※ 注意：請用 2B 鉛筆作答於答案卡，並先詳閱答案卡上之「畫記說明」。

Single-choice questions (2 points each) 單選題 每題 2 分

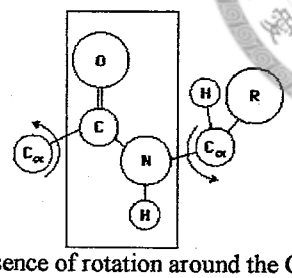
1. Which of the following protein would be eluted last from the DEAE (diethylaminoethyl cellulose) ion-exchange column in an elution buffer of pH 7.5 : (A) cardiotoxin (pI 10.8) (B) hemoglobin (pI 6.8), (C) serum albumin (pI 4.9), (D) myoglobin (pI 7.6) (E) ribonuclease (pI 9.6).

2. What is the approximate pI of the dipeptide Arg-Arg (The three pKa of arginine are 2.2, 9.0 & 12.5)? (A) 2.2 (B) 5.6 (C) 9.0 (D) 10.8 (E) 12.5

3. What is the pH of the solution by mixing one part of 0.3 mM Tris hydrochloride and two parts of 0.2 mM Tris (pKa of Tris.HCl = 7.8, log 2=0.301 and log 3=0.477)? (A) 3.24 (B) 5.62 (C) 7.80 (D) 7.92 (E) 9.02

4. Pauling and Corey's studies of the peptide bond showed that:
   (A) at pH 7, many different peptide bond conformations are equally probable.
   (B) peptide bonds are essentially planar, with no rotation about the C—N axis.
   (C) peptide bonds in proteins are unusual, and unlike those in small model compounds.
   (D) peptide bond structure is extraordinarily complex.
   (E) primary structure of all proteins is similar, although the secondary and tertiary structure may differ greatly.

5. In the diagram below, the plane drawn behind the peptide bond indicates the:



   (A) absence of rotation around the C—N bond because of its partial double-bond character.
   (B) plane of rotation around the Cα—N bond.
   (C) region of steric hindrance determined by the large C=O group.
   (D) region of the peptide bond that contributes to a Ramachandran plot.
   (E) theoretical space between –180 and +180 degrees that can be occupied by the ϕ and ψ angles in the peptide bond.

6. Which scientist disapprove the theory of "Spontaneous Generation of Organisms" in Nature? (A) J. Watson (B) L. Pasteur (C) L. Pauling (D) F. Sanger (E) H. Krebs.

7. A D-amino acid would interrupt an α helix made of L-amino acids. Another naturally occurring hindrance to the formation of an α helix is the presence of:
   (A) a negatively charged Arg residue. (B) a nonpolar residue near the carboxyl terminus.
   (C) a positively charged Lys residue. (D)a Pro residue. (E) two Ala residues side by side.

8. The major reason that antiparallel β-stranded protein structures are more stable than parallel β-stranded structures is that the latter:

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(A) are in a slightly less extended configuration than antiparallel strands. (B) do not have as many disulfide crosslinks between adjacent strands. (C) do not stack in sheets as well as antiparallel strands. (D) have fewer lateral hydrogen bonds than antiparallel strands. (E) have weaker hydrogen bonds laterally between adjacent strands.

9. When oxygen binds to a heme-containing protein, the two open coordination bonds of Fe^{2+} are occupied by:
(A) one O atom and one amino acid atom. (B) one O_2 molecule and one amino acid atom. (C) one O_2 molecule and one heme atom. (D) two O atoms. (E) two O_2 molecules.

10. In the binding of oxygen to myoglobin, the relationship between the concentration of oxygen and the fraction of binding sites occupied can best be described as:
(A) hyperbolic. (B) linear with a negative slope. (C) linear with a positive slope. (D) random. (E) sigmoidal.

11. Myoglobin and the subunits of hemoglobin have:
(A) no obvious structural relationship. (B) very different primary and tertiary structures. (C) very similar primary and tertiary structures. (D) very similar primary structures, but different tertiary structures. (E) very similar tertiary structures, but different primary structures.

