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 each.

1. Regarding the presidential campaign, he does not see eye to eye with his wife.
   (A) have any affection for  (B) have any interest  (C) agree with (D) show any passion as

2. He suffered a massive hemorrhage and was immediately sent to the hospital.
   (A) severe  (B) compact  (C) critical  (D) immense

3. A novel idea suddenly came to her mind, she immediately went to see her boss.
   (A) imaginary  (B) new  (C) developed  (D) realistic

4. The voters opted for this presidential candidate because he promised to reduce taxes.
   (A) chose  (B) forgave  (C) opposed  (D) advocated

5. He was put through university with money left by his grandfather.
   (A) was admitted to  (B) successfully finished  (C) gave a mission to  (D) carried a responsibility for

6. The lectures in our university are quite liberal and broad minded.
   (A) preeminent  (B) obsessed  (C) renowned  (D) permissive

7. In Sense and Sensibility, one sister ends up in a happy marriage while the other loses her first suitor and must fall back on a boring alternative suitor.
   (A) fail to accomplish  (B) slip and hit the ground  (C) change seasons  (D) accept a second choice

8. University of California report warns that unless China radically changes its energy policies, its increases in greenhouse gases will be several times larger than the cuts in emissions being made by rich nations under the Kyoto Protocol.
   (A) oil consumption  (B) discharge of smoke  (C) production of coal  (D) energy saving

9. As a spectator, it's quite easy to pick holes in other people's work.
   (A) come up with  (B) keep pace with  (C) get even with  (D) find fault with

10. The students in our school are predominantly from the South.
    (A) mostly  (B) scarcely  (C) particularly  (D) partially

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

The media [of an increasing number of surgical makeovers] says a lot about Korea's own ______ makeover. Not long ago, many people saw the country as a decidedly uncool industrial park pumping out cheap cars and appliances. But that started to change in the late 1990s, when the Korean government decided that entertainment could be an export industry. The film business in particular ______ government help and a big influx of private capital...

The popularity of Korean stars is ______ Korean ______ features as a standard of beauty across the region. Some sociologists see a subtext in the craze: a rebellion by Asian people against the images of Caucasian good looks that ______ much of the international trend.

11. (A) country  (B) image  (C) race  (D) medicine
12. (A) benefited from  (B) inherited  (C) messed up with  (D) suffered from
13. (A) naturalizing  (B) blurring  (C) establishing  (D) diminishing
14. (A) ethnic  (B) export  (C) prominent  (D) legendary
15. (A) export  (B) in charge  (C) take over  (D) dominate

Question 16-18

The topic of thought is one area of psychology, and many observers have considered this aspect in connection with robots and computers: Some of the old worries about AI (artificial intelligence) ______ the question of
whether computers could think. The first massive electronic computers, capable of rapid (if often unreliable) computation and little or no creative activity, were soon dubbed ‘electronic brains.’ A reaction to this terminology quickly followed. __17__ computers were called ‘high-speed idiots,’ and effort to protect human vanity. In such a climate, the possibility of computers actually __18__ was rarely considered: It was bad enough that computers might be capable of thought.

16. (A) link closely to (B) is linking closely to (C) have closely linked (D) be closely linked
17. (A) Putting them in their place (B) They are in their place (C) To put them in their place (D) With putting them in their place
18. (A) being alive (B) could be alive (C) which alive (D) are alive

**Question 19-20**

The average American produces about 20 tons of the major greenhouse gas carbon dioxide (CO2) every year. That might sound like a lot — and Americans do have among the biggest carbon footprints in the world — but the entire world emits around 27 billion tons of CO2 each year. __19__ transportation, electricity use, deforestation. Look at those numbers for a moment, and you'll realize there's very little that any of us can do on an individual level to stop climate change. Live like a monk, take away your 20 tons — stop breathing if you'd like — and you'll __20__ scratch the surface.

19. (A) by (B) in (C) through (D) with
20. (A) often (B) barely (C) strongly (D) constantly

**Question 21-25**

Why do Mickey Mouse, Ronald McDonald, and Superman have __21__? They are all easily identified and powerful symbols of what some people call American ‘cultural imperialism.’ Most Americans would be surprised that these beloved cultural icons are often unwelcome by many overseas. The cries of cultural imperialism are a __22__ phenomenon. __23__ western colonial empires in Asia, Africa and South America, nationalists in the newly independent countries often became outraged over the staying power of colonial cultures. These nationalists named the presence and domination of Western culture as ‘cultural imperialism.’ Paul Harrison in his book, __24__, described it this way, “And so there grew up, alongside political and economic imperialism, that more insidious form of control --- cultural imperialism. It conquered not just the bodies. __25__ the souls of its victims.”

21. (A) in general (B) in this respect (C) in common (D) in short
22. (A) relatively recent (B) recently relative (C) relative recent (D) recent relative
23. (A) In order shrink of (B) Shrinking of (C) Upon shrinking of (D) With the shrinking of
24. (A) is called Inside the Third World (B) Inside the Third World (C) who writes Inside the Third World (D) that names Inside the Third World
25. (A) and (B) so (C) as (D) but

**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.

Why don’t people consult an herbalist and take his advice instead? One reason is that only a few herbalists have made a thorough analysis of herbal medicine. Most of the time, some herbalists don’t know what makes up the herbal medicine they are prescribing. It is not uncommon that some people, especially young children, may suffer great pain because the herbal medicine qualifications of some herbalists are sometimes called into question. Some
of them have never received enough formal medical education. At best, they have just passed a test, which is
given to make sure that they know the names of certain herbal drugs and their composition; at worst, they are no
more than quacks. Finally, few large-scale experiments with herbal drugs are conducted.

