

國立清華大學命題紙

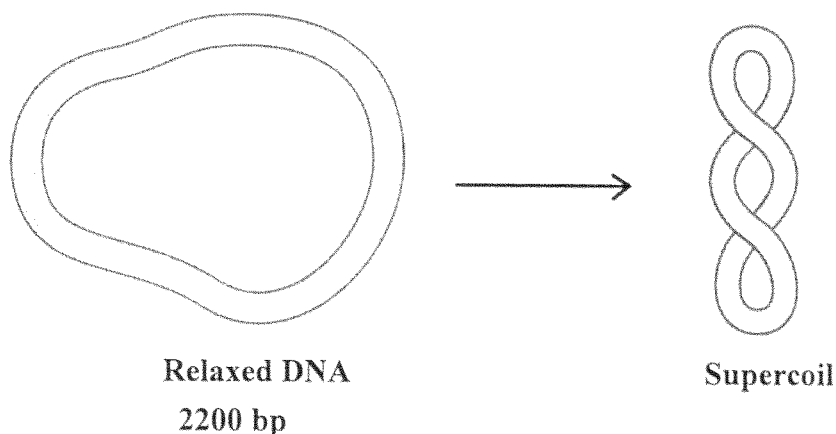
98 學年度_生命科學院、生命科學院醫學生物科技學程_系(所)_甲、乙_組碩士班入學考試

科目_生物化學_ 科目代碼_0201、0301、0501_共 8 頁第 1 頁 *請在【答案卡】內作答

選擇題 (共 60 題, 60%. 從 A~D 或 A~E 選正確答案. 單選題, 每題一分)

- (1) The pitch, or distance required to complete one helical turn in B-DNA is
(A) 33.2 Å, (B) 45.6 Å, (C) 38.4 Å, (D) 24.6 Å, (E) 28.4 Å.
- (2) Which of the following substances is found in RNA molecules but NOT in DNA molecules?
(A) Adenine, (B) Deoxyribose, (C) Uracil, (D) Phosphorus, (E) Thymine.
- (3) Which kind of experiment procedure is used to probe DNA sequences?
(A) Eastern Blotting, (B) Western Blotting, (C) Southern Blotting, (D) Northern Blotting.
- (4) Chose the wrong statement about PCR.
(A) PCR, which means polymerase chain reaction, is a technique for dramatically amplifying the amount of a specific nucleic acid.
(B) In RT-PCR, the nucleic acid which to be amplified is an RNA. This RNA serves as the template for cycles of PCR.
(C) We heat the reaction mixture to 95 to dissociate the DNA, followed by cooling, annealing of primers.
(D) If we have 20 rounds of PCR, we would have about 1 million times the amount of target DNA.

The following figure shows a circular A-form DNA molecule in different topological states. Please answer questions (5) and (6).



- (5) What is linking number (L) for this supercoil?
(A) 198, (B) 202, (C) 208, (D) 212, (E) 218.
- (6) What is the writhe (W) for this supercoil?
(A) +2, (B) +4, (C) -2, (D) -4, (E) 0.
- (7) If a messenger RNA codon is UAC, which of the following would be the complementary anticodon triplet in the transfer RNA?
(A) ATG, (B) AUC, (C) ATT, (D) AUG, (E) ATC.
- (8) Working independently, Frederick Griffith and Oswald Avery provided the first evidence that DNA carries genetic information by showing that _____.

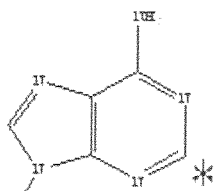
國立清華大學 命題紙

98 學年度_生命科學院、生命科學院醫學生物科技學程_系(所)_甲、乙_組碩士班入學考試

科目__生物化學__ 科目代碼__0201、0301、0501__共 8 頁第 2 頁 *請在【答案卡】內作答

- (A) DNA brings about transformation of bacterial cells.
 (B) DNA is composed of a double helix.
 (C) DNA is contained in chloroplasts.
 (D) DNA is present in all tissue cells.
 (E) DNA is present in chromosomes.
- (9) For a 99% probability of finding a particular sequence within the 3×10^6 kbp human genome, how many individual clones must be screened if the cloned fragments averaged 10 kbp in size?
 (for your information: the probability, P , the number of screened cloned, N , and the fraction, f , of the particular fragment. $N = \frac{\ln(1-P)}{\ln(1-f)}$)
 (A) 2.8×10^4 , (B) 5.6×10^5 , (C) 8.4×10^5 , (D) 1.4×10^6 , (E) 3.6×10^7 .
- (10) Which of the following is not a step in PCR?
 (A) cooling to 70°C after DNA template dissociation, (B) annealing of primers to DNA template, (C) DNA synthesis by reverse transcriptase, (D) heating to 95°C to dissociate DNA template.
- (11) During replication of DNA, a nucleotide base that would bond with cytosine is _____.
 (A) Uracil, (B) Thymine, (C) Guanine, (D) Adenine, (E) None of the above are correct.

