

國立高雄大學九十五學年度轉學招生考試試題

科目：普通生物學
考試時間：90 分鐘

系所：生命科學系二年級
本科原始成績：滿分 100 分

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一、單選題 (54%，每題1.5分，共36題)

- 1). Humans can digest starch but not cellulose because A) the monomer of starch is glucose, while the monomer of cellulose is galactose. B) humans have enzymes that can hydrolyze the beta (β) glycosidic linkages of starch but not the alpha (α) glycosidic linkages of cellulose. C) humans have enzymes that can hydrolyze the alpha (α) glycosidic linkages of starch but not the beta (β) glycosidic linkages of cellulose. D) humans harbor starch-digesting bacteria in the digestive tract. E) the monomer of starch is glucose, while the monomer of cellulose is maltose.
- 2). All of the following are part of a prokaryotic cell *except* A) DNA. B) a cell wall. C) a plasma membrane. D) ribosomes. E) an endoplasmic reticulum.
- 3). What membrane-surface molecules are thought to be most important as cells recognize each other? A) phospholipids B) integral proteins C) peripheral proteins
D) cholesterol E) glycoproteins.
- 4). Which term most precisely describes the cellular process of breaking down large molecules into smaller ones? A) catalysis B) metabolism C) anabolism
D) dehydration E) catabolism.
- 5). Which of the following statements about NAD^+ is *false*? A) NAD^+ is reduced to NADH during both glycolysis and the citric acid cycle. B) NAD^+ has more chemical energy than NADH. C) NAD^+ is reduced by the action of dehydrogenases. D) NAD^+ can receive electrons for use in oxidative phosphorylation. E) In the absence of NAD^+ , glycolysis cannot function.
- 6). What is the primary function of the light reactions of photosynthesis? A) to produce energy-rich glucose from carbon dioxide and water B) to produce ATP and NADPH C) to produce NADPH used in respiration D) to convert light energy to the chemical energy of PGAL E) to use ATP to make glucose.
- 7). Most signal molecules A) bind to specific sites on receptor proteins in a membrane. B) are water-soluble. C) are able to pass through the plasma membrane by active transport. D) A and B

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only E) A, B, and C.

8). Cytokinesis usually, but not always, follows mitosis. If a cell completed mitosis but not cytokinesis, the result would be a cell with A) a single large nucleus. B) high concentrations of actin and myosin. C) two abnormally small nuclei. D) two nuclei. E) two nuclei but with half the amount of DNA.

9). Which of the following is a *correct* statement about the genomes of prokaryotes?

A) Prokaryotic genomes are diploid throughout most of the cell cycle. B) Prokaryotic chromosomes are sometimes called "genochromes." C) Prokaryotic cells have multiple chromosomes packaged with a relatively large amount of protein.

D) Prokaryotic chromosomes are not contained within a nucleus but, rather, are found at the nucleoid region. E) Prokaryotic genomes are composed of linear DNA (that is, DNA existing in the form of a line with two ends).

10). Which of the following statements concerning protists is *false*? A) All protists are eukaryotic organisms; many are unicellular or colonial. B) The organism that causes malaria is transmitted to humans by the bite of the tsetse fly. C) All apicomplexans are parasitic. D) Cellular slime molds have an amoeboid stage that may be followed by a stage during which spores are produced. E) The euglenozoans that are functionally mixotrophic contain chloroplasts.

11). Plant spores give rise directly to A) sporophytes. B) gametes. C) gametophytes.

D) sporophylls. E) seeds.

12). Plants with a dominant sporophyte are successful on land partly because

A) having no stomata, they lose less water. B) they all disperse by means of seeds.

C) diploid plants experience fewer mutations than do haploid plants. D) their gametophytes are protected by, and obtain nutrition from, the sporophytes. E) eggs and sperm need not be produced.

13). What best accounts for the extremely fast growth of a fungal mycelium?

A) a rapid distribution of synthesized proteins by cytoplasmic streaming B) their lack of motility

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that requires rapid spread of hyphae C) a long tubular body shape D) the readily available nutrients from their predatory mode of nutrition E) a dikaryotic condition that supplies greater amounts of proteins and nutrients.

14). Vascular plant tissue includes all of the following cell types *except* A) vessel elements. B) sieve cells. C) tracheids. D) companion cells. E) cambium cells.

15). Some botanists argue that the entire plant should be considered as a single unit rather than a composite of many individual cells. Which of the following cellular structures *cannot* be used to support this view? A) cell wall B) cell membrane

C) cytosol D) tonoplast E) symplast.

