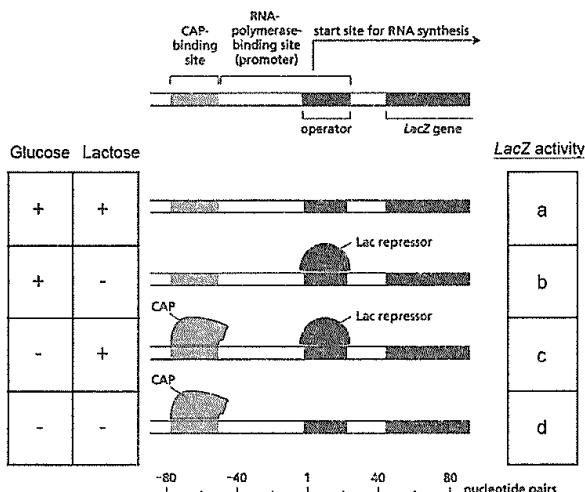


※ 注意：請於試卷內之「非選擇題作答區」作答，並應註明作答之題號。

1. Match the damage type or repair step at the left with a related enzyme at right. Only one answer will be the most direct for each. (11%)

- | | |
|--|---|
| ___ cytosine deamination | (a) hypoxanthine -N-glycosylase |
| ___ base loss | (b) AP endonuclease |
| ___ adenine deamination | (c) mutH protein |
| ___ binds to GATC sequences | (d) DNA polymerase I |
| ___ binds to mismatch in DNA | (e) uracil N-glycosylase |
| ___ DNA synthesis in gaps | (f) mutS -mutL complex |
| ___ seals nicks | (g) ABC excinuclease |
| ___ O ⁶ -methylguanine | (h) DNA photolyase |
| ___ direct chemical reversal of pyrimidine dimer formation | (i) O ⁶ -methylguanine methyltransferase |
| ___ double-strand break | (j) DNA ligase |
| ___ excision of a lesion-containing oligonucleotide | (k) λ integrase |
| | (l) RecA protein |
| | (m) restriction endonuclease |

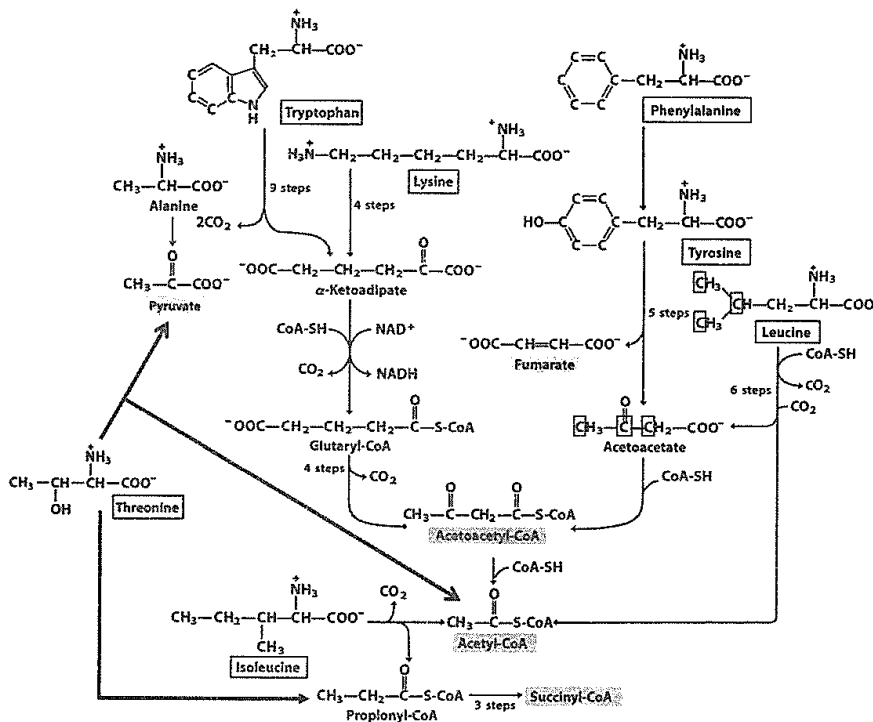
2. In Figure below, the bacterial activator protein CAP and the Lac repressor have been placed in the four possible combinations on their binding sites in the promoter for the Lac operon. Each combination of gene regulatory proteins corresponds to a particular mixture of glucose and lactose. For each of the four combinations, indicate on the left-hand side of the figure which sugars must be present and, on the right-hand side (a-d), whether the operon is expected to be turned ON or OFF. (4%)



3. DNA synthesis on the lagging strand in *E. coli* is a complex process known to involve several proteins. Initiation of a new chain is catalyzed by the enzyme (a) _____, and elongation is catalyzed by the enzyme (b) _____. Synthesis is discontinuous, yielding short segments called (c) _____, which are eventually joined by the enzyme (d) _____, which requires the cofactor (e) _____. (5%)

