

國立清華大學 104 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系 甲組（生物組）

考試科目（代碼）：生物化學(2201)

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I. 單選題: (42%; 2% of each) *請依題序，順序在【答案卡】作答

- 1) Which of the following statements regarding structural proteins is true?
 - A) silk fibroin is made from a repeat of three amino acids where each third amino acid is Gly
 - B) α -keratin is composed of peptides that contain mostly α -helical structure with the exception of short sequences where the peptide folds back on itself
 - C) collagen has its own helical structure where three individual peptides are wound around each other in a left-handed helix
 - D) generally speaking, structural proteins are soluble in water
 - E) none of the above

- 2) Which of the following is true regarding β -sheet structures?
 - A) hydrogen bonds in an parallel sheet are non-linear
 - B) hydrogen bonds in an antiparallel sheet are non-linear
 - C) the rise per residue is greater for a parallel sheet than for an antiparallel sheet
 - D) β -sheets are an $n=3$ helix with each residue rotated 120° with respect to its neighbors
 - E) none of the above

- 3) Which amino acid is often referred to as a “helix-breaker” due to its absence from α -helices but is often found in structures such as β -turns?

A) Val	B) Met	C) Pro
D) Phe	E) Leu	

- 4) Which of the following correctly identifies key elements present on the exterior of Gram-negative (GN) and Gram-positive (GP) bacteria?
 - A) GN: single lipid bilayer; GP: two lipid bilayers
 - B) GN: single peptidoglycan layer; GP: multiple peptidoglycan layers
 - C) GN: extensively crosslinked peptidoglycans; GP: uncrosslinked peptidoglycan
 - D) GN: contains both N-acetylmuramic acid and N-acetylglucosamine;
GP: contains only N-acetylmuramic acid
 - E) none of the above