16). Which of the following is *true* in plants? A) Meiosis occurs in gametophytes to produce gametes. B) Meiosis occurs in sporophytes to produce spores. C) The gametophyte is the dominant generation in flowering plants. D) Plants exist continually as either sporophytes or gametophytes. E) Male gametophytes and female gametophytes have the same structure.

17). New combinations of linked genes are due to which of the following?

A) nondisjunction B) crossing over C) independent assortment D) mixing of sperm and egg E) both A and C.

18). Which of the following terms is *least* related to the others? A) pedigree

B) karyotype C) amniocentesis D) chorionic villus sampling E) epistasis.

19). What is the function of topoisomerase? A) relieving strain in the DNA ahead of the replication fork B) elongation of new DNA at a replication fork by addition of nucleotides to the existing chain

C) the addition of methyl groups to bases of DNA

D) unwinding of the double helix E) stabilizing single-stranded DNA at the replication fork.

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

21). The most prominent component of the DNA in eukaryotic genomes is A) operons.

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- B) tandemly repeating DNA. C) gene regulatory sequences. D) transposable elements and related sequences. E) *Alu* elements.
- 22). What is a cloning vector? A) an enzyme that cuts DNA into restriction fragments
B) a DNA probe used to locate a particular gene in the genome C) an agent, such as a plasmid, used to transfer DNA from an *in vitro* solution into a living cell D) the laboratory apparatus used to clone genes E) the sticky end of a DNA fragment.
- 23). The general process that leads to the differentiation of cells is called
A) determination. B) specialization. C) identification. D) differentialization.
E) cellularization.
- 24). Most copies of harmful recessive alleles in a sexual species are carried by individuals that are
A) haploid. B) polymorphic. C) homozygous for the allele.
D) heterozygous for the allele. E) B and C.
- 25). A defining characteristic of allopatric speciation is A) the appearance of new species in the midst of old ones. B) asexually reproducing populations. C) geographic isolation. D) artificial selection. E) large populations.
- 26). Which of the following is *not* found in annelids? A) a hydrostatic skeleton
B) segmentation C) a digestive system with separate mouth and anus D) a closed circulatory system E) a cuticle made of chitin.
- 27). Why is the amniotic egg considered an important evolutionary breakthrough? It
A) has a shell that increases gas exchange. B) allows incubation of eggs in a terrestrial environment.
C) prolongs embryonic development. D) provides insulation to conserve heat. E) permits internal fertilization to be replaced by external fertilization.
- 28). Collagenous fibers are primarily found in what type of animal tissue?
A) connective B) striated muscle C) nerve D) epithelial E) bone.
- 29). Which of the following is *not* a function of plasma proteins in humans?

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- A) maintenance of blood osmotic pressure B) transport of water-insoluble lipids
 C) blood clotting D) immune responses E) oxygen transport.
- 30). What is the functional unit of the kidney? A) cortex B) vasa recta C) nephron
 D) bladder E) glomerulus.
- 31). Where is it likely that you will find the receptor molecules for chemical signals?
 A) in the nucleus of target cells B) in the interstitial fluid surrounding target cells
 B) in the cytoplasm of target cells D) in the cell membrane of target cells
 E) associated with the DNA of target cells.
- 32). In vertebrate animals, spermatogenesis and oogenesis differ, in that A) oogenesis begins at the
 onset of sexual maturity. B) oogenesis produces four haploid cells, whereas spermatogenesis
 produces only one functional spermatozoon. C) oogenesis produces one functional ovum, whereas
 spermatogenesis produces four functional spermatozoa. D) spermatogenesis begins before birth. E)
 spermatogenesis is not complete until fertilization occurs.
- 33). The sodium-potassium pump of neurons pumps A) Na^+ and K^+ into the cell.
 B) Na^+ and K^+ out of the cell. C) Na^+ into the cell and K^+ out of the cell. D) Na^+ out of the cell and
 K^+ into the cell. E) Na^+ and K^+ into the cell and H^+ out of the cell through an antiport.
- 34). Animals tend to maximize their energy intake-to-expenditure ratio. What is this behavior called?
 A) agonistic behavior B) optimal foraging C) dominance hierarchies
 D) animal cognition E) territoriality.
- 35). Evidence shows that some grasses benefit from being grazed. Which of the following terms
 would best describe this plant-herbivore interaction? A) mutualism
 B) commensalism C) parasitism D) competition E) predation.
- 36). The amount of chemical energy in consumers' food that is converted to their own new biomass
 during a given time period is called A) biomass. B) standing crop.
 C) biomagnification. D) primary production. E) secondary production.

