

# 國立中山大學 104 學年度轉學考招生考試試題

科目名稱：普通化學【生科系二年級】

題號：721002

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## Part I. Multiple Choices (40%)

- Which statements about bonding molecular orbitals are correct?
  - Electrons in bonding orbitals tend to stabilize the molecule.
  - Only  $\sigma$  bonds can result from bonding molecular orbitals.
  - In a bonding molecular orbital, the electron density is high between the two atoms.
  - Bonding molecular orbitals result from *in phase* overlap of the wave functions of the atomic orbitals.
  - The relative numbers of electrons in bonding versus antibonding orbitals determine the overall stability of the molecule.
- The first ionization energy of sulfur (1005 kJ/mol) is less than that of phosphorus (1060 kJ/mol). Reasonable explanations for this fact involve:
  - the stability of the half-filled subshell in atomic sulfur.
  - pairing of two electrons in one  $3p$  orbital in sulfur atoms.
  - the smaller size of sulfur atoms relative to phosphorus atoms.
  - the electron-electron repulsion cause the fourth  $3p$  electron in sulfur to be easily removed.
  - the larger effective nuclear charge  $Z_{\text{eff}}$  of sulfur atoms
- Consider  $\text{CH}_4$  and  $\text{CF}_4$ . Electronegativities: C = 2.5, H = 2.1, F = 4.0. Which statement is true?
  - Both are  $sp^3$  hybridized at carbon.
  - The bond angles in  $\text{CF}_4$  are smaller than those in  $\text{CH}_4$ .
  - The C-F bonds are more polar than the C-H bonds.
  - Both molecules are nonpolar.
  - The bond dipoles in  $\text{CF}_4$  are directed toward the fluorine, but those in  $\text{CH}_4$  are directed toward the carbon atom.
- A catalyst
  - increases the amount of products present at equilibrium.
  - increases the rate at which equilibrium is reached but decreases the equilibrium constant.
  - increases the rate at which equilibrium is reached without changing the equilibrium constant.
  - increases  $\Delta H$  for the process.
  - lowers the activation energy by changing the reaction pathways.
- The gas phase reaction  $\text{A} + \text{B} \rightarrow \text{C}$  has a reaction rate which is experimentally observed to follow the relationship  $\text{rate} = k[\text{A}]^2[\text{B}]$ . Which one of the following would affect the value of the specific rate constant,  $k$ ?
  - increasing the temperature
  - changing the concentration of A
  - changing the concentration of B
  - adding a catalyst
  - all of the above
- For real gas, it follows  $(P + \frac{n^2 a}{V^2})(V - nb) = nRT$ . Which one of the statements is true?
  - A real gas behaves more nearly as an ideal gas at high temperatures and low pressures.
  - In the van der Waals equation, the "a" factor corrects for attractive forces, and one would expect a larger value of "a" for HF than for He.
  - The "b" factor in the van der Waals equation should be larger for He than for  $\text{Cl}_2$ .
  - Gases approach their liquefaction points as temperature decreases and as pressure increases.
  - Both "a" and "b" of the van der Waals equation have values of zero for an ideal gas.

