

請務必於試卷紙上作答，違者該科不於計分。

1. Describe DNA replication in *E. coli*, especially discuss on replication origin, Okazaki fragment, DNA polymerase, and topoisomerase (20%).
2. Describe transcriptional initiation and termination in prokaryotes (15%).
3. Describe translational initiation and termination in eukaryotes (20%).
4. Describe how to perform Western blotting to analyze the expression of dopamine receptor in neuronal cells with or without gene knockdown and how to interpret the predicted results (15%).
5. Briefly describe the following terms (30%, 6% for each):
 - a. DNA damage induced by ultraviolet (UV) light and its repair
 - b. microRNA (synthesis, maturation, and functions)
 - c. mRNA splicing (mechanism and products)
 - d. Post-translational modifications (3 examples)
 - e. Telomerase (components and functions)

問答題 (100%)

- 1、試舉例說明人體如何運作恆定控制 (Homeostatic control)。(20%)
- 2、請說明人體發燒 (fever) 的生理機制。(10%)
- 3、細胞之間的訊息傳遞者，例如：荷爾蒙、神經傳遞因子、Paracrine 或 Autocrine，請說明其如何影響組織或細胞功能。(20%)
- 4、細胞膜的運輸有哪些方式，請說明。(10%)
- 5、請說明細胞接受器之訊息傳遞。(10%)
- 6、請敘述調控血液中鈣 (calcium)、磷 (phosphorus)平衡之荷爾蒙及其作用機制。(20%)
- 7、請敘述在胚胎性別分化上性荷爾蒙的作用。(10%)

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I. 解釋名詞：(18%)

1. fluid mosaic model
2. malate-aspartate shuttle
3. zwitterion
4. induced pluripotent stem cells (iPS)
5. glucose-alanine cycle
6. telomere

II. 簡答題：(56%)

1. 舉例四種可以做為葡萄糖新生(gluconeogenesis)的中間代謝物質？(4%)
2. 藉由可逆式共價修飾(reversible covalent modification)調控酵素活性的生化反應有那些？(6%)
3. 敘述下列生化實驗/技術的原理：(12%)
 - (1) Real-time polymerase chain reaction (Real-time PCR)
 - (2) yeast two-hybrid analysis
 - (3) DNA microarray
 - (4) Ion-exchange chromatography
 - (5) Electrophoretic mobility shift assay (EMSA)
 - (6) New generation sequencing (NGS)
4. 進行電子傳遞鏈(electron transport chain)反應時，那 3 位置 complex 會將 H^+ pump out 出粒腺體基質？電子傳遞鏈過程最後將電子傳遞給那分子？並同時將此分子轉變成何種產物？(5%)
5. 舉例三種酵素進行生化反應時需要輔酶 Thiamine pyrophosphate (TPP)參與作用？TPP 在此反應主要功能？(5%)
6. 回答下列反應參與的酵素：(4%) (限英文作答！！)
 - (1) pyruvate \rightarrow acetyl-CoA
 - (2) malate \rightarrow oxaloacetate
 - (3) acetyl-CoA \rightarrow malonyl CoA
 - (4) HMG-CoA \rightarrow mevalonate
7. 脂肪酸合成反應(lipogenesis)會重複地進行那四個步驟？反應過程需要何種輔酶參與？那些生化反應可以提供此輔酶？(7%)
8. 回答下列酵素或試劑專一性地切斷 polypeptide chain 的胺基酸位置？(7%)
(例如：pepsin: Leu, Phe, Trp, Tyr 的 N 端)
 - (1) Trypsin
 - (2) Chymotrypsin
 - (3) Cyanogen bromide
 - (4) Endoproteinase Lys C
9. 何謂乳糖不耐症(lactose intolerance)？(3%)
10. Francis Crick (1958)首先提出的分子生物學中心教條思想(central dogma of molecular biology)的理論是？(3%)

III. 問答題：(26%)

1. 人體的脂蛋白(lipoprotein)主要分為幾大類？其功能分別為何？(10%)
2. 試計算一分子棕櫚酸(palmitic acid)經人體代謝後；可以淨得多少分子 ATP？要詳細說明計算過程！
(假設 $NADH=3\text{ ATP}$ ， $FADH_2=2\text{ ATP}$) (8%)
3. 何謂蛋白質的一級、二級、三級和四級結構？並舉例說明？(8%)

