

國立高雄大學九十八學年度轉學招生考試試題(轉 2 年級)

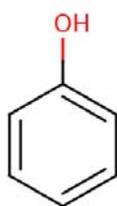
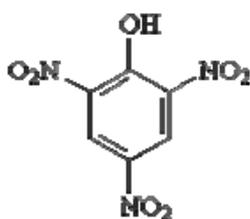
科目：普通化學  
考試時間：80 分鐘

系所：  
生命科學系  
本科原始成績：100 分

是否使用計算機：否

**PART A 簡答題 (40 points)**

1. Design a galvanic cell experiment to measure the solubility product, i.e.,  $K_{sp}$ , for  $PbSO_4$ . Specify the concentrations and electric voltmeter reading in your experiment with parameters and express the obtained  $K_{sp}$  value in terms of these parameters. The standard potential for the reduction half-reaction  $PbSO_4(s) + 2e^- \rightarrow Pb(s) + SO_4^{2-}$  at  $25^\circ C$  is  $-0.36 V$ . **(10 points)**
2. Given in the following are the structures of picric acid (left) and phenol (right). Please compare the acidity and explain your answer in very detail. **(10 points)**



3. Describe the amphiprotic property of water. **(5 points)**
4. Draw the MO diagram of  $Ne_2$  by assuming two Ne atoms approaching along the y-axis. In your diagram specify  $2p_x$ ,  $2p_y$ , and  $2p_z$  orbitals. Predict the stability and the bond order of  $Ne_2$ . **(15 points)**

**PART B 單選題 (60 points)**

1. According to Bronsted and Lowry acid-base theory, what is the definition of a base?  
A) A base is a hydroxide donor in aqueous solution.  
B) A base increases the concentration of hydroxide ion.  
C) A base is a hydrogen ion acceptor in aqueous solution.  
D) A base is an electron pair donor in an aqueous solution.
2. Which of the following is NOT a characteristic of gaseous compounds?  
A) They are either nonpolar or weakly polar molecules.  
B) The atoms are held together by covalent bonds.  
C) They are strong electrolytes.  
D) They have low molecular weights.
3. Given a constant amount of gas and constant pressure, the relationship between temperature and volume is  
A) volume is inversely proportional to the absolute temperature.

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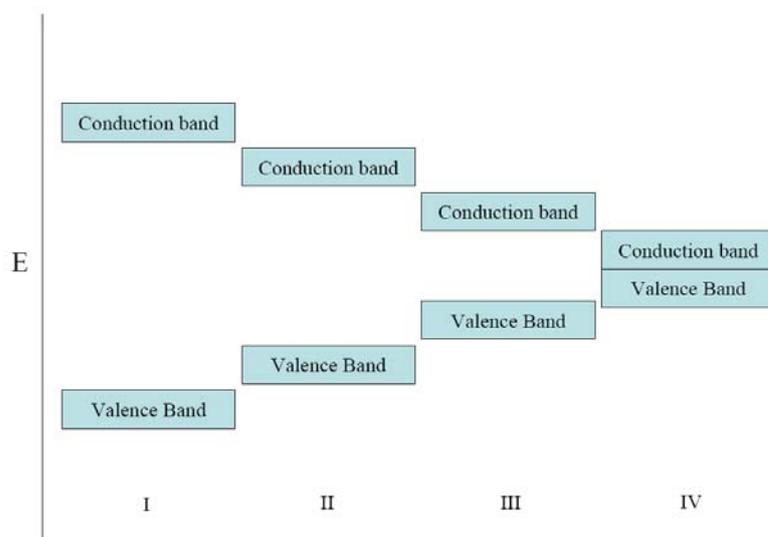
- B) volume is proportional to the temperature in degrees Celsius.  
C) volume is proportional to the absolute temperature.  
D) the product of volume times temperature is a constant.
4. A reaction of A that is thought to be second order with respect to A is studied by measuring concentration as a function of time. How would the rate constant ( $k$ ) for this reaction be determined?
- A) The slope of a graph of  $1/[A]$  versus time is equal to  $k$ .  
B) The slope of a graph of  $\ln[A]$  versus time is equal to  $-k$ .  
C) The slope of a graph of  $\ln[A]$  versus time is equal to  $k$ .  
D) The slope of a graph of  $[A]$  versus time is equal to  $k$ .
5. What is an adhesive force?
- A) The intermolecular interactions between molecules in a liquid  
B) The forces that make droplets of water form on a surface  
C) The attractive forces between the liquid and a substance  
D) The forces that allow insects to walk easily on water
6. What is capillary action?
- A) The ability of liquids to spread across the surface of a liquid or solid  
B) The tendency of liquids to resist flow through a narrow tube  
C) The resistance of liquids to increase their surface area  
D) The tendency of polar liquids to rise in a small-diameter glass tubing
7. The formation constant for the complex  $[\text{Hg}(\text{NH}_3)_4]^{2+}$  is  $1.8 \times 10^{19}$ . What is the concentration of  $\text{Hg}^{2+}$  in a solution prepared by adding 10 ml of 0.010 M  $\text{HgCl}_2$  to 10 ml of 0.100 M aqueous ammonia?
- A)  $5.6 \times 10^{-18}$  M    B)  $9.3 \times 10^{-21}$  M    C)  $4.4 \times 10^{-17}$  M    D)  $3.4 \times 10^{-16}$  M
8. What will occur if 10 ml of 0.500 M sodium acetate solution is added to 90 ml of 0.100 M silver nitrate solution ( $K_{\text{sp}}$  for silver acetate is  $2.0 \times 10^{-3}$ )?
- A) The solution will become acidic.  
B) The solution will remain clear.  
C) A precipitate will form.  
D) Two immiscible liquid layers will form.

