) \rightarrow \text{Na}_2\text{SO}_4 (\text{aq})$   
C)  $\text{H}^+ (\text{aq}) + \text{OH}^- (\text{aq}) \rightarrow \text{H}_2\text{O} (\text{l})$   
D)  $\text{H}_2\text{SO}_4 (\text{aq}) + 2\text{OH}^- (\text{aq}) \rightarrow 2\text{H}_2\text{O} (\text{l}) + \text{SO}_4^{2-} (\text{aq})$   
E)  $2\text{H}^+ (\text{aq}) + 2\text{NaOH} (\text{aq}) \rightarrow 2\text{H}_2\text{O} (\text{l}) + 2\text{Na}^+ (\text{aq})$
- 22) A neutralization reaction between an acid and a metal hydroxide produces \_\_\_\_\_.
- A) water and a salt  
B) ammonia  
C) oxygen gas  
D) sodium hydroxide  
E) hydrogen gas
- 23) How many grams of  $\text{NaOH}$  (MW = 40.0) are there in 500.0 mL of a 0.175 M  $\text{NaOH}$  solution?
- A)  $2.19 \times 10^{-3}$   
B)  $3.50 \times 10^3$   
C) 114  
D) 14.0  
E) 3.50
- 24) Which one of the following is a weak acid?
- A)  $\text{HI}$       B)  $\text{HClO}_4$       C)  $\text{HF}$       D)  $\text{HCl}$       E)  $\text{HNO}_3$

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- 25) Which combination will produce a precipitate?
- A)  $\text{NaCl (aq)}$  and  $\text{HC}_2\text{H}_3\text{O}_2 \text{ (aq)}$
  - B)  $\text{AgNO}_3 \text{ (aq)}$  and  $\text{Ca(C}_2\text{H}_3\text{O}_2)_2 \text{ (aq)}$
  - C)  $\text{NH}_4\text{OH (aq)}$  and  $\text{HCl (aq)}$
  - D)  $\text{NaOH (aq)}$  and  $\text{Fe(NO}_3)_2 \text{ (aq)}$
  - E)  $\text{NaOH (aq)}$  and  $\text{HCl (aq)}$
- 26) Of the following, \_\_\_\_\_ radiation has the shortest wavelength.
- A) radio
  - B) ultraviolet
  - C) microwave
  - D) X-ray
  - E) infrared
- 27) The deBroglie wavelength of a particle is given by \_\_\_\_\_.
- A)  $h/mv$
  - B)  $mv/c$
  - C)  $hmv$
  - D)  $mv$
  - E)  $h + mv$
- 28) There are \_\_\_\_\_ orbitals in the third shell.
- A) 16
  - B) 25
  - C) 9
  - D) 1
  - E) 4
- 29) The \_\_\_\_\_ quantum number defines the shape of an orbital.
- A) azimuthal
  - B) principal
  - C) magnetic
  - D) spin
  - E) psi
- 30) The first ionization energies of the elements \_\_\_\_\_ as you go from left to right across a period of the periodic table, and \_\_\_\_\_ as you go from the bottom to the top of a group in the table.
- A) increase, increase
  - B) increase, decrease
  - C) decrease, increase
  - D) decrease, decrease
  - E) are completely unpredictable
- 31) Oxides of the active metals combine with water to form \_\_\_\_\_.
- A) metal hydrides
  - B) water and a salt
  - C) oxygen gas
  - D) metal hydroxides
  - E) hydrogen gas
- 32) The chloride of which of the following metals should have the greatest lattice energy?
- A) cesium
  - B) potassium
  - C) rubidium
  - D) lithium
  - E) sodium
- 33) Of the ions below, only \_\_\_\_\_ has a noble gas electron configuration.
- A)  $\text{K}^-$
  - B)  $\text{O}^{2+}$
  - C)  $\text{Cl}^-$
  - D)  $\text{S}^{3-}$
  - E)  $\text{I}^+$

