

國 立 宜 蘭 大 學

1 0 6 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：

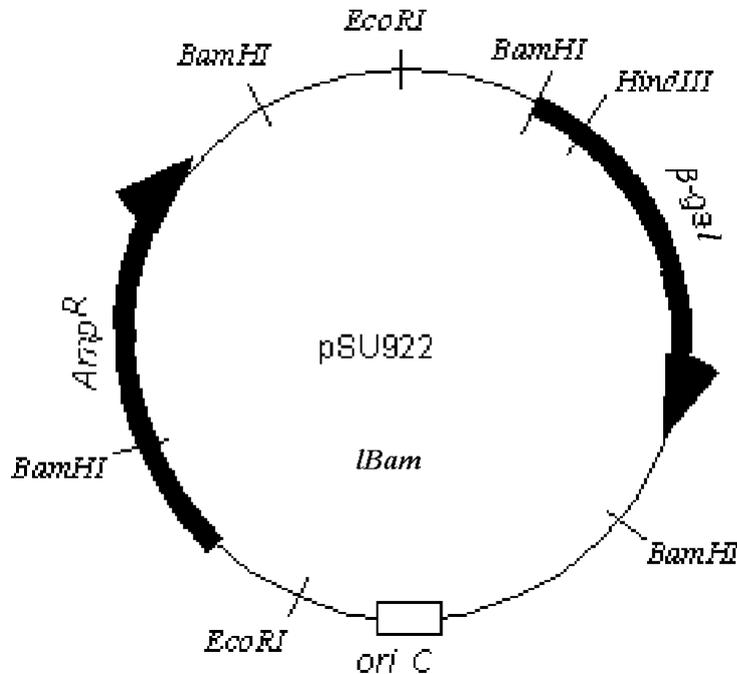
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### 《作答注意事項》

- 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 50 題選擇題，一題 2 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。