背面有題

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7. About the surface tension, which statements are true?
- The intermolecular interactions among the liquid molecules are responsible for the phenomenon of surface tension.
  - The molecules at the surface do not have other molecules on all sides of them and therefore are pulled inwards, which creates internal pressure and forces liquid surfaces to contract to the minimal area.
  - Surface tension can also be thought of as the amount of energy required to increase the surface area of a liquid.
  - Surface tension is not related to the capillary action.
  - From the energy point of view, molecules in the surface area are in the lower energy state than molecules in the interior of a liquid.
8. About proteins, which statements are true?
- The primary structure is the order of the amino acids, which is crucial to the protein's biological function.
  - Factors that might affect the tertiary structure of a protein include hydrogen bonds, electrostatic interactions, and hydrophobicity.
  - $\alpha$ -helix and  $\beta$ -sheet are common secondary structures of proteins.
  - Heat and pH change can lead to denatured proteins.
  - The biological functions of proteins are not affected by their tertiary structure.
9. Consider the following reaction occurring at constant pressure and temperature, for which the value of  $\Delta E$  is negative. Which statements are true ?
- $$\text{CH}_4(\text{g}) + 2 \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{l})$$
- Work is done by the surroundings on the system.
  - Work is positive.
  - Heat is released by the system.
  - The volume must increase at constant pressure.
  - The reaction is non-spontaneous..
10. Which of the following statements regarding a 1 M sucrose solution is correct?
- The boiling point is greater than 100 °C.
  - The freezing point is lower than that of a 1 M NaCl solution.
  - The freezing point is less than 0.0 °C.
  - The boiling point is lower than that of a 1 M NaCl solution.
  - The vapor pressure at 100 °C is less than 760 torr.
11. About the color of a coordination compound, which statements are true?
- The color of the complex is the sum of the light absorbed by the complex
  - Besides the types of ligands, the color of a complex also depends on the central metal ion and its oxidation state
  - It is the energy level of the coordination compound that determines at which wavelength the light can be absorbed
  - For complexes with more than one d-electron, there could be several absorption bands
  - Higher oxidation state tends to have larger splitting, therefore altering the color of the complex
12. Which statement regarding the photoelectric effect is correct?
- Electrons can be ejected only if the light is of sufficiently short wavelength.
  - The current increases with increasing intensity of the light.
  - Electrons can be ejected only if the light is of sufficiently high energy.

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- (d) The current does not depend on the color of the light as long as the wavelength is short enough.  
(e) The wavelength limit sufficient for the ejection of electrons is the same for all metals.
13. Which statement regarding a stable **heteronuclear** diatomic molecule is true?  
(a) The bonding molecular orbitals have more of the character of the more electronegative element than of the less electronegative element.  
(b) The antibonding molecular orbitals have more of the character of the more electropositive element than of the more electronegative element.  
(c) All have bond orders greater than zero.  
(d) Their molecular orbital diagrams are more asymmetrical than those of homonuclear diatomic molecules.  
(e) The greater the difference in energy between two overlapping atomic orbitals, the more polar is the bond resulting from the electrons occupying the bonding molecular orbital.
14. There are two ways that  $C_4H_{10}$  can exist. Which of the following statements about these two forms is false?  
(a) The two forms have the same boiling point.  
(b) The two forms are called constitutional isomers.  
(c) The two forms have the same molecular weight.  
(d) All carbons in both of the two forms have four bonds.  
(e) The two forms are both alkanes.
15. Which of the following statements about polyprotic acids is correct?  
(a) Polyprotic acids can furnish two or more hydronium ions per molecule.  
(b) It is generally accepted practice to ignore second or third ionizations when calculating the concentration of  $H_3O^+$ .  
(c) The ionizations of polyprotic acids occur simultaneously.  
(d) Successive ionization constants for polyprotic acids generally decrease.  
(e) Phosphoric acid is a typical polyprotic acid
16. Which of the following statements concerning octahedral complexes are correct?  
(a) Strong field ligands produce large crystal field splittings.  
(b) Weak field ligands produce high spin complexes.  
(c) Halide ions are strong field ligands.  
(d) Weak field ligands result in relatively small values for  $\Delta_{Oct}$ .  
(e) A relatively large value for  $\Delta_{Oct}$  causes a complex ion to absorb light with shorter wavelength.
17. Which of the statements regarding energy is correct?  
(a) The total energy content of the universe is constant.  
(b) Energy can be converted from one form to another.  
(c) Energy can be defined as the capacity to do work or to produce heat.  
(d) Energy may be destroyed in chemical reactions.  
(e) Energy is a state function, which is dependent on the pathway.
18. Which of the following statements are correct?  
(a) For an electrolysis cell,  $W_{electrical} < 0$   
(b) For a spontaneous process,  $\Delta G < 0$   
(c) For an adiabatic expansion process,  $q = 0$   
(d) For an isothermal compression process,  $q = -w$   
(e) For an exothermic process,  $\Delta H > 0$

