

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

簡答題

1. The Nobel prize in chemistry 2015 was awarded to Professors Tomas Lindahl, Paul Modrich and Aziz Sancar for their "Mechanistic studies of DNA repair". During every cell division, $> 3 \times 10^9$ DNA base pairs are replicated and transferred to the daughter cells. Please briefly answer the following question:

- (a) List the possible causes of DNA damage, including *in vivo* and external factors. (4 分)
- (b) What are the three DNA repair systems discovered by the three prize awardees? (6 分)
- (c) If DNA damage is not properly repaired, several types of mutation may be generated in the cell. Define the following terms: (14 分)
 - i. Base-pair substitutions:
 - ii. Frameshift mutations:
 - iii. Transition and transversion:
 - iv. Missense mutation:
 - v. Nonsense mutation:
 - vi. Silent mutation:
 - vii. Synonymous mutation:
- (d) List 3 human diseases that are known to be caused by defective genes in DNA repair systems. (6 分)
- (e) What are the 2 common repair mechanisms through which the cell undergoes when repairing DNA double strand break? (4 分)

2. Briefly describe the role or the meaning of the following terms: (16 分)

- (a) Long non-coding RNA
- (b) Pluripotent stem cells
- (c) Ubiquitination
- (d) Transcription factors
- (e) Epithelial-mesenchymal transition
- (f) Genome editing
- (g) Exosome
- (h) Transcriptome

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3. 日本醫學家，京都大學教授山中伸彌 (Yamanaka Shinya) 獲得 2012 年諾貝爾生理學或醫學獎。他發現的“誘導性多功能幹細胞”(induced pluripotent stem cells; 縮寫作 iPS) 與我們過去傳統的胚胎幹細胞有何不同? (6%) 這樣的發現在醫學上將可以應用在哪些疾病或醫學領域上? (6%)
4. 所謂“基因改造物種”(genetic modifier organism) 原理為何? (3%) 對農糧作物有何幫助? (3%) 就食品安全角度考量，它對人類或生物體的影響為何? (3%) 科學家如何偵測出我們的食品是否為基因改造食品? (3%)
5. 如果“A 基因”對細胞功能相當重要，科學家發現缺乏“A 基因”背景的實驗鼠無法生產出下一代的小鼠；倘若我們要研究此“A 基因”在心臟功能上的重要性，需要以實驗鼠做為動物模式來研究時，可以有哪些不同的方法來解決此一實驗問題? (8%)

解釋名詞 (18%; 各 3%)

1. Translational medicine
2. Micro RNA
3. Proteomics
4. Apoptosis
5. Autophagy
6. Innate immunity