(12)



* denotes position (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

- (13) Molecules of a given protein have all EXCEPT: (A) a fixed amino acid composition, (B) a defined amino acid sequence, (C) a sequence read from C-terminal end to N-terminal end, (D) an invariant molecular weight, (E) a nucleotide sequence from which they are encoded.
- (14) The “N” represents the amide nitrogen, “C α ” is the α -carbon, and “CO” is the carbonyl carbon of amino acids in a peptide, the peptide backbone of a protein consists of the repeated sequence:
 (A)-C α -N-CO-, (B)-N-CO-C α -, (C)-N-C α -CO-, (D)-CO-C α -N-, (E) None of the above.
- (15) The peptide bond has partial _____ character. (A) hydrogen bond, (B) double bond, (C) triple bond, (D) van der Waals bond, (E) All of the above.
- (16) Proteins with two different polypeptide chains are: (A) monomeric proteins, (B) trimeric proteins, (C) homodimeric proteins, (D) heterodimeric proteins, (E) none of the above.
- (17) Amino acid analysis of a protein gives: (A) the sequence of the protein, (B) the number of residues of each amino acid in the protein, (C) the molecular weight of the protein, (D) an identification of the N-terminal and C-terminal amino acids, (E) the percentage or ratio of the various amino acids in the protein.

國 立 清 華 大 學 命 題 紙

98 學年度_生命科學院、生命科學院醫學生物科技學程_系(所)_甲、乙_組碩士班入學考試

科目__生物化學__ 科目代碼__0201、0301、0501__共 8 頁第 3 頁 *請在【答案卡】內作答

- (18) Edman degradation will:
- (A) determine the C-terminal amino acid by using a carboxypeptidase,
 - (B) cleave the protein into a multitude of smaller peptides,
 - (C) compare overlapping sets of peptide fragments,
 - (D) determine the N-terminal amino acid,
 - (E) generate two different, but overlapping sets of peptide fragments.
- (19) All of the statements about homologous proteins such as hemoglobin from different organisms are correct EXCEPT: (A) share little sequence homology with other proteins with similar function, (B) have nearly identical lengths, (C) share a significant degree of sequence similarity, (D) perform the same function in different organisms, (E) have sequence identity in direct correlation to the relatedness of the species from which they were derived.
- (20) _____ between tightly packed amino acid side chains in the interior of the protein are a major contribution to protein structure. (A) Hydrogen bonds, (B) Electrostatic interactions, (C) Covalent ester bonds, (D) van der Waals interactions, (E) All are true.
- (21) The resonance structure which forms the "amide plane" contains which atoms? (A) $C\alpha H-CO-NH-C-C\alpha H$, (B) $C\alpha H-CO-NH$, (C) $C\alpha-CO-NH-C\alpha$, (D) $NH-CO$, (E) $NH-CO-C\alpha$.
- (22) Alpha helices are stabilized primarily by: (A) hydrogen bonds between the main chain peptide bond component atoms, (B) electrostatic interactions between R-groups, (C) hydrophobic interactions between the α -carbons of the main chain, (D) hydrogen bonding between the R-groups, (E) hydrophobic interactions between R-groups and the solvent water.
- (23) _____ and _____ act as helix breakers due to their unique structures, which fix the value of the $C\alpha-N-C$ bond angle. (A) Histidine, lysine (B) Proline, hydroxyproline; (C) Arginine, lysine; (D) Serine, threonine; (E) Tyrosine, serine.
- (24) If the following section of a polypeptide is folded into an α -helix, to which amino acid is the carbonyl group of alanine hydrogen bonded? "ala-ser-val-asp-glu-leu-gly" (A) Serine, (B) Aspartic acid, (C) Valine, (D) Leucine, (E) Glutamic acid.
- (25) Triacylglycerol (A) is amphipathic, (B) dissolves easily in water, (C) contains carbon, hydrogen and oxygen in the ratio of 1:2:1, (D) is soluble in benzene and ether, (E) is often found in biomembranes.
- (26) Chitin and agarose are (A) polysaccharides, (B) polypeptides, (C) polynucleotides, (D) lipids, (E) enzymes.
- (27) Cell membrane mainly consists of (A) polysaccharides and DNA, (B) carbohydrates and lipids, (C) phospholipids and proteins, (D) proteins and carbohydrates, (E) nucleic acids and phospholipids.
- (28) The main purpose of fermentation is to (A) oxidize glucose to generate NADH, (B) regenerate NAD^+ from NADH, (C) generate proton gradient for ATP synthesis, (D) synthesize new glucose molecules, (E) generate amino acids for protein synthesis.