Yet some people still ask herbalists for advice. They do so when doctors declare that no chemical medicine can
treat a certain disease. Under the circumstances, people may gamble with their own lives, acting human guinea
pigs for herbalists.

26. According to this passage, people may take herbs like ginger for several reasons. Which of the following is
NOT one of them?
(A) The herbs are cheap and easy to come by.  (B) Their illness may not be serious enough
(C) The herbs may taste good.            (D) The herbs may really help them recover

27. In this passage, three reasons are given to explain why people won’t go to see an herbalist. Which of the
flowing is NOT one of them?
(A) Qualification tests are not credible.  (B) Herbalists are poorly educated
(C) Experiments are not widely conducted.  (D) The components of herbal medicine are poisonous.

28. By saying “people may gamble with their own lives,” the author suggests that it is ______ to ask an herbalist
for advice.
(A) sensitive  (B) inevitable  (C) risky  (D) expensive

29. According to this passage, people may go to see an herbalist when their illness is ______.
(A) unknown  (B) incurable  (C) infectious  (D) serious

In the past, writing was considered exclusive and time-consuming. The advent of the printing press popularized
the written word and ushered in the gradual rise in global literacy. The speed and legibility of writing was greatly
improved by the typewriter. But all of these were eclipsed when the personal computer came of age as the
standard tool for writing. But what new dimensions and drawbacks, if any, does it offer?

30. The expression ‘ushered in’ is closest in meaning to ______.
(A) hindered  (B) instigated  (C) procured  (D) harmonized

31. Which of the following could best replace the word ‘eclipsed’?
(A) taken over  (B) redeemed  (C) outshined  (D) reproached

The rules of etiquette in American restaurants depend upon a number of factors: the physical location of the
restaurant, e.g., rural or urban; the type of restaurant, e.g., informal or formal; and certain standards that are more
universal. In other words, some standards of etiquette vary significantly while other standards apply almost
everywhere. Learning the proper etiquette in a particular type of restaurant in a particular area may sometimes
require instruction, but more commonly it simply requires sensitivity and experience. For example, while it is
acceptable to read a magazine in a coffee shop, it is inappropriate to do the same in a more luxurious setting. And,
if you are eating a very rustic setting, it may be fine to tuck your napkin into your shirt, but if you are eating in a
very rustic setting it may be fine to demonstrate a lack of manners. It is safe to say, however, that in virtually
every restaurant it is unacceptable to indiscriminately throw your food on the floor. The conclusion we can most
likely draw from the above is that while the types and locations of restaurants determine etiquette appropriate to
them, some rules apply to all restaurants.
32. With what topic is this passage primarily concerned?
(A) rules of etiquette  (B) instructions in proper etiquette  
(C) the importance of good manners  (D) variable and universal standards of etiquette

33. According to the passage, which of the following is a universal rule of etiquette?
(A) tucking a napkin in your shirt  (B) not throwing food on the floor  
(C) reading a magazine at a coffee shop  (D) eating in rustic settings

Now scientists are beginning to find that the most sexual part of the human body is the brain and it is inherently different in men and women. Scientific literature contains abundant evidence that males and females, even when little boys and girls, fall into distinct behavioral stereotypes. But with the advent of ever more powerful brain scanners, it seems these distinctions are the result of physical differences in the chemistry and neural circuitry of the brain that are laid down at birth.

34. This passage might be from an article on
(A) Human Revolution  (B) Men and Women: Minds Apart
(C) Difference in Sexuality between Men and Women  (D) The Newly developed brain scanner

35. “That men are better in target-directed motor skills, whereas women are stronger in precision manual tasks” would be a good example of _______.
(A) behavioral distinctions between males and females.  
(B) the fact that brain is inherently different in men and women.  
(C) cultural influences  (D) men being more capable than women

British people have mixed opinions about the Americans, reflecting the close but sometimes troubled relationship between the two nations. When people get to know Americans as individuals they have a lot more respect and affections for them than the popular, rather negative stereotype based on a casual meeting or on television programs might suggest. For many British people the US is associated with power in international politics, Hollywood, money and violence. Although Americans believe they rule the world, few of them know much about anything outside the US. The British think that money matters more than anything else to Americans, and they also think the US is a dangerous place where cannot walk in the streets or subways without fear of being attacked. Despite this, many want to go there for their holidays. And Young people generally have a much more positive attitude and love everything that comes out of America.

On the other hand, the US once belonged to Britain, and many Americans have British ancestors, so when Americans think of Britain, they think of a place that seems very familiar. Americans watch British television programs, especially period dramas, see James Bond films, and read detective stories by Agatha Christie. On the basis of these experiences, which are common even to people who are not of British origin, most Americans know more about Britain than about any other country. However, many Americans would have difficulty drawing map of Britain. They think the country consists of London and a village in Scotland where one of their ancestors came from. Every British has a servant and has great respect to the Queen. Americans admire the behavior of the British believing that they are quaint, although they themselves would never want all their social rules. British people, to them, are perfectly polite and proper, always knowing which knife and fork to use, saying “please” and “Excuse me.” However, they are often conceived as being snobbish and do not seem friendly. The famous British reserve seems cold to Americans who are more used to an open enthusiastic way of communicating. Thus a result, when British say: “That’s no problem” when they know that it will be a big problem, it confuses the Americans.

