

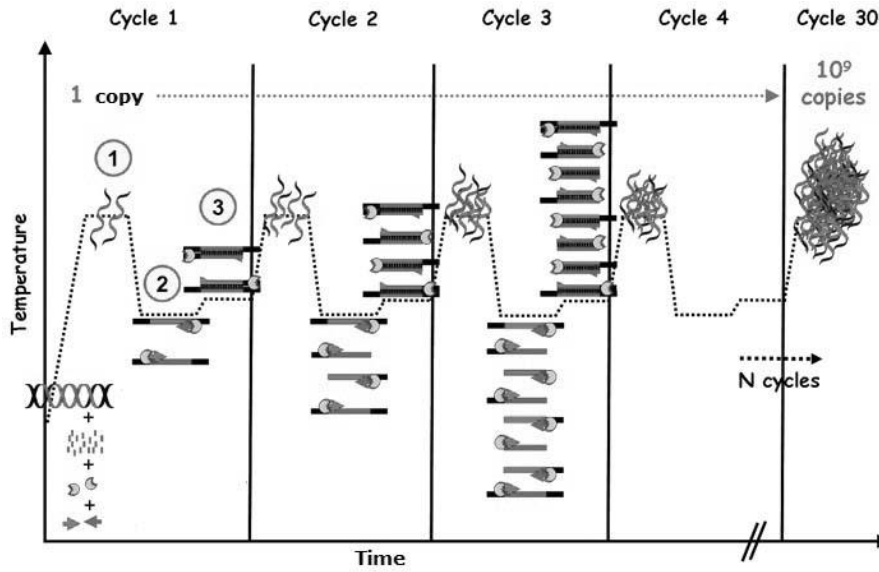
一、單選題：每題 2 分。

1. Which is the most proper way to use 99.5% ethanol and pure water to make 1 liter of 70% ethanol?
 - A) Mix ~700 ml of 99.5% ethanol and 300 ml of pure water.
 - B) Mix ~70 ml of 99.5% ethanol and 930 ml of pure water.
 - C) Mix ~700 ml of 99.5% ethanol and 1000 ml of pure water.
 - D) Mix ~70 ml of 99.5% ethanol and 1000 ml of pure water.
2. Proteins are biological polymers composed of monomeric building blocks called _____, which are linked covalently by the _____ bond.
 - A) monosaccharides glycosidic
 - B) nucleotides phosphodiester
 - C) amino acids peptide
 - D) glycerols hydrogen
3. _____ can be used to break the bond _____.
 - A) Proteases ... between two residues in a polypeptide
 - B) Restriction enzymes ... of the DNA backbone at a specific sequence
 - C) Phosphatases ... between a phosphate group and its attached molecule
 - D) All of above are correct.
4. Which of the following statement is NOT correct?
 - A) When a protein is denatured, it loses its tertiary structure but the primary structure remains unchanged.
 - B) Adding SDS to a protein sample will disrupt the native conformation of a protein and also break the disulfide bond.
 - C) Ion exchange chromatography can separate different proteins in a mixture based on their charges.
 - D) How fast a protein moving through a sucrose gradient during centrifugation is dependent on the mass and shape of the protein.
5. The isoelectronic point of an amino acid is the point where
 - A) the pK of the carboxylic acid is the same as the amino group.
 - B) sodium ions are attracted to the amino groups.
 - C) the solubility of the amino acid is maximized.
 - D) the amino acid carries no net electrical charge.