國立清華大學 命題紙

98 學年度_生命科學院、生命科學院醫學生物科技學程_系(所)_甲、乙_組碩士班入學考試

科目__生物化學_ 科目代碼__0201、0301、0501__共 8 頁第 4 頁 *請在【答案卡】內作答

- (29) Which fatty acid has a melting temperature higher than that of stearic acid (18:0)? (A) Oleic acid (18:1), (B) Linoleic acid (18:2), (C) Linolenic acid (18:3), (D) Arachidic acid (20:0), (E) Palmitic acid (16:0).
- (30) Only a small portion of the energy of glucose has been converted to ATP after going through glycolysis and citric acid cycle. At this point, most of the usable energy is stored in (A) acetyl-CoA, (B) NAD^+ and FAD, (C) NADH and FADH_2 , (D) succinyl-CoA, (E) proton gradient.
- (31) Which of the following statements about cyclic photophosphorylation is FALSE? (A) It requires light energy, (B) It involves photosystem I, (C) It produces NADPH, (D) It takes place in thylakoid membranes, (E) It is inhibited by uncouplers.
- (32) Which compartment of chloroplasts becomes acidic when the electron transport system is operating? (A) Lumen inside the thylakoid sac, (B) Stroma, (C) Space between inner and outer membranes, (D) Thylakoid membranes, (E) Cytoplasm.
- (33) Which intermediate of the citric acid cycle can be synthesized from pyruvate without going through acetyl-CoA? (A) Citrate, (B) Succinate, (C) Fumarate, (D) Malate, (E) Oxaloacetate.
- (34) Which of the following statements about cytochromes is TRUE? (A) They have an iron atom at the center of the imidazole ring, (B) They cycle between Fe^{2+} and Fe^{3+} during redox reactions, (C) They are colorless, (D) They always exist in free form in cells, (E) They normally associate with protons.
- (35) Which of the following monosaccharides is not an aldose? (A) Ribose, (B) Glucose, (C) Galactose, (D) Fructose, (E) Mannose.
- (36) Na^+ , K^+ -ATPase helps animal cells to (A) extrude Na^+ and K^+ , (B) accumulate Na^+ and K^+ , (C) extrude Na^+ and accumulate K^+ , (D) extrude K^+ and accumulate Na^+ , (E) none of the above.
- (37) Choose the most correct statement about biotransformation between glucose and pyruvate. (A) glycolysis releases more heat than gluconeogenesis, (B) gluconeogenesis releases more heat than glycolysis, (C) glycolysis releases equal heat as does gluconeogenesis, (D) no equal basis for comparison, (E) none of the above.
- (38) Suppose there is a good swimmer on an empty life boat after sea wreck on South Pacific Ocean. His height is 175 cm and weight is 80 kg. It is now the 5th day after the sea wreck. What could be his most POSSIBLE and DIRECT cause of death? (A) Low blood glucose, (B) Low blood pH, (C) Dehydration, (D) Malnutrition, (E) Deficiency in vitamin C.
- (39) After you were borne a nurse withdrew 50 μl of blood from your subcutaneous skin. What did she try to do for you most likely? (A) Test trisomy 21, (B) Test Rh factor, (C) Test G-6-PD deficiency, (D) Test HVB, (E) Test AIDS.
- (40) When you were 3 weeks old you suffered from jaundice mainly due to (A) your liver is not functioning yet, (B) your lungs were not functioning yet, (C) your hemoglobin had a too high affinity for oxygen, (D) your kidneys were not functioning yet, (E) your immune system was not functioning.