36. What might be a proper title for this reading?
(A) What British people think of Americans.  (B) What Americans think of British people.  
(C) Great Britain, the ancestors of the Americans.  (D) Cultural stereotypes.
37. What do British usually think of Americans?
   (A) They have mixed feelings.     (B) They feel indifferent.
   (C) They never want to have any association with American.     (D) They admire everything that is American.

38. Which of the following is true about the US from British perspective?
   (A) Most Americans know a lot about the world outside the US.
   (B) Few Americans know a lot about the world outside the US.
   (C) Americans value power more than anything else.
   (D) The US subway is the only public transportation available.

39. When Americans think of Britain, what do they usually feel?
   (A) They feel indifferent.     (B) They feel annoyed.
   (C) They feel familiar.     (D) They never want to be associated with Britain.

40. According to the reading, which of the following is true?
   (A) American can easily draw a British map.
   (B) Many Americans watch British television programs.
   (C) Americans never wanted to be associated with Britain because they once belonged to Britain.
   (D) Americans think only the British movie stars can have servants.

Part IV. Essay. 20 points.

Please write a well-structured essay in 150 to 200 words on the following topic:

As a global citizen, what do you think your responsibilities and rights are supposed to be? Please use examples to support your statements.
1. 請寫出你對 biobank 的認知，及你對台灣成立 biobank 的態度及想法。

2. 許多時候，不同的病人對同一種藥物的治療會有不同程度的療效，有些藥物甚至在某些人會引起嚴重副作用，這些情況可能與基因有關，請你解釋為何基因會與上述情況有關。

3. 許多常見疾病都與基因有關，如：高血壓、癌症等。但這些常見疾病的遺傳模式很不明確，請解釋為何如此。
*可使用電子計算機*

Answers can be stated in Chinese or English.

1. Please explain and differentiate the following epidemiological terms:
   (a) Random sampling and Random allocation (6%)
   (b) Validity and Precision (6%)
   (c) Confounding factor, intermediate variable, and effect modifier (6%)
   (d) Ecological bias and Berkson bias (6%)

2. A case-control study is implemented to determine whether betel-quid chewing leads to diabetes. 300 diabetes patients and 300 controls were recruited from a hospital.
   (a) If questionnaire data are to be used, would you ask about current betel quid chewing consumption? (5%)
   (b) For which of the following variables should be matched to cases: age, sex, addition of betel leaf to betel quid, cigarette smoking and alcohol drinking? Why? (6%)
   (c) The hospital-controls are used in the study, should patients with specific diseases be avoided? (5%)

3. In a clinical trial, 24 of 138 patients with arthritis taking a new drug continue to have rheumatic arthritis attacks 3 months later, whereas 68 of 146 patients with arthritis using a traditional drug continue to have arthritis attacks. Whether new treatment approach is more effective in preventing arthritis attacks? Please answer the following questions.
   (a) What was the reduction risk of rheumatic arthritis attacks attributable to new drug? (3%)
   (b) What was the relative risk in new drug users compared to traditional drug users? (3%)
   (c) What proportion of rheumatic arthritis reduction in new drug users was attributable to new drug? (3%)
   (d) In order to assess the effectiveness of new drug intervention, how many patients will be needed to treat (NNT) to get a patient with a benefit outcome? (3%)

4. In trying to determine the relationship between smoking habit and depression, adult men with similar age accepted for questionnaire interview and depression assessment. The smoking status was classified as non-smoke, low level (<10 cigarettes/day), and high level of smoke (≥10 cigarettes/day). The differences are statistically significant and presented in the table below.
   (a) If the data are from a cross-sectional study, please list two reasons for leading to the differences. (5%)
(b) If the data are from a cohort study, please list two reasons for leading to the differences. (5%)

<table>
<thead>
<tr>
<th>Smoking status</th>
<th>population</th>
<th>cases</th>
<th>rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-smoke</td>
<td>1500</td>
<td>15</td>
<td>0.01</td>
</tr>
<tr>
<td>Low dose</td>
<td>1300</td>
<td>65</td>
<td>0.05</td>
</tr>
<tr>
<td>High dose</td>
<td>1200</td>
<td>120</td>
<td>0.10</td>
</tr>
<tr>
<td>total</td>
<td>4000</td>
<td>200</td>
<td>0.05</td>
</tr>
</tbody>
</table>

5. The data show the mortality of motor-related accidents in workers and no-workers in one community. The age-specific mortality rates of accidents are different between two groups, but the crude mortality rates of accidents are very similar.

