※ 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」。

1. α-helices are stabilized by which of the force?
(A) hydrophobic interaction (B) Vanderwall force (C) hydrogen bonds between the (CO) and the (NH) units in the peptide backbone (D) hydrogen bonding between the R groups.

2. The molecule 2,3-bisphosphoglycerate [BPG] is present in red blood cells, in which it binds noncovalently to hemoglobin. Which functional groups in hemoglobin can make the strongest noncovalent interactions with BPG at a pH value of 7.0?
(A) Sulfhydryl groups (B) Alcoholic hydroxyl groups(C) Hydrocarbon groups (D) Amino groups

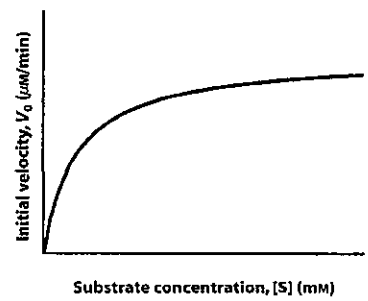
3. The component of a water-soluble globular protein that is most likely to be present in the center of the molecule rather than on its surface is
(A) A glutamate side chain (B) A Phenylalanine (C) An oligosaccharide covalently linked to an asparagine side chain (D) A phosphate group covalently linked to a serine side chain

4. Which one of the following amino acids would be considered most polar?
(A) Methionine (B) Isoleucine (C) Threonine (D) Tryptophan

5. The oxygen-binding curve of hemoglobin is sigmoidal because
(A) The binding of oxygen to a heme group increases the oxygen affinities of the other heme groups
(B) The solubility of the hemoglobin molecule changes with its oxidation state
(C) The subunits are held in place by interchain disulfide bonds
(D) The distal histidine allows the hemoglobin molecule to change its conformation in response to an elevated carbon dioxide concentration.

6. Which one of the following statements about enzyme-catalyzed reactions is true?
(A) Enzymes do not affect the activation energy of chemical reactions.
(B) Enzymes shift the equilibrium of chemical reactions to favor substrate formation.
(C) All enzymes are proteins.
(D) Enzymes accelerate chemical reactions by binding tightly to the transition state.
(E) None of the above.

7. The graph shown below was obtained from a kinetic experiment. Assuming the enzyme concentration $[E]_{total}$ used for the experiment is known, what kinds of kinetic parameters can be derived from this experiment? (Choose the best answer.)



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(A) Vmax, Km, and kcat (B) Vmax and Km (C) Vmax and kcat (D) Km and kcat (E) None of the above.

8. From the following scheme of an enzymatic reaction, we know that Enzyme(+) + Substrate(-) → E(+)S(-) complex → Enzyme(+) + Product (The net charges of enzyme and substrate are shown in ( ).)
(A) No reaction at low pH, due to the protonation of enzyme.
(B) No reaction at high pH, due to the ionization of substrate.
(C) No reaction at low pH, due to ionization of substrate.
(D) No reaction at high pH, due to ionization of enzyme.
(E) No reaction at high pH, due to protonation of substrate.

9. When purified mitochondria are placed in a low pH buffer, ATP will be produced. Why?
(A) Low pH increases the concentration of H+ causing mitochondria to pump out H+ to the inter membrane space leading to ATP production.
(B) Low pH increases the acid concentration in the mitochondrial matrix, a condition that normally causes ATP production.
(C) Low pH increases the OH- concentration in the matrix resulting in ATP production by ATP synthetase.
(D) The high external acid concentration causes an increase in H+ in the inter membrane space leading to increased ATP production by ATP synthetase.
(E) None of the above.

10. In the absence of oxygen, the primary purpose of fermentation is to:
(A) Produce pyruvate for the subsequent citric acid cycle.
(B) Generate a proton gradient for ATP synthesis.
(C) Oxidize glucose to generate FADH2.
(D) Regenerate NAD+ from NADH allowing glycolysis to continue.
(E) Generate acetyl-CoA for biosynthesis.

11. Which of the following is responsible for the first and principal regulatory step in the biosynthesis of bile acid?
(A) HMG-CoA synthase (B) HMG-CoA reductase (C) Cholesterol 7α-hydroxylase (D) Acyl-CoA-cholesterol acyltransferase

12. Which of the following is a ω-3 fatty acid?
(A) oleic acid (B) stearic acid (C) linoleic acid (D) α-linolenic acid (E) γ-linolenic acid

13. Which of the following statements is **true**?

(A) A principle action of insulin on adipose tissue is to inhibit fatty acid synthesis.

(B) Acetyl-CoA carboxylase has a requirement for biotin as coenzyme.

(C) Fatty acid C18:2$\triangle^{9,12}$ can be converted to C18:3$\triangle^{9,12,15}$ in the liver of man.

