Part I. Question 1 to 10, you should choose the answer closest in meaning to the underlined word or phrase. **One answer only.** 2 points for each.

1. When they heard the good news about the court's decision, the angry crowd cheered and then began to disperse.
A. roar　　B. get upset　　C. get excited　　D. scatter　　E. gather

2. Because their fundamental difference, they would never get to like each other.
A. disparity　　B. contradictory　　C. hatred　　D. delinquency　　E. intensity

3. No one suspected that Jerry was a spy. On the surface he behaved like any normal citizen. When his covert activity was discovered and announced to the world, we were all shocked.
A. friendly　　B. helpful　　C. loud　　D. stimulating　　E. hidden

4. Michael is an ardent supporter of his presidential candidate. That became obvious to me when I found out how much time he's donated to the campaign.
A. old　　B. intelligent　　C. foolish　　D. very strong　　E. stubborn

5. Kathy was looking for a strong but light material to use for making her water jugs. Unfortunately, she chose noodelite. It proved too porous to hold jelly.
A. good for holding things　　B. protective　　C. permeable　　D. necessary　　E. luscious

6. Based on what is known, the term pulsar is used to describe the phenomenon of short, precisely timed radio bursts that are emitted from somewhere in space.
A. released　　B. jumped　　C. revolved　　D. received　　E. wandered

7. This replica fooled a lot of experts and was considered a valuable work of art.
A. a dishonest act　　B. something ugly　　C. anything that has no value　　D. a copy　　E. an evil act

8. The status quo of the country remains a debated issue among people.
A. future　　B. current situation　　C. crisis　　D. benefit　　E. changing situation

9. These results support the hypothesis that individuals are willing to pay more in order to live in communities that provide high-quality services.
A. angle　　B. experiment　　C. theory　　D. benefit　　E. evidence

10. The examiners soon realized that this student came to the oral defense for his thesis off the cuff.
A. on time　　B. in a hurry　　C. with careful observation　　D. enthusiastically　　E. without preparation

Part II. Question 11-15, please choose the answer that best completes the sentence. Question 16-25 you should chose the best answer to fill each of the numbered blanks in the passage. **One answer only.** 2 points for each.

11. They said they had their equipment _____ yesterday.
A. to be shipped　　B. shipped　　C. shipping　　D. ship　　E. was being shipped.

12. The ability to identify and exploit opportunities is the key ___ business product.
A. to　　B. of　　C. for　　D. toward　　E. in

13. _____ the size of urban populations in the world is the most urgent problem many countries face.
A. Rising　　B. Rise with　　C. The rise of　　D. Being Risen by　　E. Rise in

14. _____ incidents of Ebola virus outbreaks have been isolated incidents.
A. The most　　B. Mostly　　C. Most　　D. Most of　　E. The most of

15. _____ the difficulty and expense of working on an isolated island, construction took nearly a decade.
A. Due to　　B. Because　　C. Despite　　D. Although　　E. Regarding

Question 16~18

America's 78 million credit cardholders carried an average balance of $7,564 last year. The cost __16__ interest and fees amounted to more than $1,000 for the typical budget. If you just said, "Budget - what budget?," you know what I mean. Truth is, most of us go on spending sprees from time to time.

But, when power shopping creates the illusion of success, even __17__, it has become a weakness. Some obvious

signs that spending is out of control include making minimum payments on your credit cards, late fees, __18__, lack of a budget and loss of sleep over money worries.

16. A. on　　　B. in　　　C. with　　　D. by　　　E. of
17. A. with debts spiral out of control　　　　　B. which debts spiraled out of control
　　C. because debts spiraling out of control　　D. as debts spiral out of control
　　E. when debts being spiral out of control
18. A. bouncing checks　　B. bounce checks　C. check bounces　D. bounce of checks　　E. bounced checks

Question 19 to 22

Freeze-drying is a technique that can help to provide food for astronauts. But it also has other applications nearer home. Freeze-drying is like suspended animation for food; you can store a __19__ for years, and then, when you're finally ready to eat it, you can completely revitalise it with a little hot water. Even after several years, the original foodstuff will be virtually unchanged.

　　The technique basically involves completely removing the water from some material, such as food, while __20__. The main reason for doing this is either to preserve the food __21__ reduce its weight. Removing the water from food keeps it from spoiling, because the microorganisms such as bacteria that cause spoiling cannot survive without it. Similarly, the enzymes which occur naturally in food cannot cause ripening without water, so __22__ from food will also stop the ripening process.

19. A. freeze-dried meal　　　　B. freeze-drying meal　　　　C. meal with freeze dry
　　D. meal in freeze drying　　　E. frozen dry meal
20. A. it leaves the rest of material virtually being intacted　　B. leaving the rest of the material virtually intact
　　C. leave the rest of the material virtually intact　　　　D. leave the rest of the material virtually being intacted
　　E. left the rest of the material virtually intact
21. A. to　　　B. but　　　C. and to　　　D. or to　　　E. also to
22. A. to remove water　　　B. remove water　　　C. have water removed
　　D. that remove water　　　E. removing water

Question 23 to 25

Dolphins are often the star attractions at zoos, aquariums and aquatic theme parks. They jump on command through fiery hoops and __23__ other dolphins. They seem delighted to perform their tricks and side up to their human handlers, content with the applause of their audience, a pat on the head and a gift of some raw fish now and then __24__, Dolphins have a darker side. Dolphins have an unusual ability: to plot with others, communicate plans and execute them effectively. This indicates intelligence and communicative skills beyond __25__. Dolphins, porpoises and whales are often thought of as fish since they live in the water. However, they are aquatic mammals. They cannot live indefinitely under water and must come to the surface periodically for air. They have "blowholes" at the top of their skulls to exhale air, even under water. Their young are born alive and are suckled by the parents.