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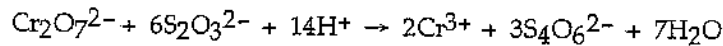
- 34) The Lewis structure of  $N_2H_2$  shows \_\_\_\_\_.
- A) a nitrogen-nitrogen single bond
  - B) each hydrogen has one nonbonding electron pair
  - C) each nitrogen has one nonbinding electron pair
  - D) each nitrogen has two nonbinding electron pairs
  - E) a nitrogen-nitrogen triple bond
- 35) Resonance structures differ by \_\_\_\_\_.
- A) number of electrons only
  - B) placement of atoms only
  - C) number and placement of electrons
  - D) placement of electrons only
  - E) number of atoms only
- 36) The molecular geometry of \_\_\_\_\_ is square planar.
- A)  $XeF_4$                   B)  $ICl_3$                   C)  $PH_3$                   D)  $CCl_4$                   E)  $XeF_2$
- 37) The F-B-F bond angle in the  $BF_2^-$  ion is approximately \_\_\_\_\_.
- A)  $90^\circ$                   B)  $109.5^\circ$                   C)  $60^\circ$                   D)  $180^\circ$                   E)  $120^\circ$
- 38) The hybridization of the carbon atom in carbon dioxide is \_\_\_\_\_.
- A)  $sp^3$                   B)  $sp^3d$                   C)  $sp^2$                   D)  $sp^3d^2$                   E)  $sp$
- 39) During the formation of a coordination compound, ligands act as \_\_\_\_\_.
- A) Arrhenius acids
  - B) Arrhenius bases
  - C) Lewis bases
  - D) Brønsted bases
  - E) Lewis acids
- 40) What is the charge of the central metal ion in  $Ca_3[Fe(CN)_6]_2$  \_\_\_\_\_?
- A)  $1+$                   B)  $0$                   C)  $2+$                   D)  $6+$                   E)  $3+$
- 41) Linkage isomerism can only occur \_\_\_\_\_.
- A) with cobalt complexes
  - B) in cis-isomers of octahedral complexes
  - C) with coordination number 6
  - D) with ligands that have more than one possible donor atom
  - E) with tetrahedral complexes



42) Which of the following cannot form both high- and low-spin octahedral complexes?

- A)  $\text{Co}^{3+}$
- B)  $\text{Mn}^{2+}$
- C)  $\text{V}^{2+}$
- D)  $\text{Cr}^{2+}$
- E) All of the above can form both high- and low-spin complexes.

43) \_\_\_\_\_ is reduced in the following reaction:



- A)  $\text{S}_2\text{O}_3^{2-}$
- B)  $\text{H}^+$
- C)  $\text{S}_4\text{O}_6^{2-}$
- D)  $\text{Cr}_2\text{O}_7^{2-}$
- E)  $\text{Cr}^{3+}$

44) The purpose of the salt bridge in an electrochemical cell is to \_\_\_\_\_.

- A) provide a source of ions to react at the anode and cathode.
- B) provide oxygen to facilitate oxidation at the anode.
- C) provide a means for electrons to travel from the anode to the cathode.
- D) maintain electrical neutrality in the half-cells via migration of ions.
- E) provide a means for electrons to travel from the cathode to the anode.

45) The first law of thermodynamics can be given as \_\_\_\_\_.

- A) for any spontaneous process, the entropy of the universe increases
- B)  $\Delta S = q_{\text{rev}}/T$  at constant temperature
- C) the entropy of a pure crystalline substance at absolute zero is zero
- D)  $\Delta H^\circ_{\text{rxn}} = \sum n\Delta H^\circ_f(\text{products}) - \sum m\Delta H^\circ_f(\text{reactants})$
- E)  $\Delta E = q + w$

46) The entropy of the universe is \_\_\_\_\_.

- A) continually decreasing
- B) continually increasing
- C) the same as the energy,  $E$
- D) zero
- E) constant

47) Which one of the following processes produces a decrease of the entropy of the system?

- A) explosion of nitroglycerine
- B) dissolving sodium chloride in water
- C) dissolving oxygen in water
- D) boiling of alcohol
- E) sublimation of naphthalene

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- 48) A reaction was found to be second order in carbon monoxide concentration. The rate of the reaction \_\_\_\_\_ if the [CO] is doubled, with everything else kept the same.
- A) is reduced by a factor of 2.
  - B) triples
  - C) increases by a factor of 4
  - D) remains unchanged
  - E) doubles
- 49) The half-life of a first-order reaction is 13 min. If the initial concentration of reactant is 0.085 M, it takes \_\_\_\_\_ min for it to decrease to 0.055 M.
- A) 8.2
  - B) 0.048
  - C) 11
  - D) 8.4
  - E) 3.6
- 50) In general, as temperature goes up, reaction rate \_\_\_\_\_.
- A) stays the same if the reaction is first order
  - B) goes up if the reaction is exothermic
  - C) goes up if the reaction is endothermic
  - D) goes up regardless of whether the reaction is exothermic or endothermic
  - E) stays the same regardless of whether the reaction is exothermic or endothermic

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