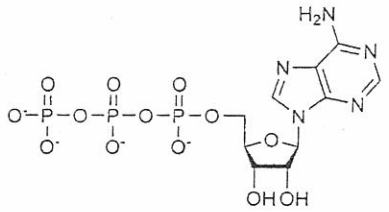
【第一大題 1～14 選擇，第二大題 15～28 非選】 ※選擇題請作答於「選擇題作答區」。



1. The structure above is
(A) ATP (B) CTP (C) dATP (D) dCTP (E) None of them (2%)

2. Which of the following amino acids is a key gluconeogenic amino acid that is synthesized in muscle by transamination of glucose-derived pyruvate, released into the bloodstream, and taken up by the liver? (2%)
(A) Gly (B) Val (C) Ala (D) Leu (E) Pro

3. Glucose can form 16 isomers. Mannose and galactose are glucose's
(A) D and L isomers (B) Epimers (C) Alpha and beta anomers
(D) Pyranose and furanose ring structures (E) Aldose-ketose isomers (2%)

4. The liver plays a crucial role in lipid metabolism EXCEPT
(A) The digestion and absorption of lipids by the production of bile
(B) The synthesis and oxidation of fatty acids
(C) The synthesis of metabolism of plasma lipoproteins
(D) The conversion of fatty acids to ketone bodies
(E) None of them (2%)

5. Tautomers are isomers of organic compounds that readily interconvert by a chemical reaction called tautomerization. Which of the following tautomerisms does exhibit in the oxo group of purines and pyrimidines? (2%)
(A) lactam-lactim
(B) amide-imidic acid
(C) amine-imine
(D) keto-enol
(E) None of them

6. Which of the following statements is/are *WRONG*? (2.5%)
(1) Human cells can only metabolize L-isoforms of monosaccharides. (2) L-galactose and L-mannose are epimers of each other. (3) Many prokaryotic cells can utilize either L- or D-isoforms of amino acids.
(A) 1 (B) 1, 3 (C) 2, 3 (D) 1, 2 (E) 1, 2, 3

7. Which of the following coenzymes is a prosthetic group, i.e. covalently linked to an enzyme? (2.5%)
(1) Lipoate, (2) Biotin, (3) Thiamine pyrophosphate (TPP), (4) Nicotinamide adenine dinucleotide (NAD^+)
(A) 1, 2 (B) 2, 3 (C) 3, 4 (D) 1, 4 (E) 1, 2, 3

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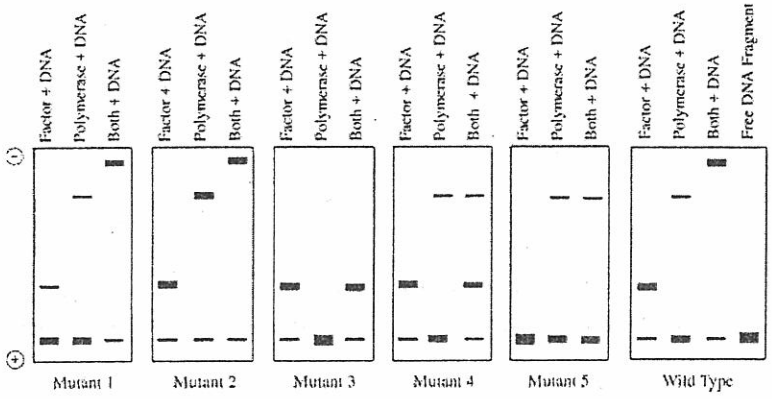
8. Glycobiology is an important branch of modern biology. Carbohydrate molecules are *NOT* involved in which biological event below? (2.5%)
   (A) Recognition of pathogens by neutrophils
   (B) Maintenance of intestinal epithelium
   (C) Regulation of gene transcription by chromatin conformational change
   (D) ABO blood type incompatibility
   (E) None of the above.

9. Which description of citric acid cycle is *WRONG*? (2.5%)
   (A) Mainly occurs in the mitochondria.
   (B) The carbon atoms of the generated CO_2 are derived from the input acetyl-CoA.
   (C) Three molecules of NADH are generated during one cycle.
   (D) Citric acid cycle is an important amphibolic pathway/cycle in aerobic organisms.
   (E) None of the above.

Questions 10-12

Five *E. coli* strains have been identified, each of which has a different mutation that disrupts the normal regulation of a particular operon. For each mutant strain, the mutation has been mapped to the promoter or the operator region; however, the exact sequence changes are not known for these mutations. It is known that the normal promoter/operator consists of a single binding site for a positively acting transcription factor located just upstream of the promoter itself. Short DNA fragments containing the promoter and the operator were subcloned from each of the five mutant strains and from the wild type, purified, and radiolabeled. These fragments were then incubated under conditions of DNA excess with either purified regulatory factor or RNA polymerase or with both polymerase and regulatory factor. The resulting protein-DNA complexes were separated by electrophoresis, and the radioactive DNA fragments were detected by exposure to x-ray film, giving the results shown below. Electrophoresis is from top to bottom; the largest complexes run slowest.



