

第一大題選擇題(1-28) · 答案請劃記於答案卡

1. (2 points) What is the equation on the right called?

- (A) Gibbs free energy equation
- (B) Michaelis–Menten equation
- (C) Henderson–Hasselbalch equation
- (D) Lineweaver–Burk equation
- (E) Nernst equation

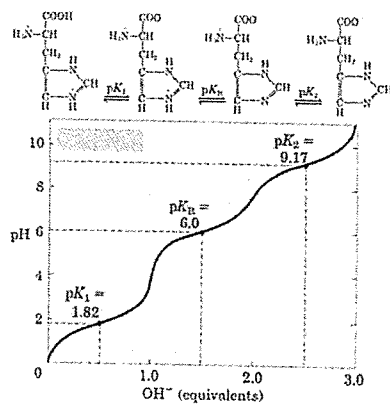
$$pH = pKa + \log \frac{[A^-]}{[HA]}$$

2. (2 points) Which of the following statements are true?

- (A) HA is an acid while A<sup>-</sup> is its base.
- (B) A<sup>-</sup> is an acid while HA is its base.
- (C) When pH > pKa, there are more negatively charged A<sup>-</sup> than non-charged HA
- (D) pKa is the pH when half A is charged.
- (E) By lowering the pH of the solution, more A molecules are charged.

3. (2 points) The figure on the right shows the titration curve of amino acid X.

- (A) The amino acid X is proline.
- (B) pK<sub>1</sub> shows the tendency of the proton to from the amino group.
- (C) The isoelectric point pI is (pK<sub>1</sub> + pK<sub>R</sub>) / 2.
- (D) The isoelectric point pI is (pK<sub>R</sub> + pK<sub>2</sub>) / 2.
- (E) The isoelectric point pI is (pK<sub>1</sub> + pK<sub>R</sub> + pK<sub>2</sub>) / 3.



curve of  
dissociate

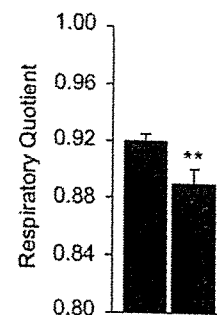
4. (2 points) Respiratory quotient (RQ) is the ratio of CO<sub>2</sub> exhaled divided by O<sub>2</sub> consumed.

- (A) Diet rich in starch (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) makes a RQ value close to 1.
- (B) Diet rich in starch (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) makes a RQ value close to 0.7.
- (C) Diet rich in fatty acid (C<sub>16</sub>H<sub>32</sub>O<sub>2</sub>) makes a RQ value close to 1.
- (D) Diet rich in fatty acid (C<sub>16</sub>H<sub>32</sub>O<sub>2</sub>) makes a RQ value close to 0.7.
- (E) Diet rich in starch or fatty acid will not affect RQ values.

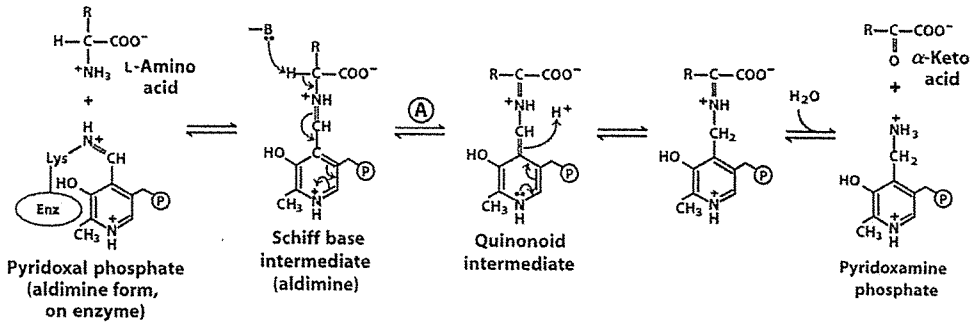
■ Bad +/+  
 ■ Bad -/-

5. (2 points) Based on the figure on the right,

- (A) Compared to the wild type mice (Bad +/+), mice lacking the Bad gene (-/-) shows a significantly reduced RQ.
- (B) Compared to the wild type mice (Bad +/+), mice lacking the Bad gene (-/-) shows a significantly elevated RQ.
- (C) Mice lacking the Bad gene metabolize more glucose.
- (D) Mice lacking the Bad gene metabolize more fatty acid.
- (E) Mice lacking the Bad gene metabolize glucose or fatty acid equally.