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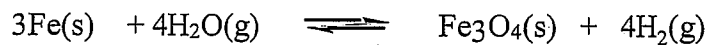
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19. Which of the following statements about the reaction quotient,  $Q$  are true?
- The value of  $Q$  can be used to predict equilibrium concentrations.
  - It has the same expression as the equilibrium constant,  $K_c$ .
  - Its value is calculated using non-equilibrium concentrations.
  - If  $Q > K_c$ , the reaction must move to equilibrium by forming more reactants.
  - For  $Q < K_c$ , the free energy change is negative.
20. Which one of the following parameters increases as the strength of the attractive intermolecular forces increases?
- the heat of vaporization
  - the normal boiling temperature
  - the extent of deviations from the ideal gas law
  - the sublimation temperature of a solid
  - the vapor pressure of a liquid

Part II. Single Choices (40%)

21. Consider the following reaction



which would be the appropriate equilibrium constant expression: (single choice)

- $\frac{[\text{H}_2\text{O}]^4}{[\text{H}_2]^4}$
  - $\frac{[\text{H}_2]^4}{[\text{H}_2\text{O}]^4}$
  - $\frac{[\text{Fe}_3\text{O}_4][\text{H}_2]}{[\text{Fe}][\text{H}_2\text{O}]}$
  - $\frac{[\text{Fe}_3\text{O}_4][\text{H}_2]^4}{[\text{Fe}]^3[\text{H}_2\text{O}]^4}$
  - $\frac{[\text{Fe}]^3[\text{H}_2\text{O}]^4}{[\text{Fe}_3\text{O}_4][\text{H}_2]^4}$
22. Nitrogen (atomic mass = 14.0067 amu) has two naturally occurring isotopes. The masses of  $^{14}\text{N}$  and  $^{15}\text{N}$  are 14.003074 and 15.000108 amu, respectively. What is the percent abundance of  $^{15}\text{N}$ ?
- 15.0001%
  - 14.0031%
  - 99.635%
  - 0.365%
  - 0.0104%
23. What are the number of protons, neutrons, and electrons in the  $^{34}_{16}\text{S}^{2-}$  ion.
- 16 p, 18 n, 16 e
  - 16 p, 18 n, 14e
  - 16 p, 16 n, 19 e
  - 16 p, 18 n, 18 e
  - 34 p, 16 n, 18 e
24. The second law of thermodynamics states:
- The entropy increase for all exothermic processes.
  - The enthalpy of the universe always increases in spontaneous processes.
  - A spontaneous process always increases entropy.
  - $\Delta H < 0$  and  $\Delta S > 0$  for all spontaneous processes
  - The entropy of the universe always increases in spontaneous processes.

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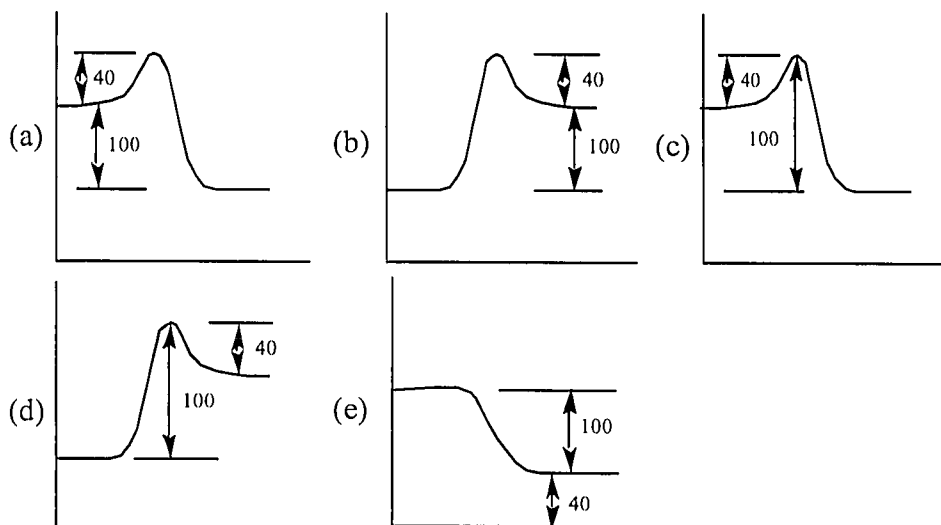
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25. What is the bond order for each of the following species:  $N_2$ ,  $N_2^-$ ,  $N_2^+$  and which one would be predicted to have the shortest bond length?