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I. SENTENCE COMPLETION: You are to choose the word or phrase that best completes the sentence. 20%

- _____ he began studying in the high school, he experienced strange health problems.
(A) Shortly before (B) Not long after (C) No sooner than (D) No longer
- She didn't work on the project yesterday, _____ work on it tomorrow.
(A) nor she will (B) nor she does (C) nor will she (D) nor does she
- _____ hardiness, orchids can be cultivated particularly easily.
(A) Their (B) Since their (C) Because of their (D) It is their
- A linguist does not merely analyze language, but is able to investigate _____ make errors.
(A) what causes language learners to (B) causes language learners to what
(C) what to cause language learners (D) what cause to language learners
- The primary activity of the panda, Yuan Zai, is sleep, _____ its waking hours looking for food.
(A) that it spends (B) for spending (C) and it spends (D) will spend
- They were running although they suspected that the shuttle bus _____.
(A) has already gone (B) was already going (C) already went (D) had already gone
- _____ the movie for years, Mrs. Holiday knew instinctively what the next crisis would be.
(A) Watch (B) Watched (C) She watched (D) Having watched
- Engines are machines _____ power or motion.
(A) produce (B) producing (C) produced (D) which produced
- Besides being expensive, the food in this restaurant tastes _____.
(A) badly (B) too much bad (C) too badly (D) bad
- Being seriously anxious, _____.
(A) we have to ask him to take medicine. (B) he went to the restroom for several times.
(C) a doctor was sent for him at once. (D) his test score was really low.

II. CLOZE TEST: This passage contains several missing words or phrases. You are to choose the best answer for each missing word or phrase in the passage. 10%

Amid leaden wintry skies, it may come as a surprise to Londoners (11) new figures suggest the city has beaten its arch rival, Paris, to become the world's most popular city for tourists. However, a growing spat between the two cities' administrations suggests that, when it comes to comparisons between London and Paris, there are only lies, damn lies and statistics.

Figures (12) this week by the UK's Office for National Statistics show that 4.9 million people visited London from July to September 2013. That was an increase of 20% on the same period in the previous year – (13) London hosted the Olympics – and a new quarterly record. Taking a wider view, for the first nine months of 2013, 12.8 million visitors (14) to the British capital, an increase of 12% compared with the previous year. The figures prompted the city's promotional body, London and Partners, to proclaim that London was "on course to welcome over 16 million visitors in one year." That in turn has led to reports in Britain and abroad that London has trumped Paris as the most visited city in the world.

The two cities have actually swapped the top spot on various lists in recent years. According to the MasterCard Global Destinations Cities Index for 2012, London narrowly beat (15) Paris for the top spot with 16.9 million visitors.

(Source: "London beats Paris as top tourist city. Really?" by Simon Busch in *CNN*, published on January 20, 2014)

- (A) but (B) and (C) or (D) so
- (A) releasing (B) is releasing (C) released (D) has released
- (A) which (B) during which (C) that (D) X
- (A) flattered (B) interceded (C) attributed (D) flocked

15. (A) out (B) on (C) in (D) up

III. WRITTEN EXPRESSION: In questions 16-20 each sentence has four underlined words or phrases. Identify the one underlined word or phrase that must be changed in order for the sentence to be correct. 10%

16. Jane Addams, pursuing social reforms and humanitarianism, founding the first charitable institution, Hull-House, in

Chicago and expertly organized civic groups to bring pressure on legislatures and government officials.

17. Behind the notion of the nuclear reactors are the release of the tremendous energy in each fission.

18. The economic development of a country lies not only in a stable basis of finance, but also on a firm foundation of industry.

