

亞洲大學

115 學年度學士後獸醫學系招生試題紙

學系別	考試科目	考試日期	時 間
學士後獸醫學系	生物化學	115.04.25	13:30-15:00

- Which molecule acts as a mobile electron carrier within the inner mitochondrial membrane?
A. Cytochrome c B. Coenzyme Q (ubiquinone) C. NAD⁺ D. Iron-sulfur proteins
- Which enzyme of the Tricarboxylic acid cycle (TCA cycle) is directly regulated by the cellular NADH/NAD⁺ ratio?
A. Citrate synthase B. Fumarase C. Succinyl-CoA synthetase D. Isocitrate dehydrogenase
- Which statement best explains why alanine aminotransferase (ALT) is more specific than aspartate aminotransferase (AST) for hepatocellular injury?
A. ALT is located exclusively in hepatocyte mitochondria
B. AST has a longer plasma half-life than ALT
C. ALT is predominantly cytosolic and has limited expression in extrahepatic tissues
D. ALT requires pyridoxal phosphate, whereas AST does not
- A mutation that deletes the operator sequence of the lac operon would most likely result in:
A. No transcription under any conditions
B. Transcription only when lactose is present
C. Constitutive transcription regardless of lactose availability
D. Transcription only when glucose is absent
- An enzyme shows strong substrate specificity, yet mutation of a single active-site residue leads to a dramatic increase in catalytic rate but a decrease in substrate affinity. Which interpretation best fits this observation?
A. The mutation stabilizes the enzyme-substrate complex but destabilizes the transition state
B. The mutation decreases the activation energy but weakens binding interactions in the active site
C. The mutation increases both k_{cat} and K_M by stabilizing the transition state
D. The mutation eliminates a key catalytic group but improves substrate recognition
- Which of the following intermediates can not serve as the material for the synthesis of glucose via gluconeogenesis?
A. acetyl-CoA B. Glycerol C. Oxaloacetate D. Glyceral
- Which of the following is unique to eukaryotic DNA replication?
A. Bidirectional replication forks
B. Requirement of primers
C. Use of ligase to join Okazaki fragments
D. Multiple origins of replication per chromosome
- Which of the following is able to release an ammonium ion?
A. Conversion of hydroxymethylbilane to uroporphyrinogen III by uroporphyrinogen III synthase
B. Conversion of serine to glycine by serine hydroxymethyltransferase
C. Conversion of glutamate to glutamine by glutamine synthetase
D. Conversion of cystathionine to cysteine and α -ketobutyrate by cystathionine γ -lyase

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9. A researcher finds that an enzyme follows the induced fit model rather than the lock and key model. Which experimental observation best supports this conclusion?
 - A. The enzyme binds multiple substrates with similar affinities
 - B. Substrate binding causes a detectable conformational shift in enzyme structure
 - C. The enzyme exhibits a very low turnover number
 - D. The enzyme undergoes irreversible inactivation after substrate binding
10. A loss-of-function mutation in the lacZ gene would most directly cause:
 - A. Inability to convert lactose into glucose and galactose
 - B. Inability to transport lactose into the cell
 - C. Failure of the repressor to bind lactose
 - D. Reduced binding of CAP to DNA
11. Which step of β -oxidation directly generates FADH_2 ?
 - A. Thiolysis by β -ketothiolase
 - B. Hydration by enoyl-CoA hydratase
 - C. Oxidation by acyl-CoA dehydrogenase
 - D. Oxidation by β -hydroxyacyl-CoA dehydrogenase
12. Which of the following statements correctly distinguishes the mode of gene silencing by microRNA versus RNAi?
 - A. microRNA almost always leads to slicing of mRNA, whereas RNAi does not
 - B. RNAi is typically associated with perfect complementarity, whereas microRNA often represses translation through imperfect pairing
 - C. RNAi uses Dicer but microRNA does not
 - D. RNAi functions only in the nucleus
13. The ABC excinuclease plays a crucial role in:
 - A. Base-excision repair
 - B. Mismatch repair
 - C. Nucleotide-excision repair
 - D. SOS repair
14. What is the kinetic characteristic of allosteric enzymes in their high-activity state?
 - A. High $V_{\max}$ and low K_m
 - B. Low $V_{\max}$ and high K_m
 - C. High $V_{\max}$ and high K_m
 - D. Low $V_{\max}$ and low K_m
15. Which component identifies the Shine–Dalgarno sequence during translation initiation?
 - A. eIF-4E
 - B. 16S rRNA
 - C. fMet-tRNA^{fMet}
 - D. EF-Ts
16. During translation elongation, which molecule acts as a guanine nucleotide exchange factor?
 - A. EF-Ts
 - B. EF-Tu
 - C. EF-G
 - D. Initiation factor IF-2
17. Which of the following is responsible for cholesterol transport to the liver?
 - A. HDL
 - B. Chylomicron
 - C. VLDL
 - D. IDL
18. Which of the following is an example of an epimer pair?
 - A. Glucose and fructose
 - B. Glucose and mannose
 - C. Lactose and maltose
 - D. Lactose and fructose