	$N_2$	$N_2^-$	$N_2^+$	
	bond order			shortest bond length
(a)	3	3.5	2.5	$N_2^+$
(b)	3	2.5	2.5	$N_2$
(c)	3	4	2	$N_2^-$
(d)	2	3	1	$N_2^-$
(e)	3	4	2	$N_2^-$

26. A reaction has an activation energy of 40 kJ and an overall energy change of reaction of  $-100$  kJ. In each of the following potential energy diagrams, the horizontal axis is the reaction coordinate and the vertical axis is potential energy in kJ. Which potential energy diagram best describes this reaction?



27. What volume of  $0.1125 M K_2Cr_2O_7$  would be required to oxidize  $48.16 mL$  of  $0.1006 M Na_2SO_3$  in acidic solution? The products include  $Cr^{3+}$  and  $SO_4^{2-}$  ions.

- (a) 14.36 mL                      (b) 28.75 mL                      (c) 43.12 mL  
 (d) 56.12 mL                      (e) 32.15 mL

28. The dissolution process is exothermic if the amount of energy released in bringing about   a   interactions exceeds the sum of the amounts of energy absorbed in overcoming   b   and   c   interactions.

- |     | a               | b               | c               |
|-----|-----------------|-----------------|-----------------|
| (a) | solute-solute   | solvent-solvent | solvent-solute  |
| (b) | solvent-solvent | solute-solute   | solvent-solute  |
| (c) | solvent-solute  | solute-solute   | crystal lattice |
| (d) | solute-solute   | crystal lattice | solvent-solvent |
| (e) | solvent-solute  | solute-solute   | solvent-solvent |

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29. If the concentration of  $\text{CO}_2$  is 2.90 g of  $\text{CO}_2$  per 1.00 L of soft drink when bottled under 2.0 atm of  $\text{CO}_2$  pressure, what will be the concentration of the  $\text{CO}_2$  in the drink after it has been opened and left to come to equilibrium with the atmosphere which has a  $\text{CO}_2$  partial pressure of  $3.0 \times 10^{-4}$  atm?

- (a)  $2.2 \times 10^{-3}$  g  $\text{CO}_2/\text{L}$       (b)  $2.0 \times 10^{-4}$  g  $\text{CO}_2/\text{L}$       (c)  $1.0 \times 10^{-4}$  g  $\text{CO}_2/\text{L}$   
 (d)  $4.4 \times 10^{-4}$  g  $\text{CO}_2/\text{L}$       (e)  $4.6 \times 10^{-2}$  g  $\text{CO}_2/\text{L}$

30. What is the mass % solute of a 2.00 molal (※ note: not molar)  $\text{H}_2\text{SO}_4$  solution in water?

- (a) 1.1 % (b) 9.8 % (c) 19.6 % (d) 2.0 % (e) 16.4 %

31. Sucrose is a nonvolatile, nonionizing solute in water. Determine the vapor pressure lowering, at  $27^\circ\text{C}$ , of a solution of 75.0 grams of sucrose,  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ , dissolved in 180.0 g of water. The vapor pressure of pure water at  $27^\circ\text{C}$  is 26.7 torr. Assume the solution is ideal.

- (a) 0.585 torr (b) 0.058 torr (c) 0.571 torr (d) 5.62 torr (e) 0.548 torr

32. If the van't Hoff factor for  $\text{NaCl}$  is 1.88, what is the freezing point of a 0.50 molal  $\text{NaCl}$  solution in water?  $K_f = 1.86^\circ\text{C}/m$  for water.

- (a)  $-0.93^\circ\text{C}$  (b)  $1.86^\circ\text{C}$  (c)  $-1.75^\circ\text{C}$  (d)  $1.75^\circ\text{C}$  (e)  $-1.86^\circ\text{C}$

33. The following reaction is partially responsible for acid rain:



Rate data have been determined at a particular temperature for the reaction in which all reactants and products are gases.

Trial Run	Initial $[\text{SO}_3]$	Initial $[\text{H}_2\text{O}]$	Initial Rate ( $M \cdot s^{-1}$ )
1	0.35 M	0.35 M	0.150
2	0.70 M	0.35 M	0.600
3	0.35 M	0.70 M	0.300
4	0.70 M	0.70 M	1.20

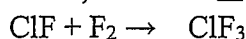
The rate-law expression is \_\_\_\_\_.