(a) If we want to compute mortality rates of accidents in workers and no-workers, adjusting for age distribution. Which standardized method is proper, direct or indirect? (3%)

(b) Compute mortality rates of accidents in workers and no-workers, adjusting for age distribution (whole state as the standard) and state your findings. (8%)

<table>
<thead>
<tr>
<th>Age</th>
<th>No-workers</th>
<th>Workers</th>
<th>Whole state</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total death</td>
<td>Mortality</td>
<td>Total death</td>
</tr>
<tr>
<td></td>
<td>population</td>
<td></td>
<td>population</td>
</tr>
<tr>
<td>30-44</td>
<td>2500</td>
<td>0.0280</td>
<td>1000</td>
</tr>
<tr>
<td>45-60</td>
<td>2000</td>
<td>0.0175</td>
<td>3500</td>
</tr>
<tr>
<td>&gt;60</td>
<td>1500</td>
<td>0.0100</td>
<td>1500</td>
</tr>
<tr>
<td>Total</td>
<td>6000</td>
<td>0.0200</td>
<td>6000</td>
</tr>
</tbody>
</table>

6. A case-control study examines the risks of coffee drinking and smoking in relation to bladder cancer. The data show in table below. Please answer the following questions.

(a) compute odds ratios for coffee drinking in the absence of smoking, smoking in the absence of coffee drinking, and combined exposure relative to neither factor. (9%)

(b) compute synergy index, S, between coffee drinking and smoking. (3%)

<table>
<thead>
<tr>
<th>Coffee drinker</th>
<th>Smoker</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Case</td>
<td>62</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>39</td>
<td>87</td>
</tr>
<tr>
<td>No</td>
<td>Case</td>
<td>10</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>25</td>
<td>126</td>
</tr>
</tbody>
</table>
An epidemic event in one elementary school shows the distribution of onset times and case numbers in the Table below. In the epidemic of 271 students occurred vomiting and diarrhea after eating lunch at school. Please answer the following questions:

(a) What type of epidemics is most likely to explain the distribution? Was it propagated by person to person spread? State your reasons. (5%)

(b) Please calculate the incubation time in this epidemic? (5%)

(c) How do you account for the two cases with onset time 10.0 to 11.0 hours after lunch? (5%)

<table>
<thead>
<tr>
<th>Hours after eating lunch</th>
<th>Case numbers</th>
<th>Cumulative incidence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.5</td>
<td>8</td>
<td>0.0295</td>
</tr>
<tr>
<td>0.5~1</td>
<td>26</td>
<td>0.1255</td>
</tr>
<tr>
<td>1~1.5</td>
<td>38</td>
<td>0.2657</td>
</tr>
<tr>
<td>1.5~2</td>
<td>50</td>
<td>0.4502</td>
</tr>
<tr>
<td>2~2.5</td>
<td>41</td>
<td>0.6015</td>
</tr>
<tr>
<td>2.5~3</td>
<td>48</td>
<td>0.7786</td>
</tr>
<tr>
<td>3~3.5</td>
<td>17</td>
<td>0.8413</td>
</tr>
<tr>
<td>3.5~4</td>
<td>20</td>
<td>0.9151</td>
</tr>
<tr>
<td>4~4.5</td>
<td>15</td>
<td>0.9705</td>
</tr>
<tr>
<td>4.5~5</td>
<td>3</td>
<td>0.9816</td>
</tr>
<tr>
<td>5~5.5</td>
<td>3</td>
<td>0.9889</td>
</tr>
<tr>
<td>10~10.5</td>
<td>1</td>
<td>0.9926</td>
</tr>
<tr>
<td>10.5~11</td>
<td>1</td>
<td>1.0000</td>
</tr>
</tbody>
</table>
Biomechanics is the study of the mechanics of the living body, especially of the forces exerted by muscles and gravity on the skeletal structure. The human body has to constantly resist the forces of gravity. For instance, at 12-15 pounds, the head weighs more than the average bowling ball. Therefore the neck (as well as lower back) has to have a curve in it to act as a shock absorber and dissipate the weight. Loss of the normal curvature to the neck or lower back can result in future disc problems and even bone spur formation.

Whenever the physical requirements of a job and the physical capacity of a worker are mismatched, musculoskeletal disorders can result. People working with intense concentration or at high speeds often work with poor posture. Cumulative trauma disorders (also called repetitive strain injuries) are caused by repeating the same motion in awkward positions or with noticeable force, such as in lifting heavy objects.

Please summarize the description above into 2 points in English and in Chinese. (15%)
1. The one dimensional Schrödinger equation for a particle is

\[
\frac{-\hbar^2}{2m} \frac{d^2\psi(x)}{dx^2} + V(x)\psi(x) = E\psi(x)
\]

Please solve the wave function and the energy for a particle in the box with length \(l\). (15%)

\[
\begin{array}{c|c|c}
V = \infty & V = 0 & V = \infty \\
0 & l & x
\end{array}
\]

2. The rate constant for the reaction of hydrogen with iodine is \(2.45 \times 10^{-4} \text{ M}^{-1}\text{s}^{-1}\) at 302°C and 0.950 \(\text{M}^{-1}\text{s}^{-1}\) at 508°C. Calculate the activation energy and Arrhenius preexponential factor for this reaction. (10%)

3. Consider the following sequential reaction scheme:

\[
A \xrightleftharpoons[k_i]{k_1} I \xrightarrow{k_f} P
\]

Assuming that only reactant \(A\) is present at \(t = 0\), what is the expected time dependence of \([P]\) using the steady-state approximation? (10%)

4. Consider the following energy-level diagram.

Determine the probability of occupying the second energy level at 300 K. (10%)

5. Consider the following reaction of methane with molecular chlorine:

\[
\text{CH}_4(g) + \text{Cl}_2(g) \rightarrow \text{CH}_3\text{Cl}(g) + \text{HCl}(g)
\]

