

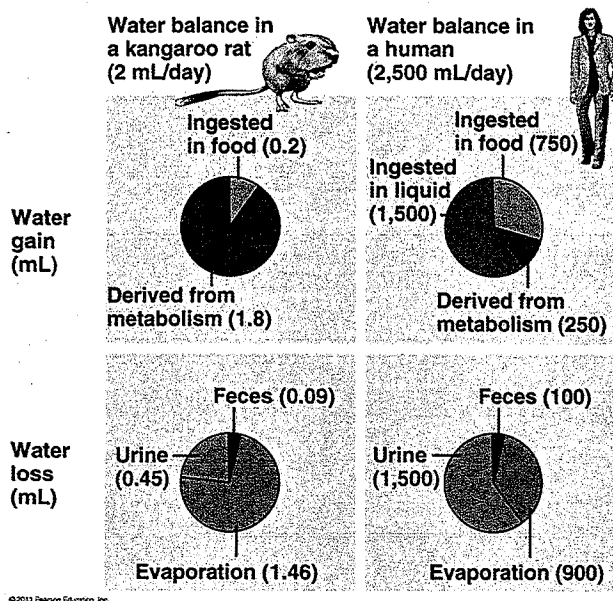
國立中山大學 101 學年度轉學生招生考試試題

科目：普通生物學【生科系學士班二年級】

題號：7016
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一、問答題 (共 68 分)

01. 請描繪一般神經細胞的結構[請標示樹突(dendrite)、細胞本體(cell body)、軸突(axon)與軸丘(axon hillock)]。(6%)
02. 請比較內分泌(endocrine)、旁分泌(paracrine)與自分泌(autocrine)三種細胞訊息傳導的方式 (6%)
03. 下圖為兩種陸生哺乳類水份平衡的比例圖，請根據下圖比較跳鼠(kangaroo rat)與人類獲取水份與流失水份的差異。(6%)



04. 請陳述一個新物種產生的理論過程，以及異域種化(allopatric speciation)在其中所扮演的角色。(10%)
05. 請說明內共生假說之所以被認為可以解釋真核生物胞器起源的證據為何 (10%)
06. 請將文昌魚、盲鰻、八目鰻、軟骨魚、條鰭魚、腔棘魚、肺魚、兩生類、羊膜類之間的親緣關係畫出來，並說明每一個親緣關係樹上的節間上的重要演化事件為何？並請指出硬骨魚這個名詞包含了以上那些類群？(20%)
07. 請就食物網穩定性與生物累積作用的觀點說明，為什麼不應該食用櫻花蝦與黑鮪魚？此外養殖漁業是否就是一項永續的產業？為什麼？(10%)

二、單選題 (每題 2 分; 共 32 分)

01. Which of the events listed below occurs in the light reactions of photosynthesis?
(A) NADP is produced. (B) NADPH is reduced to NADP⁺. (C) Carbon dioxide is incorporated into PGA. (D) ATP is phosphorylated to yield ADP. (E) Light is absorbed and funneled to reaction-center chlorophyll *a*.
02. Land plants are composed of all of the following tissue types *except*
(A) mesodermal (B) epidermal (C) meristematic (D) vascular (E) ground tissue.
03. All of the following cell types are correctly matched with their functions *except*
(A) mesophyll–photosynthesis. (B) guard cell–regulation of transpiration. (C) sieve-tube member–translocation. (D) vessel element–water transport. (E) companion cell–formation of secondary xylem and phloem.
04. Water rises in plants primarily by cohesion-tension. Which of the following is *not* true about the cohesion-tension model?
(A) Water loss (transpiration) is the driving force for water movement. (B) The "tension" of this model represents the excitability of the xylem cells. (C) Cohesion represents the tendency for water molecules to stick together by hydrogen bonds. (D) The physical forces in the capillary-sized xylem cells make it easier to overcome gravity. (E) The water potential of the air is more negative than the xylem.
05. An example of a mutualistic association between a plant and a fungus would be
(A) nitrogen fixation. (B) *Rhizobium* infection. (C) mycorrhizae. (D) parasitic infection. (E) assisted pollination.
06. In the life cycle of an angiosperm, which of the following stages is diploid?
(A) megaspore (B) generative nucleus of a pollen grain (C) polar nuclei of the embryo sac (D) microsporocyte (E) both megaspore and polar nuclei
07. A parent with an S₁S₂ genotype exhibiting sporophytic self-incompatibility can potentially fertilize which of the following plant genotypes of the same species with pollen grains?
(A) S₁S₃ (B) S₂S₃ (C) S₃S₄ (D) S₁S₄ (E) S₂S₄
08. The rapid leaf movements resulting from a response to touch (thigmotropism) primarily involve
(A) rapid growth response. (B) potassium channels. (C) nervous tissue. (D) aquaporins. (E) stress proteins.
09. A plant will recognize a pathogenic invader
(A) if it has many specific plant disease resistance (*R*) genes. (B) when the pathogen has an *R* gene complementary to the plant's antivirulence (*Avr*) gene. (C) only if the pathogen and the plant have the same *R* genes. (D) if it has the specific *R* gene that corresponds to the pathogen molecule encoded by an *Avr* gene. (E) when the pathogen secretes *Avr* protein.