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9. Based on the preceding diagram, which band system would correspond to an insulator?

- A) Band I    B) Band II    C) Band III    D) Band IV

10. In contrast to molecular formulas, structural formulas show

- A) the total number of each type of atom.  
B) the arrangement of the atoms in three dimensions.  
C) which atoms are bonded to each other.  
D) how the compound will behave physically.

11. What is the correct formula for the dichromate ion?

- A)  $\text{Cr}^{3+}$     B)  $\text{CrO}_4^{2-}$     C)  $\text{Cr}_2\text{O}_7^{2-}$     D)  $\text{CrO}_4^-$

12. Many ionic compounds occur as hydrates. What is a hydrate?

- A) A compound that contains hydrogen  
B) A compound that contains loosely bound water molecules  
C) A compound that dissolves easily in water  
D) A compound that decomposes in the presence of water

13. In an oxidation reduction reaction, which of the following is NOT true?

- A) There must be an oxidant and a reductant.  
B) The number of electrons lost in the reduction must be gained in the oxidation.  
C) The oxidant gains electrons.  
D) The reactant that is oxidized loses electrons.

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14. When sodium chloride dissolves in water to form an aqueous solution, which of the following is NOT true?
- A) The sodium ions are surrounded by water molecules with the hydrogen atoms directed inward.  
B) Each of the cations and anions are surrounded by their own shell of water molecules.  
C) The sodium ion and chloride ion are separated from each other by many water molecules.  
D) The sodium and chloride ions are each hydrated by water molecules.
15. A solution of lead from a battery plant has a concentration of  $3.65 \times 10^{-7}$  M. What is this concentration in ppb? Assume the solution has a density of 1.000 g/ml. (Pb: 207.2 amu.)  
A) 75.6 ppb    B) 6.57 ppb    C) 365 ppb    D) 1361 ppb
16. In naming an ionic compound, which of the following is NOT true?
- A) If a metal forms more than one cation, the charge is put in parentheses as a Roman numeral.  
B) The name of the cation is given first, followed by the name of the anion.  
C) The number of anions and cations are specified using the prefixes *mono*, *di*, etc.  
D) If a metal forms only one cation, the charge is not specified.
17. Potassium permanganate ( $\text{KMnO}_4$ ) reacts with oxalic acid ( $\text{C}_2\text{H}_2\text{O}_4$ ) according to the reaction  
 $\text{KMnO}_4 + \text{C}_2\text{H}_2\text{O}_4 + \text{H}_2\text{SO}_4 \rightarrow \text{MnSO}_4 + \text{CO}_2 + \text{H}_2\text{O} + \text{K}_2\text{SO}_4$ . (not balanced)  
What volume of 0.250 M  $\text{KMnO}_4$  is required to react with 3.225 g of oxalic acid?  
A) 143 ml    B) 287 ml    C) 35.7 ml    D) 57.3 ml
18. The compound  $\text{NO}_2$  is an exception to the octet rule because  
A) this compound is not an exception to the octet rule.  
B) the compound has an odd number of electrons.  
C) the compound has more than one double bond.  
D) the N atom must be surrounded by more than eight electrons to form two bonds.
19. What is the electron pair geometry for a molecule with five pairs of electrons around the central atom?  
A) tetrahedral    B) trigonal bipyramidal    C) octahedral    D) trigonal pyramidal
20. In an ionic solid, the energy that holds the ions in a three-dimensional array is the  
A) bond energy.    B) ionization energy.    C) lattice energy.    D) interaction energy.