19. The most living things depend on two main types of cell division, mitosis and meiosis, to reproduce themselves.

20. He has finally got used to cook on an electric stove after having a gas one for so long.

IV. COMPREHENSION QUESTION: read each passage and answer questions. 60%

READING ONE

You Just Don't Understand

- A People have different conversational styles. So when people from different parts of the country, or different ethnic or class backgrounds, talk to each other, it is likely that their words will not be understood exactly as they were meant. The desire to affirm that women are equal has made some scholars reluctant to show that they are different. There *are* gender differences in ways of speaking, and we need to identify and understand them.
- B Men often engage the world as “an individual in a hierarchical social order in which they are either one-up or one-down”, a question of gaining and keeping the upper hand. Women are more likely to approach it as “a network of connections” in which conversations are negotiations for closeness and people try to seek and give confirmation and support, and to reach consensus.
- C So, to Josh, checking with his wife about a convenient date for a dinner party resembles “seeking permission”; to Linda it is simply a recognition that lives are interwoven and complex. This is the struggle between independence and **intimacy**. The modern face of chivalry: holding the door is an act of power — showing that I (the male) grant you (the female) permission to pass through. There seems to be a male obsession with ‘freedom’ or independence. Women academics value the opportunity to pursue interests; men value the freedom from others’ control.
- D Throughout history, women have been punished physically and psychologically for talking too much, yet studies show that men talk more and for longer periods. In one study men’s turns ranged from 10.66 to 17.07 seconds, while women’s lasted from 3 to 10 seconds. The difference is that men are more comfortable with public speaking, report talk, women with private speaking, rapport talk. Rapport talk establishes relationships, seeking similarities and matching experiences. “For most men, talk is primarily a means to preserve independence and negotiate and maintain status in a hierarchical order.” Men are more likely to tell jokes in public than women: it is another way of gaining centre stage and proving their abilities.
- E Whereas women’s cooperative overlaps frequently annoy men by seeming to coopt their topic, men frequently annoy women by taking over or switching the topic. Women and men feel interrupted by each other because of the differences in what they are trying to accomplish with talk. Men who approach conversation as a contest are likely to expend effort not to support the other’s talk but to lead the conversation in another direction, perhaps one in which they can take centre stage by telling a story or joke or by displaying knowledge. Women’s effusion of support can be irritating to men who would rather meet with verbal debates.
- F Women are frequently judged differently even if they speak the same way as men. Hayes Bradley found that women using tag-questions were judged less intelligent than men who also used them. Women who did not provide evidence to support their arguments were judged less intelligent than men who did not. People asked why a baby is crying say — if it is a boy — that he is angry and — if it is a girl — that she is scared. When women and men are together, women tend to follow the topics the males want: “male-female conversations are more like men’s conversations than they are like women’s.”
- G “If you understand gender differences in what I call conversational style, you may not be able to prevent disagreements from arising, but you stand a better chance of preventing them from spiraling out of control... Understanding the other’s ways of talking is a giant leap across the communication gap between women and men, and a giant step toward opening lines of communication.”

21. The article is mainly about _____.
 - (A) reasons women talk differently from men
 - (B) ways people have different conversational style
 - (C) the differences between men and women using language
 - (D) things that make understanding opposite gender difficult
22. The main idea of Paragraph A is _____.
 - (A) understanding people's words is difficult
 - (B) understanding people of the same ethnic backgrounds is easier
 - (C) scholars are reluctant to show that genders are different
 - (D) we need to know the differences between genders in ways of speaking
23. Paragraph B is mainly about _____.
 - (A) the engagement of a hierarchical social order
 - (B) the importance of social network
 - (C) the gender differences regarding social relationships
 - (D) how men and women have different social status in speaking
24. Paragraph C is mainly about _____ existing in different genders.
 - (A) the struggle between independence and intimacy
 - (B) the difference between permission and recognition
 - (C) the discrepancy between power and interests
 - (D) the contradictory between freedom and opportunity
25. In Paragraph C, *intimacy* probably means _____.
 - (A) closeness
 - (B) control
 - (C) power
 - (D) freedom
26. The main idea of Paragraph D is _____.
 - (A) women talk more than men
 - (B) it's a stereotype that women talk more than men
 - (C) men and women have different styles of talking
 - (D) women talk more in private, and men talk more in public
27. Which sentence from Paragraph E states the main idea?
 - (A) Men frequently annoy women by taking over or switching the topic.
 - (B) Women and men feel interrupted by each other because of the differences in what they are trying to accomplish with talk.
 - (C) Men are likely to expend effort not to support the other's talk but to lead the conversation in another direction.
 - (D) Women's effusion of support can be irritating to men who would rather meet with verbal debates.
28. Which sentence from Paragraph F states the main idea?
 - (A) Women are frequently judged differently even if they speak the same way as men.
 - (B) Women using tag-questions were judged less intelligent than men who also used them.
 - (C) Women who did not provide evidence to support their arguments were judged less intelligent than men who did not.
 - (D) Male-female conversations are more like men's conversations than they are like women's.
29. Which of the following is a logical inference based on Paragraph F?
 - (A) People have stereotype regarding gender differences in speaking.
 - (B) Women use tag-questions more than men do.
 - (C) Men talk with evidence more than women do.
 - (D) Boys have bad temper than girls do.
30. Paragraph G is mainly about _____.
 - (A) the importance of understanding the differences of gender in conversational style
 - (B) the disagreements existing in the communication gap between women and men
 - (C) the giant communication gap between women and men
 - (D) the ways of understanding a giant leap and step in communication