- (a) rate =  $k[\text{SO}_3]^2[\text{H}_2\text{O}]^2$  (b) rate =  $k[\text{SO}_3]^2[\text{H}_2\text{O}]$  (c) rate =  $k[\text{SO}_3][\text{H}_2\text{O}]^2$   
 (d) rate =  $k[\text{SO}_3]^2$  (e) rate =  $k[\text{SO}_3][\text{H}_2\text{O}]$

34. At  $25^\circ\text{C}$ , the following heats of reaction are known:

	$\Delta H$ (kJ/mol)
$2\text{ClF} + \text{O}_2 \rightarrow \text{Cl}_2\text{O} + \text{F}_2\text{O}$	167.4
$2\text{ClF}_3 + 2\text{O}_2 \rightarrow \text{Cl}_2\text{O} + 3\text{F}_2\text{O}$	341.4
$2\text{F}_2 + \text{O}_2 \rightarrow 2\text{F}_2\text{O}$	-43.4

At the same temperature, calculate  $\Delta H$  for the reaction:



- (a) -217.5 kJ/mol (b) -130.2 kJ/mol (c) +217.5 kJ/mol (d) -108.7 kJ/mol (e) +108.7 kJ/mol

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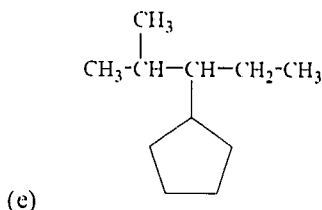
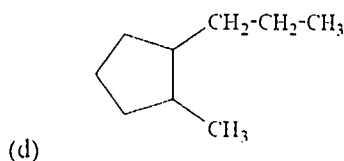
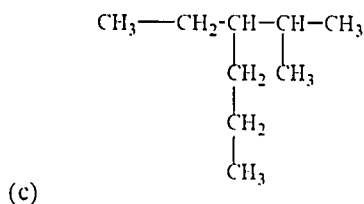
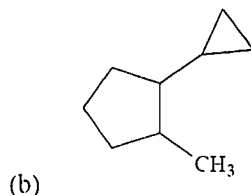
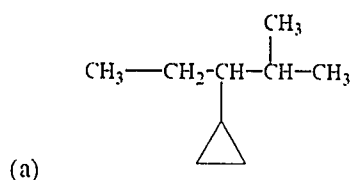
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35. Which of the following is the correct structure for 3-cyclopropyl-2-methylpentane?



36. A sample of ammonia has a mass of 45.5 g. How many hydrogen atoms are in this sample?

- a)  $2.67 \times 10^{22}$    b)  $1.61 \times 10^{24}$    c)  $2.25 \times 10^{23}$    d)  $4.83 \times 10^{24}$    e)  $9.02 \times 10^{-16}$

37. The hybridization of the nitrogen atom in the cation  $\text{NH}_2^+$  is:

- a)  $sp^2$    b)  $sp^3$    c)  $dsp^3$    d)  $sp$    e)  $sp^3 d^2$

38. Calculate the enthalpy of formation of  $\text{LiF}(s)$  given the following:

sublimation energy for $\text{Li}(s)$	+161 kJ/mol
$1/2 \text{F}_2(g) \rightarrow \text{F}(g)$	+77 kJ/mol
first ionization energy of $\text{Li}(g)$	+520 kJ/mol
electron affinity of $\text{F}(g)$	-328 kJ/mol
lattice energy for $\text{LiF}(s)$	-1047 kJ/mol

- a) -177 kJ/mol   b) -617 kJ/mol   c) -804 kJ/mol   d) -1047 kJ/mol   e) -1234 kJ/mol

39. The fact that  $\text{O}_2$  is paramagnetic can be explained by

- a) the Lewis structure of  $\text{O}_2$    b) resonance   c) a violation of the octet rule  
d) the molecular orbital diagram for  $\text{O}_2$    e) hybridization of atomic orbitals in  $\text{O}_2$