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(D) Chylomicron remnants can be uptaken by the liver through ApoB-48 binding to LDL-receptor.

(E) Fatty acid synthase complex is a multienzyme complex composed of seven proteins responsible for seven enzyme activities.

14. A mole of stearic acid, when fully oxidized in mitochondria, would produce how many mole of ATP than a mole of oleic acid does?

(A) 0 (B) 1.5 (C) 3 (D) 4.5 (E) 6

15. Which of the following are in the core of a lipoprotein particle?

(A) Cholesterol and phospholipids

(B) Cholesterol and triacylglycerol

(C) Cholesteryl ester and phospholipids

(D) cholesteryl ester and triacylglycerol

(E) cholesterol, cholesteryl ester and triacylglycerol

16. How many complexes among Complex I, II, III, IV, and V (ATP synthase) can facilitate proton transportation between matrix and intermembrane space of mitochondria in the process of oxidative phosphorylation to generate ATP?
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5.

17. How insulin activates glycogen synthase activity and inhibits phosphorylase activity?
(A) Insulin directly inhibits glucagon receptor activity through tyrosine phosphorylation
(B) Insulin activates both phosphodiesterase and GSK3 to regulate glycogen synthase and phosphorylase activity.
(C) Insulin activates phosphodiesterase and inhibits GSK3 to modulate glycogen synthase and phosphorylase activity.
(D) Insulin inhibits both phosphodiesterase and GSK3 to activate glycogen synthase and inhibit phosphorylase activity.
(E) Insulin only activates phosphodiesterase to degrade cAMP to 5'-AMP to modulate glycogen synthase and phosphorylase activity.

18. Which two amino acids are required for the urea cycle
(A) Arginine and aspartate (B) Aspartate and glutamate (C) Arginine and methionine (D) Aspartate and methionine (E) Arginine and glutamine.

19. Which is not a product after glycine catabolism?
(A) Serine (B) Cysteine (C) Pyruvate (D) CO_2 (E) NH_4.

20. Dark color of feces is mainly due to
(A) Bilirubin reduction (B) Bilirubin oxidation (C) Bilirubin peroxidation (D) Urobilinogen reduction

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(E) Urobilinogen oxidation.

21. Which following isotope is not radioactive?
(A) ^{3}H (B) ^{14}C (C) ^{15}N (D) ^{35}S (E) ^{131}I

22. The pK value for acetic acid is close to
(A) 1 (B) 3 (C) 5 (D) 7 (E) 9

23. The deficiency of which following vitamin can cause scurvy
(A) vitamin A (B) vitamin B1 (C) vitamin B2 (D) vitamin C (E) vitamin D

24. Which following biomolecule can not be used as a template for polymerase chain reaction?
(A)mRNA (B) plasmid DNA (C) human genome (D) *E. coli* genome (E) histone gene

25. Which following protein does not contain iron ion?
(A) transferrin (B) hemoglobin (C) insulin (D) myoglobin (E) ferritin

26. Which enzyme can digest DNA into small oligonucleotides?
(A) phospholipase (B) polynucleotide kinase (C) phosphorylase (D) phosphodiesterase (E) phosphatase

27. Which of the event is important for signal transduction of tumor necrosis factor alpha (TNF_{α})?
(A) ADP-ribosylation (B) Farnesylation (C) Protein degradation (D) Peroxidation (E) Glycosylation

28. Prostaglandin E_2 is converted from arachidonate by which of the following enzyme?
(A) Caspase (B) Cyclooxygenase (C) Phospholipase (D) Lipoxygenase (E) HMG-CoA reductase

29. Phosphatidylserine is involved in which of the following events:
(A) Apoptosis (B) Calcium mobilization (C) Lipid phosphorylation (D) Ras activation (E) Channel opening

30. Which of the following compounds is involved in G protein activity?
(A) GDP (B) Pertussis toxin (C) Saxitoxin (D) Phorbol ester (E) Nitric oxide

31. Increase of β-galactosidase activity by isopropylthiogalactoside (IPTG) in *E coli*.is the result of
(A) stimulation of Lac repressor function
(B) IPTG binding to the *lac* operon and inducing transcription.
(C) IPTG binding to the *lacI* gene product and inhibiting its activity.
(D) inhibition of β-galactosidase degradation.
(E) Ligand binding of IPTG to β-galactosidase

32. Coactivator protein influences eukaryotic gene expression by
(A) binding to the TATA box of the gene promoter
(B) interacting with RNA polymerase II directly to enhance transcription
(C) binding to *cis*-element in the promoter region.

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(D) Interacting with basal transcriptional factor such as TFII-E
(E) interacting with transcriptional activator.