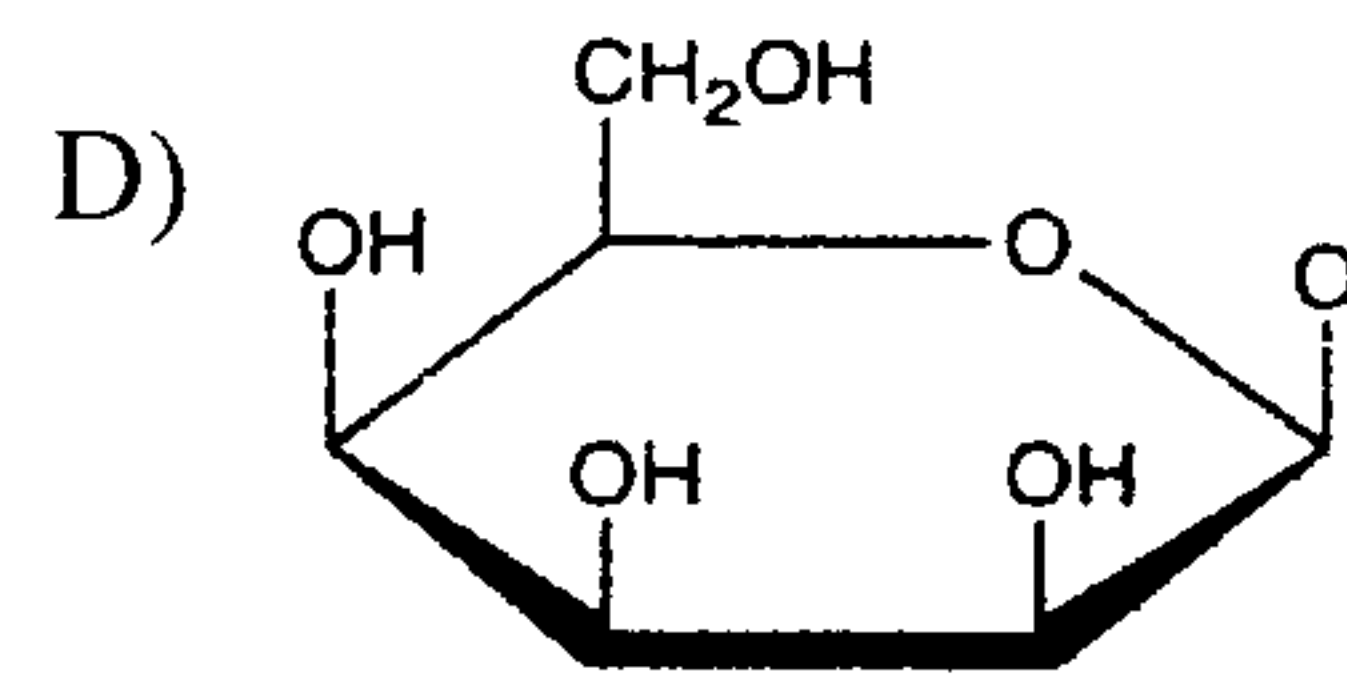
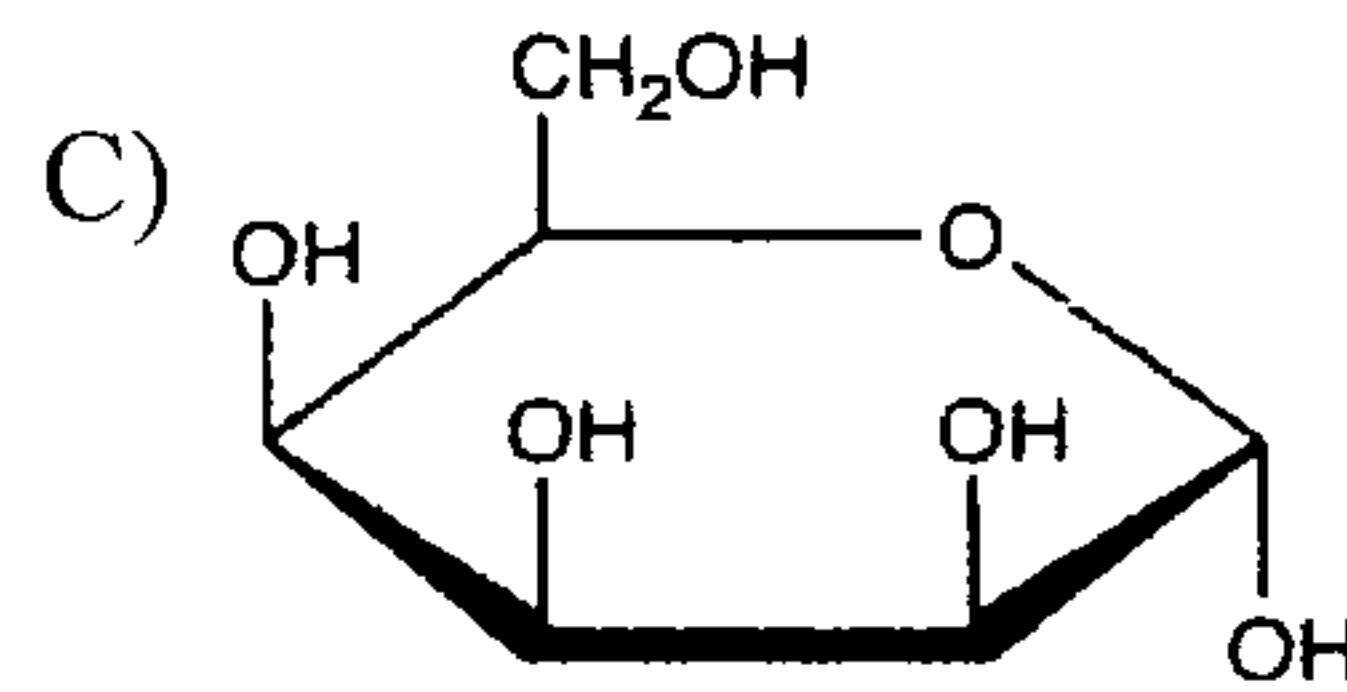