23. A. synchronized with　　　B. in synchronization with　　　C. synchronizing with
　　D. having synchronization with　　　E. that have synchronized
24. A. However　　　B. Therefore　　　C. Consequently　　　D. For example　　　E. Comparatively
25. A. that most other animals are possessing　　　B. other animals possess　　C. possessed by other animals
　　D. which other animals have possessed　　　E. what most other animals possess

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Part III. Reading Comprehension. In this part, you will read several passages. Each one is followed by one question or a number of questions about it (them). Question 26-40, you should choose the **ONE** best answer to each question. 2 points each.

Turner almost wished that he hadn't listened to the radio. He went to the closet and grabbed his umbrella. He would feel silly carrying it to the bus stop on such a sunny morning.

26. Which probably happened?

A. Turner realized that he had an unnatural fear of falling radio parts.

B. Turner had promised himself to do something silly that morning.

C. Turner had heard a weather forecast that predicted rain.

D. Turner planned to trade his umbrella for a bus ride.

E. Turner planned to take a taxi.

Someday we will all have robots that will be our personal servants. They will look and behave much like real humans. We will be able to talk to these mechanical helpers and they will be able to respond in kind. Amazingly, the robots of the future will be able to learn from experience. They will be smart, strong, and untiring workers whose only goal will be to make our lives easier.

27. Which sentence from the paragraph expresses the main idea?

A. Someday we will all have robots that will be our personal servants.

B. We will be able to talk to these mechanical helpers and they will be able to respond in kind.

C. They will be smart, strong and untiring workers.

D. Amazingly, the robots of the future will be able to learn from experience.

E. They will look and behave much like real humans.

The success of fluoride in combating dental decay is well established and, without a doubt, socially beneficial. However, fluoride's toxic properties have been known for a century. In humans excessive intake (for adults, over 4 milligrams per day) over many years can lead to skeletal fluorosis, a well-defined skeletal disorder, and in some plant species, fluoride is more toxic than ozone, sulfur dioxide, or pesticides.

Some important questions remain. For example, the precise lower limit at which the fluoride content of bone becomes toxic is still undetermined. And while fluoride intake from water and air can be evaluated relatively easily, it is much harder to estimate how much a given population ingests from foodstuffs because of the wide variations in individual eating habits and in fluoride concentrations in foodstuffs. These difficulties suggest that we should by wary of indiscriminately using fluoride, even in the form of fluoride-containing dental products.

28. The passage suggests which of the following about the effect of fluoride on humans?

A. The effect is more easily measured than is the effect of exposure to pesticides.

B. The effect of fluoride intake from water and air is relatively difficult to monitor.

C. In general the effect is not likely to be as harmful as the effect of exposure to sulfur dioxide.

D. An intake of 4 milligrams over a long period of time usually leads to a skeletal disorder in humans.

E. An intake of slightly more than 4 milligrams for only a few months is not likely to be life-threatening.

29. The paragraph following these passages is mostly likely about

A. how to use fluoride carefully.

B. diseases caused by ingesting too much fluoride.

C. interesting results of experiment by some dental scientists.

D. an analysis of fluoride in its use in other industries.

E. scientific evidence provided by orthopedic specialists.

Superconductivity is the ability of certain materials to conduct electrical current with no resistance and extremely low losses. This ability to carry large amounts of current can be applied to electric power devices such as motors and generators, and to electricity transmission in power lines. For example, superconductors can carry as much as 100

times the amount of electricity of ordinary copper or aluminum wires of the same size.

Scientists had been intrigued with the concept of superconductivity since its discovery in the early 1900s, but the extreme low temperatures the phenomenon required was a barrier to practical and low-cost applications. This all changed in 1986, when a new class of ceramic superconductors was discovered that "superconducted" at higher temperatures. The science of high-temperature superconductivity (HTS) was born, and along with it came the prospect for an elegant technology that promises to "supercharge" the way energy is generated, delivered, and used.

30. In which of the following publication types would this article most likely appear in?
A. A scholarly journal read by specialists and scientists who work directly with superconductivity
B. A modern science magazine intended for leisure reading.
C. A book chapter in an advanced chemistry textbook
D. A magazine intended to be dispersed at home craft fair
E. A trade show magazine which focuses on super-cooled refrigeration units

31. What is the barrier to superconductivity at the early stage of its discovery?
A. high resistance　　　B. technology that supercharge the way energy is used　　　C. low-cost application
D. its capacity to carry electricity　　　E. low temperature

Those who criticize the United States government today for not providing health care to all citizens equate health care provision with medical insurance coverage. By this standard, seventeenth- and eighteenth-century America lacked any significant conception of public health law. However, despite the general paucity of bureaucratic organization in pre-industrial America, the vast extent of health regulation and provision stands out as remarkable.

Of course the public role in the protection and regulation of eighteenth-century health was carried out in ways quite different from those today. Organizations responsible for health regulation were less stable than modern bureaucracies, tending to appear in crises and wither away in periods of calm. The focus was on epidemics which were seen as unnatural and warranting a response, not to the many endemic and chronic conditions which were accepted as part and parcel of daily life. Additionally, religious influence was significant, especially in the seventeenth century. Finally, in an era which lacked sharp demarcations between private and governmental bodies, many public responsibilities were carried out by what we would now consider private associations. Nevertheless, the extent of public health regulation long before the dawn of the welfare state is remarkable and suggests that the founding generation's assumptions about the relationship between government and health were more complex than is commonly assumed.