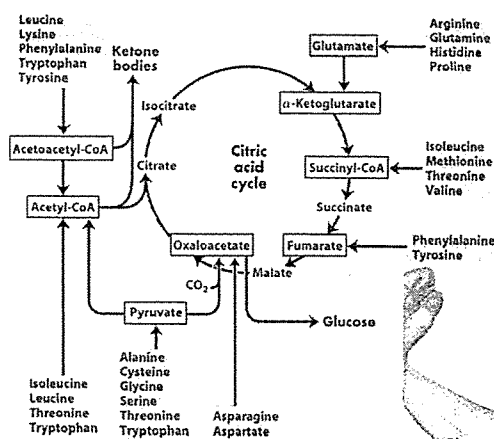


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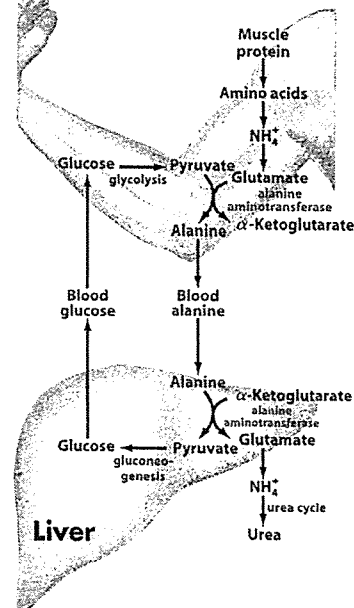


6. (2 points) Enz stands for an enzyme in the above reactions. Based on the reactions, which of the following statements are true?
- (A) The pyridoxal phosphate serves as a prosthetic group of the enzyme (Enz).
  - (B) The pyridoxal phosphate serves as a coenzyme of the enzyme.
  - (C) The reactions describe the steps for transferring the amino group of an amino acid.
  - (D) The reactions describe the steps for transferring the  $\alpha$ -keto acid of an amino acid.
  - (E) During the reactions, the pyridoxal group loses its covalent bonding with the enzyme.

7. (2 points) Based on the figure on the right,
- (A) The figure describes catabolism of the carbon skeleton of amino acids.
  - (B) The figure describes catabolism of the amino group of amino acids.
  - (C) Isoleucine is glucogenic.
  - (D) Leucine is only ketogenic.
  - (E) Tyrosine is glucogenic.



8. (2 points) Based on the figure on the right,
- (A) It depicts how muscle deals with nitrogen wastes of amino acids.
  - (B) It depicts how muscle deals carbon skeleton of amino acids.
  - (C) Alanine shuttles nitrogen wastes from muscle to the liver for catabolism.
  - (D) The main role of the liver is to regenerate glucose.
  - (E)  $\alpha$ -ketoglutarate is regenerated by glutamate dehydrogenase that cleaves ammonium off glutamate.



9. (2 points) The formation of a disulfide bond would be an example of what level of protein structure?
- (A) primary
  - (B) secondary
  - (C) tertiary
  - (D) quaternary
  - (E) both c and d are correct
10. (2 points) The amino acid sequence is NOT:
- (A) a distinctive characteristic of a polypeptide.
  - (B) encoded by the nucleotide sequence of DNA.
  - (C) a form of genetic information.
  - (D) read from N-terminal end to C-terminal end.
  - (E) constant for proteins with the same function from different organisms.
11. (2 points) Proteins destined for an extracellular location are characteristically:
- (A) phosphoproteins.
  - (B) glycoproteins.
  - (C) lipoproteins.
  - (D) nucleoproteins.
  - (E) flavoproteins.
12. (2 points) Hemoglobin is an example of a(n):
- (A) enzyme.
  - (B) regulatory protein.
  - (C) transport protein.
  - (D) storage protein.
  - (E) structural protein.
13. (2 points) In the tertiary structure of a protein, an electrostatic interaction could form between the R-groups of which two amino acids?
- (A) Gln and Lys
  - (B) Asp and Thr
  - (C) Leu and Asp
  - (D) Glu and Arg
  - (E) Arg and His
14. (2 points) Which of the following mutations would probably be least likely to impact the function of the protein?
- (A) Lys to Ser
  - (B) Ala to Asp
  - (C) His to Pro
  - (D) Val to Ile
  - (E) Phe to Tyr
15. (2 points) Which of the following does not contribute to the spontaneous nature of the protein folding process?
- (A) formation of electrostatic interactions
  - (B) loss of translational freedom as portions of the protein interact
  - (C) formation of hydrophobic interactions
  - (D) formation of hydrogen bonds
16. (2 points) Which of the following proteins does not have quaternary structure?
- (A) immunoglobulins
  - (B) insulin
  - (C) glycogen phosphorylase
  - (D) myoglobin
  - (E) alcohol dehydrogenase