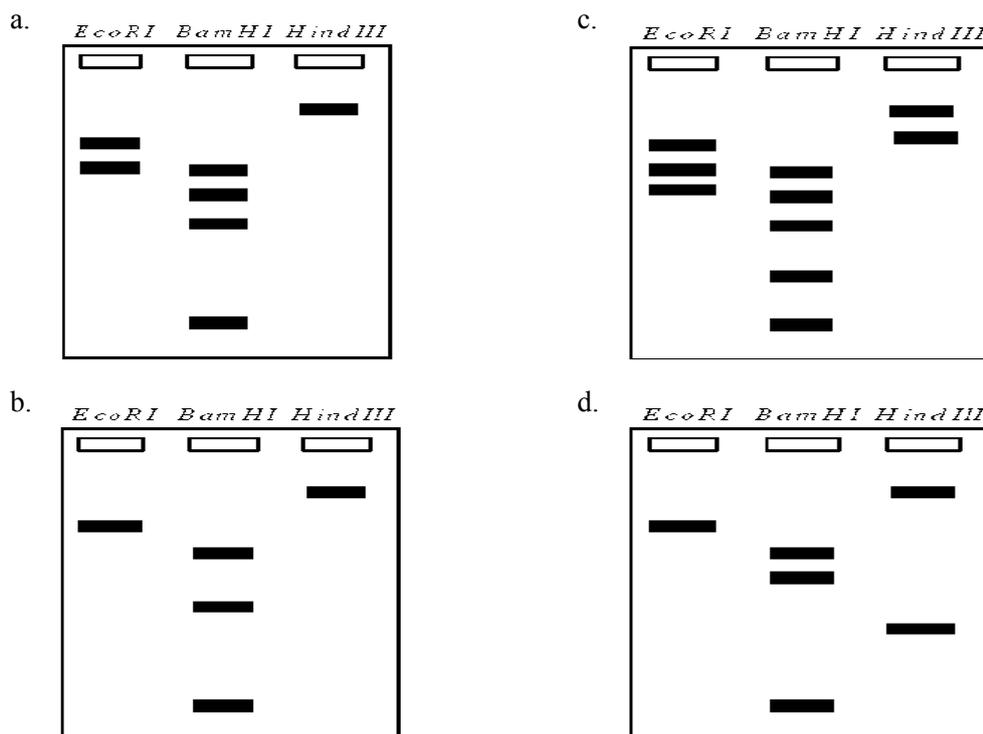
Exhibit 1

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



NARREND

1. Refer to Exhibit 1. 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.
2. Refer to Exhibit 1. In three separate vessels, the plasmid is treated with the restriction endonucleases *Eco*RI, *Bam*HI, and *Hind*III. Which of the following best represents the electrophoretic gel one would see from these digests?



3. Refer to Exhibit 1. Neglecting any discussion of whether it's a good or bad choice, I attempt to insert a gene fragment into the *HindIII* site and transform bacteria with the plasmid. How can I tell which transformants have the insert?

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

4. The polymerase chain reaction requires

- primers complementary to the ends of the sequence to be amplified
- careful temperature control
- both of these
- neither of these

5. The following item was the most important one for the development of PCR as a commercially successful and widely-used procedure:
- Taq* DNA Polymerase.
  - Heat-resistant DNA.
  - Heat-resistant primers for DNA synthesis.
  - Robotic machines to run the PCR® procedure.
  - Heat-resistant nucleoside triphosphate substrates.
6. Which of the following is a unique feature of qPCR compared to the original PCR?
- qPCR uses a DNA polymerase from a heat stable source
  - qPCR requires a primer
  - qPCR allows the reaction to run until all of the primers have been exhausted
  - 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
7. In a metabolic study using microarrays, a yellow dot represents the location of DNA on the microarray:
- for which mRNA was produced in both the control and the test case
  - for which no mRNA was produced
  - for which only the control case produced mRNA
  - for which only the test case produced mRNA
8. Which of the following monosaccharides is a ketose?
- glucose
  - fructose
  - galactose
  - mannose
9. The simplest aldotriose is:
- acetone
  - dihydroxyacetone
  - glyceraldehyde
  - threose

10. In humans, pyruvate can be converted to
- acetyl-CoA only.
  - lactate only.
  - ethanol only.
  - acetyl-CoA and lactate.
11. Which of the following is not an end product of glucose metabolism via either aerobic or anaerobic means?
- ethanol
  - carbon dioxide
  - lactate
  - fructose
  - all of these are end products of glucose metabolism
12. What is the net ATP yield per glucose during glycolysis?
- 1
  - 2
  - 3
  - 4
  - 6
13. Which enzyme is the key regulatory enzyme in glycolysis?
- Glyceraldehyde-3-phosphate dehydrogenase
  - Enolase
  - Phosphofructokinase
  - Aldolase
14. Which of the following exercise(s) allosteric control in the reaction of phosphofructokinase?
- ATP
  - fructose 2,6-bisphosphate
  - both of these
  - neither of these

15. Which of the following enzymes of glycolysis is not involved in regulation of the pathway?

- a. Hexokinase
- b. Phosphofructokinase
- c. Aldolase
- d. Pyruvate kinase
- e. All of these proteins regulate glycolysis.

16. A characteristic of the glycerol phosphate shuttle is

- a. it shuttles NADH across the mitochondrial membrane to yield 5 ATP/NADH
- b. it shuttles the electrons from NADH across the mitochondrial membrane to FADH<sub>2</sub>, yielding 5 ATP/NADH
- c. it only operates efficiently at high levels of NADH
- d. malate is a key component in the shuttle process

17. *E. coli* replication to remove primer on the lagging strand

- a. is carried out by DNA polymerase I
- b. is carried out by DNA polymerase II
- c. is carried out by DNA polymerase III
- d. is carried out by DNA ligase

18. In eukaryotic replication, the RNA primers are degraded by:

- a. the 5' to 3' exonuclease activity of pol  $\delta$
- b. DNA ligase
- c. Helicase
- d. FEN-1 and RNase H1

19. The promoter site is

- a. the start site for transcription in DNA
- b. the binding site for regulatory proteins that stimulate transcription
- c. the general region of DNA downstream from the start site
- d. the site on DNA at which RNA polymerase binds to initiate transcription

20. Which of the following is the best description of an operon?
- An enhancer that positively regulates gene expression.
  - An silencer that negatively regulates gene expression.
  - A binding element for the sigma ( $\sigma$ ) factor.
  - A group of genes under the control of a common promoter.
21. Which of the conditions would result in the greatest amount of transcription of the *lac* operon?