32. Among the following statements about the United States government's role in the provision of health care, which finds the LEAST support in the passage?
A. The government today addresses health concerns that formerly were not considered serious enough to warrant government involvement.
B. What were once public health-care functions are now served by the private sector.
C. Philosophical considerations play a less significant role today in the formulation of .public health-care policies than in previous centuries.
D. Public health care today is guided largely by secular rather than religious values.
E. Modern public health-care agencies are typically established not as temporary measures but rather as permanent establishments.

33. Which of the following best expresses the author's point of contention with "those who criticize the United States government for not providing health care to all citizens" (lines 1)?
A. Their standard for measuring such provision is too narrow.
B. They underestimate the role that insurance plays in the provision of health care today.
C. They fail to recognize that government plays a more significant role today in health care than in previous eras.
D. They misunderstand the intent of the founding generation with respect to the proper role of the government in the

area of health care.

E. They lack any significant conception of public health law.

34. Which of the following best expresses the main point of the passage?

A. The government's role in health care has not expanded over time to the extent that many critics have asserted.

B. The government should limit its involvement in health care to epidemiological problems.

C. Health problems plaguing pre-industrial America resulted largely from inadequate public health care.

D. History suggests that the United States government has properly played a significant role in provision of health care.

E. Private insurance is an inadequate solution to the problem of health care.

Graffiti is a general term for wall writing, perhaps humankind's earliest art form. The crude wall writings of prehistoric times and the highly stylized street art of today's inner-city youths share one common feature: Each stems from a basic human need to communicate with others. For youths who may not be able to express themselves through other media, such as prose or music, graffiti represents an easily accessible and effective way to communicate with a large audience. Anyone can obtain a can of spray paint and "make their mark" on a highway overpass or the side of a building.

Modern graffiti generally falls into one of three categories—junk graffiti, gang graffiti, and tagging. Junk graffiti messages are not gang-related but often involve obscene, racist, or threatening themes. The line separating gang graffiti and tagging to more threatening gang activities, is now considered an entry level offense that can lead to more serious crimes, including burglary and assault.

35. According to these two passages, what is the common feature of Graffiti?

A. To threaten others　　B. To make their mark　　C. To communicate with others as a human need

D. To vandalize the landscape　　E. To challenge the public

36. Paragraphs following these passages are most like about

A. detailed description of three categories of graffiti.

B. how to punish those who make graffiti.

C. why youths need to express themselves through such an urban crime.

D. other ways to communicate with people through other art forms.

E. the development of earlier graffiti.

Most cultures set an age at which its young people become adults in the eyes of the law. This age is called the age of majority. When people reach this age, usually 18, they become entitled to certain inalienable rights from which they were precluded as minors, such as the right to vote. Before becoming adults, minors are not able to enter into legal contracts. This is seen as being for their own protection. They are also protected from statutory rape, from being exploited in the labor market, and from having to go through the same penal system as adults.

37. Which of the following would be an example of a protection specifically to minors?

A. The right to vote　　B. The right to a fair trial　　C. Child labor laws

D. Separate penal system　　E. Legal contracts

38. Which of the following would be an example of a right denied to minors?

A. The right to vote　　B. The right to a fair trial　　C. Child labor laws

D. Separate penal system　　E. Going to court

39. The word "statutory" in the passage is closest in meaning to

A. part of a statue　　B. punishable under the law　　C. said or stated　　D. serious　　E. casual

40. In which of the following publication types would this article most likely appear in?

A. A scholarly journal read by sociologists.　　B. A modern magazine intended for leisure reading.

C. A book chapter in a textbook about law and life　　D. A newsletter intended to be dispersed at court

E. A scholarly journal read by lawyers.

Part IV. Essay.　20 points.

The world's climate scientists recently reported unequivocally that the Earth's climate system is increasingly heating up and that it likely has not been this warm for at least 1300 years. We all must begin reducing global warming, and fortunately there is much to do. **Please write an essay in about 150 words about how you can help to reduce global warming.**

2007 entrance exam

1. What kinds of scientific knowledge can be important for genomic research? Please list all of them and explain why they can contribute to genomic research. For example, you can say biochemistry is important because understanding DNA structure needs biochem training.
2. Please explain what pharmacogenomics is and why pharmacogenomic research can influence future medicine and our daily life.
3. Is a gene or its protein(s) more related to physiology or disease pathogenesis? If your answer is "gene", please tell us why we need to study proteomics. If your answer is "protein", then why we need to study genomics.
4. Please tell us what part of genomic studies you are particularly interested in, and how you plan to do research in your favorite genetic topic. For example, if you are interested in cancer genetics, briefly describe your research direction and plan.
5. Genetics used to be a not popular science. However, it becomes a very hot topic currently. Based on your knowledge, please tell us why genetic sciences become so important.