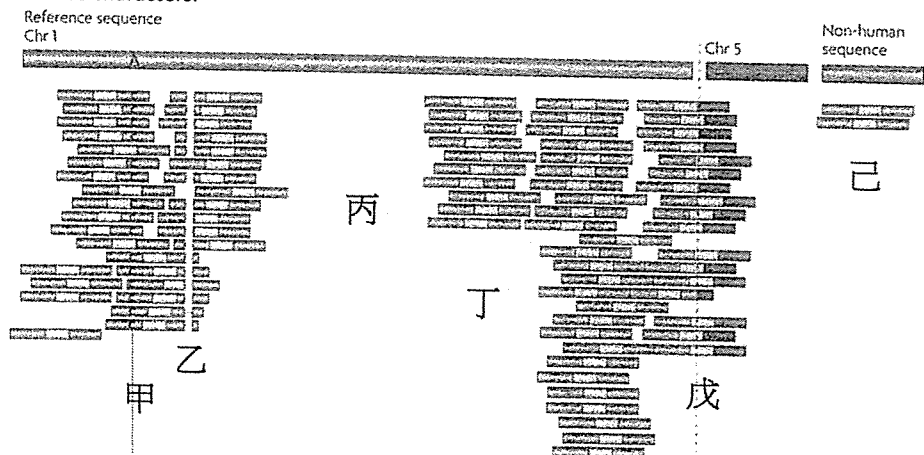
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17. (2 points) \_\_\_\_ is an example of a disulfide-rich protein.
- (A) Insulin
  - (B) Glyceraldehyde-3-phosphate dehydrogenase
  - (C) Hemoglobin
  - (D) Triose phosphate isomerase
  - (E) All are true.
18. (2 points) Why should the core of most globular and membrane proteins consist almost entirely of  $\alpha$ -helix and  $\beta$ -sheets?
- (A) Hydrogen bonded structures must be kept away from water solvent.
  - (B) Highly polar N-H and C=O moieties of the peptide backbone must be neutralized in the hydrophobic core of the protein.
  - (C) Hydrogen bonding only occurs in the core of proteins.
  - (D) Trapped water stabilizes the helix and sheet structures.
  - (E) None are true.
19. (1 points) Arsenite reacts with vicinal (neighboring) sulfhydryl groups of organic compounds and forms covalent adducts. Which one of the following enzymes would be inhibited by arsenite?
- (A) Glyceraldehyde-3-P Dehydrogenase
  - (B) Aldolase
  - (C) Pyruvate Dehydrogenase
  - (D) Pyruvate Decarboxylase
  - (E) all of the above
20. (1 points) Which one of the following substrates cannot be oxidized by isolated mitochondria (i.e. purified mitochondria that are incubated in buffer and substrate)?
- (A) Pyruvate
  - (B) Lactate
  - (C) Succinate
  - (D) Fumarate
  - (E) Malate
21. (1 points) Vitamine B1 (or thiamine) is the precursor to the coenzyme thiamine pyrophosphate (TPP). Thiamine deficiency would decrease which one of the following enzyme activities?
- (A) Fumarase
  - (B) Isocitrate dehydrogenase
  - (C) Malate dehydrogenase
  - (D) Succinate dehydrogenase
  - (E)  $\alpha$ -Ketoglutarate dehydrogenase
22. (1 points) The relative concentrations of ATP and ADP control the cellular rates of:
- (A) the TCA cycle
  - (B) pyruvate dehydrogenase
  - (C) the electron transport chain
  - (D) gluconeogenesis
  - (E) all of the above
23. (1 points) Which one of the following enzymes does NOT catalyze a decarboxylation reaction?
- (A) 6-Phosphogluconate dehydrogenase
  - (B)  $\alpha$ -Ketoglutarate dehydrogenase
  - (C) Pyruvate dehydrogenase
  - (D) Succinate dehydrogenase
  - (E) Isocitrate dehydrogenase