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4. What is low-density lipoproteins (LDL)? How LDL is formed? And how it its catabolized? (8%)
5. What are ketone bodies? When and how ketone bodies are formed? (8%)
6. How many kinds of membrane proteins do you know? List them. Think about multiple ways by which proteins interact with membranes. (4%)
7. Answer the questions based on the figure below. (8%)

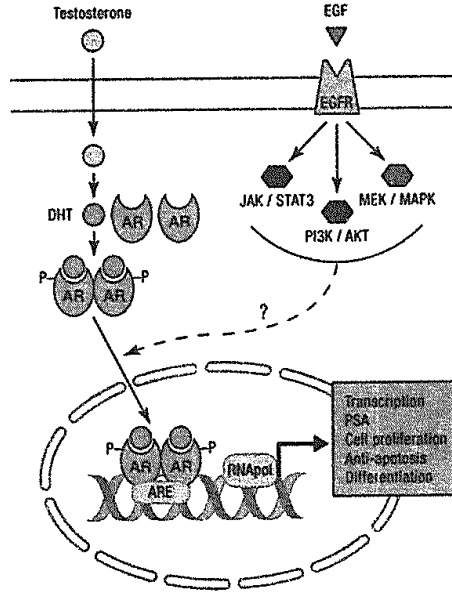


- 1) How many amino acids are there in the figure? (1%)
- 2) List ketogenic amino acids. (1%)
- 3) List strictly ketogenic amino acids. (1%)
- 4) List glucogenic amino acids. (1%)
- 5) List strictly glucogenic amino acids. (1%)
- 6) List ketogenic and glucogenic amino acids. (1%)
- 7) Which amino acid produce the most amount of acetyl-CoA per mole? How many? (2%)
8. There are different platforms of next-generation sequencing: pyrosequencing, sequencing by ligation, sequencing by synthesis, SMRT sequencing and semiconductor sequencing. Pick one and describe how it works. (4%)

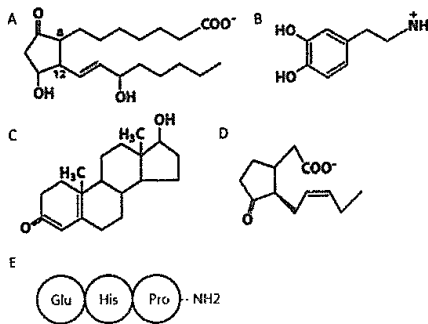
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9. It has been well-studied that several hormones can promote prostate cancer cell growth: (1) Testosterone can enter the cells and then be converted to DHT, a specific ligand for androgen receptor (AR); (2) Epidermal Growth Factor (EGF) will signal through EGF receptor (EGFR) to promote cancer cell proliferation. Please answer the following questions based on what you have learned about signaling transduction. (8%)

- 1) What type of receptor do you think AR is? (2%)
- 2) Upon Testosterone binding to AR, what will happen next? (more than one correct answer) (3%)
 - A) AR Dimerization
 - B) AR degradation
 - C) AR binding to DNA
 - D) AR autophosphorylation of several tyrosine residues
 - E) AR conformation change



- 3) Testosterone can pass through plasma membrane without a transporter. Based on this information, which molecule do you think is likely to be testosterone? (1%)
- 4) Which molecule do you think will be synthesized less in the presence of Aspirin? (Select one hormone structures from above) (2%)



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10. Please describe signaling cascades (4%).
11. Which one of the following is NOT a general feature of hydrophilic hormones? (2%)
- A) They are proteins and polypeptides
 - B) They do not need a transport protein
 - C) Their plasma half-life is long in hours
 - D) They act through second messenger
12. Pancreatic hormones include the following EXCEPT: (2%)
- A) Insulin
 - B) Glucagon
 - C) Cholecystokinin
 - D) Somatostatin
13. John inoculated two test tubes with the same amount of identical growth medium and with the same number of identical yeast cells and grew these cells under identical conditions except for the presence or absence of oxygen. After 12 hours, all of the glucose in each culture had been consumed. He determined the number of total yeast cells in each culture and found that one culture has more cells than the other.
- 1) Which culture would have the greater cell density, the one grown aerobically or the one grown anaerobically? (1%)
 - 2) Explain why the culture you chose above can make more cells with the same amount of glucose than the other culture. (4%)
14. John enjoys eating foods containing high levels of lactose and please help explain how lactose is metabolized. What enzyme is responsible for the degradation of lactose into its component parts? As what molecule does each of the sugars enter glycolysis? What is lactose intolerance? (5%)
15. True or false: oxygen is not involved in any reactions in the Krebs cycle so the cycle is an anaerobic metabolism. Please explain your answer. (3%)
16. Briefly explain why starch and cellulose have different physical shapes and biological properties even though they have the same chemical composition. (3%)
17. Please explain the role of following components in protein translation. (8%)
- 1) Shine-Dalgarno sequence.
 - 2) Ribosomal RNA.
 - 3) Release factor.
 - 4) tRNA.
18. Please explain the role of importin and the G-protein Ran in nuclear protein import and explain how to regulate G-protein activity. (4%)
19. Please explain the function of protein phosphorylation and explain how to regulate phosphorylation. (4%)