

國立中央大學 108 學年度碩士班考試入學試題

所別：生命科學系 碩士班 分子與細胞生物組(一般生)

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生命科學系 碩士班 分子與細胞生物組(在職生)

科目：生物化學

本科考試禁用計算器

一. 單選題(每題 2 分；共 70 分)

1. Which of the following reagents is commonly used to stain a nucleic acid gel? (A) bromophenol blue (B) EtBr (C) ninhydrin reagent (D) CNBr (E) Coomassie Brilliant Blue.
2. A protein is composed of 200 amino acids. What is its approximate molecular weight? (A) 10 (B) 22 (C) 100 (D) 220 (E) 3,300 kDa.
3. The concentration of a nucleic acid can be determined by its UV-Vis absorbance at ___ nm. (A) 190 (B) 200 (C) 240 (D) 260 (E) 280.
4. The Western blotting technique is used for the measurement of (A) protein (B) DNA (C) RNA (D) lipid (E) carbohydrates.
5. Which of the following amino acids has only one codon? (A) Arg (B) Ala (C) Val (D) Met (E) His.
6. Dithiothreitol (DTT) is a reducing agent that interacts with proteins by disrupting which of the following? (A) Hydrogen bonds (B) Disulfide bridges (C) Hydrophobic interactions (D) Salt bridges (E) Covalent bonds.
7. The most abundant lipid in the human body is (A) Waxes (B) Triacylglycerol (C) Fatty acids (D) Cholesterol (E) Glycerol.
8. Which amino acid commonly serves as either a general acid or a general base in the enzyme mechanism? (A) serine (B) cysteine (C) glutamic acid (D) arginine (E) histidine
9. How many turns of the fatty acid spiral are needed to "process" a C₁₉ fatty acid molecule? (A) 6 (B) 7 (C) 8 (D) 10 (E) 14
10. NADPH can be produced from (A) TCA cycle (B) glycolysis (C) pentose phosphate pathway (D) fatty acid oxidation (E) lipid biosynthesis.
11. In one catalytic cycle, the Na⁺/K⁺ ATPase transporter transports: (A) 2 Na⁺ out, 3 K⁺ in, and converts 1 ATP to ADP + Pi. (B) 2 Na⁺ out, 3 K⁺ in, and converts 1 ADP + Pi to ATP. (C) 3 Na⁺ in, 2 K⁺ out, and converts 1 ATP to ADP + Pi. (D) 3 Na⁺ out, 2 K⁺ in, and converts 1 ADP + Pi to ATP. (E) 3 Na⁺ out, 2 K⁺ in, and converts 1 ATP to ADP + Pi.
12. What are the β-oxidation products of stearic acid (18:0)? (A) 9 acetyl-CoA, 9 NADH, 9 FADH₂, 2 ATP used for activation (B) 9 acetyl-CoA, 8 NADH, 8 FADH₂, 2 ATP used for activation (C) 9 acetyl-CoA, 9 NADH, 9 FADH₂, 1 ATP used for activation (D) 9 acetyl-CoA, 8 NADH, 8 FADH₂, 1 ATP used for activation (E) 9 acetyl-CoA, 8 NADH, 7 FADH₂, 2 ATP used for activation.
13. What are the β-oxidation products of oleic acid (18:1^{Δ9}) and how many ATP equivalents are required for activation? (A) 8 acetyl CoA, 8 NADH, 7 FADH₂, 1 ATP equivalents (B) 9 acetyl CoA, 8 NADH, 7 FADH₂, 2 ATP equivalents (C) 9 acetyl CoA, 7 NADH, 7 FADH₂, 1 ATP equivalents (D) 8 acetyl CoA, 7 NADH, 6 FADH₂, 2 ATP equivalents (E) 8 acetyl CoA, 8 NADH, 8 FADH₂, 1 ATP equivalents.
14. Which of the following organisms is a prokaryote? (A) *Saccharomyces cerevisiae* (B) *Caenorhabditis elegans*

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(C) *Escherichia coli* (D) *Drosophila melanogaster* (E) *Arabidopsis thaliana*

15. Which scientist made a significant contribution to the technology of DNA sequencing? (A) K. B. Mullis (B) F. Sanger (C) A. D. Hershey and M. Chase (D) S. B. Prusiner (E) J. D. Watson and H. C. Crick.
16. Which of the following reactions is not located in the mitochondria? (A) β -oxidation (B) cholesterol biosynthesis (C) ketone body synthesis (D) tricarboxylic acid cycle (E) electron transport and oxidative
17. Which amino acid listed below can serve as the precursor for dopamine? (A) Val (B) Leu (C) Trp (D) Thr (E) Tyr
18. A deficiency in folic acid will not impair the metabolism of which of the following amino acids? (A) Met (B) Val (C) Ser (D) Ala (E) His
19. Hydroxymethylglutaryl-CoA reductase (A) is the rate-limiting enzyme for triglyceride synthesis (B) is the rate-limiting enzyme for estrogen synthesis (C) is activated by lovastatin (D) uses NADH as the cofactor (E) is inhibited by cholesterol.
20. Which of the following descriptions about the Michaelis-Menten rate equation is incorrect? (A) K_M measures the substrate concentration at which the reaction rate is $V_{max}/2$ (B) k_{cat} is the turnover number that measures the rate of the catalytic process (C) The ratio k_{cat}/K_M is a convenient measure of enzyme efficiency (D) A competitive inhibitor increases the apparent K_M . (E) $V_{max} = k_{cat}/K_M$
21. Non-steroidal anti-inflammatory drugs (NSAIDs) like aspirin and ibuprofen act by blocking production of: (A) vitamin D (B) prostaglandins (C) sphingolipids (D) glycerol (E) none of the above.
22. When a bacterium such as *E. coli* is shifted from a warmer growth temperature to a cooler growth temperature, it compensates by: (A) increasing its metabolic rate to generate more heat (B) synthesizing thicker membranes to insulate the cell. (C) putting longer-chain fatty acids into its membranes (D) shifting from aerobic to anaerobic metabolism (E) putting more unsaturated fatty acids into its membranes
23. After drinking of coke, the major monosaccharides absorbed into the blood are (A) glucose (B) fructose (C) glucose and fructose (D) glucose and galactose (E) galactose, glucose, and fructose.
24. Which of the following is not a reducing sugar? (A) Glyceraldehyde (B) Glucose (C) Fructose (D) Lactose (E) Sucrose
25. The pK_a s of phosphoric acid are 2.1, 6.9, and 12.4. The ionic form that predominates at pH 7.5 is: (A) H_3PO_4 (B) $H_2PO_4^-$ (C) HPO_4^{2-} (D) PO_4^{3-} (E) None of the above.
26. Which of the following is not involved in the process of assisted folding of proteins? (A) Heat shock proteins (B) Peptide bond hydrolysis (C) Chaperonins (D) Disulfide interchange (E) Peptide bond isomerization.
27. The ___ molecules are not amphipathic. (A) phosphatidyl choline (B) phosphatidyl ethanolamin (C) cholesterol (D) sphingomyelin (E) none of the above