40. Iron is biologically important in the transport of oxygen by red blood cells from the lungs to the various organs of the body. In the blood of an adult human, there are approximately  $2.69 \times 10^{13}$  red blood cells with a total of 5.80 g of iron. On the average, how many iron atoms are present in each red blood cell? (molar mass Fe = 55.85 g/mol)

- a)  $8.60 \times 10^{-10}$    b)  $2.32 \times 10^9$    c)  $3.13 \times 10^{22}$    d)  $2.69 \times 10^{13}$    e)  $6.02 \times 10^{-2}$

背面有題

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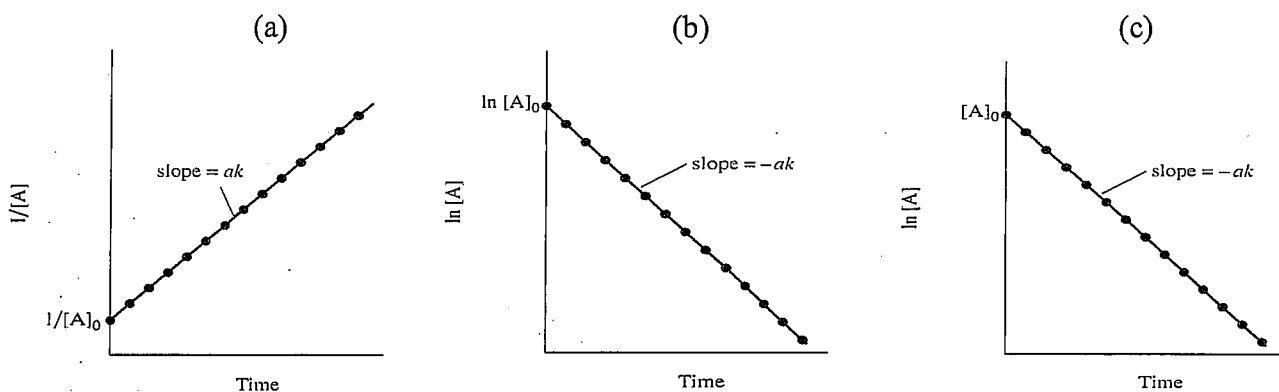
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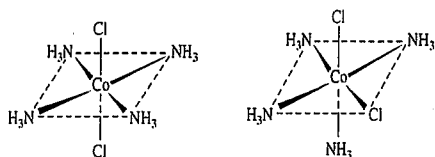
## Part III. Non-choice (20%)

1. (6%) For the following graphs, determine their corresponding reaction order:

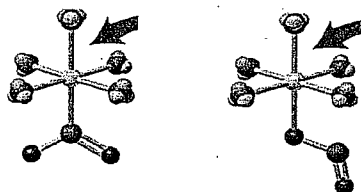


2. (6%) Identify the type of isomers for the following sets of isomer

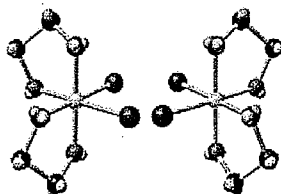
A.



B.



C.



(a) which set belongs to the optical isomer?

(b) which set belongs to the constitutional isomer?

(c) which set belongs to the linkage isomer?



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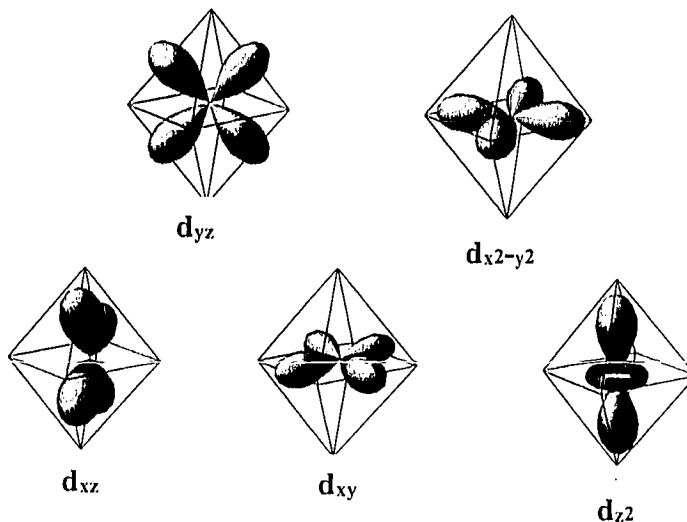
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3. (8%) Crystal field theory treats the ligands as point charges and considers the effect of these point charges on the relative energies of the d orbitals.