READING TWO

Slow Down! Why Some Languages Sound So Fast

A It's an almost universal truth that any language you don't understand sounds like it's being spoken at 200 m.p.h. — a storm of alien syllables almost impossible to tease apart. That, we tell ourselves, is simply because the words make no sense to us. Surely our spoken English sounds just as fast to a native speaker of Urdu. And yet it's equally true that some languages seem to zip by faster than others. Spanish blows the doors off French; Japanese leaves German in the dust — or at least that's how they sound.

B But how could that be? The dialogue in movies translated from English to Spanish doesn't whiz by in half the original time after all, which is what it should if the same lines were being spoken at double time. Similarly, Spanish films don't take four hours to unspool when they're translated into French. Somewhere among all the languages must be a great equalizer that keeps us conveying information at the same rate even if the speed limits vary from **tongue** to tongue.

C To investigate this puzzle, researchers from the Université de Lyon recruited 59 male and female volunteers who were native speakers of one of seven common languages — English, French, German, Italian, Japanese, Mandarin and Spanish — and one not so common one: Vietnamese. All of them were instructed to read 20 different texts, including the one about the house cat and the locked door, into a recorder. All of the volunteers read all 20 passages in their native languages. Any silences that lasted longer than 150 milliseconds were edited out, but the recordings were left otherwise untouched.

D The investigators next counted all of the syllables in each of the recordings and further analyzed how much meaning was packed into each of those syllables. A single-syllable word like *bliss*, for example, is rich with meaning — signifying not ordinary happiness but a particularly serene and rapturous kind. The single-syllable word *to* is less information-dense. And a single syllable like the short *i* sound, as in the word *jubilee*, has no independent meaning at all.

E With this raw data in hand, the investigators crunched the numbers together to arrive at two critical values for each language: the average information density for each of its syllables and the average number of syllables spoken per second in ordinary speech. Vietnamese was used as a reference language for the other seven, with its syllables (which are considered by linguists to be very information-dense) given an arbitrary value of 1.

F For all of the other languages, the researchers discovered, the more data-dense the average syllable was, the fewer of those syllables had to be spoken per second — and thus the slower the speech. English, with a high information density of .91, was spoken at an average rate of 6.19 syllables per second. Mandarin, which topped the density list at .94, was the spoken slowpoke at 5.18 syllables per second. Spanish, with a low-density .63, ripped along at a syllable-per-second velocity of 7.82. The true speed demon of the group, however, was Japanese, which edged past Spanish at 7.84, thanks to its low density of .49. Despite those differences, at the end of, say, a minute of speech, all of the languages would have conveyed more or less identical amounts of information.

G "A tradeoff is operating between a syllable-based average information density and the rate of transmission of syllables," the researchers wrote. "A dense language will make use of fewer speech chunks than a **sparser** language for a given amount of semantic information." In other words, your ears aren't deceiving you: Spaniards really do **sprint** and Chinese really do stroll, but they will tell you the same story in the same (39) of time.