一、說明下列生物技術原理及應用（8 分）
　　1.DNA footpringting　2.DNA microarray　3.FISH　4.Northern blot

二、說明下列物質之作用機轉及其在細胞之訊息傳遞擔任的角色（8 分）
　　a) Inositol triphosphate　　b) Steroid hormones　　c) Camodulin　　d) cAMP

三、下列蛋白質之作用如何?並請說明其分別負責何種 DNA damage 之修復作用？（8 分）
　　1) MutS　　2) AP endonuclease　　3) Photolyase　　4) Rec A

四、敘述下列酵素之作用及生理角色，並說明其可作為 Viagra、Lovastatin、Taxol 、Aspirin Amethopterin(Methotrexate)、Rifamycin、、5-Fluorouracil 、那個藥物作用之標的（12 分）
　　1)HMG-CoA reductase
　　2)Thymidylate synthase
　　3)cGMP phosphodiesterase

五、酵素之催化，若依 Michaelis-Menten equation，則當[s]=4Km 時，v/Vmax 為何？（4 分）

六、攝取高蛋白質食物，建議多喝水，請以生化代謝的觀點解釋之。（4 分）

七、詳述 protein kinase A 如何調節肝臟 glucose 及 glycogen 之代謝(8 分)

八、Oligomycin 阻斷 proton 進入 mitochondria matrix，請說明 a.其如何影響電子傳遞鏈 b.對 ATP 之形成及葡萄糖氧化之影響（8 分）

九、細菌之 amino acid 生合成會受 leader peptide 調控酵素的表現所影響，請舉例說明此種基因調控之機轉（8 分）

十、Fatty acid 合成需要 fatty acid synthase,其為具有多功能酵素活性之複合體，請詳述其所含之多種酵素活性。(8 分)

十一、寫出 ketone bodies 之化學構造，並說明其在體內合成之主要步驟和異常代謝的原因（8 分）

十二、多吃糖比多吃脂肪更容易引起脂肪(Triacylglycerols)堆積體內，請由生化之角度闡述你自己的見解？（8 分）

十三、何謂 micro RNA?並說明其在細胞內可能扮演的角色（8 分）

* 可使用電子計算機 *

Answers can be stated in Chinese or English.

1. Please state the specific objectives of epidemiology (state at least 5 objectives)? (15%)

2. Please discriminate the following epidemiological terms? (18%)
   (a) Incubation period; Induction period; Latency period and Lead time
   (b) Attack rate and Secondary attack rate

3. A cross-sectional study conducted from March 1st, 2005 through February 28th, 2006 identified 1,200 cases of diabetes in a city of 2 million persons. The incidence rate of diabetes in this population is 5 per 100,000 persons half a year. What percent of the 1,200 cases were newly diagnosed during the study period? (5%)

4. In trying to assess the relationship between tryptophan use and Eosinophilia-Myalgia syndrome (EMS), however, some subjects may have made an error when indicating whether they had ever used tryptophan. In reality, 88 and 12 EMS patients were tryptophan users and nonusers, respectively, whereas 22 and 78 non-EMS patients were tryptophan users and nonusers. In a case-control study, the investigators found that 39% of the cases misidentified their use of tryptophan and 41% of the controls mislabeled their tryptophan use.
   (a) What was the OR for the reality and the study, respectively? (8%)
   (b) What type of misclassification possibly occurred in this case-control study? (2%)

5. In a case-control study of maternal cigarette smoking as a hazard for low birth weigh, it appeared that the mothers of children with low birth weight underreported the extent of their cigarette smoking compared with the mothers of normal birth weight babies.
   (a) This is an example of what kind of bias? (3%)
   (b) As a result of this problem, how the risk that was calculated will probably be influenced? (3%)

6. The results of a 1979 case-control study assessing the risk of myocardial infarction (MI) based on use of oral contraceptive (OCs) are listed in the table below.
   (a) Calculate the overall risk of IM based on use of OCs, and then calculate the risk for each age category? (12%)
   (b) Comment briefly on the limitation of this type of method. (6%)

Age group (years)	Exposure	Disease status	
		MI	No disease
25-29	Total no. of women	7	356
	No. of women using OCs	2	108
30-34	Total no. of women	11	371
	No. of women using OCs	4	119
35-39	Total no. of women	9	306
	No. of women using OCs	3	85
40-44	Total no. of women	26	396
	No. of women using OCs	9	97
45-49	Total no. of women	41	423
	No. of women using OCs	18	112

7. In a clinical trial, 9 of 29 asthmatics taking a new drug continue to have asthma attacks 3 months later, whereas 12 of 74 asthmatics using a new breathing exercise continue to have asthma attacks.
   (a) Which new treatment approach is more effective in preventing asthma attacks? (4%)
   (b) Before drawing the above conclusion, what will you concern about? (6%)

8. A physical examination and an audiometric test were given to 500 persons with suspected hearing problems, of whom 300 were actually found to have them. The results of examinations were as follows. Please assess the quality of the two diagnostic tests. (6%)

| | Physical examination | | Audiometric test | |
| | Hearing problems | | Hearing problems | |
Result	Present	Absent	Present	Absent
Positive	220	50	250	80
Negative	80	150	50	120

9. If the risks for subjects exposed to factor A but not B, and exposed to factor B but not A are 6.4 and 4.2, respectively. Subjects with neither exposure to factors A nor to factor B are observed at a risk of 1.8.
   (a) Using the additive model of interaction, what is the risk for subjects exposed to both factors? (3%)
   (b) Using the multiplicative model of interaction, what is the risk for subjects exposed to both factors? (3%)
   (c) If subjects exposed to neither factors have an attributable risk of 0, using the additive model, what is the risk for subjects exposed to both factors? (3%)
   (d) If subjects exposed to neither factors have a relative risk of 1, using the multiplicative model, what is the risk for subjects exposed to both factors? (3%)