	[glucose]	[lactose]
I.	low	high
II.	low	low
III.	high	low
IV.	high	high

- I
  - II
  - III
  - IV
22. Which of the following is not a characteristic of catabolite activator protein (CAP)?
- it is a positive regulator of the *lac* operon
  - when the cell has sufficient glucose and lactose, CAP will not be bound to the CAP binding site
  - CAP binding near the promoter site depends on CAP complexation with cAMP
  - the binding of CAP to DNA requires ATP hydrolysis
23. Capping of eukaryotic mRNA
- occurs at the 5' end.
  - occurs at the 3' end.
  - occurs at both ends.
  - doesn't occur at all.

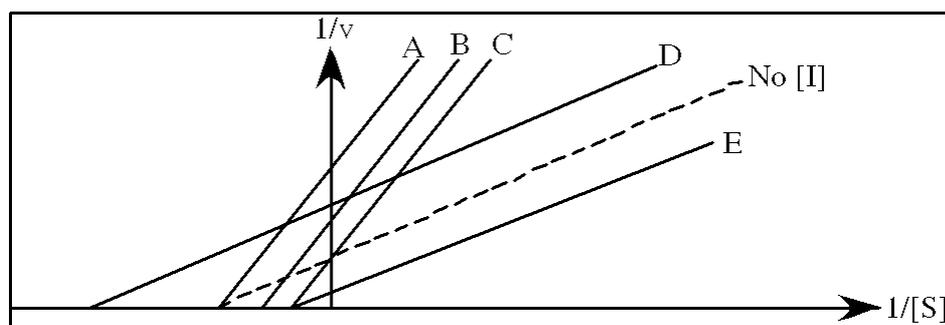
24. Which separates based on the ionic charge on a protein?
- Gel filtration
  - Affinity chromatography
  - Cation exchange
  - Anion exchange
  - Cation or anion exchange
25. Which would be best to separate a protein that binds strongly to its substrate?
- Gel filtration
  - Affinity chromatography
  - Cation exchange
  - Anion exchange
  - Cation or anion exchange
26. 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
27. 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
28. Cyanogen bromide (CNBr) cleaves proteins
- after positively charged residues, such as K & R.
  - after negatively charged residues, such as D & E.
  - after aromatic residues, such as Y & W.
  - after methionine residues.

29. The most efficient method for determining the sequence of a short peptide is:

- Edman degradation
- Trypsin digestion
- Chymotrypsin digestion
- Cyanogen bromide digestion

30. Refer to Exhibit 6A. "Restratinin" is an inhibitor of triose phosphate isomerase. When it is added to cells at a concentration of 0.4 nM, the enzyme's apparent  $K_M$  for the substrate is altered to 100  $\mu\text{M}$ , but the  $V_{\max}$  is unchanged.

In the following graph, which line best represents the Lineweaver-Burk plot obtained in the presence of restrainin?