H None of that, of course, makes the skull-cracking business of trying to learn a new language any easier. It does, however, serve as one more reminder that beneath all of the differences that separate Tagalog from Thai, from Norwegian, from Wolof, from any one of the world's 6,800 other languages, lie some very simple, very common rules. The DNA of speech — like our actual DNA — makes us a lot closer to one another than we think.

(Source: "Slow Down! Why Some Languages Sound So Fast" by Jeffrey Kluger in *Time*, published on September 8, 2011)

31. In Paragraph B, *tongue* probably means _____.

- (A) an organ (B) a language (C) a mouth (D) a word

32. In Paragraph G, *sparse* probably means _____.

- (A) little (B) abundant (C) ancient (D) diverse

33. In Paragraph G, *sprint* probably means _____.

- (A) wander (B) spat (C) run (D) roam

34. One word is missing in Paragraph G. Which of the following can make the sentence meaningful?

- (A) way (B) number (C) line (D) span

35. Regarding the speed limits of languages, which of the following is not true?
- (A) The speed of spoken Mandarin is faster than that of English.
 - (B) The speed of spoken Urdu is as fast as that of English.
 - (C) The speed of spoken Spanish is faster than that of French.
 - (D) The speed of spoken German is slower than that of Japanese.
36. Which of the following descriptions about the study mentioned in the article is correct?
- (A) Because a two-hour Spanish film is always translated into a four-hour French one, a group of researchers conducted the research.
 - (B) The study recruited subjects who could speak at least two languages.
 - (C) Mandarin is a common language, and so is Italian.
 - (D) All the silences were excluded from the experiment.
37. Which language was used as a reference language for the study?
- (A) English (B) Spanish (C) Mandarin (D) Vietnamese
38. Researchers of the study collected two critical values for each language they investigated. What were they?
- (A) the number of raw data and the information density for each syllable
 - (B) the information density for each syllable and the number of syllables spoken per second
 - (C) the number of raw data and the number of syllables spoken per second
 - (D) None of the above.
39. What was the finding of the study?
- (A) The shorter a syllable is, the more meaning it carries.
 - (B) Each Spanish syllable carries more information than each English syllable does.
 - (C) The number of raw data for Mandarin is higher than that for Spanish.
 - (D) All languages would have carried more or less identical amounts of information during the same amount of time.
40. Which language is easier to learn?
- (A) the one which bears less information in a sentence
 - (B) the one which is spoken in a relatively slow way
 - (C) the one whose DNA is closer to our body's DNA
 - (D) none of the above

READING THREE

British Education System

- A Education in the UK is **compulsory**. Children are legally obliged to attend school from the ages of 5 (4 in Northern Ireland) to 16. In 1992 there were 9.5 million full-time school/college students.
- B Parents can choose between ending their children to state schools or to private schools. State schools are funded by local and central government. About 93% of pupils receive free education from the public sector. The government also sometimes assists schools established by religious groups.
- C Since 1993, parents have the right to express a preference for a particular state school for their children. A system of “**league tables**” – comparative tables which rank schools according to public examination results, truancy rates, destinations of school leavers, and so on – are published in order to help parents make choices. While children usually attend the school they live closest to, now ambitious parents sometimes move to a different neighborhood in order to be close to a well-performing school. Needless to say, good schools tend to be in middle class neighborhoods and it is the wealthier middle classes who can most easily afford to move if they think it is necessary.
- D In the private sector there are independent schools which are commonly, but confusingly, called public schools. (They are called public schools because they were originally seen as “public” alternatives to having private tutors in aristocratic households.) Independent schools receive their funding through the private sector and through tuition rates, with some government assistance. Independent schools are not part of the national education system, but the quality of instruction and standards are maintained through visits from Her Majesty’s Inspectors of Schools. Parents choose to pay fees in order to send their children to these schools because the quality of education is such that their children have a better chance of getting into good universities and/or getting better jobs when they leave school.