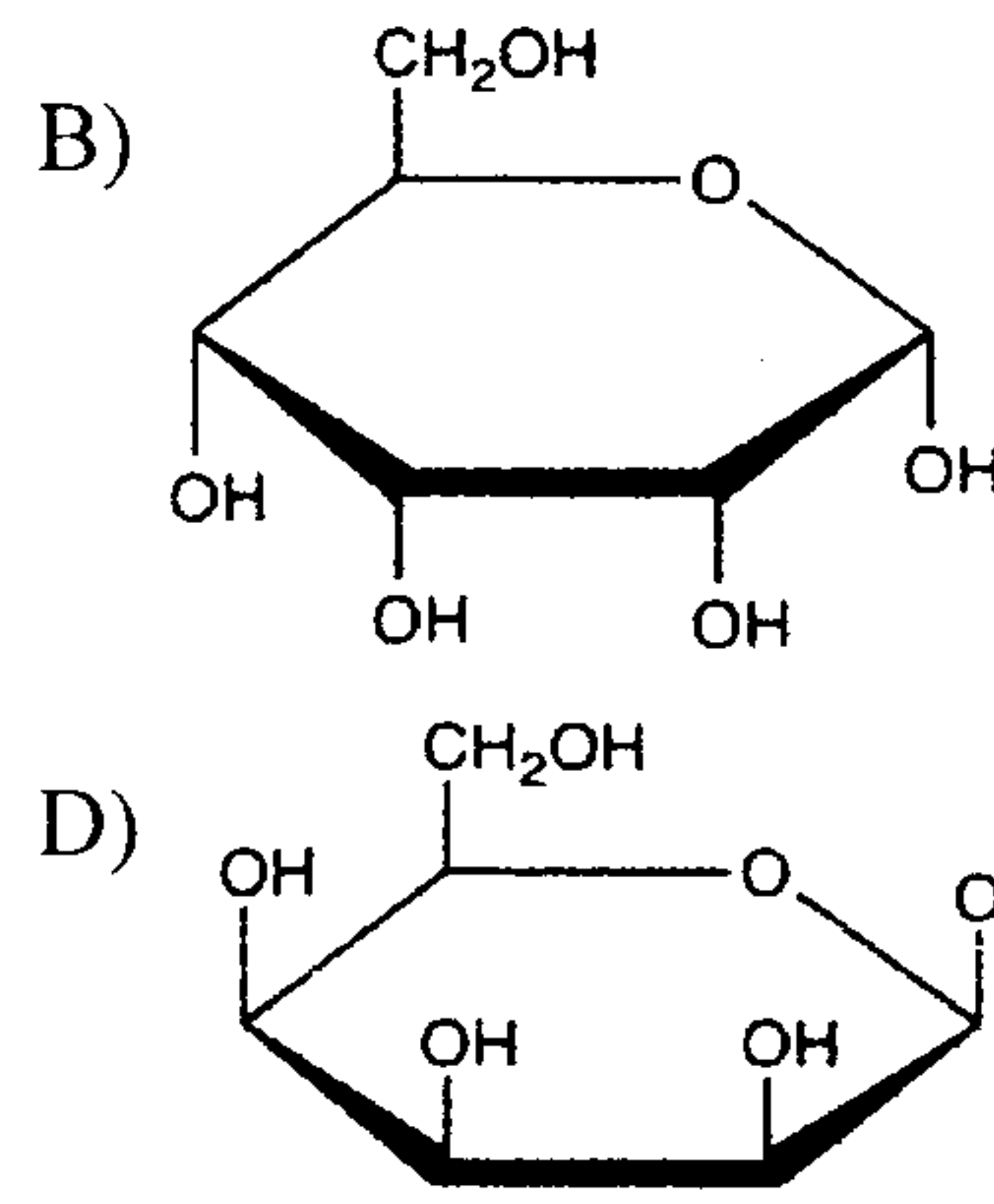
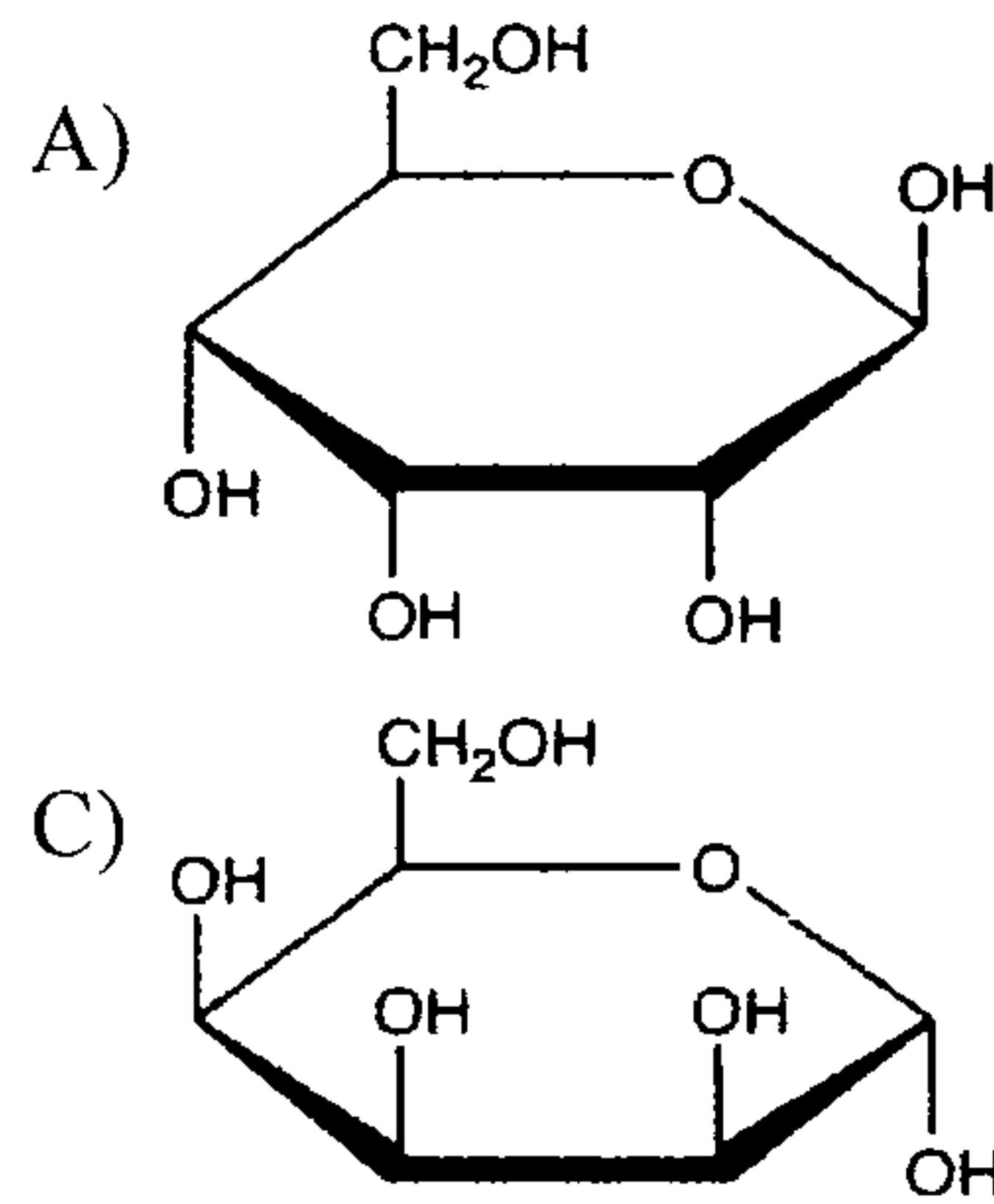
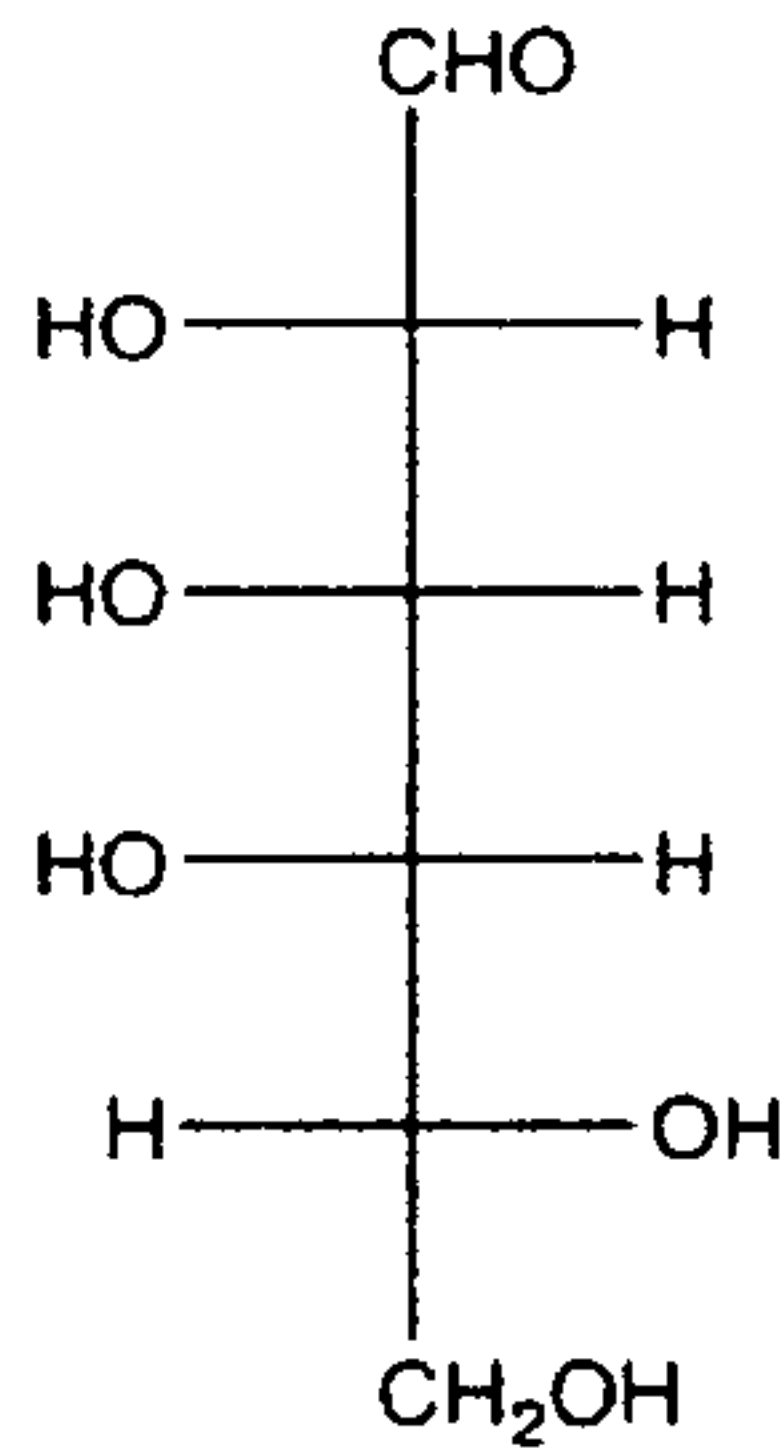
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5) Which of the following would be the correct Haworth projection for β -D-talose (linear form is shown on the left)?