33. Which of the following restriction enzymes when used for digesting an *E. coli* genomic DNA sample can generate more DNA fragments. (The cleavage sequence recognized by each enzyme is shown in parenthesis)
(A) Not I (GC/GGCCGC)
(B) Hind III (A/AGCTT)
(C) BamHI (G/GATCC)
(D) TaqI (T/CGA)
(E) Hpa I (GTT/AAC)

34. UV irradiation can switch prophage in *E. coli* to undergo lytic cycle. Choose the WRONG statement describing the switch to lytic cycle.
(A) The lytic cycle is dependent on protein degradation.
(B) Increased expression of Cro protein inhibits λ repressor transcription.
(C) LexA, induced by UV binds to λ repressor, disabling its binding to Or1.
(D) Cro transcription is increased after UV irradiation.
(E) Repressor is proteolytically cleaved to lose its DNA binding activity.

35. Which of the following protein in the pre-initiation complex (PIC) of pol II-dependent transcription is involved in DNA repair.
(A) TFIIA, (B) TFIIB (C) TFIIE (D) TBP (E) TFII-H

Questions 36-38

When normal human fibroblasts are cultured in medium containing calf serum, they divide with an average generation time of approximately 22 hours (M = 1 hr, G_1 = 10 hr, S = 6 hr, G_2 = 5 hr). To determine the effects of serum deprivation on cell cycle distribution, cells were incubated for 48 hours in medium with or without serum. At the end of this incubation, cells were harvested and stained with propidium iodide, which binds to DNA and fluoresces when exposed to ultraviolet light. The stained cells were analyzed for DNA content (fluorescence) in a flow cytometer. The results with serum are shown in Figure 1a. If deprived of serum, the cells stop proliferating and enter a quiescent state (Figure 1b).

In a second experiment, cells were deprived of serum for 48 hours and then treated either with serum alone or serum plus cycloheximide (CHX), an inhibitor of protein synthesis. At various times after treatment, RNA was isolated from the cells. Equal amounts of total cellular RNA from each sample were analyzed by gel electrophoresis and Northern blotting to detect the level of c-*fos* mRNA. The c-*fos* protein is involved in regulating cell proliferation. The results of this experiment are shown in Figure 2. ("–" indicates serum alone and "+" indicates serum plus CHX.)

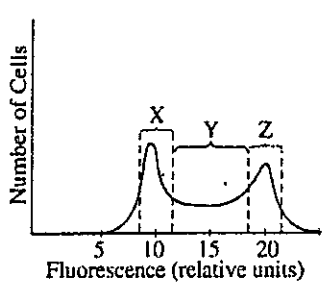

Figure 1a. With serum

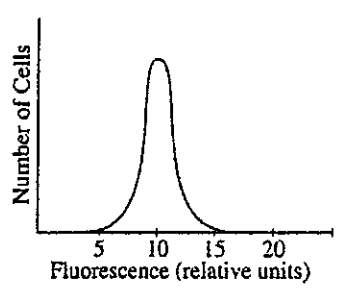

Figure 1b. Without serum

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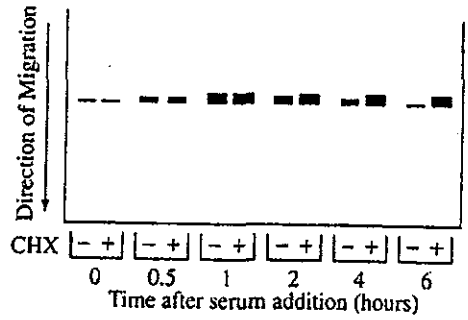

Figure 2. *c-fos* mRNA

36. Based on the results shown in Figure 2, the differences in the amounts of *c-fos* mRNA in the presence versus the absence of cycloheximide at 2, 4, and 6 hours is best explained by which of the following?
(A) *c-fos* mRNA is degraded by an unstable nuclease.
(B) The *c-fos* promoter is regulated by an unstable transcriptional activator.
(C) The *c-fos* protein activates its own promoter.
(D) Splicing of *c-fos* pre-mRNA requires an unstable splicing factor.
(E) *c-fos* mRNA is degraded by cycloheximide-induced nuclease.

37. In Figure 1a, the cells in the region labeled Y are in what stage of the cell cycle?
(A) G1 (B) S (C) G2 (D) M (E) G0

38. Cells growing in the presence of serum were labeled for 3 hours with ^{3}H-thymidine and then analyzed by flow cytometry. Which of the following regions defined in Figure 1a will contain radioactive cells?
(A) X only (B) Y only (C) Z only (D) Y and Z only (E) X, Y, and Z

39. The specialized structure located at the ends of eukaryotic chromosomes are called
(A) terminators (B) telomeres (C) long terminal repeats(LTR's) (D) centromeres (E) kinetochores

40. Regarding the subcellular localization, please indicate where is the site of the transcriptional inactive take place:
(A) Nuclear envelope (B) Nucleolus (C) Euchromatin (D) Heterochromatin (E) Nuclear lamina

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