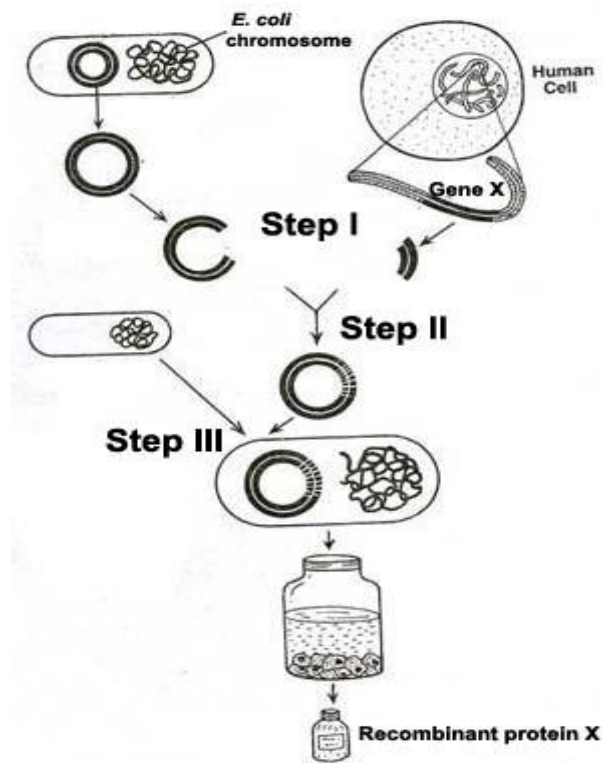
6. An enzyme-linked immunosorbent assay requires
- A) a radioactive substrate.
 - B) a complementary nucleotide probe.
 - C) an antibody that binds the protein of interest.
 - D) a catalytic antibody.
7. Which of the following about enzyme inhibition is correct?
- A) An uncompetitive inhibitor prevents the substrate from binding to the active site of the enzyme.
 - B) A competitive inhibitor lowers the V_{\max} but the K_M remains unaffected.
 - C) An irreversible inhibitor binds to and modifies the enzyme through non-covalent interaction such as hydrogen bonds, electrostatic, or van der Waals interaction.
 - D) No answer from above is correct.
8. Which of the following statements about gene manipulation is NOT correct?
- A) Classic gene knockout technology is achieved by replacing the target gene with the introduced plasmid construct through homologous recombination.
 - B) Morpholino oligonucleotides can be used to inhibit embryo gene expression in animal such as zebrafish and frogs.
 - C) The RNA interference technique uses single-stranded RNA complementary to the target gene and interferes its expression.
 - D) CRISPR/Cas9 system is a new technology which uses a guide RNA and specific nuclease to edit the genome.
9. Which of the following statements about cell biology is NOT correct?
- A) Mitotic spindles, centrosomes, and cilia are structures composed of actin filaments.
 - B) The proteasome recognizes a protein carrying long chains of ubiquitin units and degrades the protein.
 - C) Transcription factors, when activated, translocate to the nucleus, bind to specific DNA sequences, and regulate the mRNA synthesis of their target gene.
 - D) Ion channels allow ions to move across two membrane compartments downhill to the electrochemical gradient, while ion pumps facilitate ions to move uphill with the input of energy.