10. In an analysis of the nucleotide composition of DNA, which of the following will be found?
(A) $A = C$ (B) $T = G$ (C) $A = G$ and $C = T$ (D) $A + C = G + T$ (E) $G + C = T + A$
11. 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
12. In the structural organization of many eukaryotic genes, individual exons may be related to which of the following?
(A) the sequence of the intron that immediately precedes each exon (B) the number of polypeptides making up the functional protein (C) the various domains of the polypeptide product (D) the number of restriction enzyme cutting sites (E) the number of start sites for transcription
13. There are 61 mRNA codons that specify an amino acid, but only 45 tRNAs. This is best explained by the fact that
(A) some tRNAs have anticodons that recognize four or more different codons. (B) the rules for base pairing between the third base of a codon and tRNA are flexible. (C) many codons are never used, so the tRNAs that recognize them are dispensable. (D) the DNA codes for all 61 tRNAs but some are then destroyed. (E) competitive exclusion forces some tRNAs to be destroyed by nucleases.
14. The tryptophan operon is a repressible operon that is
(A) permanently turned on. (B) turned on only when tryptophan is present in the growth medium. (C) turned off only when glucose is present in the growth medium. (D) turned on only when glucose is present in the growth medium. (E) turned off whenever tryptophan is added to the growth medium.
15. Which of the following describes the function of an enzyme known as Dicer?
(A) It degrades single-stranded DNA. (B) It degrades single-stranded mRNA. (C) It degrades mRNA with no poly-A tail. (D) It trims small double-stranded RNAs into molecules that can block translation. (E) It chops up single-stranded DNAs from infecting viruses.
16. Two potential devices that eukaryotic cells use to regulate transcription are
(A) DNA methylation and histone amplification. (B) DNA amplification and histone methylation. (C) DNA acetylation and methylation. (D) DNA methylation and histone modification. (E) histone amplification and DNA acetylation.

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Useful information:

Planck's constant = $6.626 \times 10^{-34} \text{ J} \cdot \text{s}$

Speed of light = $2.9979 \times 10^8 \text{ m/s}$

Gas constant, $R = 0.08206 \text{ L} \cdot \text{atm/K} \cdot \text{mol} = 8.3145 \text{ J/K} \cdot \text{mol}$

Atomic weight: $\text{H} = 1; \text{C} = 12; \text{O} = 16$

$\log 2 = 0.301; \log 3 = 0.477; \ln a = 2.303 \log a; e = 2.718$

1 faraday (F) = 96,485 coulombs/mol e^-

一、單選題 (每題 4 分 ; 共 80 分 ; 答錯不倒扣分)

1. A student obtains the number 0.065007700 on a calculator. If this number actually has 4 significant figures, how should it be written?
(A) 0.6500
(B) 0.6501
(C) 0.0650
(D) 0.06500
(E) 0.06501
2. The correct name for CaCl_2 is
(A) Calcium chloride
(B) Calcium dichloride
(C) Calcium(II) chloride
(D) Calcium(II) dichloride
(E) none of the above
3. How many grams of H_2O will be formed when 32.0 g H_2 is mixed with 27.0 g of O_2 and allowed to react to form water?
(A) 59.0 g
(B) 15.2 g
(C) 30.4 g
(D) 7.6 g
(E) 24.5 g
4. A 5.95-g sample of AgNO_3 is reacted with BaCl_2 to give 4.19 g of AgCl . What is the percent yield of AgCl ? (atomic weight of Ag: 107.9; atomic weight of Cl: 35.45)
(A) 59.4%
(B) 83.5%
(C) 100%
(D) 70.4%
(E) 41.7%

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5. Which of the following would have a higher rate of effusion than C_2H_4 ?
- (A) Cl_2
 - (B) O_2
 - (C) I_2
 - (D) CH_4
 - (E) CO_2
6. What is true about the value of q , w , ΔE , and ΔH ?
- (A) The change in internal energy, ΔE , for a process is not equal to the amount of heat absorbed at constant volume, q_v .
 - (B) The change in enthalpy, ΔH , for a process is equal to $q+w$.
 - (C) A bomb calorimeter measures ΔH directly.
 - (D) If q_p for a process is negative, the process is endothermic.
 - (E) The freezing of water is an example of an exothermic reaction.
7. A line in the spectrum of atomic mercury has a wavelength of 258 nm. When mercury emits a photon of light at this wavelength, the frequency of this light is
- (A) $8.61 \times 10^{-16} s^{-1}$
 - (B) $7.70 \times 10^{-19} s^{-1}$
 - (C) $77.3 s^{-1}$
 - (D) $1.16 \times 10^{15} s^{-1}$
 - (E) none of these
8. Which one is most likely to be ionic?
- (A) NO_2
 - (B) BaF_2
 - (C) Cl_4
 - (D) Br_2
 - (E) PH_3
9. How is the Xe atom in XeF_4 hybridized?
- (A) sp
 - (B) sp^2
 - (C) sp^3
 - (D) dsp^3
 - (E) d^2sp^3