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一、單選題 (每題 2 分，共 80 分)

1. Which of the following is not an observation or inference on which natural selection is based?

- (A) There is heritable variation among individuals.
- (B) Poorly adapted individuals never produce offspring.
- (C) Species produce more offspring than the environment can support.
- (D) Individuals whose characteristics are best suited to the environment generally leave more offspring than those whose characteristics are less suited.
- (E) Only a fraction of the offspring produced by an individual may survive.

2. Within a few weeks of treatment with the drug 3TC, a patient's HIV population consists entirely of 3TC-resistant viruses. How can this result best be explained?

- (A) HIV can change its surface proteins and resist vaccines.
- (B) The patient must have become reinfected with 3TC-resistant viruses.
- (C) HIV began making drug-resistant versions of reverse transcriptase in response to the drug.
- (D) A few drug-resistant viruses were present at the start of treatment, and natural selection increased their frequency.
- (E) The drug caused the HIV RNA to change.

3. Which definition of evolution would have been most foreign to Charles Darwin during his lifetime?

- (A) change in gene frequency in gene pools
- (B) descent with modification
- (C) the gradual change of a population's heritable traits over generations
- (D) populations becoming better adapted to their environments over the course of generations
- (E) the appearance of new varieties and new species with the passage of time

4. Which is a true statement concerning genetic variation?

- (A) It is created by the direct action of natural selection.
- (B) It arises in response to changes in the environment.
- (C) It must be present in a population before natural selection can act upon the population.
- (D) It tends to be reduced by the processes involved when diploid organisms produce gametes.
- (E) A population that has a higher average heterozygosity has less genetic variation than one with a larger average heterozygosity.

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5. The snowball Earth hypothesis provides a possible explanation for the
- A) diversification of animals during the late Proterozoic.
  - B) oxygenation of Earth's seas and atmosphere.
  - C) colonization of land by plants and fungi.
  - D) origin of O<sub>2</sub>-releasing photosynthesis.
  - E) existence of prokaryotes around hydrothermal vents on the ocean floor.
6. What is true of the fossil record of mammalian origins?
- A) It is a good example of punctuated equilibrium.
  - B) It shows that mammals and birds evolved from the same kind of dinosaur.
  - C) It includes transitional forms with progressively specialized teeth.
  - D) It indicates that mammals and dinosaurs did not overlap in geologic time.
  - E) It includes a series that shows the gradual change of scales into fur.
7. The correct sequence, from the most to the least comprehensive, of the taxonomic levels listed here is
- A) family, phylum, class, kingdom, order, species, and genus.
  - B) kingdom, phylum, class, order, family, genus, and species.
  - C) kingdom, phylum, order, class, family, genus, and species.
  - D) phylum, kingdom, order, class, species, family, and genus.
  - E) phylum, family, class, order, kingdom, genus, and species.
8. Penicillin is an antibiotic that inhibits enzymes from catalyzing the synthesis of peptidoglycan, so which prokaryotes should be most vulnerable to inhibition by penicillin?
- A) mycoplasmas
  - B) gram-positive bacteria
  - C) archaea
  - D) gram-negative bacteria
  - E) endospore-bearing bacteria
9. The theory of evolution is most accurately described as
- A) an educated guess about how species originate.
  - B) one possible explanation, among several scientific alternatives, about how species have come into existence.
  - C) an opinion that some scientists hold about how living things change over time.

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D) an overarching explanation, supported by much evidence, for how populations change over time.

E) an idea about how acquired characteristics are passed on to subsequent generations.

