系所組別： 製造資訊與系統研究所丙組

考試科目： 生物化學

考試日期：0220，節次：2

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請將答案寫在答案卷上，並清楚註明題號。

一、選擇題(40 分，每小題 2 分)

1. An α helix would be destabilized most by:
   A) an electric dipole spanning several peptide bonds throughout the α helix.
   B) interactions between neighboring Asp and Arg residues.
   C) interactions between two adjacent hydrophobic Val residues.
   D) the presence of an Arg residue near the carboxyl terminus of the α helix.
   E) the presence of two Lys residues near the amino terminus of the α helix.

2. Which of the following statements is *false*?
   A) Collagen is a protein in which the polypeptides are mainly in the α-helix conformation.
   B) Disulfide linkages are important for keratin structure.
   C) Gly residues are particularly abundant in collagen.
   D) Silk fibroin is a protein in which the polypeptide is almost entirely in the β conformation.
   E) α-keratin is a protein in which the polypeptides are mainly in the α-helix conformation.

3. 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

4. The double-reciprocal transformation of the Michaelis-Menten equation, also called the Lineweaver-Burk plot, is given by

$$1/V_0 = K_m/(V_{max}[S]) + 1/V_{max}.$$

   To determine K_m from a double-reciprocal plot, you would:
   A) multiply the reciprocal of the x-axis intercept by −1.
   B) multiply the reciprocal of the y-axis intercept by −1.
   C) take the reciprocal of the x-axis intercept.
   D) take the reciprocal of the y-axis intercept.
   E) take the x-axis intercept where $V_0 = 1/2\ V_{max}$.

5. Which of the following statements about starch and glycogen is *false*?
   A) Amylose is unbranched; amylopectin and glycogen contain many (α1 → 6) branches.
   B) Both are homopolymers of glucose.
   C) Both serve primarily as structural elements in cell walls.
   D) Both starch and glycogen are stored intracellularly as insoluble granules.
   E) Glycogen is more extensively branched than starch.

6. In the Watson-Crick model of DNA structure:
   A) both strands run in the same direction, 3′ → 5′; they are parallel.
   B) phosphate groups project toward the middle of the helix, where they are protected from interaction with water.
   C) T can form three hydrogen bonds with either G or C in the opposite strand.
   D) the distance between the sugar backbone of the two strands is just large enough to accommodate either two purines or two pyrimidines.
   E) the distance between two adjacent bases in one strand is about 3.4 Å.

7. The size of the DNA region specifically recognized by type II restriction enzymes is typically:
   A) 4 to 6 base pairs. B) 10 to 15 base pairs. C) 50 to 60 base pairs.
   D) 200 to 300 base pairs. E) about the size of an average gene.

(背面仍有題目,請繼續作答)

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8. The most precise modern definition of a gene is a segment of genetic material that:
A) codes for one polypeptide.
B) codes for one polypeptide or RNA product.
C) determines one phenotype.
D) determines one trait.
E) that codes for one protein.

9. An integral membrane protein can be extracted with:
A) a buffer of alkaline or acid pH.
B) a chelating agent that removes divalent cations.
C) a solution containing detergent.
D) a solution of high ionic strength.
E) hot water.

10. Protein kinase A (PKA) is:
A) activated by covalent binding of cyclic AMP.
B) affected by cyclic AMP only under unusual circumstances.
C) allosterically activated by cyclic AMP.
D) competitively inhibited by cyclic AMP.
E) noncompetitively inhibited by cyclic AMP.

11. During glycolysis, glucose 1-phosphate is converted to fructose 6-phosphate in two successive reactions:
Glucose 1-phosphate → glucose 6-phosphate $\Delta G'^{\circ} = -7.1$ kJ/mol
Glucose 6-phosphate → fructose 6-phosphate $\Delta G'^{\circ} = +1.7$ kJ/mol
$\Delta G'^{\circ}$ for the overall reaction is:

A) –8.8 kJ/mol. B) –7.1 kJ/mol. C). –5.4 kJ/mol.
D) +5.4 kJ/mol. E) +8.8 kJ/mol.