1. 人體如何調控細胞外液 (Extracellular fluid; ECF) 的恒定 (homeostasis)? 哪些狀況會引起休克(shock)? (10%)
2. 以骨骼肌受刺激後引起收縮為例, 說明 Nerve-Muscle junction 與 muscle contraction 之詳細分子機制及 Ca^{2+} 所扮演的角色 (15%)
3. 何謂 bone remodeling? 哪些情況容易引起骨質疏鬆 (osteoporosis)? (10%)
4. 試述粒線體 (mitochondria) 的構造、功能及其與細胞命運之關連 (10%)
5. 試舉例說明不同種類 ion channels 的活化方式與功能 (10%)
6. 試述 2006 年諾貝爾生理及醫學獎之得獎事蹟及其分子醫學上的應用 (10%)
7. 試述可採用哪些方法來印證 " A 因素經由 B 途徑而導致 C 事件" ? (15%)
8. 下段文字請翻譯成中文(10%)，並以自己的英文表達方式改寫之(rewrite) (10%)
   註: 不懂的專有名詞可以不用翻譯

Protein turnover via autophagy

"Autophagy" is a process of cellular "self-eating" in which portions of cytoplasm are sequestered within double-membrane cytosolic vesicles termed autophagosomes. The autophagosome cargo is delivered to the lysosome, broken down, and the resulting amino acids recycled after release back into the cytosol. Autophagy occurs in all eukaryotes and can be up-regulated in response to various nutrient limitations. Under these conditions, autophagy may become essential for viability. In addition, autophagy plays a role in certain diseases, acting to prevent some types of neurodegeneration and cancer, and in the elimination of invading pathogens. This review article provides the current information on the mechanism of autophagy, with a focus on its role in protein metabolism and intracellular homeostasis.

1. Define the following words:
    (a) elementary reaction, (b) rate of conversion, (c) composite reaction, (d)
    Michaelis constant and (e) pseudo first order.　　　　　　(10%)

2. The rate constant k_{HI}= 80.2 dm^3/mol min for $H_2 + I_2 \rightarrow 2HI$; what will be
    the value of k_{H_2}　　　　　　(10%)

3. What are the concentration changes with time for a competing reaction?
    $A \longrightarrow F$;　　　　　　$A \longrightarrow G$　　　　　　(10%)

4. Explain the importance of (a) Compression factor Z; (b) Law of
    corresponding state.　　　　　　(10%)

5. Explain why the phase rule is written as $f = c_{ind} - p + 2$?　　　　(10%)

6. For the gas-phase reaction,
    I$_2$ + cyclopentene　⇌　cyclopentadiene + 2HI　　　　(10%)
    measured K_p^o values in the range 450 to 700 K are fitted by
    $\log K_p^o = 7.55 - (4.83 \times 10^3)$ (K/T), Calculate ΔH^o, ΔG^o, ΔS^o, ΔC_p^o at 510 K
    for this reaction. Assume all are ideal gases

7. Please prove　$(\frac{\partial H}{\partial P})_T = V - T(\frac{\partial V}{\partial T})_P$　　if temperature is a constant　　(10%)

8. Please describe the Joule experiment and what is the purpose of this
    experiment?　　　　　　(10%)

9. Find $\Delta_{mix}G$, $\Delta_{mix}V$, $\Delta_{mix}S$ and $\Delta_{mix}H$ for mixing 150 g of benzene with 100 g
    of toluene at 20℃ and 1 atm. Assume an ideal solution.　　　　(10%)

10. Please define the following words:　　　　　　(10%)
    a. Colligative properties　　　　b.　Excess Gibbs energy
    c. Convention II activity coefficient　　d.　Reverse osmosis
    e. Azeotrope

可使用電子計算機

第一部份：單選題 (50%)

1. Consider the numbers 23.68 and 4.12. The sum of these numbers has _____ significant figures, and the product of these numbers has _____ significant figures.

   A) 3, 3　　　　B) 4, 4　　　　C) 3,4　　　　D) 4,3　　　　E) none of these

2. When NH_3(aq) is added to Cu^{2+}(aq), a precipitate initially forms. Its formula is:

   A) $Cu(NH_3)$　B) $Cu(NO_3)_2$　C) $Cu(OH)_2$　D) $Cu(NH_3)$　E) CuO

3. Which of the following salts is insoluble in water?

   A) Na_2S　　　　B) K_3PO_4　　　　C) $Pb(NO_3)_2$　D) $CaCl_2$

   E) All of these are soluble in water.

4. You have exposed electrodes of a light bulb in a solution of H_2SO_4 such that the light bulb is on. You add a dilute solution and the bulb grows dim. Which of the following could be in the solution?

   A) $Ba(OH)_2$　B) $NaNO_3$　　　C) K_2SO_4　　　D) $Ca(NO_3)_2$　E) none of these

5. You have two salts, AgX and AgY, with very similar K_{sp} values. You know that K_a for HX is much greater than K_a for HY. Which salt is more soluble in acidic solution?

   A) AgX　　　　B) AgY　　　　C) They are equally soluble in acidic solution.

   D) Cannot be determined by the information given.　　　　E) None of these

6. On a new temperature scale (°Z), water boils at 120.0°Z and freezes at 40.0°Z. Calculate the normal human body temperature using this temperature scale. On the Celsius scale, normal human body temperature could typically be 37.5°C, and water boils at 100.0°C and freezes at 0.00°C.

