

國 立 宜 蘭 大 學

1 0 8 學 年 度 研 究 所 碩 士 班 考 試 入 學

生物化學試題

(生 物 技 術 與 動 物 科 學 系 生 物 技 術 碩 士 班)

准考證號碼：

《作答注意事項》

- 1.請先檢查准考證號碼、座位號碼及答案卷號碼是否相符。
- 2.考試時間：100分鐘。
- 3.本試卷共有40題，一題2.5分，共計100分。
- 4.請將答案寫在答案卷上。
- 5.考試中禁止使用手機或其他通信設備。
- 6.考試後，請將試題卷及答案卷一併繳交。
- 7.本試卷採雙面影印，請勿漏答。
- 8.應試時不得使用電子計算機。

1. What is the pH of an acetic acid solution where the concentration of acetic acid is 2 mM and the concentration of sodium acetate is 20 mM. The pK_a of acetic acid is 4.76.
 - a. 5.76
 - b. 10.6
 - c. 12.6
 - d. 8.8
2. What is the pH of an acetic acid solution where the concentration of acetic acid is 2 mM, 100 mL and the concentration of NaOH is 2 mM, 50 mL. The pK_a of acetic acid is 4.76.
 - a. 4.76
 - b. 5.76
 - c. 12.6
 - d. 8.8

Exhibit A

Amino acid	α -carboxyl group pK_a	α -amino group pK_a	R-group pK_a
Ala	2.3	9.7	
Arg	2.2	9.0	12.5
Asn or Gln	2.1	9.0	
Asp or Glu	2.2	9.8	4.0
Cys	1.7	10.8	8.3
His	1.8	9.2	6.0
Ser	2.2	9.2	
Tyr	2.1	9.1	10.1

3. **Refer to Exhibit A.** Which of these amino acids could act as a good buffer at $pH = 4.5$
 - a. Alanine
 - b. Arginine
 - c. Asparagine
 - d. Cysteine
 - e. Aspartic Acid
4. **Refer to Exhibit A.** Which one has a pI of 5.0?
 - a. Alanine

- b. Arginine
- c. Histidine
- d. Cysteine
- e. Glutamic acid

Exhibit B

The following question(s) refer to this peptide:

Cys-Ala-Gly-Arg-Gln-Met

5. **Refer to Exhibit B.** The overall, net ionic charge on this peptide at pH = 7 would be:

- a. +2
- b. +1
- c. 0
- d. -1
- e. -2

6. In the Bohr effect the binding of oxygen to hemoglobin

- a. is increased by the presence of Na⁺
- b. is increased by the presence of H⁺ and CO₂
- c. is decreased by the presence of H⁺ and CO₂
- d. is unchanged

Exhibit C

The following diagram shows the anode, cathode, and pH gradient of an isoelectric focusing bed:

anode+														-cathode
pH	1	2	3	4	5	6	7	8	9	10	11	12	13	14

7. **Refer to Exhibit C.** A mixture of asp, asn, and arg is placed in the bed where the pH is 7, and the current is turned on. From left to right, which best represents the final positions of the individual amino acids?

- a. asp asn arg
- b. arg asn asp
- c. asn asp arg
- d. arg asp asn

8. If a protein with the sequence FEWPRQVDMARINE is treated with chymotrypsin, what will the products be?
- F EW PRQVMARINE
 - FE WPRQVD MARINE
 - FEWPR QVDMAR INE
 - FEWPRQVDM ARINE
9. If a protein with the sequence PQRKYPIG is treated with trypsin, what will the products be?
- PQR KYPIG
 - PQRK YPIG
 - PQR K YPIG
 - PQ R KPIG0
10. If the y-intercept of a Lineweaver-Burk plot = 1.91 (sec/millimole) and the slope = $K_M/V_{max} = 75.3$ L/sec, K_M equals:
- 0.0254 millimolar (mM).
 - 0.523 millimolar (mM).
 - 5.23 millimolar (mM).
 - 39.4 millimolar (mM).
 - 75.3 millimolar (mM).
11. The K_M of hexokinase for glucose = 0.15 mM and for fructose, $K_M = 1.5$ mM. Which is the preferred substrate?
- Glucose.
 - Fructose.
 - Neither substrate is preferred over the other.
 - You cannot tell from the data given.
 - None of these answers is correct.
12. For competitive inhibition
- the value of K_M decreases
 - the value of V_{max} decreases
 - it is possible to overcome the effect of the inhibitor by increasing the concentration of substrate
 - none of the above