10. DNA sequences in many human genes are very similar to the sequences of corresponding genes in chimpanzees. The most likely explanation for this result is that

A) humans and chimpanzees share a relatively recent common ancestor.

B) humans evolved from chimpanzees.

C) chimpanzees evolved from humans.

D) convergent evolution led to the DNA similarities.

E) humans and chimpanzees are not closely related.

11. Males of different species of the fruit fly *Drosophila* that live in the same parts of the Hawaiian islands have different elaborate courtship rituals that involve fighting other males and stylized movements that attract females. What type of reproductive isolation does this represent?

A) habitat isolation

B) temporal isolation

C) behavioral isolation

D) gametic isolation

E) postzygotic barriers

12. Which of the following steps has not yet been accomplished by scientists studying the origin of life?

A) synthesis of small RNA polymers by ribozymes

B) abiotic synthesis of polypeptides

C) formation of molecular aggregates with selectively permeable membranes

D) formation of protobionts that use DNA to direct the polymerization of amino acids

E) abiotic synthesis of organic molecules

13. Photoautotrophs use

A) light as an energy source and  $\text{CO}_2$  as a carbon source.

B) light as an energy source and methane as a carbon source.

C)  $\text{N}_2$  as an energy source and  $\text{CO}_2$  as a carbon source.

D)  $\text{CO}_2$  as both an energy source and a carbon source.

E)  $\text{H}_2\text{S}$  as an energy source and  $\text{CO}_2$  as a carbon source.

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14. On a field trip, a student in a marine biology class collects an organism that has differentiated organs, cell walls of cellulose, and chloroplasts with chlorophyll a. Based on this description, the organism could be a brown alga, a red alga, a green alga, a charophyte recently washed into the ocean from a freshwater or brackish water source, or a land plant washed into the ocean. The presence of which of the following features would definitively identify this organism as a land plant?

- A) alternation of generations
- B) sporopollenin
- C) rosette cellulose-synthesizing complexes
- D) flagellated sperm
- E) embryos

15. Suppose a moss evolved an efficient conducting system that could transport water and other materials as far as a tree is tall. Four of the following five statements about "trees" of such a species are correct. Select the exception.

- A) Fertilization would probably be more difficult.
- B) Spore dispersal distances might increase but probably would not decrease.
- C) Females could only produce one archegonium.
- D) Unless its body parts were strengthened, such a "tree" might flop over.
- E) Individuals could compete more effectively for access to light.

16. When does translation begin in prokaryotic cells?

- A) after a transcription initiation complex has been formed
- B) as soon as transcription has begun
- C) after the 5' caps are converted to mRNA
- D) once the pre-mRNA has been converted to mRNA
- E) as soon as the DNA introns are removed from the template

17. Choose the answer that has these events of protein synthesis in the proper sequence.

1. An aminoacyl-tRNA binds to the A site.
2. A peptide bond forms between the new amino acid and a polypeptide chain.
3. tRNA leaves the P site, and the P site remains vacant.
4. A small ribosomal subunit binds with mRNA.
5. tRNA translocates to the P site.

- A) 1, 3, 2, 4, 5

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- B) 4, 1, 2, 5, 3
- C) 5, 4, 3, 2, 1
- D) 4, 1, 3, 2, 5
- E) 2, 4, 5, 1, 3

18. 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.

19. Which life cycle stage is found in plants but not animals?

- A) Gamete
- B) Zygote
- C) Multicellular diploid
- D) Multicellular haploid
- E) Unicellular diploid

20. 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

21. What would occur if the repressor of an inducible operon were mutated so it could not bind the operator?

- A) irreversible binding of the repressor to the promoter
- B) reduced transcription of the operon's genes
- C) buildup of a substrate for the pathway controlled by the operon
- D) continuous transcription of the operon's genes
- E) overproduction of catabolite activator protein (CAP)

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22. Absence of bicoid mRNA from a *Drosophila* egg leads to the absence of anterior larval body parts and mirror-image duplication of posterior parts. This is evidence that the product of the bicoid gene

- A) is transcribed in the early embryo.
- B) normally leads to formation of tail structures.
- C) normally leads to formation of head structures.
- D) is a protein present in all head structures.
- E) leads to programmed cell death.