   A) 3000 °Z　B) 12.5 °Z　　C) 70.0 °Z　　D) 113 °Z　　E) 30.0 °Z

7. How many moles of $Fe(OH)_2$ [$K_{sp} = 1.8 \times 10^{-15}$] will dissolve in 1.0 liter of water buffered at pH = 12.93?

   A) 2.5×10^{-13}　B) 8.5×10^{-2}　　C) 7.2×10^{-3}　D) 4.0×10^{12}　E) 2.1×10^{-14}

8. Given the following reaction in acidic media:

   $$Fe^{2+} + Cr_2O_7^{2-} \rightarrow Fe^{3+} + Cr^{3+}$$

   The coefficient for water in the balanced reaction is

   A) 1.　　　　B) 3　　　　C) 5.　　　　D) 7.　　　　E) none of these

9. If a reducing agent M reacts with an oxidizing agent N^+ to give M^+ and N, and the equilibrium constant for the reaction is 2.0, then what is the E° value for the oxidation-reduction reaction at 25°C? (R=8.3145$JK^{-1}mol^{-1}$, F=96485C/mol, $Hint$:$\Delta G = \Delta G^0 + RTlnQ$)

   A) 1.8×10^{-2} V　　　　　　B) -1.8×10^{-2} V　　　　　　C) 8.9×10^{-3} D) -8.9×10^{-3} V　E) 3.6×10^{-2} V

10. A common car battery consists of six identical cells each of which carries out the reaction

    $$Pb + PbO_2 + 2HSO_4^- + 2H^+ \rightarrow 2PbSO_4 + 2H_2O$$

    Suppose that in starting a car on a cold morning a current of 125 amperes is drawn for 13.0 seconds from a cell of the type described above. How many grams of Pb would be consumed? (The atomic weight of Pb is 207.19.)

    A) 3.49　　　B) 1.74　　　　C) 1.03×10^{-2} D) 1.12×10^{-4} E) 8.42×10^{-3}

第二部分：問答題 (50%)

1. Beer's law ($A = \varepsilon bc$) is a limiting law. Please explain what make(s) Beer's law a limiting law? (12%)

2. (a) Define "cyclic voltammetry" (CV), an electrochemical technique.(7%)
   (b) Interpret what this technique is mainly used for?(7%)

3. (a) Define "reversed-phase chromatography".(6%)
   (b) For ion-exchange chromatography, an eluent suppressor column is often used in order to enhance the detection sensitivity. Please define the compositions of an eluent suppressor column and interpret its working mechanism.(6%)

4. It is important to investigate the mechanisms by which ions or molecules are transported from the bulk of the solution to a surface layer. Three mechanisms of mass transport are recognized. Please interpret all of them in detail.(12%)

Multiple Choice Questions (single answer): 40%

1. Melting of DNA can be monitored by the absorption of UV light at ___ nm. As DNA denature, its absorption of UV light will ___. A) 260; decrease B) 260; increase C) 280; decrease D) 280; increase E) 230; decrease

2. A 420-bp covalently closed circular DNA with a linking number of 36 has 4 negative supercoils. When the linking number of this DNA is changed to 39 by a topoisomerase, this DNA will A) have 3 negative supercoils B) have 3 positive supercoils C) have 1 negative supercoil D) have 1 positive supercoils E) be relaxed

3. A major chemical group contributing to the enzymatic activity of ribozymes is A) carbonyl group on uracil B) phosphoryl group C) 2'-hydroxy group on ribose D) 3'-hydroxy group on ribose E) 5'-hydroxy group on ribose

4. Yeast genome is 1.2×10^7 bp and human genome is 3.3×10^9 bp. What is the approximate ratio of the number of genes in yeast genome compared to human genome? A) 1:1 B) 1:5 C) 1:250 D) 1:1000 E) 1:25000

5. You randomly isolate a human genomic DNA fragment of ~3000 bp. It is most likely to include A) a protein-coding gene B) a LINE-1 element C) an Alu element D) a satellite DNA E) a microRNA gene

6. The following are 5 key steps in homologous recombination. Which is the correct order? 1. formation of initial short regions of base pairing between the two recombining DNA molecules, 2. cleavage (or resolution) of Holliday junctions, 3. alignment of 2 homologous chromosomes, 4. movement of Holliday junctions by melting and formation of base pair, 5. introduction of breaks in DNAs. A) 35241 B) 24135 C) 35142 D) 24531 E) 13452

7. Which of the following RNAs is not transcribed by RNA polymerase III? A) tRNA B) 5S rRNA C) 5.8S rRNA D) U6 snRNA E) H1 RNA of RNase P

8. Self-splicing of group II introns is similar to the nuclear pre-mRNA splicing because A) both need guanosine B) both need ATP C) both need snRNPs D) both form lariat structure E) both form spliceosome

9. Isoleucine is larger than valine by only a single methylene group. The isoleucyl-tRNA synthetase contain a catalytic pocket and an editing pocket. A) AMP-valine is too large for the catalytic pocket B) AMP-valine is too large for the editing pocket C) AMP-isoleucine is too large for the catalytic pocket D) AMP-isoleucine is too large for the editing pocket

10. The high-resolution, 3-D structure of the ribosome reveals that no amino acid of ribosomal proteins is located closer than 18 Å from the A) P site B) A site C) decoding center D) factor binding center E) peptidyl transferase center

11. An antibiotic inhibits prokaryotic protein synthesis. In its presence, translation can initiate, but only dipeptides that remain bound to the ribosome are formed. This antibiotic appears to block A) binding of fMet-tRNA$_i$ to P site B) binding of aminoacyl-tRNA to A site C) peptide bond formation D) translocation E) termination