Consider the five d orbitals in an octahedral coordination configuration



(a) Which orbitals point their lobes *directly* at the point-charge ligands, and are classified as  $e_g$  orbitals? (2%)

(b) Which orbitals point their lobes *between* at the point-charge ligands, and are classified as  $t_{2g}$  orbitals? (3%)

(c) Which set of orbitals are higher in energy ( $e_g$  or  $t_{2g}$ )? (1%) Please explain why? (2%)

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科目名稱：普通生物學【生科系二年級】

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一、Single choice (two points for each question)

01. In an analysis of the nucleotide composition of DNA, which of the following will be found?

- A.  $A = C$
- B.  $G = T$
- C.  $A = G$  and  $C = T$
- D.  $A + C = G + T$
- E.  $G + C = T + A$

02. To repair a thymine dimer by nucleotide excision repair, in which order do the necessary enzymes act?

- A. Exonuclease, DNA polymerase III, RNA primase
- B. Helicase, DNA polymerase I, DNA ligase
- C. DNA ligase, nuclease, helicase
- D. DNA polymerase I, DNA polymerase III, DNA ligase
- E. Endonuclease, DNA polymerase I, DNA ligase

03. The role of a metabolite that controls a repressible operon is to

- A. bind to the promoter region and decrease its affinity for RNA polymerase
- B. bind to the operator region and block the attachment of RNA polymerase
- C. increase the production of inactive repressor proteins
- D. bind to the repressor protein and inactivate it
- E. bind to the repressor protein and activate it

04. If you were to observe the activity of methylated DNA, you would expect it to

- A. be replicating nearly continuously
- B. be unwinding in preparation for protein synthesis
- C. have turned off or slowed down the process of transcription
- D. be very actively transcribed and translated
- E. induce protein synthesis by not allowing repressors to bind to it

05. Yeast artificial chromosomes contain which of the following elements?

- A. centromere only
- B. telomeres only
- C. origin of replication only
- D. centromeres and telomeres only
- E. centromere, telomeres, and an origin of replication

# 國立中山大學 104 學年度轉學考招生考試試題

科目名稱：普通生物學【生科系二年級】

題號：721001

※本科目依簡章規定「不可以」使用計算機(混合題)

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06. RFLP analysis can be used to distinguish between alleles based on differences in which of the following?
- A. restriction enzyme recognition sites between the alleles
  - B. the amount of DNA amplified from the alleles during PCR
  - C. the ability of the alleles to be replicated in bacterial cells
  - D. the proteins expressed from the alleles
  - E. the ability of nucleic acid probes to hybridize to the alleles
07. Which of the following describes peristalsis in the digestive system?
- A. a process of fat emulsification in the small intestine
  - B. voluntary control of the rectal sphincters regulating defecation
  - C. the transport of nutrients to the liver through the hepatic portal vessel
  - D. a common cause of loss of appetite, fatigue, and dehydration
  - E. smooth muscle contractions that move food through the alimentary canal
08. Most nutrients absorbed into the lymph or bloodstream are in which form?
- A. disaccharides
  - B. polymers
  - C. monomers
  - D. enzymes
  - E. peptides
09. Which of the following hormone actions will occur when more energy is required by a human?
- A. Blood insulin increases
  - B. Blood glucagon increases
  - C. Both insulin and glucagon increase
  - D. Both insulin and glucagon decrease
  - E. Thyroid hormone is increased
10. Which of the following are the only vertebrates in which blood flows directly from respiratory organs to body tissues without first returning to the heart?
- A. amphibians
  - B. birds
  - C. fishes
  - D. mammals
  - E. reptiles