12 An allosteric interaction between a ligand and a protein is one in which:
(A) binding of a molecule to a binding site affects binding of additional molecules to the same site.
(B) binding of a molecule to a binding site affects binding properties of another site on the protein.
(C) binding of the ligand to the protein is covalent. (D) multiple molecules of the same ligand can bind to the same binding site. (E) two different ligands can bind to the same binding site.

13. The amino acid substitution of Val for Glu in Hemoglobin S results in aggregation of the protein because of _____ interactions between molecules.
(A) covalent (B) disulfide (C) hydrogen bonding (D) hydrophobic (E) ionic

14. Of the 20 standard amino acids, only _____ is not optically active. The reason is that its side chain _____.
(A) alanine; is a simple methyl group (B) glycine; is a hydrogen atom (C) glycine; is unbranched
(D) lysine; contains only nitrogen (E) proline; forms a covalent bond with the amino group

15. Two amino acids of the standard 20 contain sulfur atoms. They are:
(A) cysteine and serine. (B) cysteine and threonine. (C) methionine and cysteine
(D) methionine and serine (E) threonine and serine.

16. All of the amino acids that are found in proteins, except for proline, contain a(n):
(A) amino group. (B) carbonyl group. (C) carboxyl group. (D) ester group. (E) thiol group.

17. Which of the following statements about aromatic amino acids is correct?
(A) All are strongly hydrophilic. (B) Histidine's ring structure results in its being categorized as aromatic or basic, depending on pH. (C) On a molar basis, tryptophan absorbs more ultraviolet light than tyrosine. (D) The major contribution to the characteristic absorption of light at 280 nm by proteins is the phenylalanine R group. (E) The presence of a ring structure in its R group determines whether or not an amino acid is aromatic.

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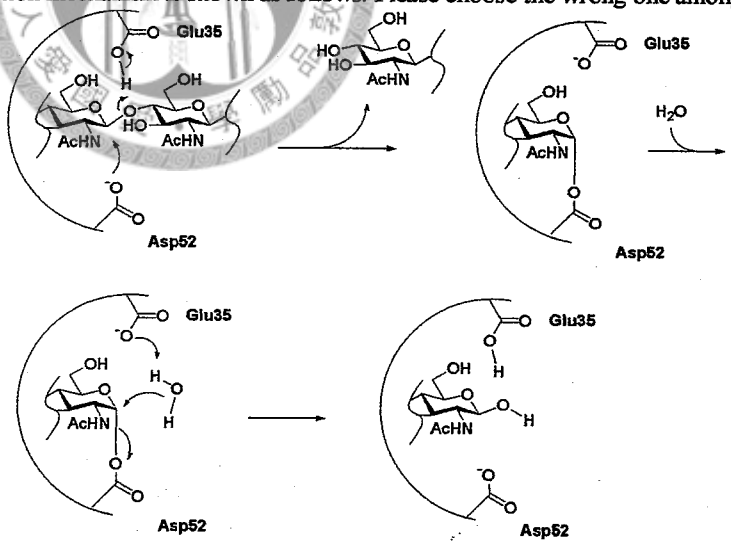
18. Which of the following statements about *cystine* is correct?
(A) Cystine forms when the R—CH_2—SH group is oxidized to form a —CH_2—S—S—CH_2— disulfide bridge between two cysteines.
(B) Cystine is an example of a nonstandard amino acid, derived by linking two standard amino acids.
(C) Cystine is formed by the oxidation of the carboxylic acid group on cysteine.
(D) Cystine is formed through a peptide linkage between two cysteines.
(E) Two cystines are released when a —CH_2—S—S—CH_2— disulfide bridge is reduced to —CH_2—SH.

19. Amino acids are ampholytes because they can function as either a(n):
(A) acid or a base. (B) neutral molecule or an ion. (C) polar or a nonpolar molecule.
(D) standard or a nonstandard monomer in proteins. (E) transparent or a light-absorbing compound.

20. The peptide alanylglutamylglycylalanylleucine has (A) a disulfide bridge. (B) five peptide bonds. (C) four peptide bonds. (D) no free carboxyl group. (E) two free amino groups.