10. One of the mutations increases the affinity of the polymerase for the promoter. Transcription of the operon is not stimulated by the regulatory factor in this mutant. Which mutant is most likely to show this effect? (2%)
   (A) Mutant 1　(B) Mutant 2　(C) Mutant 3　(D) Mutant 4　(E) Mutant 5

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11. One of the mutations maps to the operator. Transcription of the operon is not stimulated by the regulatory factor in this mutant. Which mutant is most likely to show this effect? (2%)
(A) Mutant 1 (B) Mutant 2 (C) Mutant 3 (D) Mutant 4 (E) Mutant 5

12. One of the mutations is known to result from a small deletion between the operator and the promoter. The polymerase and the regulatory factor are each able to bind to the mutated DNA sequence, but are unable to form the three component complex. Transcription of the operon is not stimulated by the regulatory factor in this mutant. Which mutant shows the properties that might be expected for such a change? (2%)
(A) Mutant 1 (B) Mutant 2 (C) Mutant 3 (D) Mutant 4 (E) Mutant 5

13. The increase in the number of nucleoli during oocyte development in the frog *Xenopus laevis* is the result of (A) accelerated cell division (B) rapid chromosome replication (C) rapid synthesis of transfer RNA (D) amplification of the ribosomal RNA genes (E) accumulation of yolk protein (2%)

14. Which of the following statements about repetitive DNA is NOT true? (2%)
(A) Repetitive DNA is associated with the centromeres and telomeres in higher eukaryotes.
(B) Repetitive DNA is restricted to nontranscribed regions of the genome.
(C) Repetitive DNA sequences are often found in tandem clusters throughout the genome.
(D) Repetitive DNA was first detected because of its rapid reassociation kinetics.
(E) Transposable elements can contribute to the repetitive DNA fraction.

15. Two polypeptides, A and B, have similar tertiary structures, but A normally exists as a monomer, whereas B exists as a tetramer, B_4. What differences might be expected in the amino acid composition of A versus B? (4%)

16. Consider the following peptide sequences:
LGVHLDITVPLSWTWTLYVKL
QQNWGGLVVILTLVWFLM
YTREQSDGHIPKMNCDS
AGPFGPDGPTIGPK
Which of the preceding sequences would be likely to be found in each of the following: (6%)
a. A parallel β-sheet b. An antiparallel β-sheet c. A tropocollagen molecule

17. Please describe at least 5 gene regulation mechanisms at transcriptional and post-transcriptional levels in eukaryotes (10%).

18. Please describe the significance of membrane ligands in cell signaling. Also, please design three specific strategies (including necessary reagents) to isolate these intact proteins and perform their functional assays. (10%)

19. The ratio k_{cat}/K_m is frequently calculated during the kinetic analysis of enzymes. Please describe the applications and usefulness of this ratio. (6%)

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20. An enzyme usually displays highest affinity for which of the following compounds?
(A) substrate (B) transition state analog (C) product
Please provide a brief explanation for your answer. (2%)

21. Please give <u>one</u> example on the biotechnological applications of "reverse transcriptase". (2%)

22. How dietary cholesterol is absorbed and transported to the liver? (5%)

23. How insulin and glucagon regulate the breakdown of fats to fatty acids and glycerol in adipose tissue? (5%)

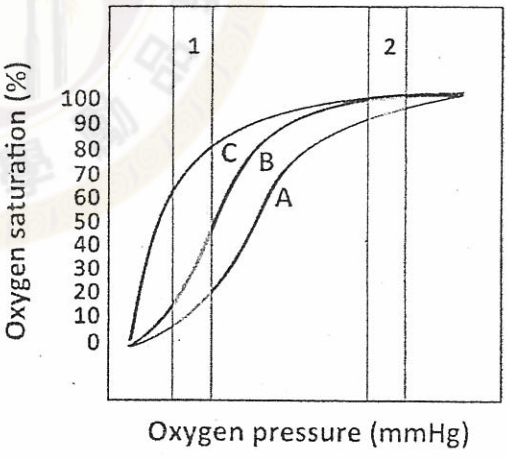
24. What signal pathways activated by insulin are able to simultaneously turn off phosphorylase activity and turn on glycogen synthase? (3%)

25. What is the biological function of pentose phosphate pathway? (2 %)

26. What is the importance of oxidative deamination in the biosynthesis of urea? (2 %)

27. If a patient has an obstructive jaundice, what is the status of urine urobilinogen, urine bilirubin and fecal urobilinogen, compared to the situation in a health person? Your answers can be provided by increased, decreased, no change, present or absent. (3 %)

28. The figure on the right plots oxygen binding affinity of myoglobin / hemoglobin against oxygen pressure (curves A, B, and C). Write **True or False** next to each question. (10 points, 1 point for each question)



(A) The higher the oxygen pressure is, the higher the binding percentage is
(B) Area 1 could represent oxygen pressure range in the lungs, area 2 could represent oxygen pressure range in the peripheral tissues
(C) In area 2, both curves B and C are close to saturation with oxygen
(D) In area 1, more oxygen is released from curve B than from C
(E) Curve C could represent hemoglobin, curve B could represent myoglobin
(F) In the figure above, draw the Km point for curve A
(G) Curve A has the highest affinity for oxygen compared to the other curves
(H) Curve A could represent fetal hemoglobin, curve B could represent maternal hemoglobin
(I) Curve A depicts binding at a low pH, curve B depicts binding at a high pH
(J) Curve A could represent binding behavior under hyperventilation, curve B could represent binding behavior under normal ventilation

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