E) none of the above

6) Which of the following mechanisms of membrane transport is correctly defined?

A) simple diffusion: uses concentration gradient to move highly polar molecules and ions across membranes

B) facilitated diffusion: uses proteins such as ion channels to move substances against their concentration gradient across a membrane

C) primary active transport: uses ATP hydrolysis to move ions against their concentration gradient across a membrane

D) secondary active transport: uses ATP hydrolysis along with an ion gradient to move polar molecules or ions against their concentration gradient across a membrane

E) all of the above

7) In animals, the bulk of energy is stored as _____.

A) fatty acids

B) triacylglycerols

C) glycogen

D) waxes

E) glycerophospholipids

8) Given the following peptide, what would be the overall charge at pH 5?

Met-Glu-Ser-Arg-His-Phe-Pro-Asn-Ala-Glu-Cys-Ala-Ser

A) +2

B) +1

C) 0

D) -1

E) -2

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- 9) Which of the following is a common mechanism for the covalent attachment of a lipid to a peripheral membrane protein?
- A) addition of a geranylgeranyl group to the hydroxyl of serine, forming an ether
 - B) addition of a farnesyl group to the thiol of cysteine, forming a thioether
 - C) addition of a myristoyl group to the amine of lysine, forming an amide
 - D) reaction of the amine group of phosphatidylethanolamine with the carboxylate of glutamic acid, forming an amide
 - E) all of the above
- 10) The conversion of _____ represents a conservative change while the conversion of _____ represents a nonconservative change.
- A) Asp to Arg; Ile to Ser
 - B) Tyr to Phe; Lys to Arg
 - C) Gln to Asn; Ser to Thr
 - D) Ile to Leu; Asn to Ala
 - E) Cys to His; Lys to Glu
- 11) Base stacking, or the “stacking interaction,” is most likely the result of which noncovalent interaction.
- A) charge-dipole interaction
 - B) dipole-dipole interaction
 - C) dipole-induced dipole interaction
 - D) van der Waals interaction
 - E) none of the above
- 12) Which of the following is a major difference between B-DNA and A-DNA?
- A) B-DNA has a right-handed helix, A-DNA has a left-handed helix
 - B) B-DNA has 10 residues per helix turn while A-DNA has 9
 - C) B-DNA base pairs are stacked almost parallel to one another while A-DNA base pairs are significantly tilted with respect to each other
 - D) the major groove of A-DNA is much larger than that in B-DNA
 - E) none of the above

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- 13) While RNA is often single stranded, transfer RNA (tRNA) is usually found with some double stranded structure. Which of the following explains this?
- A) tRNAs contain self-complimentary stem-loop structures
 - B) after synthesis, tRNA molecules are hydrolyzed in specific places to allow double stranded structures to form
 - C) regions of tRNAs become supercoiled, thus forcing formation of double stranded regions
 - D) tRNAs adopt a form much like Z-DNA allowing double stranded regions to form
 - E) none of the above
- 14) In a circular DNA molecule of 126 bp with 10.5 bp/turn, which of the following represents an unstrained circle? (L = linking number, T = twist and W = writhe)
- A) L = 12, T = 12, W = 0
 - B) L = 11, T = 11, W = 0
 - C) L = 11, T = 12, W = -1
 - D) L = 12, T = 11, W = +1
 - E) L = 11, T = 10, W = 0
- 15) Which of the following correctly describes the structure of a nucleotide?
- A) adenine is bound via a link between N-7 and C-1 of ribose
 - B) phosphates are always bound to C-2 of ribose
 - C) cytosine is bound via a link between the amine on C-4 and C-1 of ribose
 - D) guanine is bound via a link between N-9 and C-1 of ribose
 - E) none of the above
- 16) Which of the following is correctly defined?
- A) sphingomyelin: ceramide + choline
 - B) glycolipid: glycerol + fatty acid + monosaccharide + phosphate
 - C) cerebroside: ceramide + monosaccharide
 - D) ganglioside: sphingomyelin + oligosaccharide
 - E) none of the above

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- 17) In the fasting state, the following energy metabolic pathways are correct **EXCEPT?**
- A) Ketone bodies are used as energy sources for brain and heart
 - B) Red blood cells uptake fatty acid to perform TCA cycle
 - C) Glycerol and fatty acids are released from adipose tissues
 - D) Glucagon is secreted by pancreas α -cells
 - E) Muscle proteins are degraded into alanine and glutamine and send back to liver for generating glucose.
- 18) In addition to carbohydrate and lipid energy metabolism, the liver serves other purposes **EXCEPT:**
- A) producing insulin to regulate metabolism.
 - B) converting amino acids into metabolic fuel.
 - C) ketone body production.
 - D) detoxification of poisons and drugs.
 - E) Gluconeogenesis.
- 19) _____ is a highly conserved protein that is involved in protein degradation.
- A) dynamin
 - B) recombinase
 - C) degradase
 - D) ubiquitin
 - E) peptidyl transferase
- 20) Which type(s) of RNA molecules are involved in the translation process?
- A) mRNA
 - B) tRNA
 - C) rRNA
 - D) mRNA and tRNA
 - E) All of these