Experimental studies have shown that the rate law for this reaction is one-half order with respect to \(\text{Cl}_2\). Show that the following mechanism is consistent with this behavior. (15%)

\[
\begin{align*}
\text{Cl}_2 & \xrightarrow{k_1} 2\text{Cl}^* \\
\text{Cl}^* + \text{CH}_4 & \xrightarrow{k_2} \text{HCl} + \text{CH}_3^* \\
\text{CH}_3^* + \text{Cl}_2 & \xrightarrow{k_3} \text{CH}_3\text{Cl} + \text{Cl}^* \\
\text{Cl}^* + \text{Cl}^* & \xrightarrow{k_4} \text{Cl}_2
\end{align*}
\]
6. How many types of energy levels are there for polyatomic molecules? Arrange them in the order of increasing energy-level spacing. (10%)

7. Please explain the following terms: (20%)
   a. State function
   b. Pauli exclusion principle
   c. Greenhouse gases
   d. Supercritical fluids
   d. Phosphorescence

8. The average bond enthalpy of the O–H bond in water is defined as one-half of the enthalpy change for the reaction $\text{H}_2\text{O}(g) \rightarrow 2\text{H}(g) + \text{O}(g)$. The formation enthalpies, $\Delta H^o_f$, for H(g) and O(g) are 218.0 and 249.2 kJ mol$^{-1}$, respectively, at 298.15 K, and $\Delta H^o_f$ for H$_2$O(g) is $-241.8$ kJ mol$^{-1}$ at the same temperature. (10%)
   a) Determine the average bond enthalpy of the O–H bond in water at 298.15 K.
   b) Determine the average bond energy, $\Delta U$, of the O–H bond in water at 298.15 K.
      Assume ideal gas behavior.
1. Write the multiplier for the following prefix. (4%)
   a) Z
   b) n

2. Write the full name of SRM in English. (6%)

3. The distribution of replicate data in most of the quantitative analytical experiments approaches __________ curve, the highest value in the curve the __________ of the sample. (4%)

4. What kind of chemical or physical properties can be employed in the following instrumental methods? (6%)
   i. Roman spectroscopy
   ii. Coulometry

5. Which of the following digital data domain represent the most efficient method for encoding data? (a) count serial data, (b) binary-coded aerial data (serial), (c) paralleled binary data (3%)

6. Choose the best answer that the following circuits represent. (6%)
   (1) resistors in parallel (2) current divider (3) voltage divider (4) resistors in series
   a) 
   b) 

7. Write the operation mode for the following CE separations. (6%)
   a) 
   b)
第二部份：簡答及計算

1. What kind of fields or gradients can be used in the FFF (field flow fractionation)? (9%)

2. The following spectrum was obtained for a liquid with the empirical formula of \( C_3H_4O \). Identify the compound. (9%)

![Spectrum Image]

3. How do the spectra for electron-impact and field ionization sources differ from each other? (6%)

4. Define (10%)
   
a) gradient elution
   
b) stop-flow injection

5. Calculate the (a) median; (b) spread, or range; of the following data: (2.7, 3.0, 2.6, 2.8, 3.2). (6%)

6. Draw the titration curve for amperometric titration which the analyte is the only electroactive species. (5%)

7. Supply the missing data in the table below \( (K_{bHIO_3} = 1.7 \times 10^{-4}) \). (15%)

<table>
<thead>
<tr>
<th>Acid</th>
<th>( c_T = c_{HA} + c_{A^-} )</th>
<th>pH</th>
<th>[HA]</th>
<th>[A(^-)]</th>
<th>( \alpha_2 )</th>
<th>( \alpha_1 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iodic acid (HIO(_3))</td>
<td>0.200</td>
<td></td>
<td></td>
<td></td>
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<td>0.765</td>
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8. Write the full name of SFC in English and predict the effects of the following changes to the elution time when we use SF CO\(_2\) as an eluant. (9%)
   
i. Increases flow rate (under constant pressure and temperature)
   
ii. Increased temperature (under constant pressure and flow rate)
1.) Single choice Question: (60%)
Select the one that is best in each case and then completely fill in the corresponding space on the answer sheet. (3 point per choice)

1. Virus-mediated tranfer of cellular genetic material from one bacterial cell to another by means of virus particles is called:  
   A) Induction  B) Transfection  C) Transformation  D) Transposition  E) Transduction

2. Which of the following processes leads to formation of polytene chromosomes? 
   A) Nondisjunction of chromatides during meiosis  B) Recombination between adjacent chromosome segments  C) Sister chromatid exchange  D) Inactivation of one chromosome of each homologous pair  E) Repeated replication without separation of chromatids.

3. In the classical model of transcriptional control described by Jacob and Monod, a repressor protein binds to A) an enhancer B) an AUG sequence C) an operator D) a ribosome-binding site E) a TATA box.

4. The completion of the S phase of the cell cycle of a mammalian cell is marked by all of the following EXCEPT: 
   A) Histone content per cell is double that of cells in G1.  B) In replicated DNA, newly incorporated bases are paired with parental bases. 
   C) Each replicated chromosome has four telomeres.  D) Sister chromatids disjoin from one another.  E) The nucleus contains the equivalent amount of DNA of a tetraploid cell in G1.

5. All of the following contribute to promoter binding by RNA polymerase in E. coli EXCEPT the A) rho factor B) -10 consensus sequence C) -35 consensus sequence D) β' subunit of RNA polymerase E) β subunit of RNA polymerase.