國 立 清 華 大 學 命 題 紙

98 學年度_生命科學院、生命科學院醫學生物科技學程_系(所)_甲、乙_組碩士班入學考試

科目__生物化學__ 科目代碼__0201、0301、0501__共 8 頁第 5 頁 *請在【答案卡】內作答

- (41) A premature infant must inhale certain kind of surface reactant which is (A) SDS surface reactant, (B) phospholipid containing choline derivative, (C) phospholipid containing ethanolamine derivative, (D) hydrophilic amino acid mixtures, (E) hydrophobic amino acid mixtures.
- (42) Glucose-1-phosphate can be converted to Glucose-6-phosphate by a (A) dehydrogenase, (B) epimerase, (C) isomerase (D) mutase, (E) transferase.
- (43) Indole is important in the following syntheses: (A) amino acids, (B) purine synthesis, (C) pyrimidine synthesis, (D) heme synthesis, (E) chlorophyll synthesis.
- (44) Glycogen catabolism involves all of the following enzymes EXCEPT: (A) phosphorylase, (B) mutase, (C) transferase, (D) glucosidase, (E) hydrolase.
- (45) Glucose can be converted to phospholipid through (A) choline, (B) ethanolamine, (C) serine, (D) glycerol-3-phosphate, (E) acetyl-CoA.
- (46) Desaturase creates one double bond on a saturated fatty acyl-CoA. What is the net change of oxidation number for the saturated fatty acyl-CoA after desaturation? (A) +2, (B) -2, (C) +4, (D) -4, (E) zero.
- (47) Mevinoline was one of the most successful drugs to treat cardiovascular diseases because it inhibits the cholesterol biosynthesis by mimicking the mechanism of (A) HMG-CoA synthase, (B) HMG-CoA lyase, (C) HMG-CoA reductase, (D) HMG-CoA synthetase, (E) beta-ketothiolase.
- (48) Viagra was accidentally found to induce smooth muscle relaxation because it mimics the structure of (A) cAMP, (B) cCMP, (C) cGMP, (D) ATP, (E) nitric oxide.
- (49) All are characteristics of Maple Syrup Urine Disease EXCEPT: (A) hereditary enzyme defect, (B) elevated levels of Val, Leu, and Ile and their corresponding α -keto acids in blood and urine, (C) restrictive intake of proteins with Val, Leu and Ile is required, (D) fatal without detection and treatment, (E) elevated blood levels of acetoacetate and β -hydroxybutyrate.
- (50) The carbon skeletons of all of the amino acids below converge to pyruvate EXCEPT: (A) alanine, (B) serine, (C) cysteine, (D) glycine, (E) glutamate.
- (51) All are convergent metabolic intermediates of α -amino acid carbon skeletons EXCEPT: (A) citrate, (B) α -ketoglutarate, (C) oxaloacetate, (D) succinyl-CoA, (E) fumarate.
- (52) Chorismate biosynthesis occurs via the shikimate pathway and is an important precursor in the synthesis of all of the following EXCEPT: (A) vitamin K, (B) folic acid, (C) threonine, (D) tyrosine, (E) tryptophan.
- (53) Homoserine and homocysteine are related to serine and cysteine by having: (A) an extra amino group, (B) an additional methylene group, (C) an additional carboxyl group, (D) an aldehyde group, (E) a phosphoryl group.

國 立 清 華 大 學 命 題 紙

98 學年度_生命科學院、生命科學院醫學生物科技學程_系(所)_甲、乙_組碩士班入學考試

科目__生物化學__ 科目代碼__0201、0301、0501__共 8 頁第 6 頁 *請在【答案卡】內作答

- (54) All of the following are true of transamination EXCEPT: (A) It is characterized by the transfer of an α -amino group from an amino acid to the α -keto position of an α -keto acid. (B) The amino donor becomes an α -keto acid. (C) The coenzyme needed is thiamin pyrophosphate (TPP). (D) Humans are capable of synthesizing the α -keto acid analog of nonessential amino acids and using transamination to form the amino acids, but are not able to construct carbon skeletons of the essential amino acids. (E) The α -keto acid acceptor becomes an α -amino acid.
- (55) Thymine nucleotides are not synthesized directly by cells but indirectly from other pyrimidine deoxyribonucleotides. All of the following statements regarding thymine nucleotide synthesis are true EXCEPT: (A) dUMP is the immediate precursor for dTMP. (B) The action of dUTPase allows dUTP to serve as a substrate in DNA synthesis. (C) Thymidylate synthase catalyzes the formation of dTMP from dUMP. (D) The methyl donor in the reaction of dTMP is N^5, N^{10} -methylene-THF. (E) THF is used as a cofactor.
- (56) Which of the following is an advantage of metabolic channeling? (A) It allows the product of one reaction to be available for a reaction later in another pathway. (B) It allows the diffusion of substrates. (C) It allows the dilution of substrates. (D) It allows a more diverse interaction of substrates, intermediates, and enzymes. (E) It does not allow for substrate dilution into the milieu and for the accumulation of intermediates.
- (57) All are substrates of carbamoyl phosphate synthetase II (CPS-II) EXCEPT: (A) H_2O , (B) NH_4^+ , (C) HCO_3^- , (D) glutamine, (E) 2ATP.
- (58) What is the importance of the purine nucleoside cycle? (A) It participates in the conversion of purines into pyrimidines. (B) It generates fumarate, which inhibits the formation of AMP from IMP. (C) It provides fumarate as an anaplerotic enhancement of the citric acid cycle. (D) It inhibits the citric acid cycle in skeletal muscles. (E) It is used in energy metabolism in the liver.
- (59) The fate of IMP is regulated by relative levels of _____ and _____; and energy to drive AMP synthesis is provided by _____, and energy for GMP synthesis by _____. (A) IMP; PRPP; ATP; GTP, (B) PRPP; ATP; ATP; GTP, (C) AMP; ATP; GTP; ATP, (D) AMP; GMP; GTP; ATP, (E) IMP; GMP; ATP; GTP.
- (60) What is the limiting substance in the biosynthesis of purines? (A) ribose-5-phosphate, (B) 5-phosphoribosyl- β amine, (C) formylglycinamide ribonucleotide, (D) 5-phosphoribosyl- α -pyrophosphate (PRPP), (E) α -D-ribose-5-phosphate.