12. According to the wobble rules, a tRNA with the anticodon 5'-GCA-3' can recognize the codons A) 5'-CGU-3' and 5'-UGU-3' B) 5'-UGC-3' and 5'-UGU-3' C) 5'-CGU-3' and 5'-UGC-3' D) 5'-UGA-3', 5'-UGC-3' and 5'-UGU-3' E) 5'-IGC-3'

13. Glucose represses the expression of *lac* operon. This repression is mediated by A) an activator B) a repressor C) a co-repressor D) attenuation E) a riboswitch

14. Expression of β-galactosidase in a partial diploid *E. coli* with the genotype of $I^+ O^c lacZ^- / I^- O^+ lacZ^+$ is A) constitutive B) inducible C) noninducible

15. Which DNA-binding domains combines dimerization and DNA-binding surfaces in a long α helix? A) helix-turn-helix   B) zinc finger   C) leucine zipper   D) helix-loop-helix   E) acidic domain

16. Which of the following enzymes is not required for nucleotide excision repair? A) nuclease   B) helicase   C) DNA glycosidase   D) DNA polymerase   E) DNA ligase

17. Which is not the feature of processed pseudogenes? A) lack of upstream promoter sequence   B) lack of intron sequences   C) presence of A-rich sequences at 3' end   D) presence of LTR sequences at 5' and 3' ends

18. A $(CA)_{20}$ tandem repetitive DNA is classified as a   A) SNP   B) microsatellite   C) minisatellite   D) SINE element   E) LINE element

19. After RNA splicing, will the two phosphates at the 5' and 3' splice sites (as shown by the boldfaces in exon-Np/GU-intron-AGp/N-exon) be in the spliced exon or in the excised intron? A) 5' p in the intron, 3' p in the exon   B) 5' p in the exon, 3' p in the intron   C) both 5' p and 3' p in the intron   D) both 5' p and 3' p in the exon

20. Which of the following methods is not used to measure the expression level of mRNA? A) Northern blotting   B) cDNA microarray   C) real-time RT-PCR   D) RNAi   E) RNase protection assay

Essay Questions: 60%

1. A) DNA in most cells, including prokaryotes and eukaryotes, is negatively supercoiled. What are the purposes of maintaining DNA in negative supercoiling? (4%)
   B) Negative supercoiling is introduced into prokaryotic and eukaryotic DNA by different mechanisms. What are the mechanisms? (4%)

2. A) Explain why DNA polymerase is unable to complete DNA replication at chromosome ends. (4%)
   B) Describe how telomerase solves this replication problem. (4%)

3. A) Describe how EMSA (electrophoretic mobility shift assay) and ChIP (chromatin immunoprecipitation) are performed. (6%)
   B) What information can be obtained by performing EMSA and ChIP? (4%)

4. A) What is epigenetic inheritance? (4%)
   B) What are the mechanisms for epigenetic inheritance? (6%)

5. Human beta-globin gene contains 3 exons (142 bp, 223 bp and 261 bp) and 2 introns (130 bp and 850 bp). A C→T point mutation within the second intron generates an aberrant mRNA of 699 nucleotides plus poly(A) tail instead of the normal mRNA of 626 nucleotides plus poly(A) tail. Propose a mechanism to explain the effect of this mutation. (5%)

6. What are the functions of mRNA 5' capping and 3' polyadenylation? (6%)

7. A) What is nonsense-mediated mRNA decay? (4%)
   B) What is the mechanism for nonsense-mediated mRNA decay? (4%)

8. Certain genomic regions or nucleotide sequences are especially prone to spontaneous mutation. What are these regions or sequences? Explain why they are prone to spontaneous mutation. (5%)

應考同學得使用普通電子計算機或工程(商業)用電子計算機。其他電子輔助機具一律不可使用。本卷所附之統計表可供計算參考，其餘書本、筆記、講義、印刷品等，請收放於考場規定位置。

1.　請根據以下的統計表，回答問題: (15%)

****

Variable: WEIGHT

GROUP	N	Mean	Std Dev	Std Error	Variances	T	DF	Prob>|T|
0	2002	55.85	10.10	0.23	Unequal	1.98	2214.2	0.048
1	1065	55.10	9.87	0.30	Equal	1.96	3065.0	0.051

For H0: Variances are equal, F' = 1.05　　DF = (2001,1064)　　Prob>F' = 0.39

****

1-1.　如果我們定 $\alpha = 0.05$，則這兩組 samples 的變異(variance) 是不是相等？為什麼？

1-2.　正確的 t 值 (t-value) 是多少？

1-3　如果我們訂定 $\alpha = 0.05$，則 T-test 的結論是什麼？

2. 某幼稚園小朋友體重是常態分佈 (normal distribution)，平均值是 8 公斤，標準差(standard deviation)是 2 公斤，則此幼稚園中體重超過 10 公斤的小朋友大約佔有多少百分比？為什麼?(10%)

3. 欲研究某藥影響睡眠在男女性別上是否有不同的效果。試驗結束後，求得男女二組平均睡眠時數差的95%信賴區間 (95% confidence interval) 為 (-0.8150~2.7215)，則我們假設檢定 (hypothesis testing)是什麼？並請解釋上述結果。(10%)

4. 請闡明迴歸 (Regression) 分析的 Assumptions 。(20%)

5. 請闡述「中央極限定理」(central limit theorem) 並舉例說明之。(15%)