6. "Zinc fingers" are important in cellular regulation because they are A) at the catalytic site of many kinases B) a structure motif in many DNA-binding proteins C) characteristic of palindromic stretches of unique-sequence DNA D) restricted to cytoplasmic domain of growth-factor receptors E) structures with high redox potential.

7. When the coding region of a prokaryotic gene is cloned into the lac Zgene downstream from the translational initiator, the chance of an in-frame fusion is A) 1/2 B) 1/3 C) 1/5 D) 1/6 E) 1/9.

8. DNA polymerase contains a lysine residue that is important for binding to DNA. Mutations were found that converted this lysine to either glutamate, glycine, valine, or arginine. Which mutations would be predicted to be the most and least harmful to the ability of the enzyme to bind DNA?
   Most  Least
   A) Valine  Aspartate
Which of the following is NOT a potential problem associated with expressing a eukaryotic, protein-coding nuclear gene in prokaryotic cells? A) Lack of an intron-splicing mechanism in prokaryotic cells B) Differences in the translation initiation cordon used by eukaryotic cells and prokaryotic cells C) Susceptibility of the protein product to prokaryotic proteases D) Stability of mRNA in prokaryotic cells E) Differences in transcriptional signals between eukaryotic and prokaryotic cells.

10. The recognition site of the restriction endonuclease Avol is CPyCGPuG, where Py ia any pyrimidine and Pu is any purine. What is the expected average distance, in nucleotide pairs, between Avol cleavage sites in a random DNA sequence? A) 4096 B) 1024 C) 682 D) 64 E) 6.

11. Two-dimenstional (2-D) gel electrophoresis performed under denature conditions can be used to separate proteins according to which of the following characteristics?

<table>
<thead>
<tr>
<th>First Dimension</th>
<th>Second Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) Subunit molecular weight</td>
<td>Density</td>
</tr>
<tr>
<td>B) Density</td>
<td>Charge</td>
</tr>
<tr>
<td>C) Amino acid composition</td>
<td>Charge</td>
</tr>
<tr>
<td>D) Isoelectric point (pI)</td>
<td>Subunit molecular weight</td>
</tr>
<tr>
<td>E) Hydrophobicity</td>
<td>Subunit molecular weight</td>
</tr>
</tbody>
</table>

11. Which of the following are found only in organisms containing polycistronic mRNA? A) Missense mutations B) Polar mutation C) Temperature-sensitive mutations D) Alternative splicing sites E) Deletio mutations.

12. The expression of the TRP operon in E. coli is regulated in part by the availability of the amino acid tryptophan. This regulatory process is referred to as A) attenuation B) translational read-through C) alternative splicing D) antitermination E) nonsense suppression.

13. Which of the following types of information CANNOT be determined from the traditional Northern blotting technique? A) The size of an mRNA species B) The half-life of an mRNA species C) The strand of DNA that is transcribed into mRNA D) The amino acid sequence of the protein coded by an mRNA species E) The relative levels of an mRNA species in different tissues.

14. An E. coli strain lacking DNA polymerase I would be deficient in DNA A) repair B) methylation C) translation D) degradation E) transcription.
15. A trait determined by the action of more than one gene is called A) Polygenic B) Holandric C) polymorphic D) Epistatic E) pleiotropic.

16. Polymerase I of *E. coli* has two domains and three distinct enzymatic activities: DNA polymerase, 5'-3' exonuclease and 3'-5' exonuclease. Which statement is CORRECT in the following A) The large domain (Klenow fragment) can be separated from the small domain by mild nuclease treatment, B) The large domain has the 3'-5' exonuclease and 5'-3' exonuclease activities, but not polymerase activity, C) The small domain has the DNA polymerase activity, D) The crystal structure of the large domain shows a very narrow cleft for binding DNA, E) The active site of the enzyme is remote from the 3'-5' exonuclease active site on the large domain.

17. Which statement is INCORRECT about translational regulation in eukaryotic mRNAs? A) Translational regulation may play an important role in regulating very long eukaryotic genes, B) Some proteins bind directly to 3'UTR of mRNA and act as translational repressors, C) Translational initiation factor eIF2 can be phosphorylated to activate translation, D) Binding proteins 4E-BPS are inactivated by protein phosphorylation, E) micro-RNAs are known to inhibit translation.

18. Restriction fragment length polymorphism (RFLP) CANNOT be used for A) detect gene expression in the tissue B) determine paternal-offspring relation C) determine victim-suspect relation in forensic medicine D) detect alternative splicing E) detect family genetic disease.

19. Eukaryotic translation differs from that of prokaryotes in several ways: A) The initiating codon frequently differs from AUG, B) There are many more releasing factors, a number of which dissociate into subunits that participate in control of the process, C) There are many more initiating factors, several of which dissociate into subunits, D) Prokaryotic translation requires an RNA cap binding factor, E) Eukaryotic translation requires GTP to charge the tRNAs instead of ATP.

20. Which of the following techniques CANNOT be used to detect tissue distribution of a gene? A) Southern Blot B) Western Blot C) RT-PCR D) Northern Blot E) In situ hybridization.