- A
- B
- C
- D
- E

31. Which of the following four fatty acids has the highest melting point?

- $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
- $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
- $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
- $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$

- a. 1
  - b. 2
  - c. 3
  - d. 4
32. Which of the following is a metabolic precursor of prostaglandins & leukotrienes?
- a. vitamin A.
  - b. arachidonic acid.
  - c. sphingomyelin.
  - d. cholesterol.
33. The dissociation constant for an acid with a  $pK_a$  value of 6.0 is
- a.  $1 \times 10^{-6}$
  - b.  $-1 \times 10^6$
  - c.  $1 \times 10^6$
  - d.  $-1 \times 10^{-6}$
34. A buffer solution at pH 10 has a ratio of  $[HA]/[A^-]$  of 10. What is the  $pK_a$  of the acid?
- a. 8
  - b. 9
  - c. 10
  - d. 11
  - e. 12
35. The pH of a solution of 0.04 M HCl is:
- a. 4
  - b. 1.4
  - c. 0.4
  - d. 0.04
  - e. The pH cannot be determined
36. The pOH a solution of 0.04 M HCl is:
- a. 1.4
  - b. 10
  - c. 12.6
  - d. 13.6
  - e. The pOH cannot be determined

37. An HCl solution has a pH = 3. If you dilute 10 mL of the solution to 1000mL, the final pH will be:
- 1.0
  - 2.0
  - The pH does not change.
  - 4.0
  - 5.0
38. A solution at pH 7 contains a weak acid, HA. The  $pK_a$  of the acid is 6.5. What is the ratio of  $[A^-]:[HA]$ ?
- 1:3
  - 1:1
  - 3:1
  - 10:1
39. The main intracellular buffer system is
- $H_3PO_4/H_2PO_4^-$
  - $H_2PO_4^-/HPO_4^{2-}$
  - $HPO_4^{2-}/PO_4^{3-}$
  - $H_3PO_4/PO_4^{3-}$
40. The main blood buffer system is
- $H_2CO_3/HCO_3^-$
  - $HCO_3^-/CO_3^{2-}$
  - $H_2CO_3/CO_3^{2-}$
  - none of the above
41. The structure of myoglobin consists
- almost entirely of  $\alpha$ -helices.
  - almost entirely of  $\beta$ -sheets.
  - of a mixture of  $\alpha$ -helices and  $\beta$ -sheets.
  - of a unique secondary motif that is neither  $\alpha$ -helix nor  $\beta$ -sheet.
42. The Bohr effect for oxygen binding states that
- Mb binds oxygen more tightly than Hb.
  - Hb will bind oxygen very tightly when the  $CO_2$  concentration is high.
  - as the pH goes down, Hb binds oxygen less tightly.
  - Hb's ability to bind oxygen increases with higher oxygen concentration.

43. Hemoglobin differs from myoglobin because
- it does not have a heme group.
  - it is a tetramer, whereas myoglobin is a single polypeptide chain.
  - it does not contain any helical regions.
  - it contains more  $\beta$ -pleated sheet structure.
44. In the Bohr effect the binding of oxygen to hemoglobin
- is increased by the presence of  $\text{Na}^+$
  - is increased by the presence of  $\text{H}^+$  and  $\text{CO}_2$
  - is decreased by the presence of  $\text{H}^+$  and  $\text{CO}_2$
  - is unchanged
45. Which of the following best describes what happens when hemoglobin binds *bisphosphoglyceric acid* (BPG)?
- Binding of BPG leads to tighter binding of oxygen.
  - Binding of BPG allows maternal (adult) Hb to bind oxygen more tightly than fetal Hb.
  - Binding of BPG causes oxygen to dissociate from Hb.
  - Binding of BPG causes the subunits of hemoglobin to separate.
46. Which of the following proteins is not homologous with the others?
- myoglobin
  - $\alpha$ -chain of hemoglobin
  - $\beta$ -chain of hemoglobin
  - collagen
47. Proteins that aid in the correct and timely folding of other proteins are called
- motifs.
  - chaperones.
  - liposomes.
  - cooperative.
48. The oxygen binding curve of which of the following is the closest to that of myoglobin?
- hemoglobin at pH 6.8
  - hemoglobin that lacks BPG
  - maternal hemoglobin
  - fetal hemoglobin

49. Which of the following codons does not code for an amino acid?

- a. AUG
- b. UGA
- c. CAU
- d. GUU
- e. All of these code for an amino acid

50. The majority of protein synthesis occurs in the

- a. nucleus
- b. mitochondrion
- c. ribosome
- d. nucleolus