二、簡答題：每題 8 分。

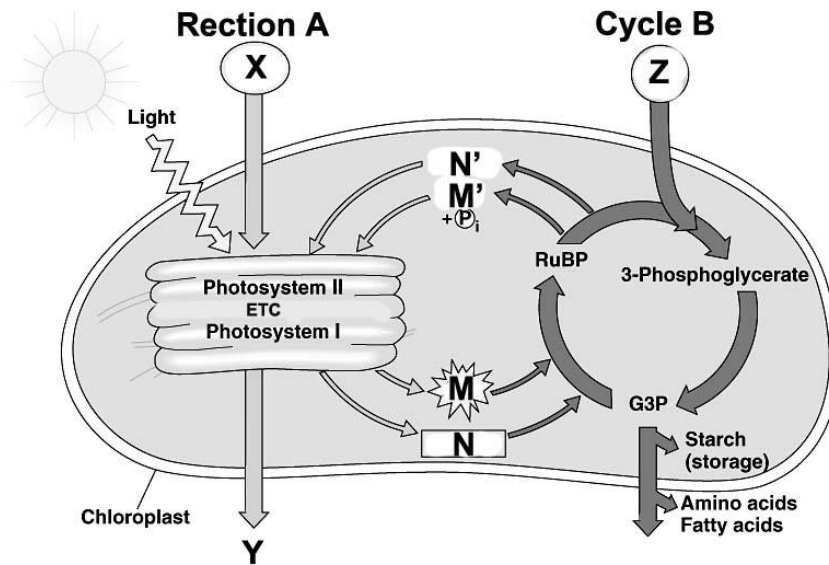
1. 附圖為一種常用的分子生物學技術，請寫出其名稱並說明操作步驟與原理。



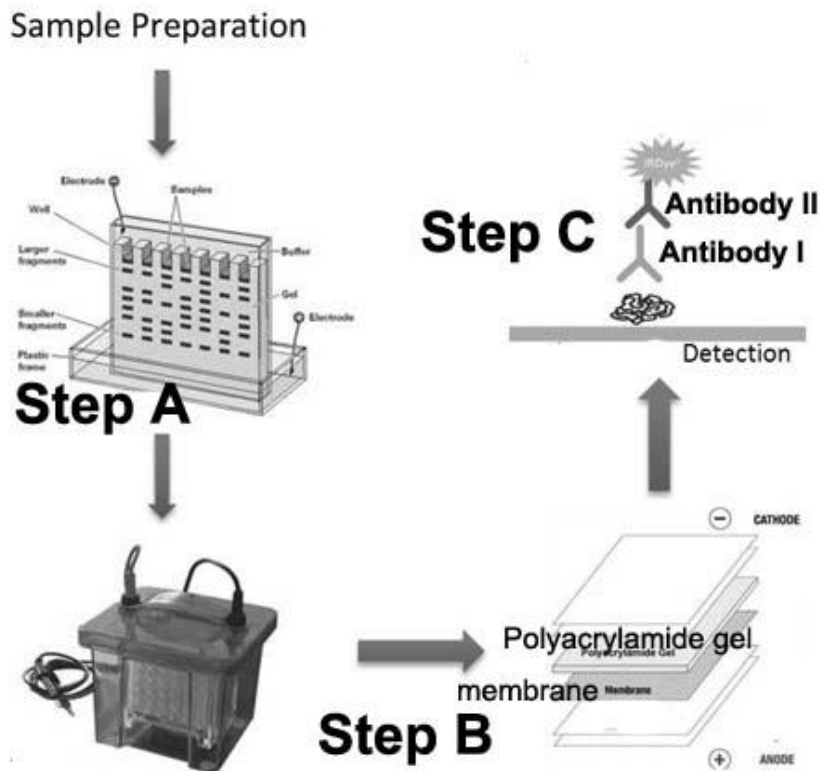
2. 附圖為利用微生物產製重組蛋白的流程示意，請為此圖撰寫說明，包括所使用的關鍵酵素。



3. 附圖為植物光合作用的示意圖，請簡述 Reaction A 與 Cycle B 的作用為何，說明時應包括分子 X、Y、Z、M、N 的名稱。



4. 附圖為一種常用以偵測特定蛋白質的技術。請為此圖撰寫說明，應包括 Step A、B、C 為何，並說明 Antibody I 與 II 之作用。



三、問答題：每題 10 分。

1. 請解釋何謂生物科技 (biotechnology)？並舉出哪些方法與技術或產品，是屬於生物科技的應用與產業 (例如：基因療法、螢光魚)。(把你知道的都儘量寫出)
2. 請說明何謂載體 (vector)？請寫出常用的載體類別與種類 (把你知道的都儘量寫出)。
3. 假設一個實驗，想要利用原位雜交反應 (*in situ* hybridization) 去觀察斑馬魚胚胎在不同發育期， β -actin 基因的表現，需要利用 RNA 探針 (probe)，請說明如何產生 β -actin 的 RNA 探針？(由 PCR 得到一段 β -actin 開始，一步步說明實驗方法)
4. 在胚胎發育與基因調控研究方面，經常使用一些特定的生物來進行實驗，我們稱之為模式生物 (model animal)，請列舉出常見之 model animal (例如：斑馬魚 zebrafish、線蟲 C. elegans)。(把你知道的都儘量寫出，中、英文名稱與學名，寫其中一種就可以)
5. 常見胺基酸有 20 種，請寫出其中 10 種。(中、英文名稱或英文縮寫都可以，一種氨基酸寫一種寫法就好，例如：甲硫胺酸、methionine, Met 三種名稱寫其中一種)