- E Up to age 5, children may have some pre-primary schooling in nursery schools, daycare, or play groups. The government has no obligation to provide such facilities and so many are private enterprise arrangements. However, the state realizes such provision is important, especially now that many mothers work, and so they provide some financial support.
- F Between the ages of 5 and 11, pupils mainly attend state sector primary schools. These schools are called co-educational or mixed schools because they admit both boys and girls.
- G From the age of 11 up to around the age of 19, students attend secondary schools. More than 80% of pupils in secondary schools in England and Wales attend mixed schools; 60% in Northern Ireland; Scotland, nearly all.
- H About 90% of secondary schools are comprehensive schools which admit children without reference to their academic abilities. Such schools provide a general education. Pupils can study everything from academic subjects like literature and sciences, to more practical subjects like cooking and carpentry.
- I Foreign languages are taught as an **integral** part of the National Curriculum, reflecting the importance of Britain's relationship with Europe.
- J Those children who do not attend comprehensive schools attend grammar schools instead. Grammar schools select children, usually at the age of 11, through an examination called "the 11-plus". Those who show academic potential are admitted to the grammar schools where the emphasis is on advanced academic work rather than the more general curriculum of the comprehensive schools. In Northern Ireland the grammar school/non-grammar school division is still common, but throughout the rest of Great Britain grammar schools are becoming increasingly rare.
- K After five years of secondary education, (at about age 16) English, Northern Irish and Welsh students sit their GCSEs exams (General Certificate of Secondary Education). GCSEs are the main means of assessing pupils' progress in their final two years of compulsory education. Based on these results, pupils then decide what avenue of education they would like to follow. They have a number of choices. At the age of 16, they can decide to quit school and find a job; or they can prepare to sit exams for university entrance; or they can concentrate on vocational training. Every 16 and 17 year old is guaranteed a place in full-time education or training.
- L Pupils who hope to attend university carry on their academic study in the sixth form for a further two years and then sit A-levels exams (General Certificate of Education – Advanced). Most pupils try to achieve three or four A-levels in the subjects they are most proficient at. Since admittance to universities depends largely on A-level results, the two years spent in the sixth form are very important and often very stressful for British pupils. Among first year university students getting to know each other, the most common question after "What's your name?" and "Where are you from?" is "What A-levels did you take?"
- M Other pupils who decide not to go to university may choose to take vocational training. The vocational equivalent of A-levels are GNVQs (General National Vocational Qualifications), which provide a broadly based preparation for work or for taking further vocational.

(Source: "The Present Education System" in *The Society and Culture of Major English-Speaking Countries*, Bookman, 2002)

41. In Paragraph A, *compulsory* probably means _____.
 (A) comprehensive (B) obligatory (C) complete (D) optional
42. In Paragraph I, *integral* probably means _____.
 (A) immigrant (B) essential (C) international (D) redundant
43. _____ receive their funding entirely through government assistance.
 (A) private schools (B) independent schools (C) state schools (D) public schools
44. The system of "league tables" shows _____.
 (A) which schools are better than others
 (B) which schools ask for more tuition
 (C) which schools have more examinations
 (D) which schools receive less funding from government
45. Which of the following is not true?
 (A) The majority of children go to boarding schools.
 (B) Good schools tend to be in middle class neighborhood.
 (C) The quality of instruction and standards of private schools are supervised.
 (D) Children studying in private schools can get better jobs when they leave school.

46. Which of the following is not true?
- (A) 3 year olds can go to nursery schools.
 - (B) 9 year olds study in primary schools.
 - (C) 15 year olds attend secondary schools.
 - (D) None of the above is correct.
47. If a student wants to emphasize on advanced academic work, which school should he or she go to?
- (A) comprehensive school
 - (B) secondary school
 - (C) independent school
 - (D) grammar school
48. The number of _____ in Britain is decreasing.
- (A) grammar schools
 - (B) comprehensive schools
 - (C) state schools
 - (D) technical schools
49. A fifth-grader of a secondary school may decide his or her future grounded on the examination called _____.
- (A) General Certificate of Education – Advanced
 - (B) General Certificate of Secondary Education.
 - (C) the common entrance examination
 - (D) General National Vocational Qualifications
50. Which of the following is not true about the British education system?
- (A) All the state sector primary schools admit both boys and girls.
 - (B) Comprehensive schools provide a general education.
 - (C) The system guarantees students of 16 years old a full-time education or training.
 - (D) The university entrance in Britain is not competitive.