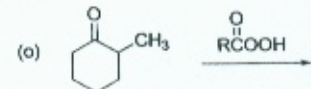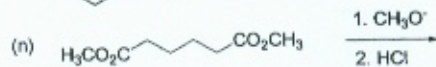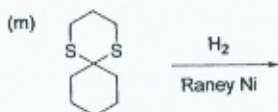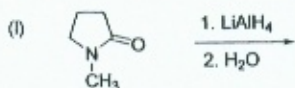6. 某班 49 個同學大一時有 31 位騎摩托車，到大四有 16 位騎摩托車，而從大一到大四都因為環保理念堅持不騎摩托車的有 10 位。請問若要檢定此班同學從大一到大四對於騎摩托車的態度有沒有改變 (此 49 位同學從大一到大四都同班)，要用什麼統計方法？如果我們定 $\alpha = 0.05$ 時，統計臨界值為 3.481，則結論為何？請將統計假說與檢定計算過程寫出。(15%)

7. 某臨床試驗三種不同藥物，施用於三組不同的老鼠。第一組 22 隻，體重平均 33.4 g，變異數= 30.56、第二組 24 隻，體重平均 30.4 g，變異數= 29.35、第三組 15 隻，體重平均 28.3 g，變異數= 24.05。請問這三組老鼠的體重有沒有顯著差異？要用什麼統計方法？如果我們訂定 $\alpha = 0.05$ 時，統計臨界值為 3.16，請將統計檢定時所用的假說與自由度及計算過程寫出。(15%)

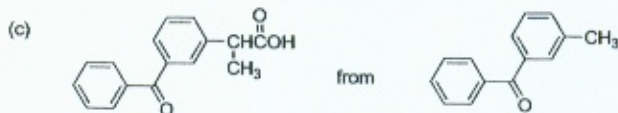(60%) 1. Give the major product of each of the following reactions.

(a)
$$CH_3CHCH=CH_2 \quad (CH_3) \xrightarrow[\text{peroxide}]{\text{HBr}}$$

(b)
$$H_3C-\overset{CH_3}{\underset{H}{C}}-CH_3 \xrightarrow[\text{hv or } \Delta]{\text{Br}_2}$$

(c)
$$\xrightarrow[\text{2. NaBH}_4]{\text{1. Hg(OAc)}_2,\ CH_3OH}$$

(d)
$$CH_3C{\equiv}CCH_3 \xrightarrow{\text{Na, NH}_3\ \text{(liq)}}$$

(e)
$$CH_3CH_2CH_2CH_2OH \xrightarrow{\text{H}_2CrO_4}$$

(f)
$$\underset{H_3C}{\overset{H}{\diagdown}}C{=}C\underset{CH_3}{\overset{Br}{\diagup}} \quad + \quad (CH_3CH_2)_2CuLi \longrightarrow$$

(g)
$$H_3C-\overset{OH}{\underset{CH_3}{C}}-\overset{OH}{\underset{CH_3}{C}}-CH_3 \xrightarrow[\Delta]{\text{H}_2SO_4}$$

(h)
$$\xrightarrow[\Delta]{\text{Na}_2Cr_2O_7,\ H^+}$$

(i)
$$\overset{O}{\overset{\|}{C}}{-}CH_2CH_3 \xrightarrow[\text{HO}^-,\ \Delta]{\text{H}_2NNH_2}$$

(j)
$$\overset{+}{N}{\equiv}N \quad Cl^- \xrightarrow{\text{CuCN}}$$

(k)
$$\overset{CO_2H}{} \xrightarrow[\text{2. H}_3O^+]{\text{1. LiAlH}_4}$$

(l)

1. LiAlH₄
2. H₂O

(m)

H₂
———
Raney Ni

(n) H₃CO₂C ⌒⌒⌒ CO₂CH₃

1. CH₃O⁻
———
2. HCl

(o)

  RCOOH

(p)

  + $\overset{H_3C}{\underset{H_3C}{>}}NH$ + $H-\overset{O}{\overset{\|}{C}}-H$ trace H⁺
———

(q)

  + ⟨⟩—NHNH₂   H⁺
———
Δ

(r) O=C=O

1. CH₃MgBr
———
2. H₃O⁺

(s)

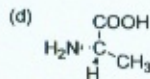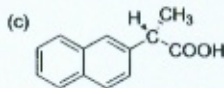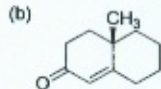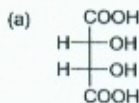 + $Ph_3P=C\overset{CH_3}{\underset{CH_3}{<}}$ ———

(t)

HCl
———
NaCN
excess

(15%) 2. How would you synthesize each of the following compounds from the given strating material?

(a)

  from ⟨⟩

(b) CH₃CH₂CH₂CH₂$\overset{O}{\overset{\|}{C}}$OH   from   EtO$\overset{O}{\overset{\|}{C}}$CH₂$\overset{O}{\overset{\|}{C}}$OEt
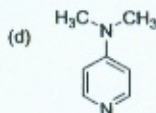
(c)

from
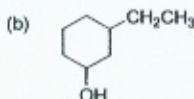

(10%) 3. Assign an *R* or *S* configuration to each asymmetric carbon of the following compounds.

(a)
```
     COOH
   H─┼─OH
   H─┼─OH
     COOH
```

(b)

(c)

(d)

(10%) 4. Give the systematic name for each of the following compounds.

(a)

(b)

(c)

(d)

(e)

(5%) 5. Propose a reasonable mechanism for the following reactions.