24. (1 points) After drinking a pint of beer, the ethanol in the blood is taken up by liver cells and converted into acetate, which is then activated like a fatty acid to form acetyl-CoA. The conversion of one mole ethanol into one mole acetyl-CoA requires one of the following:
- (A) 1 mole  $\text{NAD}^+$  and 1 mole ATP
  - (B) 2 moles  $\text{NADP}^+$  and 1 mole AMP
  - (C) 1 mole FAD and 1 mole ATP
  - (D) 2 moles  $\text{NAD}^+$  and 1 mole ATP
  - (E) 1 mole  $\text{NADP}^+$  and 1 mole AMP
25. (1 points) The carbon of which one of the following groups is the most oxidized?
- (A)  $-\text{CH}_2\text{OH}$  (B)  $-\text{CH}_2-$  (C)  $-\text{COOH}$  (D)  $-\text{CHO}$  (E)  $-\text{CH}_3$
26. (1 points) Which one of the following enzymes catalyzes substrate-level phosphorylation?
- (A) Hexokinase
  - (B) Phosphofructokinase
  - (C) Glucokinase
  - (D) Glycerol kinase
  - (E) Phosphoglycerate kinase
27. (1 points) Which of the following cofactors do not form covalent adducts with enzymes' lysine residues?
- (A) Lipoic acid
  - (B) Biotin
  - (C) NADH
  - (D) Pyridoxyl phosphate
  - (E) All of the above
28. (1 points) In normal mitochondria, the rate of NADH consumption (oxidation) will:
- (A) be increased in active muscle, decreased in inactive muscle.
  - (B) be very low if the ATP synthase is inhibited, but increase when an uncoupler is added.
  - (C) decrease if mitochondrial ADP is depleted.
  - (D) decrease when cyanide is used to prevent electron transfer through the electron transport chain.
  - (E) All of the above are correct.

第二大題非選擇題，請作答於答案卷

29. (4 points) The figure below depicts deep sequencing reads matched to reference sequence. Fill the blanks with the Chinese characters.



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- (A) Deletion of a piece of DNA in a gene \_\_\_\_\_
- (B) Hemizygous gene deletion \_\_\_\_\_
- (C) Gene translocation \_\_\_\_\_
- (D) Point mutation \_\_\_\_\_

**QUESTION30: SHORT ANSWER (6 points)**

(i) Why isn't the hexokinase step (STEP 1) the committed step in glycolysis, since it is irreversible and occurs prior to the phosphofructokinase step (STEP 3)? (3 points)

(ii) Although oxygen does not participate directly in the TCA cycle, the cycle operates only under aerobic conditions. Briefly explain why? (3 points)

**QUESTION 31**

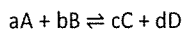
Consider the reaction,  $A \rightleftharpoons B+B$ , where  $\Delta G^0$  is zero.

Please determine what the sign of the free energy change will be if the concentrations of all the species are raised above the standard conditions by 2-fold. Circle your answer from the three listed, and show your assumptions and equations used to justify your response. (4 points)

- (A) NEGATIVE      (B) NO SIGN / ZERO      (C) POSITIVE

\*This is a list of the equations which you might need to use for this question.

$$\Delta G = \Delta H - T\Delta S$$



$$K_{eq}' = ([C]^c[D]^d) / ([B]^b[A]^a)$$

$$\Delta G^{o'} = -RT \ln K_{eq}'$$

$$\Delta G = \Delta G^{o'} + RT \ln Q$$

$$Q = ([C]^c[D]^d) / ([B]^b[A]^a)$$

**QUESTION 32**

What is low density lipoprotein (LDL)? What is high density lipoprotein (HDL)? Please explain their roles in atherogenesis. (12 points)

**QUESTION 33**

What is hormone sensitive lipase? Please explain the functional roles of this enzyme. (8 points)

**QUESTION 34**

How will the high concentrations of alanine and citrate modulate glycolysis? (5 points)

**QUESTION 35**

What mechanisms in human beings can maintain the homeostasis of blood glucose levels? (5 points)

**QUESTION 36**

What biochemical modifications in human bodies facilitate the secretion of drugs or food additive compounds? (6 points)

**QUESTION 37**

What important physiological roles will methionine play in biochemical metabolisms? (4 points)

試題隨卷繳回