21. Chymotrypsin has three important amino acids to participate in the catalysis, including His57, Asp102 and Ser195. Which one of the following descriptions is true?
(A) The enzyme activates a water molecule for nucleophilic attack. (B) The enzyme utilizes His57 for a nucleophilc attack. (C) The enzyme utilizes Asp102 for a nucleophilc attack (D) The enzyme utilizes Asp102 for an electrophilic addition (E) The enzyme utilizes Ser195 for a nucleophilc attack

22. The three-dimentional structure of hen egg white lysozyme was determined by David Phillips and coworkers in 1965. The reaction mechanism is shown as follows. Please choose the wrong one among the following descriptions.



(A) Asp52 serves as a nucleophile; (B) Water serves as a nucleophile; (C) The reaction shown is a S_N1 pathway; (D) The reaction results in a retention of configuration; (E) Glu35 functions as the general acid and base

23. Which one of the following descriptions is *not* true regarding to bacterial cell wall (peptidoglycan)?
(A) N-acetylglucosamine (GlcNAc) is β(1,4)-linked to N-acetylmuraminic acid (MurNAc)
(B) Gram-positive bacteria have thicker layers of cell walls than Gram-negative bacteria
(C) Bacterial cell walls contain sugar polymers of alternating GlcNAc and MurNAc residues

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(D) The sugar polymers are cross-linked together by the short peptides that to make a rigid three dimentinal network to withstand osmotic pressure. (E) Penicillin and related antibiotics kill the bacterial by preventing polymerization of sugar polymers

24. A polysaccharide of unknown structure was isolated, subjected to exhaustive methylation, and hydrolyzed. Analysis of the products revealed three methylated sugars in the ratio 20:1:1. The sugars were 2,3,4-tri-O-methyl-D-glucose; 2,4-di-O-methyl-D-glucose; and 2,3,4,6-tetra-O-methyl-D-glucose. What is the structure of the polysaccharide?
(A) Chains of (1,3)-linked D-glucose residues with occasional (1,6)-linked branches.
(B) Chains of (1,6)-linked D-glucose residues with occational (1,4)-linked branches.
(C) Chains of (1,6)-linked D-glucose residues with occational (1,3)-linked branches.
(D) Chains of (1,4)-linked D-glucose residues with occational (1,3)-linked branches.
(E) Chains of (1,6)-linked D-glucose residues with occational (1,2)-linked branches.

25. Which of the following statements about a plot of V_0 vs. [S] for an enzyme that follows Michaelis-Menten kinetics is *false*?
(A) At very high [S], the velocity curve becomes a horizontal line that intersects the y-axis at K_m. (B) As [S] increases, the initial velocity of reaction V_0 also increases. (C) K_m is the [S] at which $V_0 = 1/2\ V_{max}$. (D) The shape of the curve is a hyperbola. (E) The y-axis is a rate term with units of μM/min.

26. Aside from maintaining the integrity of its hereditary material, the most important general metabolic concern of a cell is:
(A) keeping its glucose levels high.(B) maintaining a constant supply and concentration of ATP. (C) preserving its ability to carry out oxidative phosphorylation.(D) protecting its enzymes from rapid degradation.(E) running all its major metabolic pathways at maximum efficiency.

27. Which of the following is true of glycogen synthase?
(A) Activation of the enzyme involves a phosphorylation. (B) It catalyzes addition of glucose residues to the nonreducing end of a glycogen chain by formation of ($\alpha 1 \rightarrow 4$) bonds.
(C) It uses glucose-6-phosphate as donor of glucose units.(D) The conversion of an active to an inactive form of the enzyme is controlled by the concentration of cAMP. (E) The enzyme has measurable activity only in liver.

28. Michaelis and Menten assumed that the overall reaction for an enzyme-catalyzed reaction could be written as

$$E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_2} E + P$$

Using this reaction, the rate of breakdown of the enzyme-substrate complex can be described by the expression:
(A) k_1 ([E_t] – [ES]). (B) k_1 ([E_t] – [ES])[S].(C) k_2 [ES]. (D) k_{-1} [ES] + k_2 [ES]. (E) k_{-1} [ES].