2.) Essay Question: (40%)

1. Please describe the processing of mRNA precursors in eukaryotic cells.(10 point)

2. Describe the types of post-translational modification in protein of eucaryotes,
and give one example to explain its importance. (10 point)

3. Researchers studying the regulation of a hormone-responsive gene isolated 742 base pairs of DNA immediately preceding the start site of transcription (+1). They demonstrated that if these sequences are cloned upstream of the bacterial chloramphenicol acetyltransferase (CAT) gene and the DNA then introduced into mammalian cells, CAT enzyme activity increase in response to hormone treatment. To define the sequences involved in regulation of this gene, they made a series of deletions containing various lengths of the 5’ regulation sequences. They cloned these truncated DNA fragments upstream of the CAT gene as shown in the figure below, introduced the constructs into mammalian cells, and assays for CAT enzyme activity in the absent (-) and present (+) of hormone. The figure below gives the results of a representative experiment.

<table>
<thead>
<tr>
<th>5’ Regulatory Sequences</th>
<th>Units of CAT Activity</th>
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<tbody>
<tr>
<td></td>
<td>Hormone: -  +</td>
</tr>
<tr>
<td></td>
<td>CAT gene</td>
</tr>
<tr>
<td>-742</td>
<td>21  212</td>
</tr>
<tr>
<td>-638</td>
<td>27  228</td>
</tr>
<tr>
<td>-424</td>
<td>8   54</td>
</tr>
<tr>
<td>-315</td>
<td>6    59</td>
</tr>
<tr>
<td>-116</td>
<td>5    7</td>
</tr>
<tr>
<td>-27</td>
<td>0.2   0.2</td>
</tr>
<tr>
<td></td>
<td>CAT gene</td>
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<td></td>
<td>0.2  0.1</td>
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Please answer the following question:

a. Assuming that there is a single hormone-responsive regulatory element in the gene, where is the element located? (5 point)

b. What kind of transcriptional regulation information did you get from above exp.? (5 point)

c. If you are the researcher, what kind of other else technique did you used to proof the above experiment result? Please describe its operate principle. (10 point)
請回答下列生物統計學有關的問題，每題 20 分，計 100 分。

1. Pearson r 與 χ² 檢定均屬用以探討兩變項之間的相關，但兩者對於兩變項測量屬性 (levels of measurement) 的規範卻有很大的不同。試問兩者之間規範的差異在那裏？又 χ² 檢定在何種特殊情況下才考慮改用 Fisher’s exact test？

2. 無母數檢定 (nonparametric tests) 又稱 distribution free tests，顯然無母數檢定是不受制於資料分佈偏態的影響。試問當資料呈現嚴重偏態時，常用的兩個具代表性的母數檢定如 t 檢定與 F 檢定呈現不顯著差異時應如何進一步考量？

3. 單因子變異數分析 (one-way ANOVA) 的 F 檢定在進行分析之前研究者要考慮資料應滿足那些條件的假設 (assumptions)？當檢定後達統計學上顯著性差異時，研究者可進行那些事後兩兩的多重比較 (post hoc pairwise multiple comparisons)，請列舉三種。

4. 某一國內醫務管理研究者欲探討醫院層級大小 (分醫學中心、區域醫院、地區醫院以及診所四個等級) 與醫療服務品質 (分好、中等以及不好三個等級) 之間的關係。試問該研究者應以何種生物統計分析才是正確的方法？若醫療服務品質是進一步以量化連續性的指標來評估，則此一研究者欲比較此四層級醫療院所醫療服務品質上的差異，那他/她應該選用何種生物統計分析方法？

5. 某研究者欲以複迴歸分析 (multiple regression analysis) 預測病患性別、年齡、疾病嚴重度 (分輕度、中度、嚴重)、住院天數對某一疾病總醫療費用的影響。在進行分析之前為慎重起見，他/她先進行共線性診斷 (collinearity diagnostics)。試問此研究者為何要進行共線性診斷？又此複迴歸分析的結果跑出 R 及 R²。試問 R 及 R² 所代表的意義為何？
[I] 畫出下列方程式的主要產物：（40%）

1) \[
\begin{align*}
\text{CH}_3 & \quad \text{CH}_2\text{CH}_2\text{C} &= \text{CH}_2 \\
& \quad 1) \text{BH}_3 \\
& \quad 2) \text{NaOH}, \text{H}_2\text{O}_2
\end{align*}
\]

2) \[
\begin{align*}
\text{CH}_3\text{CH}_2\text{C} &= \text{C(\text{CH}_3)_2} \\
& \quad 1) \text{Hg(OAc)}_2, \text{H}_2\text{O} \\
& \quad 2) \text{NaBH}_4
\end{align*}
\]

3) \[
\begin{align*}
\text{CH}_2\text{OH} \quad \text{PCC} \\
& \quad \text{CH}_2\text{Cl}_2
\end{align*}
\]

4) \[
\begin{align*}
\text{Claisen rearrangement} & \quad 250 \degree \text{C}
\end{align*}
\]

5) \[
\begin{align*}
\text{HCl} & \quad \text{Et}_2\text{O}
\end{align*}
\]

6) \[
\begin{align*}
1) \text{O}_3 \\
2) \text{Zn}, \text{AcOH}
\end{align*}
\]

7) \[
\begin{align*}
\text{CH}_3(\text{CH}_2)_3\text{C} &= \text{CH} \\
& \quad \text{H}_2\text{O} \quad \text{HgSO}_4
\end{align*}
\]