12. Which of the following statements is *incorrect*?
A) Aerobically, oxidative decarboxylation of pyruvate forms acetate that enters the citric acid cycle.
B) In anaerobic muscle, pyruvate is converted to lactate.
C) In yeast growing anaerobically, pyruvate is converted to ethanol.
D) Reduction of pyruvate to lactate regenerates a cofactor essential for glycolysis.
E) Under anaerobic conditions pyruvate does not form because glycolysis does not occur.

13. Glycogen phosphorylase *a* can be inhibited at an allosteric site by:
A) AMP. B) calcium. C) GDP. D) glucagon.
E) glucose.

14. Which of the following is *not* true of the citric acid cycle?
A) All enzymes of the cycle are located in the cytoplasm, except succinate dehydrogenase, which is bound to the inner mitochondrial membrane.
B) In the presence of malonate, one would expect succinate to accumulate.
C) Oxaloacetate is used as a substrate but is not consumed in the cycle.
D) Succinate dehydrogenase channels electrons directly into the electron transfer chain.
E) The condensing enzyme is subject to allosteric regulation by ATP and NADH.

15. What is the correct order of function of the following enzymes of β oxidation?
1. β-Hydroxyacyl-CoA dehydrogenase
2. Thiolase
3. Enoyl-CoA hydratase
4. Acyl-CoA dehydrogenase
A) 1, 2, 3, 4 B) 3, 1, 4, 2 C) 4, 3, 1, 2
D) 1, 4, 3, 2 E) 4, 2, 3, 1

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16. If a person's urine contains unusually high concentrations of urea, which one of the following diets has he or she probably been eating recently?
A) High carbohydrate, very low protein
B) Very high carbohydrate, no protein, no fat
C) Very very high fat, high carbohydrate, no protein
D) Very high fat, very low protein
E) Very low carbohydrate, very high protein

17. If electron transfer in tightly coupled mitochondria is blocked (with antimycin A) between cytochrome *b* and cytochrome c_1, then:
A) all ATP synthesis will stop.
B) ATP synthesis will continue, but the P/O ratio will drop to one.
C) electron transfer from NADH will cease, but O_2 uptake will continue.
D) electron transfer from succinate to O_2 will continue unabated.
E) energy diverted from the cytochromes will be used to make ATP, and the P/O ratio will rise.

18. The known mechanisms of activation of rubisco or of other enzymes of the Calvin cycle during illumination include all of the following *except:*
A) increased stromal pH.
B) light-driven entry of Mg^{2+} into the stroma.
C) phosphorylation by cAMP-dependent protein kinase.
D) phosphorylation of phosphoenolpyruvate carboxylase.
E) reduction of a disulfide bridge by thioredoxin.

19. Which one of the following statements best applies to synthesis of fatty acids in *E. coli* extracts?
A) Acyl intermediates are thioesters of a low molecular weight protein called acyl carrier protein.
B) CO_2 or HCO_3^- is essential.
C) Reducing equivalents are provided by NADPH
D) The ultimate source of all the carbon atoms in the fatty acid product is acetyl-CoA.
E) All of the above are true.

20. The proofreading function of DNA polymerase involves all of the following *except:*
A) a $3' \rightarrow 5'$ exonuclease.
B) base pairing.
C) detection of mismatched base pairs.
D) phosphodiester bond hydrolysis.
E) reversal of the polymerization reaction.

二、非選擇題(60 分)

1. The molecular weight (MW) of bacteriophage T4 DNA is 1.3×10^8 (double stranded). The average MW of an amino acid residue and of a complementary pair of deoxy nucleotide residues are 120 and 618, respectively.
a). How many amino acid can be coded for by T4 DNA? (3%)
b). How many different proteins of MW 55,000 could be coded for by T4 DNA? (3%)

2. Explain why each of the following statements is false. (8%)
(a) In a reaction under standard conditions, only the reactants are fixed at 1 M.
(b) When $\Delta G'^{\circ}$ is positive, $K_{eq}' > 1$.
(c) ΔG and $\Delta G'^{\circ}$ mean the same thing.
(d) When $\Delta G'^{\circ} = 1.0$ kJ/mol, $K_{eq}' = 1$.