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11. To adjust blood pressure independently in the capillaries of the gas-exchange surface and in the capillaries of the general body circulation, an organism would need a(n)
- A. open circulatory system
  - B. hemocoel
  - C. lymphatic system
  - D. two-chambered heart
  - E. four-chambered heart
12. Only certain cells in the body are target cells for the steroid hormone aldosterone. Which of the following is the best explanation for why these are the only cells that respond to this hormone?
- A. Only target cells are exposed to aldosterone
  - B. Only target cells contain receptors for aldosterone
  - C. Aldosterone is unable to enter nontarget cells
  - D. Nontarget cells destroy aldosterone before it can produce its effect
  - E. Nontarget cells convert aldosterone to a hormone to which they do respond
13. If a person drinks a large amount of water in a short period of time, he or she may die from water toxicity. ADH can help prevent water retention through interaction with target cells in the
- A. anterior pituitary
  - B. posterior pituitary
  - C. adrenal gland
  - D. bladder
  - E. kidney
14. Neurotransmitters are released from axon terminals via
- A. osmosis
  - B. active transport
  - C. diffusion
  - D. transcytosis
  - E. exocytosis
15. If a stimulus is to be perceived by the nervous system, which part of the sensory pathway must occur first?
- A. integration
  - B. transmission
  - C. transduction
  - D. reception
  - E. amplification

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16. What is a muscle spindle?

- A. an actin-myosin complex
- B. a troponin-tropomyosin complex
- C. axons wound around muscle fibers
- D. groups of dendrite-encircled muscle fibers
- E. muscle cells that make up muscle groups

17. What is the primary function of the Calvin cycle?

- A. use ATP to release carbon dioxide
- B. use NADPH to release carbon dioxide
- C. split water and release oxygen
- D. transport RuBP out of the chloroplast
- E. synthesize simple sugars from carbon dioxide

18. The polarity of a plant is established when

- A. the zygote divides
- B. cotyledons form at the shoot end of the embryo
- C. the shoot-root axis is established in the embryo
- D. the primary root breaks through the seed coat
- E. the shoot first breaks through the soil into the light as the seed germinates

19. According to the ABC model of floral development, which genes would be expressed in a flower with multiple sepals and petals but no stamens or carpels?

- A. A genes only
- B. B genes only
- C. C genes only
- D. A and B genes only
- E. A and C genes only

20. Which of the following is derived from the ground tissue system?

- A. root hairs
- B. cuticle
- C. periderm
- D. pith
- E. phloem

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21. Transpiration in plants requires all of the following except
- A. adhesion of water molecules to cellulose
  - B. cohesion between water molecules
  - C. evaporation of water molecules
  - D. active transport through xylem cells
  - E. transport through tracheids
22. The opening of stomata is thought to involve
- A. an increase in the osmotic concentration of the guard cells
  - B. a decrease in the osmotic concentration of the stoma
  - C. active transport of water out of the guard cells
  - D. decreased turgor pressure in guard cells
  - E. movement of  $K^+$  from the guard cells
23. Which of the following is not a function of rhizobacteria?
- A. To produce hormones that stimulate plant growth
  - B. To produce antibiotics that protect roots from disease
  - C. To absorb toxic metals
  - D. To carry out nitrogen fixation
  - E. To supply growing roots with glucose
24. Plants growing in a partially dark environment will grow toward light in a response called phototropism. Choose the incorrect statement regarding phototropism.
- A. It is caused by a chemical signal
  - B. One chemical involved is auxin
  - C. Auxin causes a growth increase on one side of the stem
  - D. Auxin causes a decrease in growth on the side of the stem exposed to light
  - E. Removing the apical meristem prevents phototropism
25. A flash of red light followed by a flash of far-red light given during the middle of the night to a short-day plant will likely
- A. cause increased flower production
  - B. have no effect upon flowering
  - C. inhibit flowering
  - D. stimulate flowering
  - E. convert florigen to the active form

二、非選擇題(一題五分)

26. 請說明內共生假說(endosymbiosis)之所以可能成立的證據為何？  
27. 請問一個外來物種能成功入侵它地的要件為何？

背面有題

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28. 撇開商業運作的手段，請問我們是否需要擔心基改作物會造成基因水平轉移進而危害環境？為什麼？

29. 請問生物具備世代交替可能帶來什麼好處與壞處？

30. 請問瓶頸效應(bottleneck effect)與創始者效應(founder effect)對族群遺傳的效應為何？