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21) In mammals, the rRNAs **DO NOT** include:

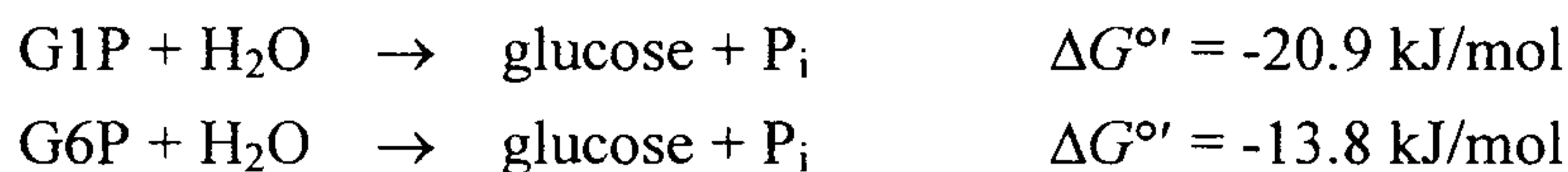
- A) 18S rRNA
- B) 5S rRNA
- C) 5.8S rRNA
- D) 28S rRNA

II. 名詞解釋: (15%, 3% of each) *請依題序，順序在【答案卷】作答

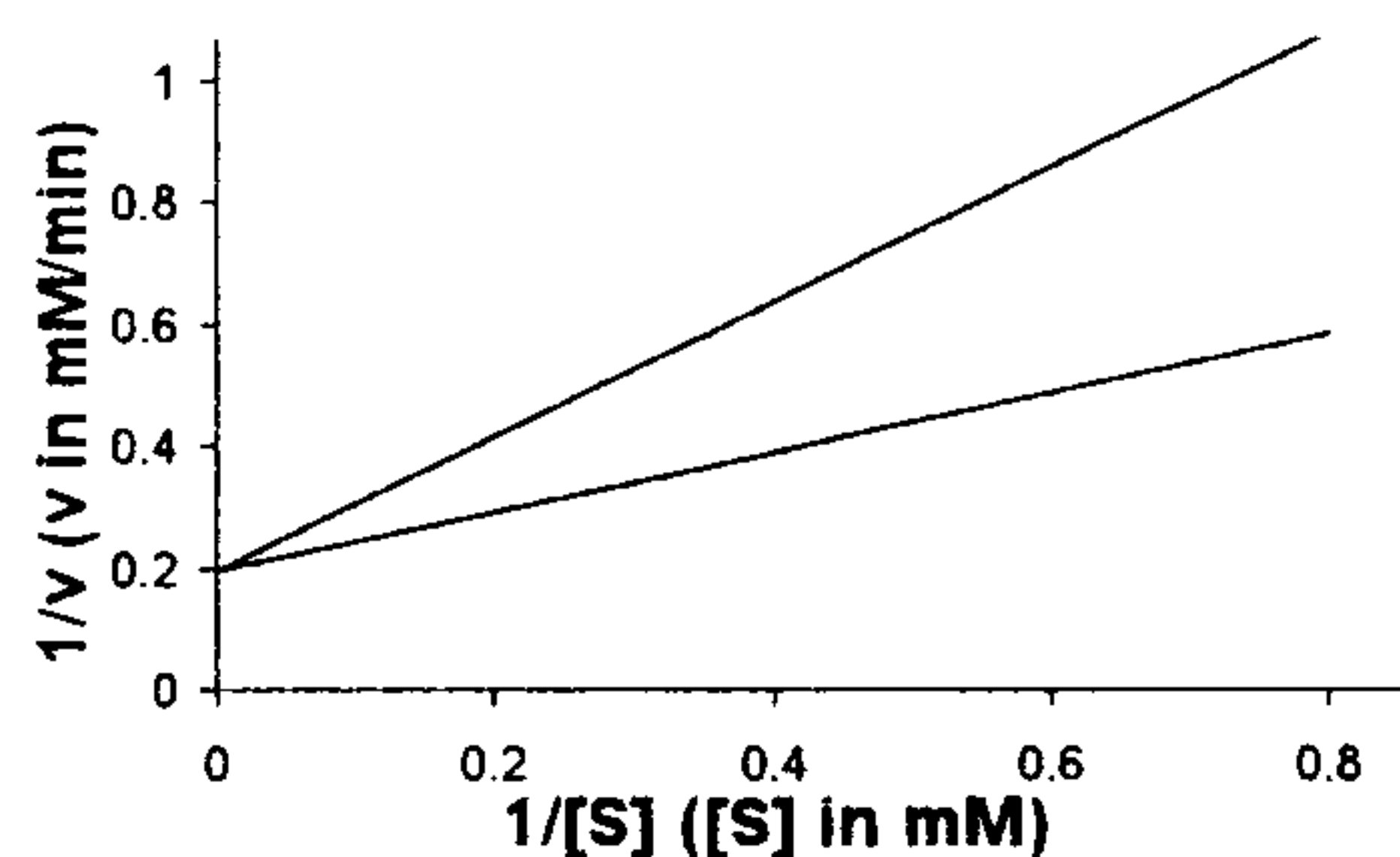
- 1) Okazaki fragments
- 2) Alcoholic fermentation
- 3) Brown fat
- 4) Frameshift mutation
- 5) Autotrophs