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二、解釋名詞（16%，每題4分，共4題）

1. Genomic imprinting
2. Antigen presentation
3. Nociceptors and Thermoreceptors
4. Outgroup and Ingroup

三、問答題（30%，每題10分，共3題）

- 1.請闡述蛋白質的結構與功能。
- 2.請闡述植物細胞有絲分裂的過程。
- 3.請解釋Endosymbiosis和Secondary Endosymbiosis？並舉例說明。

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< I > 單一選擇題(共佔 45 分，每題 3 分，答錯不倒扣，請依題序將答案寫在答案紙上)

1. A 100-mL sample of water is placed in a coffee cup calorimeter. When 1.0 g of an ionic solid is added, the temperature decreases from 21.5°C to 20.8°C as the solid dissolves. For the dissolving of the solid
- a) $\Delta H < 0$ b) $\Delta S_{\text{univ}} > 0$ c) $\Delta S_{\text{sys}} < 0$ d) $\Delta S_{\text{surr}} > 0$
 e) none of these

2. For a particular chemical reaction
 $\Delta H = 5.5 \text{ kJ}$ and $\Delta S = -25 \text{ J/K}$
 Under what temperature condition is the reaction spontaneous?
- a) When $T < -220 \text{ K}$. b) When $T < 220 \text{ K}$. c) When $T > 220 \text{ K}$.
 d) The reaction is not spontaneous at all temperatures.
 e) The reaction is spontaneous at any temperature.

3. 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 2.60×10^{13} red blood cells with a total of 2.90 g of iron. On the average, how many iron atoms are present in each red blood cell? (molar mass (Fe) = 55.85 g)
- a) 8.33×10^{-10} b) 1.2×10^9 c) 3.12×10^{22} d) 2.60×10^{13}
 e) none of these

4. On a relative basis, the weaker the intermolecular forces in a substance,
- a) the greater its heat of vaporization.
 b) the more it deviates from ideal gas behavior.
 c) the greater its vapor pressure at a particular temperature.
 d) the higher its melting point.
 e) none of these

5. A solution consists of a mixture of benzene and toluene and is allowed to come to equilibrium with its vapor. The vapor is then condensed and found to contain 50.0 mole percent of each component. Calculate the composition (mole percent) of the original solution. The vapor pressures of pure benzene and toluene at this temperature are 750. torr and 300. torr, respectively.
- a) 28.6% benzene b) 40.0% benzene c) 50.2% benzene
 d) 71.0% benzene e) none of these

6. the gas-phase decomposition of ethylene chloride.
 $\text{C}_2\text{H}_5\text{Cl} \rightarrow \text{products}$

Experiment shows that the decomposition is first order.

The following data show kinetics information for this reaction:

| Time (s) | $\ln [\text{C}_2\text{H}_5\text{Cl}] \text{ (M)}$ |
|----------|---|
| 1.0 | -1.625 |
| 2.0 | -1.735 |

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What is the rate constant for this decomposition?

- a) 0.29/s b) 0.35/s c) 0.11/s d) 0.02/s e) 0.22/s

7. Which of the following statements is true?

- a) An endothermic reaction shifts toward reactants when heat is added to the reaction.
 b) Catalysts are an effective means of changing the position of an equilibrium.
 c) The concentration of the products equals that of reactants and is constant at equilibrium.
 d) When two opposing processes are proceeding at identical rates, the system is at equilibrium.
 e) None of these statements is true.

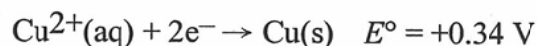
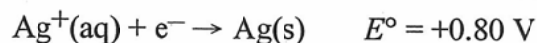
8. The equilibrium constants (K_a) for HCN and HF in H_2O at $25^\circ C$ are 6.2×10^{-10} and 7.2×10^{-4} , respectively. The relative order of base strengths is:

- a) $F^- > H_2O > CN^-$ b) $H_2O > F^- > CN^-$ c) $CN^- > F^- > H_2O$
 d) $F^- > CN^- > H_2O$ e) none of these

9. The heat of vaporization for 1.0 mole of water at $100^\circ C$ and 1.0 atm is 40.6 kJ/mol. Calculate ΔS for the process $H_2O(l) \rightarrow H_2O(g)$ at $100^\circ C$.