29. Both water and glucose share an —OH that can serve as a substrate for a reaction with the terminal phosphate of ATP catalyzed by hexokinase. Glucose, however, is about a million times more reactive as a substrate than water. The best explanation is that:
(A) glucose has more —OH groups per molecule than does water. (B) the larger glucose binds better to the enzyme; it induces a conformational change in hexokinase that brings active-site amino acids into position for catalysis. (C) the —OH group of water is attached to an inhibitory H atom, while the glucose —OH group is attached to C. (D) water and the second substrate, ATP, compete for the active site resulting in a competitive inhibition of the enzyme. (E) water normally will not reach the active site because it is hydrophobic.

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30. In a tissue that metabolizes glucose via the pentose phosphate pathway, C-1 of glucose would be expected to end up principally in:
(A) carbon dioxide. (B) glycogen. (C) phosphoglycerate. (D) pyruvate. (E) ribulose 5-phosphate.

31. Glucose labeled with ^{14}C in C-1 and C-6 gives rise in glycolysis to pyruvate labeled in:
(A) its carbonyl and methyl carbons. (B) all three carbons. (C) its carbonyl carbon. (D) its carboxyl carbon. (E) its methyl carbon.

32. A function of the glyoxylate cycle, in conjunction with the citric acid cycle, is to accomplish the:
(A) complete oxidation of acetyl-CoA to CO_2 plus reduced coenzymes. (B) net conversion of lipid to carbohydrate. (C) net synthesis of four-carbon dicarboxylic acids from acetyl-CoA. (D) net synthesis of long-chain fatty acids from citric acid cycle intermediates. (E) both B and C are correct

33. Which of the following intermediates of the citric acid cycle is prochiral?
(A) Citrate (B) Isocitrate (C) Malate (D) Oxaloacetate (E) Succinate

34. The two moles of CO_2 produced in the first turn of the citric acid cycle have their origin in the:
(A) carboxyl and methylene carbons of oxaloacetate (B) carboxyl group of acetate and a carboxyl group of oxaloacetate. (C) carboxyl group of acetate and the keto group of oxaloacetate. (D) two carbon atoms of acetate. (E) two carboxyl groups derived from oxaloacetate.

35. Which of the following statements about the oxidative decarboxylation of pyruvate in aerobic conditions in animal cells is correct?
(A) One of the products of the reactions of the pyruvate dehydrogenase complex is a thioester of acetate. (B) The methyl (—CH_3) group is eliminated as CO_2. (C) The process occurs in the cytosolic compartment of the cell. (D) The pyruvate dehydrogenase complex uses all of the following as cofactors: NAD^+, lipoic acid, pyridoxal phosphate (PLP), and FAD. (E) The reaction is so important to energy production that pyruvate dehydrogenase operates at full speed under all conditions.

36. In a mammalian cell, DNA repair systems:
(A) are extraordinarily efficient energetically; (B) some subunits of DNA repair complex involve in transcription; (C) are generally absent, except in egg and sperm cells; (D) can repair deletions, but not mismatches; (E) normally repair just only 50 % of the DNA lesions that occur.

37. Which one of the following statements about mitochondrial DNA is incorrect?
(A) mitochondrial genetic codes differ from the standard nuclear code; (B) products of mitochondrial genes are not exported to cytosol; (C) all the mitochondria of a developing embryo are derived from the mother's egg; (D) mitochondria contain one non-histone mitochondria DNA molecule;
(E) mutations in mitochondrial DNA will cause genetic diseases.

38. Which description is incorrect for eukaryotic mRNA transcription?
(A) could be blocked by α-amanitin and actinomycin D; (B) requires DNA helicase and protein kinase; (C) RNA pol II could bind to TATA box to synthesize mRNAs; (D) requires structural changes in chromatin; (E) many promoters are positively regulated.