參考用

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28. The binding of one O_2 to one subunit in the hemoglobin tetramer ($\alpha_2\beta_2$) increases the binding affinity of subsequent O_2 binding to other subunits is achieved via the ___ effect.
(A) allosteric (B) quantum (C) hydrophobic (D) hydrophilic (E) cooperative
29. DNA of the ___ form runs the slowest on the agarose gel. (A) supercoiled (B) linear (C) partially nicked (D) inter-wound (E) circular
30. Fumarate from the urea cycle is converted to malate and then to _____, which can be used for gluconeogenesis.
(A) citrate (B) succinate (C) oxaloacetate (D) α -ketoglutarate (E) pyruvate
31. A molecule that signals vasodilation is _____, which is synthesized from the precursor _____.
(A) nitric oxide (NO)/citrulline (B) nitric oxide (NO)/arginine (C) nitrous oxide (N_2O)/arginine (D) nitrous oxide (N_2O)/citrulline (E) none of the above
32. Which of the following metabolic pathways is carried out only in the liver?
(A) ogen storage (B) pentose phosphate pathway (C) fatty acid synthesis (D) triacylglycerol synthesis (E) ketogenesis
33. Ketone bodies are produced in the _____ and used by the _____ only under conditions such as a prolonged fast.
(A) liver/heart (B) liver/skeletal muscle (C) liver/brain (D) kidneys/heart (E) kidneys/brain
34. 39. Which of the lipoproteins is responsible for removing cholesterol from cells?
(A) Chylomicron (B) VLDL (C) LDL (D) VHDL (E) HDL
35. Which of the following do NOT correctly pair a hormone with its function? (A) ACTH—promotes production of thyroxin (B) insulin—regulates metabolism and blood glucose (C) FSH—stimulates processes within the gonads (D) calcitonin —regulates plasma Ca^{2+} (E) prolactin—stimulates milk production.

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二、簡答題(依各題配分；共 30 分)

1. The following data were obtained in the experiment of an enzyme (1 μM .) known to follow Michaelis-Menten kinetics:

V_0 ($\mu\text{mol}/\text{min}\cdot\text{L}$)	Substrate added (mmol/L)
217	0.9
324	2.1
435	4.2
498	6.1
648	1,000.0

Please calculate the (1) K_M (2) V_{\max} (3) k_{cat} (9 points)

2. Match these molecules with their biological roles. (5 points)

(a) glycogen, (b) starch, (c) chitin, (d) cellulose, (e) Vitamine A, (f) Vitamine D ,
(g) prostaglandins, (h) thromboxanes

- ____ (1) structural component of plant cell walls
____ (2) blood clotting
____ (3) Ca^{2+} and phosphate metabolism
____ (4) carbohydrate storage in animal liver
____ (5) mediates pain and inflammation

3. Match the biomolecule with its appropriate function. (6 points)

- ____ (1) Leptin (a) membrane proteins that mediate cell adhesion
____ (2) Aquaporins (b) regulatory subunit of calcium-dependent enzymes
____ (3) Integrins (c) protein that acts as the "primer" for the initiation of new glycogen molecules
____ (4) Calmodulin (d) a small polypeptide that is produced in adipocytes and is carried by the blood to the brain
____ (5) Carnitine (e) is essential for intracellular transport of fatty acids
____ (6) Ubiquitin (f) Cyclin-dependent protein kinases can regulate the progression of cells through the cell cycle by phosphorylation of proteins
(g) Protein that facilitate the movement of water across membranes
(h) Protein that tags another protein for proteolysis.

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4. There are five different tripeptides shown below. (10 points) (at least one answer).

(a) Ile-Ala-Phe, (b) Trp-Glu-Tyr, (c) Glu-Ala-Asp, (d) Trp-Lys-Met, (e) His-Cys-Arg

Which one of the above tripeptides:

____ (1) has the greatest UV light absorbance at 280 nm?

____ (2) contains the largest number of hydrophobic side chains.

____ (3) contain sulfur atom.

____ (4) is most negatively charged at pH 7.

____ (5) is most positively charged at pH 7.

____ (6) contain the aromatic side chain

參考用