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10. Which one is a molecular solid?
- (A) $\text{NO}_2(\text{g})$
 - (B) Diamond
 - (C) $\text{Ar}(\text{s})$
 - (D) $\text{CO}_2(\text{s})$
 - (E) Silver
11. Which one has higher solubility in hexane?
- (A) water
 - (B) CH_3OH
 - (C) $\text{C}_2\text{H}_5\text{OH}$
 - (D) $\text{C}_8\text{H}_{17}\text{OH}$
 - (E) HCl
12. Which one has higher solubility in hexane? For a reaction: $a\text{A} \rightarrow \text{Products}$, $[\text{A}]_0 = 4.4 \text{ M}$, and the first two half-lives are 56 and 28 minutes, respectively. Calculate k (without units).
- (A) 8.1×10^{-3}
 - (B) 3.9×10^{-2}
 - (C) 4.1×10^{-3}
 - (D) 7.9×10^{-2}
 - (E) none of these
13. A sample of solid NH_4NO_3 was placed in an evacuated container and then heated so that it decomposed explosively according to the following equation:
- $$\text{NH}_4\text{NO}_3(\text{s}) \rightleftharpoons \text{N}_2\text{O}(\text{g}) + 2\text{H}_2\text{O}(\text{g})$$
- At equilibrium the total pressure in the container was found to be 2.35 atm at a temperature of $500.^\circ\text{C}$. Calculate K_p .
- (A) 0.481
 - (B) 51.9
 - (C) 0.614
 - (D) 1.23
 - (E) 1.92
14. The pH of 1.0 M solution of methylamine ($K_b = 4.38 \times 10^{-4}$) is:
- (A) 12.32
 - (B) 10.21
 - (C) 8.54
 - (D) 4.38
 - (E) none of the above

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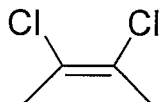
15. A student has a 250.-mL sample of 1.250 M acetic acid (CH_3COOH , $K_a = 1.8 \times 10^{-5}$). Assuming no volume change, how much NaOH must be added to make the best buffer?
- (A) 6.25 g
(B) 12.5 g
(C) 16.3 g
(D) 21.3 g
(E) none of these
16. A 300.0-mL saturated solution of copper(II) periodate, $\text{Cu}(\text{IO}_4)_2$, contains 0.32 grams of dissolved salt. Determine the K_{sp} . (atomic weight of Cu: 63.55; atomic weight of I: 126.9)
- (A) 1.1×10^{-5}
(B) 2.3×10^{-5}
(C) 2.4×10^{-3}
(D) 5.5×10^{-8}
(E) 1.5×10^{-9}
17. Calculate the K_a for the acid HB.
- $$\text{HB}(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{B}^-(aq), \quad \Delta G^\circ = 32.64 \text{ kJ/mol at } 25^\circ\text{C}.$$
- (A) 0.987
(B) -13.2
(C) 1.90×10^{-6}
(D) 3.26×10^{-5}
(E) -157
18. How long must a current of 2.50 A be applied to a solution of Ag^+ to produce 5.25 g silver metal? (atomic weight of Ag: 107.868)
- (A) 12.5 min
(B) 1.25 min
(C) 15.2 min
(D) 31.3 min
(E) none of the above
19. The pH of a 1.0 M $\text{H}_2\text{SO}_4(aq)$ is 0.00. The pH of a 1.00×10^{-2} M $\text{H}_2\text{SO}_4(aq)$ is . (K_{a1} is very large; $K_{a2} = 1.2 \times 10^{-2}$)
- (A) 1.00
(B) 1.20
(C) 1.56
(D) 1.84
(E) 2.00

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20. Name the following:

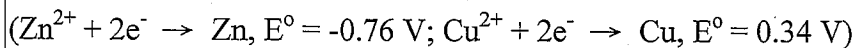
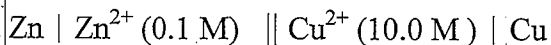


- (A) 2-Chloro-3-chloro-*cis*-2-butene
- (B) 2,3-Dichloro-*cis*-2-butene
- (C) 2,3-Dchloro-*trans*-2-butene
- (D) 1-Cloro-1-methyl-2-chloro-propene
- (E) 1,2-Dichloroethene

二、簡答題 (2 大題; 每題 10 分; 共 20 分)

1. If a student wants to prepare a solution buffered at pH 5.00 using propanoic acid (C_2H_5COOH , $K_a = 1.3 \times 10^{-5}$) and sodium hydroxide, please explain how to prepare it. (10 分)

2. Consider the cell described below:



- (a) Determine the overall cell reaction and cell potential (at 25 °C) (5 分)
- (b) Calculate ΔG° and ΔG for the cell at 25 °C. (5 分)