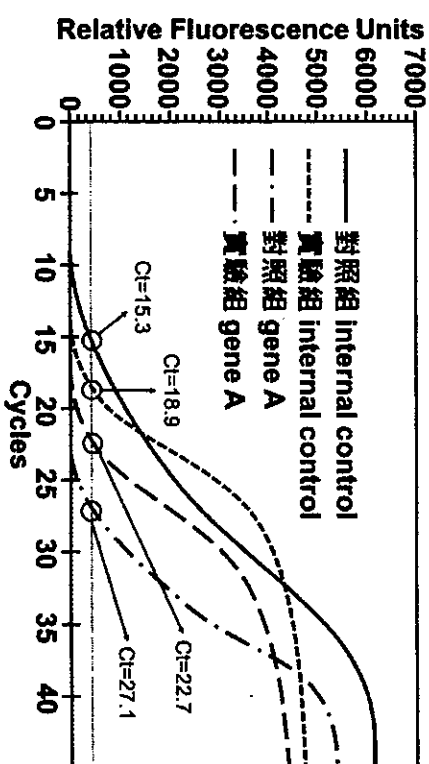


問答題：(總共 100 分)

1. Please describe what non-coding RNA is and what function it may have. (5 分)
2. Bacteriophages are viruses that can infect bacteria. They can have a lytic or lysogenic cycle after infection. What is the regulation of gene expression between the lytic and lysogenic cycles? (5 分)
3. The 2020 Nobel Prize in Chemistry is awarded for the discovery of the genetic scissors: CRISPR, a tool for rewriting the code of life. CRISPR stands for clustered regularly interspaced short palindromic repeats. Please describe what CRISPR is and how it is utilized as a tool for genetic editing. (5 分)
4. Gene silencing is generally defined as a way to suppress gene expression in a cell. Please describe how gene silencing can be achieved. (5 分)
5. RNA and DNA are both nucleic acids. Why is RNA less stable than DNA (5 分)?
6. 次世代定序(NGS, Next-generation sequencing)已成為分子生物學技術上劃時代的突破，請簡述一下你對次世代定序的了解。你可以從方法原理、機台種類、操作步驟、優勢劣勢、臨床應用等方面進行申論。(5 分)
7. 假設你的研究所指導老師發現了一個新的致癌基因(oncogene)，覺得他很有可能促進癌細胞的生長與轉移，希望你設計一系列的實驗來證明這個假設，請問你會進行哪些實驗來證明這個假設，並且未來有可能作為臨床應用的標的？請將實驗設計與可能會用到的分子生物學技術平行列出。(5 分)
8. 假設你正用即時定量聚合酶鍊鎖反應(RT-QPCR)來探討細胞加了藥物培養後(實驗組)，對 gene A 表現量的影響，結果如下圖：請問



見背面

- A. 即時定量聚合酶鍊鎖反應的原理為何? (2分)
- B. Ct 值的意義為何? (1分)
- C. Gene A 在藥物處理後，表現量如何改變? (2分)
- D. 通常會用來做為 internal control 的 gene 具備甚麼特性? 是否可以舉一個 gene 為例? (2分)
9. 癌症的診斷與監控是近年重要的議題，許多的技術也因此而發展，其中周邊循環腫瘤細胞(CTC, circulating tumor cell)就是一個應用的標的，請問如果你想達成：“捕捉癌症病人周邊循環腫瘤細胞，用以檢測其帶有的癌症基因突變”，為了達到這訴求，你需要怎麼做，會需要應用到哪些分子生物學的技术? (5分)
10. 請敘述何謂數位化聚合酶鍊鎖反應(digital PCR)，原理為何?如何判讀結果?如何應用? (3分)
11. 各種核酸聚合酶 (DNA polymerases) 為複製生物體遺傳物質的重要酵素，請列舉下列核酸聚合酶特性及生理功能 (最多 4 個)，例如：proofreading, primer synthesis, leading-strand synthesis, lagging-strand synthesis, RNA primer processing, mitochondrial DNA replication, prokaryotic DNA replication, eukaryotic DNA replication, base excision repair, mismatch repair, nucleotide excision repair, translesion synthesis, thermal stable DNA polymerase, processive DNA polymerase, nonprocessive DNA polymerase.
- (a) DNA polymerase  $\alpha$  (3分)
  - (b) DNA polymerase  $\gamma$  (3分)
  - (c) DNA polymerase  $\delta$  (3分)
  - (d) DNA polymerase I (3分)
  - (e) DNA polymerase III (3分)
  - (f) DNA polymerase  $\beta$  (2分)
  - (g) DNA polymerase  $\epsilon$  (2分)
  - (h) DNA polymerase  $\kappa$  (2分)
  - (i) Taq DNA polymerase (2分)
  - (j) DNA polymerase IV (2分)

12. Welly is receiving chemotherapy for acute myeloid leukemia, and waits for hematopoietic stem cell transplantation. The HLA genotypes of Welly's sibling and offspring are as follows. According to Mendel's laws, please figure out the HLA haplotypes of Welly and his wife in the order of HLA-A, -B, -C, -DRB1, and DQB1 loci. (10 分)

HLA Locus	A	B	C	DRB1	DQB1
Sibling	11:01, 32:02	15:01, 51:07	04:01, 14:02	01:01, 04:06	03:02, 05:01
Son 1	24:02, 31:01	07:04, 40:02	03:03, 12:02	14:03, 14:54	03:01, 05:03
Son 2	24:02, 24:02	40:01, 40:02	03:03, 07:02	09:01, 14:54	03:03, 05:03
Daughter	11:01, 24:02	15:01, 40:01	04:01, 07:02	04:06, 09:01	03:02, 03:03

13. Please describe the oscillation of gene expression, and then illustrate the feedback mechanism controlling the oscillation of *period* gene expression in *Drosophila* circadian clock. (15 分)

試題必須隨卷繳回