國 立 清 華 大 學 命 題 紙

98 學年度_生命科學院、生命科學院醫學生物科技學程_系(所)_甲、乙_組碩士班入學考試
科目_生物化學_ 科目代碼_0201、0301、0501_共8頁第7頁 *請在【答案卷】內作答
問答題 共6題, 40%。請於答案卷依題號1~6作答並標示題號。

注意: (1)未依題序作答且(2)字跡潦亂以至於無法辨識答案之部份,以錯誤計算。

- (1) There is one nucleosome for every 200 bp of eukaryotic DNA. Nucleosomes can be approximated as disks 11 nm in diameter and 6 nm long. (8%)
- (A) How many nucleosomes are there in a diploid human cell? Human diploid cells consist of 46 chromosomes. Human genome contains 3×10^9 bp.
- (B) If all the DNA molecules in a diploid human cell are in the B conformation, what is the sum of their lengths?
- (C) If this DNA is now arrayed on nucleosomes in the "beads-on-a-string" motif, what is its approximate total length?
- (2) Determine the amino acid sequence of the oligopeptide from the experimental data below. Please answer the amino acid information from each experiment (A-F). (8%)
- A. The amino acid composition is found to be [ala, lys, phe, met, cys, plus some decomposition products].
- B. The peptide has a molecular weight around 700 Da and absorbs at 280 nm.
- C. Treatment with carboxypeptidase results in tryptophan and a peptide.
- D. CNBr treatment yields a tetrapeptide and a dipeptide.
- E. Trypsin digestion produces an amino acid and a pentapeptide with met on the amino end.
- F. Chymotrypsin digestion yields a dipeptide and a tetrapeptide.
- (3) It is been found that the membrane-integral F_0 subcomplex of spinach chloroplast ATP synthase consists of three hydrophobic subunits named a, b, and c, with a subunit stoichiometry ab_2c_{14} . What is the ATP/H^+ ratio of this enzyme complex? (8%)
- (4) **Write in English.** Evaluate the metabolic status for a person in the two cases below in terms of glycolysis, gluconeogenesis, ketone body formation, acidosis, and electrolyte balances. Organize your answers and make comparisons for the two cases. Your fluency of English, ability of organization, neatness of hand writing, and the style of your written presentation will be evaluated.
- (A) After a ten-day hunger strike. (4%)
- (B) After one hour of marathon running. (4%)
- (5) SAM (S-adenosylmethionine) and N^5, N^{10} -methylene THF are common donors for one carbon unit for anabolism in organisms. What are the original amino acids that provide the methyl group (CH_3) in SAM and the methylene group (CH_2) in N^5, N^{10} -methylene THF, respectively? (4%)

國立清華大學 命題紙

98 學年度_生命科學院、生命科學院醫學生物科技學程_系(所)_甲、乙_組碩士班入學考試
科目__生物化學_ 科目代碼__0201、0301、0501__共8頁第8頁 *請在【答案卷】內作答

- (6) *E. coli* aspartate transcarbamoylase (ATCase) displays classic allosteric behavior. This $\alpha_3\beta_3$ enzyme is regulated by ATP and CTP. Illustrate the allosteric velocity versus [aspartate] curves for ATCase (a) in the presence of CTP, and (b) in the presence of ATP. (4%)