(背面仍有題目,請繼續作答)

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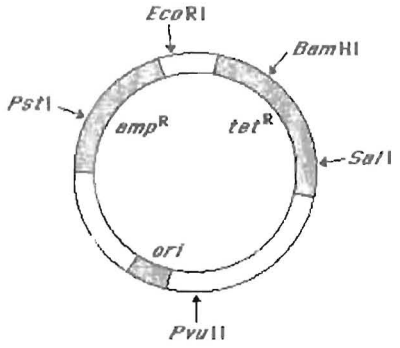
3. Match each feature of the plasmid pBR322 (at left) with *one* appropriate description presented (at right) (see illustration of pBR322 below). Descriptions may be used more than once. (10%)

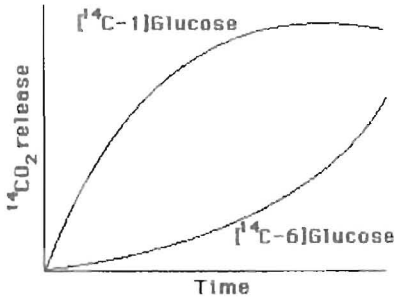


____ amp^R sequence
____ *ori* sequence
____ tet^R
____ *Bam*HI sequence
____ *Pst*I sequence

(a) permits selection of bacteria containing the plasmid
(b) a sequence required for packaging recombinant plasmids into bacteriophage
(c) origin of replication
(d) cleavage of the plasmid here does not affect antibiotic sequence resistance genes
(e) insertion of foreign DNA here permits identification of bacteria containing recombinant plasmids

4. Explain why each of the following statements is false. (8%)
   (a) In a reaction under standard conditions, only the reactants are fixed at 1 M.
   (b) When $\Delta G'^{\circ}$ is positive, $K_{eq}' > 1$.
   (c) ΔG and $\Delta G'^{\circ}$ mean the same thing.
   (e) When $\Delta G'^{\circ} = 1.0$ kJ/mol, $K_{eq}' = 1$.

5. An extract of adipose (fat) tissue can metabolize glucose to CO_2. When glucose labeled with ^{14}C in either C-1 or C-6 was added to the extract, $^{14}CO_2$ was released with the time courses shown below. What is the major path of glucose oxidation in this extract? Explain how you reached this conclusion. (6%)



6. Below, an RNA molecule is being transcribed from a strand of DNA. Indicate the 5′ and 3′ ends of the RNA molecule and of the strand of DNA that is complementary to the RNA molecule. (3%) In which direction is synthesis occurring? (3%)

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7. A recently discovered bacterium carries out ATP synthesis coupled to the flow of electrons through a chain of carriers to some electron acceptor. The components of its electron transfer chain differ from those found in mitochondria; they are listed below with their standard reduction potentials.

Electron carriers in the newly discovered bacterium:

Oxidant	Reductant	Electrons transferred	E'° (V)
NAD^+	NADH	2	–0.32
flavoprotein *b* (FP_b) (oxidized)	flavoprotein *b* (reduced)	2	–0.62
cytochrome *c* (Fe^{3+})	cytochrome *c* (Fe^{2+})	1	+0.22
Fe-S protein (oxidized)	Fe-S protein (reduced)	2	+0.89
flavoprotein *a* (FP_a) (oxidized)	flavoprotein *a* (reduced)	2	+0.77

(a) Place the electron carriers in the order in which they are most likely to act in carrying electrons. (3%)
(b) Is it likely that O_2 (for which $E'^{\circ} = 0.82$ V) is the final electron acceptor in this organism? Why or why not? (3%)
(c) How would you calculate the maximum number of ATP molecules that could theoretically be synthesized, under standard conditions, per pair of electrons transferred through this chain of carriers? (The Faraday constant, $\mathfrak{F}$, is 96.48 kJ/V·mol.) $\Delta G'^{\circ}$ for ATP synthesis is +30.5 kJ/mol. (4%)

8. The turnover number for an enzyme is known to be 5,000 min^{-1}. From the following set of data, calculate the K_m and the total amount of enzyme present in these experiments. (6%)

Substrate concentration (mM)	Initial velocity (μmol/min)
1	167
2	250
4	334
6	376
100	498
1,000	499