23. To cause a human pandemic, the H5N1 avian flu virus would have to

- A) spread to primates such as chimpanzees.
- B) develop into a virus with a different host range.
- C) become capable of human-to-human transmission.
- D) arise independently in chickens in North and South America.
- E) become much more pathogenic.

24. The host range of a virus is determined by

- A) the proteins on its surface and that of the host.
- B) whether its nucleic acid is DNA or RNA.
- C) the proteins in the host's cytoplasm.
- D) the enzymes produced by the virus before it infects the cell.
- E) the enzymes carried by the virus.

25. What is the source of the extra chromosome 21 in an individual with Down syndrome?

- A) Nondisjunction in the mother only
- B) Nondisjunction in the father only
- C) Duplication of the chromosome
- D) Nondisjunction or translocation in either parent
- E) It is impossible to detect with current technology

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

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E) a cuticle made of chitin

27. Which of the following is not a shared characteristic of all chordates?

- A) pharyngeal clefts
- B) post-anal tail
- C) notochord
- D) dorsal, hollow nerve cord
- E) four-chambered heart

28. What joins muscles to bones?

- A) ligaments
- B) tendons
- C) loose connective tissue
- D) Haversian systems
- E) spindle fibers

29. Countercurrent exchange in the fish gill helps to maximize

- A) endocytosis.
- B) blood pressure.
- C) diffusion.
- D) active transport.
- E) osmosis.

30. What are antigens?

- A) proteins found in the blood that cause foreign blood cells to clump
- B) proteins embedded in B cell membranes
- C) proteins that consist of two light and two heavy polypeptide chains
- D) foreign molecules that trigger the generation of antibodies
- E) proteins released during an inflammatory response

31. Which part of the vertebrate nephron consists of capillaries?

- A) glomerulus
- B) loop of Henle
- C) distal tubule
- D) Bowman's capsule

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E) collecting duct.

32. Hormones from the hypothalamus affect the release of all of the following except

- A) prolactin.
- B) oxytocin.
- C) growth hormone.
- D) thyroid-stimulating hormone.
- E) adrenocorticotrophic hormone.

33. Which of the following produce testosterone?

- A) sperm cells
- B) hypothalamus
- C) Leydig cells
- D) anterior pituitary
- E) seminiferous tubules

34. Which developmental sequence is correct?

- A) cleavage, blastula, gastrula, morula
- B) cleavage, gastrula, morula, blastula
- C) cleavage, morula, blastula, gastrula
- D) gastrula, morula, blastula, cleavage
- E) morula, cleavage, gastrula, blastula

35. What is the main neurotransmitter of the parasympathetic system?

- A) acetylcholine
- B) cholinesterase
- C) norepinephrine
- D) adrenaline
- E) dopamine

36. The axons of rods and cones synapse with

- A) ganglion cells.
- B) horizontal cells.
- C) amacrine cells.
- D) bipolar cells.

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E) lateral cells.

37. Ecology as a discipline directly deals with all of the following levels of biological organization except

- A) population.
- B) cellular.
- C) organismal.
- D) ecosystem.
- E) community.

38. Which of the following statements about metabolism is incorrect?

- A) Metabolism is an emergent property of life at the level of organisms.
- B) Metabolism manages the utilization of materials and energy resources.
- C) The uptake of water associated with the hydrolysis of biological polymers is part of metabolism.
- D) Metabolism depends on a constant supply of energy.
- E) None of these statements about metabolism is incorrect.

39. All of the following are directly associated with photosystem I except

- A) harvesting of light energy by chlorophyll.
- B) receiving electrons from plastocyanin.
- C) P700 reaction-center chlorophyll.
- D) extraction of hydrogen electrons from the splitting of water.
- E) passing electrons to ferredoxin.

40. Proteins that are involved in the regulation of the cell cycle, and that show fluctuations in concentration during the cell cycle, are called

- A) ATPases.
- B) kinetochores.
- C) centrioles.
- D) proton pumps.
- E) cyclins.

二、解釋名詞（每題 4 分，共 8 分）

1. Extracellular matrix
2. Positive pressure breathing

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三、問答題（每題 6 分，共 12 分）

1. List and briefly define the three stages of cell signaling.
2. What is the difference between undernourishment and malnourishment?