39. Which one doesn't involve in splicing of introns in nuclear mRNA primary transcripts?
(A) RNA helicase; (B) ATP; (C) CTD of RNA polymerase II; (D) snRNPs; (E) endonucleases

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40. What is not true about transcription factor CREB?
(A) belongs to basic-region leucine zipper (bZIP) family; (B) can be phosphorylated by PKA, PKC and MAPK at serine 133 position; (C) phosphorylated CREB could interact with a histone acetyltransferase to activate gene expression; (D) binds to CRE (cyclic-AMP-response element) with monomer; (E) some inhibitory isoforms formed from alternative splicing mechanism.

41. A fatty acid represented as $CH_3CH_2CH{=}CH\text{-}R$, where R is a hydrocarbon chain with a terminal COOH, belongs to
(A) an omega-3 fatty acid; (B) a polyunsaturated fatty acid; (C) a 3,4-*trans* unsaturated fatty acid; (D) an essential fatty acid; (E) a Δ^3 fatty acid

42. Which statement about Na^+, K^+-ATPase correct?
(A) It pumps out 2 Na^+ and pumps in 3 K^+ per molecule of ATP; (B) It produces a positive transmembrane potential of 50 to 70 mV; (C) It contains two subunits each of which spans the membrane; (D) It can be activated by ouabain and digitalis; (E) all the above are correct.

43. The topology of an integral membrane protein
(A) can be predicted from its amino acid composition; (B) can be predicted from its hydropathy plot; (C) can only be determined by enzymatic analysis followed by mass spectrometry; (D) can be predicted by circular dichroism or infra-red spectroscopy.(E) can be predicted by (A) and (B).

44. The chemical basis for the large free-energy change associated with ATP hydrolysis contains the following:
(A) the relief of repulsion between positive charges of ATP on hydrolysis; (B) resonance stabilization of inorganic phosphate; (C) the protonation of the product ADP^{2-}; (D) the protonation of inorganic phosphate; (E) none of the above is correct.

45. Ketone bodies
(A) all contain a ketone functional group; (B) are formed in the adipocyte; (C) are formed in muscle; (D) are abnormal substances in normal animals; (E) can be used as energy sources.

46. The fatty acid oxidation is inhibited through the following:
(A) transport of fatty acyl groups into mitochondria is inhibited by malonyl-CoA
(B) when [NADH]/[NAD^+] is high, β-hydroxyacyl-CoA dehydrogenase is inhibited.
(C) high [acetyl-CoA] inhibit thiolase (D) when cellular energy level is high
(E) all the above are correct

47. Which of the following statements about the metabolism of amino group is correct?
(A) In liver amino group from most amino acids is transferred to α-ketoglutarate to form glutamine; (B) Excess ammonia generated in other tissues is converted to the amino nitrogen of glutamine; (C) In muscle, excess amino groups are transferred to pyruvate to form aspartate; (D) Urea is produced from ammonia, begins inside liver mitochondria and continues its reactions in cytosol. (E) none of the above is correct.

48. Which of the following statements is false?
(A) The vigorously contracting muscles operate aerobically to produce pyruvate, lactate and ammonia from protein breakdown; (B) These products are transported to liver where glucose is synthesized and sent back to muscle; ammonia is excreted as urea. (C) This transaction is done by glucose-alanine cycle and Cori cycle (lactate from muscle is transported to liver and transformed to glucose and sent back to muscle). (D) The energetic burden of gluconeogenesis is imposed on liver. (E) All ATP in muscle is devoted to muscle contraction.

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49. Which of the following statements about brain metabolism is false?
(A) Adult mammalian brains normally use only glucose as fuel. (B) Brain has very active respiratory metabolism. (C) Brain contains very little glycogen. (D) Brain depends on incoming glucose from blood. (E) Brain cannot use β-hydroxybutyrate from liver.

50. Which of the following statement about the hormones is false?
(A) Endocrine hormones are hormones released into blood and carried throughout the body. (B) Paracrine hormones are released into extracellular space and diffuse to neighboring target cells. (C) Autocrine hormones are released by one cell and affect that same cell by binding to receptors on its own surface. (D) All hormones have their receptors on the cell membranes. (E) Hormones are chemically very diverse.