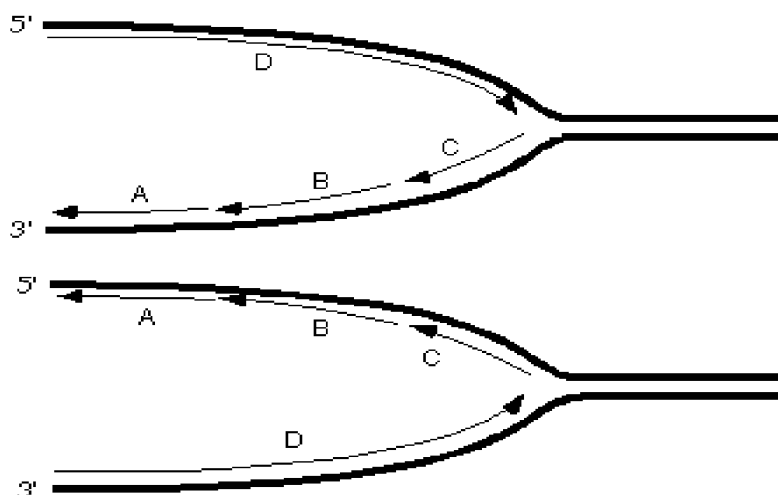
13. Where do allosteric inhibitors of final product bind on an enzyme?
- They always bind at a site different from the active site.
 - They always bind at the active site.
 - They can bind at either active site or another site.
14. Which of the following four fatty acids has the lowest melting point?
- $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
 - $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
 - $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
 - $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$
15. In the sodium-potassium pump
- sodium is transported out of the cell and potassium into the cell, both against concentration gradients
 - sodium is transported into the cell and potassium out of the cell, both against concentration gradients
 - sodium is transported out of the cell and potassium into the cell, both in the same direction as concentration gradients
 - sodium and potassium are both transported out of the cell against concentration gradients
16. Topoisomerases are associated with
- production of RNA from DNA.
 - joining of nucleotide monomers to make polynucleotides.
 - supercoiling of DNA.
 - ribosomes.
17. The study of DNA changes that are not reflected in the base sequence is called:
- Molecular biology
 - Histology
 - Epigenetics
 - Physical genetics
18. In prokaryotic replication, all DNA polymerases are capable of all of the following tasks **except**:
- Reading a template strand and putting the complementary base in the correct

position

- b. Polymerizing DNA in the 5' to 3' direction
- c. Excising DNA in the 3' to 5' direction
- d. Excising DNA in the 5' to 3' direction
- e. All of these are capabilities of all DNA polymerases

Exhibit D

Consider the following diagrams showing a replication fork moving from left to right. The thick lines represent the template/parental strands. The 5' and 3' represent the ends of those template/parental strands.



19. Refer to Exhibit D. Which Okazaki fragment was synthesized earliest?

- a. A
- b. B
- c. C
- d. D

20. A prokaryotic replisome typically contains two molecules of DNA pol III, but only one molecule of DNA pol I. Why?

- a. The DNA pol I works on the leading strand, while DNA pol IIIs work on the Okazaki fragments. since there are several of those, it takes more proteins to keep up.
- b. DNA pol I has a built-in proofreading exonuclease; DNA pol III does not. The second DNA pol III is needed to follow the first to accomplish the necessary proofreading.

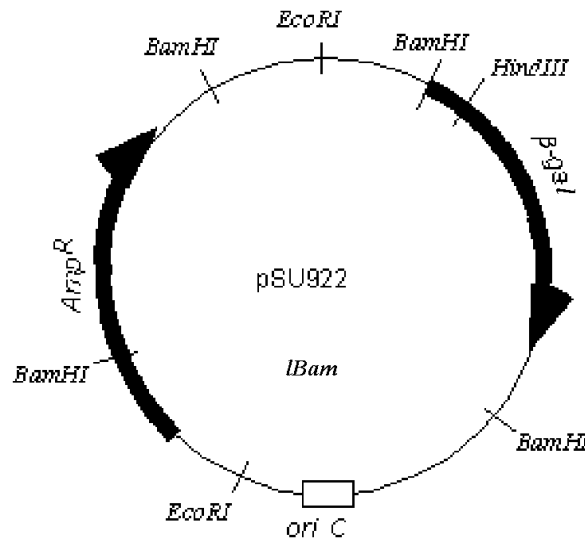
- c. The DNA pol IIIs do most of the work. DNA pol I only has to work on the telomers.
 - d. DNA pol I replaces the RNA primers with DNA, which really only needs to be done repetitively on one strand, while both strands are worked on by the DNA pol IIIs.
21. A prokaryotic replisome typically contains two molecules of DNA pol III, but only one molecule of DNA pol I. Why?
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 - d. DNA pol I replaces the RNA primers with DNA, which really only needs to be done repetitively on one strand, while both strands are worked on by the DNA pol IIIs.
22. Chain termination of RNA replication occurs, *in vivo*, when:
- a. RNA Pol gets to the end of the DNA.
 - b. The factor called rho (ρ) binds to the DNA.
 - c. A hairpin loop forms in the template.
 - d. Either a hairpin loop of DNA template forms or rho (ρ) is involved.
23. What is the need for a primer strand in transcription?
- a. It ensures the fidelity of the newly synthesized RNA strand.
 - b. There is none.
 - c. RNA polymerases requires a preexisting strand with a nucleotide having a 3'-OH.
 - d. RNA polymerase requires a preexisting strand with a nucleotide having a 5'-OH.
24. An aminoacyl-tRNA is initially bound to the ribosome
- a. at the A site on the 50S subunit
 - b. at the P site on the 50S subunit
 - c. at the A site on the 30S subunit
 - d. at the P site on the 30S subunit