8) \[
\begin{align*}
\text{CH}_3(\text{CH}_2)_1\text{OCOCH}_3 & \quad 1) \text{DIBAH}, \text{toluene}, -78 \degree \text{C} \\
& \quad 2) \text{H}_3\text{O}^+
\end{align*}
\]

9) \[
\begin{align*}
\quad \text{H}_2\text{NNNH}_2 \\
& \quad \text{KOH}
\end{align*}
\]

10) \[
\begin{align*}
& \quad \text{Ph}_3\text{P} - \text{CH}_2 \\
& \quad \text{THF}
\end{align*}
\]
11) \[ \text{苯} + \text{CH}_3\text{C} = \text{CH}_2 \xrightarrow{\text{H}_2\text{SO}_4} \]

12) \[ \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \xrightarrow{\text{H}_3\text{O}^+} \]

13) \[ \text{ClCH}_2\text{CH}_2\text{N}^+\text{CH}_2\text{CH}_3 \xrightarrow{\text{EtONa}} \]

14) \[ \text{CH}_3\text{CH}_2\text{Br} \xrightarrow{1) (\text{NH}_2\text{C}=\text{S}} \xrightarrow{2) \text{NaOH, H}_2\text{O}} \]

15) \[ \text{CH}_3\text{C} = \text{N} \xrightarrow{1) \text{LiAlH}_4, \text{Et}_2\text{O}} \xrightarrow{2) \text{H}_2\text{O}} \]

16) \[ \text{O}_2\text{NCH}_2\text{CO}_2\text{H} \xrightarrow{1) \text{BH}_3, \text{THF}} \xrightarrow{2) \text{H}_3\text{O}^+} \]

17) \[ \text{O}_2\text{NCH}_2\text{NH}_2 + \text{Ac}_2\text{O} \xrightarrow{\text{NaOH, H}_2\text{O}} \]

18) \[ \text{CH}_3(\text{CH}_2)_5\text{CO}_2\text{H} \xrightarrow{1) \text{Br}_2, \text{PBr}_3 \xrightarrow{2) \text{H}_2\text{O}}} \]

19) \[ \text{C} = \text{O} \xrightarrow{\triangle} \]

20) \[ \text{CH}_3\text{COBr} \xrightarrow{1) \text{NaOH \xrightarrow{2) \text{H}_3\text{O}^+}} \]
[II] 写出下列方程式的合成设计：（30%）

1) \[
\begin{align*}
\text{C}_8\text{H}_8\text{O} & \quad \rightarrow \quad \text{C}_8\text{H}_{12} \quad \text{C}_8\text{H}_{12}
\end{align*}
\]

2) \[
\begin{align*}
\text{C}_8\text{H}_8 & \quad \rightarrow \quad \text{C}_8\text{H}_{12} \quad \text{Br}
\end{align*}
\]

3) \[
\begin{align*}
\text{C}_8\text{H}_8 & \quad \rightarrow \quad \text{C}_8\text{H}_{12}
\end{align*}
\]

[III] 写出下列方程式可能的反应机理：（30%）

1) \[
\begin{align*}
\text{H}_3\text{C} - \text{C} - \text{CH}_3 + \text{H}_2\text{SO}_4 & \quad \rightarrow \quad (\text{CH}_3)_2\text{C} = \text{C} (\text{CH}_3)_2 + \text{H}_2\text{O}
\end{align*}
\]

2) \[
\begin{align*}
\text{H} - \text{C} - \text{OCH}_3 & \quad \rightarrow \quad \text{CHO}
\end{align*}
\]

3) \[
\begin{align*}
\text{C}_8\text{H}_8\text{N} + \text{CH}_2 = \text{CHC}_3\text{H}_3 & \quad \rightarrow \quad \text{C}_8\text{H}_{12} \quad \text{O}
\end{align*}
\]
簡答題：（每題 3 %，共 24 %）

1. 含有鹼性基(basic group)的胺基酸(amino acid)有那些?
2. Glutathione (GSH) 由那三種胺基酸組成?
3. Ketone bodies 包含那些成份?
4. Pentose phosphate pathway 主要產物有那些，有何功用?
5. Hexokinase 和 glucokinase 主要存在何種器官或組織中?
   對 glucose 作用時何者 Km 值較高?
6. 利用 site-directed mutagenesis 可進行何種研究?
7. 何謂 siRNA?
8. Bilirubin 是何種物質的代謝產物？可和血液中何種蛋白質結合？

問答題：

一、蛋白質混合物內含 x1、x2 及 x3，其 pI 值及分子量(mw)分別如下，
   
   x1: pI=2.5 ; mw = 1.5 kD  
   x2: pI=4.6 ; mw = 3.5 kD  
   x3; pI=6.5 ; mw = 4.7 kD  

請利用方法將它們分離、純化及定出蛋白質序列。 (16 %)

二、當 blood glucose 缺乏時透過那些代謝機制來調控維持 glucose 的濃度？ (10 %)

三、說明 TCA cycle 在生理代謝上有何重要性？其產能的位置有那些？ (10 %)

四、細胞週期(cell cycle) 在 S phase 時 DNA 進行何種變化？ (10 %)

五、在人體內有害的游離氧如何清除？參與的 enzyme 有那些？ (10 %)

六、說明 cholesterol 的重要性及其過多時對人體有那些危害？ (10 %)

七、說明 electron-transport chain 的傳遞順序，及其產生 ATP 的位置? (10 %)