- a) 109 J/K mol b) -109 J/K mol c) 406 J/K mol
 d) -406 J/K mol e) none of these

10. A strip of copper is placed in a 1 M solution of copper nitrate and a strip of silver is placed in a 1 M solution of silver nitrate. The two metal strips are connected to a voltmeter by wires and a salt bridge connects the solutions. The following standard reduction potentials apply:



When the voltmeter is removed and the two electrodes are connected by a wire, which of the following does not take place?

- a) Electrons flow in the external circuit from the copper electrode to the silver electrode.
 b) The silver electrode increases in mass as the cell operates.
 c) Some positive copper ions pass through the salt bridge from the copper half-cell to the silver half-cell.
 d) Negative ions pass through the salt bridge from the silver half-cell to the copper half-cell.
 e) none of these

11. Which of the following statements concerning the complex ion $Co(en)_2Cl_2^+$ is true? (en = ethylenediamine, $NH_2CH_2CH_2NH_2$)?

- a) The complex ion contains Co(I).
 b) The complex ion exhibits *cis* and *trans* geometric isomers, but no optical isomers.
 c) The complex ion exhibits two geometric isomers (*cis* and *trans*) and two optical isomers.
 d) Since en is a strong field ligand (large Δ), the complex ion is paramagnetic.
 e) The geometric isomers of the complex ion have identical chemical properties

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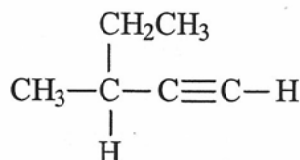
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12. How many isomers are there of "dichloroethene"?

- a) 2 b) 3 c) 4 d) 5 e) 6

13. Name the following:



- a) 1-hexyne b) 2-ethynyl butane c) 2-ethyl-3-butyne
 d) 3-methyl-1-pentyne e) 3-methyl-4-pentyne

14. Which of the following statements is (are) true?

- I. An excited atom can return to its ground state by absorbing electromagnetic radiation.
 II. The energy of an atom is increased when electromagnetic radiation is emitted from it.
 III. The energy of electromagnetic radiation increases as its frequency increases.
 IV. An electron in the $n = 4$ state in the hydrogen atom can go to the $n = 2$ state by emitting electromagnetic radiation at the appropriate frequency.
 V. The frequency and wavelength of electromagnetic radiation are inversely proportional to each other.

- a) II, III, IV b) III, V c) I, II, III d) III, IV, V e) I, II, IV

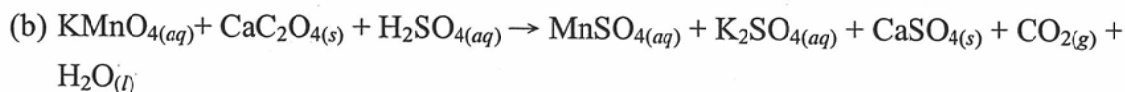
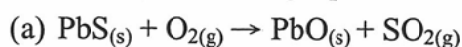
15. The hybridization of the central atom in I_3^- is:

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

< II > 計算題(共佔 55 分)

(10%) 1. Biochemists have discovered more than 400 mutant varieties of hemoglobin, the blood protein that carries oxygen throughout the body. A physician studying a variety associated with a fatal disease first finds its molar mass (M). She dissolves 21.5 mg of the protein in water at 5.0°C to make 1.50 mL of solution and measures an osmotic pressure of 0.00475 atm. What is the molar mass of this variety of hemoglobin? ($R = 0.0821 \text{ atm}\cdot\text{L}/\text{mol}\cdot\text{K}$)

(10%) 2. Balance the following equations:



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- (15%) 3. Ascorbic acid ($\text{H}_2\text{C}_6\text{H}_6\text{O}_6$; H_2Asc for this problem) known as vitamin C, is a diprotic acid ($K_{a1} = 1.0 \times 10^{-5}$ and $K_{a2} = 5 \times 10^{-12}$) found in citrus fruit. Calculate $[\text{H}_2\text{Asc}]$, $[\text{HAsc}^-]$, and $[\text{Asc}^{2-}]$ of 0.050 M H_2Asc .
- (20%) 4. In black-and-white film developing, excess AgBr is removed from the film negative by “hypo”, an aqueous solution of sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3$), which forms the complex ion $\text{Ag}(\text{S}_2\text{O}_3)_2^{3-}$. Calculate the solubility of AgBr in (a) H_2O ; (b) 1.0M hypo. K_f of $\text{Ag}(\text{S}_2\text{O}_3)_2^{3-}$ is 4.7×10^{13} and K_{sp} of AgBr is 5.0×10^{-13} .