25. A Shine-Dalgarno Sequence is a
- sequence of nucleotides in the DNA that interacts with the σ -subunit of RNA polymerase to begin transcription.
 - sequence of nucleotides in an mRNA that interacts with the small subunit of a ribosome to begin translation.
 - sequence of nucleotides in the DNA that interacts with ρ -protein to terminate transcription.
 - sequence of nucleotides in an mRNA that functions to terminate translation.
26. Protein synthesis in prokaryotes always starts with
- a methionine residue
 - a formylmethionine residue
 - a cysteine residue
 - no specific residue
27. Leader sequences for protein transport to specific organelles are removed by proteases associated with the:
- endoplasmic reticulum
 - golgi apparatus
 - nucleus
 - mitochondria
 - none of these
28. There is no codon for the amino acid hydroxyproline, but this amino acid is a prominent feature of collagen structure. Which of the following is a likely explanation?
- Hydroxyproline is substituted for proline after translation by a cut and patch mechanism.
 - Proline is covalently modified to give hydroxyproline after translation.
 - There is an alternative mechanism for synthesis of proteins that contain hydroxyproline.
 - It is not possible to form a hypothesis from the information given.
29. The protein which marks proteins for degradation is called:
- Chaperonin
 - Ubiquitin
 - Proteasomin

- d. Apoptosin
 - e. None of these names is correct.
30. When fluorescence detection methods are used in biotechnology they
- a. have limitations due to low sensitivity
 - b. can be used for only one substance at a time
 - c. are not used in DNA sequencing
 - d. do not present the hazards associated with radioactivity
31. SyBr green and SyBr gold were developed because
- a. ethidium bromide is not sensitive enough for modern research
 - b. they allow faster electrophoretic separations of DNA
 - c. they fluoresce with RNA as well as DNA, while ethidium bromide does not
 - d. ethidium bromide is carcinogenic
32. Restriction enzymes are especially useful for genetic recombination work for all of the following reasons, **except**:
- a. They cut DNA in the middle of specific sequences.
 - b. They cut DNA independent of the source of the DNA.
 - c. They often generate single stranded tails or "sticky ends".
 - d. There are a large variety of them commercially available.
 - e. All of these traits make restriction enzymes useful.
33. A plasmid is
- a. a virus that infects bacteria.
 - b. a piece of DNA derived from two or more sources.
 - c. a small circular DNA that is not part of a bacterial chromosome.
 - d. an artificially created cytoplasm.

Exhibit E

The plasmid pSU922 is a circular DNA containing 25000 base pairs. The β -gal gene codes for the enzyme β -galactosidase, the product of which will turn bacterial colonies blue when grown in the presence of X-gal; the Amp^R gene confers ampicillin resistance.



34. **Refer to Exhibit E.** Which restriction site is best for inserting a DNA fragment for analysis?

- a. *Bam*HI
- b. *Eco*RI
- c. *Hind*III
- d. They're all equally good.

35. **Refer to Exhibit E.** Neglecting any discussion of whether it's a good or bad choice, I attempt to insert a gene fragment into the *Hind*III site and transform bacteria with the plasmid. How can I tell which transformants have the insert?

- a. The bacteria will not be able to grow in the presence of ampicillin, and they will be blue.
- b. The bacteria will not be able to grow in the presence of ampicillin, and they will be white.
- c. The bacteria will be able to grow in the presence of ampicillin, and they will be blue.
- d. The bacteria will be able to grow in the presence of ampicillin, and they will be white.

36. Which of the following is a unique feature of qPCR compared to the original PCR?

- a. qPCR uses a DNA polymerase from a heat stable source
- b. qPCR requires a primer
- c. qPCR allows the reaction to run until all of the primers have been exhausted
- d. In qPCR, the speed with which the DNA is produced is used to estimate how much of the original template was in the reaction vessel

37. The glyoxylate cycle occurs in
- plants and animals.
 - bacteria and animals.
 - plants and bacteria.
 - plants, animals, and bacteria.
38. Which of the following is a source of NADPH?
- the pentose phosphate pathway
 - a series of reactions in which oxaloacetate is reduced to malate followed by oxidative decarboxylation of the malate to pyruvate
 - both of the above
 - neither of these
39. The ultimate electron acceptor in the electron transport chain is
- NAD^+ .
 - FAD.
 - oxygen.
 - ADP.
40. What is the net yield of ATP per glucose molecule that passes through all of aerobic respiration (glucose \rightarrow CO_2 + H_2O)?
- 2
 - 4
 - 6
 - 30 – 32, dependent on the shuttle system used.