III. 問答題：如各題目配分 *請依題序，順序在【答案卷】作答

- 1) (3%) The typical concentration of glucose-6-phosphate (G6P) in a cell is 1 mM. What concentration of glucose-1-phosphate (G1P) would be required to make the interconversion of G6P and G1P freely reversible at 37 °C?



- 2) (4%) A plot of enzyme activity with and without an inhibitor present gave the following plot. What type of inhibitor is present? How does this inhibitor function? What changes are seen in V_{\max} and K_M ?



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3) (4%) A 0.2-g sample of amylopectin was analyzed to determine the fraction of the total glucose residues that are branch points in the structure. The sample was exhaustively methylated and then digested. The product analysis found 50 μmol of 2,3-dimethylglucose and 0.4 μmol of 1,2,3,6-tetramethylglucose.

a) What fraction of the total residues are branch points?

b) How many reducing ends does this amylopectin have?

4) (4%) A peptide was treated with protease enzymes and cyanogen bromide followed by complete hydrolysis of the resulting products. Based upon the following data, determine the sequence of the original peptide.

Chymotrypsin gave two peptides containing the following amino acids:

Leu, Pro

Asp, Gln, Arg, Met, Tyr, Val

Cyanogen bromide gave two peptides containing the following amino acids:

Asp, Met

Gln, Leu, Arg, Tyr, Pro, Val

Trypsin gave two peptides containing the following amino acids:

Gln, Leu, Tyr, Pro

Asp, Arg, Met, Val

5) (3%) The K_M of enzyme A for its substrate S is $K_M^S = 1 \text{ mM}$. Enzyme A also acts on substrate T and its $K_M^T = 10 \text{ mM}$. The rate constant of k_2 with substrate S is $2 \times 10^4 \text{ sec}^{-1}$; with substrate T, $k_2 = 4 \times 10^5 \text{ sec}^{-1}$. Does enzyme A use substrate S or substrate T with greater catalytic efficiency?

6) (5%) What is the start building block of cholesterol? What is the control enzyme for cholesterol biosynthesis? What is the major transporter of cholesterol in circulation system?

7) (4%) mRNA precursors undergo post-transcriptional modifications such as capping, methylation and polyadenylation. What are the possible advantages of these modifications on mRNA?

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- 8) (5%) What is the oxidation number of N in nitrate, nitrite, NO, N₂O and N₂?
- 9) (6%) Describe the general features and components of “DNA replication fork” in E.coli.
- 10) (5%) How protein degradation is regulated in eukaryotic cells?