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19. Which of the following processes do not all occur in the mitochondria of mammalian cells?
 A. Fatty acid biosynthesis & TCA cycle
 B. DNA synthesis & TCA cycle
 C. TCA cycle & oxidative phosphorylation
 D. β -oxidation of fatty acids & DNA synthesis
20. Which histone modification is most commonly associated with heterochromatin formation?
 A. H3K4 trimethylation B. H3K9 trimethylation C. H3K27 acetylation D. H2A.Z incorporation
21. In prokaryotes, the sigma factor is essential for promoter recognition. Which eukaryotic factor performs the most analogous role?
 A. TFIIB B. TFIIF C. TATA-binding protein (TBP) D. Mediator complex
22. Which statement best explains why eukaryotic enhancers can regulate transcription from promoters located thousands of base pairs away?
 A. Enhancers encode small RNAs that migrate to the promoter
 B. Enhancer-promoter communication occurs via DNA looping mediated by coactivator proteins
 C. Enhancers move within the nucleus to physically bind the promoter
 D. Enhancers are transcribed into mRNA that recruits RNA polymerase II
23. Which element is present in most prokaryotic promoters but not required in eukaryotic RNA Pol II promoters?
 A. Pribnow box sequence B. TATA box C. Initiator (Inr) element D. CAAT box
24. Which component of the CRISPR-Cas9 system determines the specific genomic DNA target?
 A. Cas9 nuclease B. PAM sequence C. tracrRNA alone D. Single-guide RNA (sgRNA)
25. A deficiency in Glucose-6-phosphate dehydrogenase (G6PD) is most likely to impair which cellular process?
 A. Beta-oxidation of fatty acids B. Regeneration of reduced glutathione
 C. Synthesis of fructose-6-phosphate D. Glycogen breakdown
26. During intense exercise, lactate production increases primarily because:
 A. Oxygen availability is high
 B. Pyruvate dehydrogenase is activated
 C. NAD^+ regeneration is required to maintain glycolysis
 D. Lactate dehydrogenase is inhibited
27. Which statement best describes the primary function of the oxidative phase of the pentose phosphate pathway?
 A. Production of ribulose-5-phosphate without generating NADPH
 B. Conversion of pentose sugars into triose phosphates
 C. Generation of NADPH and ribulose-5-phosphate
 D. Production of ATP through substrate-level phosphorylation

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28. How does enzyme specificity arise according to the induced-fit model?
 - A. The enzyme active site is rigid and pre-shaped
 - B. Substrate binding causes a conformational change in the enzyme
 - C. Substrate and enzyme share identical structures
 - D. Coenzymes determine specificity directly
29. An enzyme regulated by binding of a molecule at a site other than the active site is best described as:
 - A. A competitive enzyme
 - B. A cooperatively binding enzyme
 - C. An enzyme under allosteric regulation
 - D. A constitutively active enzyme
30. Which eukaryotic translation factor directly delivers the initiator Met-tRNA_i to the small ribosomal subunit?
 - A. eIF4E
 - B. eIF5
 - C. eEF1A
 - D. eIF2-GTP
31. Which event marks the commitment of a eukaryotic ribosome to begin translation of an mRNA?
 - A. Binding of the 40S subunit to eIF4E
 - B. Recognition of the start codon by Met-tRNA_i
 - C. Association of the 60S ribosomal subunit
 - D. Formation of the closed-loop mRNA structure
32. Which factor directly recognizes the 5' cap and is commonly regulated to control translation rates?
 - A. eIF2
 - B. eIF4E
 - C. eEF2
 - D. eIF5B
33. Which enzyme converts acetaldehyde to acetate in alcohol catabolism?
 - A. Alcohol dehydrogenase
 - B. Aldehyde dehydrogenase
 - C. Catalase
 - D. CYP2E1
34. Which enzyme catalyzes the oxidation of hypoxanthine to xanthine and xanthine to uric acid?
 - A. Adenosine deaminase
 - B. Xanthine oxidase
 - C. Purine nucleoside phosphorylase
 - D. Guanine deaminase
35. Which urea cycle intermediate is transported from mitochondria to cytosol?
 - A. Citrulline
 - B. Arginine
 - C. Ornithine
 - D. Argininosuccinate
36. Which metabolic intermediate serves as the carbon skeleton precursor for alanine?
 - A. Pyruvate
 - B. Oxaloacetate
 - C. α -Ketoglutarate
 - D. 3-Phosphoglycerate
37. Why is oxidized LDL (oxLDL) more atherogenic than native LDL?
 - A. It binds more strongly to LDL receptors
 - B. It is resistant to macrophage uptake
 - C. It is recognized by scavenger receptors not subject to feedback regulation
 - D. It increases HDL synthesis
38. Which apolipoprotein serves as the primary ligand for receptor-mediated uptake of LDL by peripheral tissues?
 - A. ApoA-I
 - B. ApoB-48
 - C. ApoB-100
 - D. ApoE

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39. Why is biotin essential for fatty acid biosynthesis?

- It acts as an electron carrier like NADPH
- It activates acyl carrier protein
- It transfers acetyl groups between enzymes
- It serves as a CO₂ carrier in carboxylation reactions

40. Which step of β -oxidation directly yields FADH₂?

- Thiolytic cleavage by β -ketothiolase
- Oxidation by acyl-CoA dehydrogenase
- Hydration by enoyl-CoA hydratase
- Oxidation by β -hydroxyacyl-CoA dehydrogenase

41. Which is the characteristic in the presence of a noncompetitive inhibitor?

- Increased K_m and decreased V_{max}
- Increased K_m and unchanged V_{max}
- Decreased K_m and unchanged V_{max}
- Unchanged K_m and decreased V_{max}

42. At the molecular level, insulin signaling is initiated primarily through activation of which mechanism?

- G-protein–coupled receptor signaling
- Ligand-gated ion channel opening
- Receptor tyrosine kinase autophosphorylation
- Nuclear hormone receptor binding

43. Which second messenger is most directly responsible for mediating glucagon's intracellular effects?

A. Ca²⁺ B. cAMP C. IP₃ D. DAG

44. In skeletal muscle, epinephrine stimulates glycogen breakdown primarily by activating:

- Glycogen synthase
- Protein phosphatase-1
- Glycogen phosphorylase via phosphorylase kinase
- Glucose-6-phosphatase

45. Which of the following is a second messenger?

- Diacylglycerol
- Adenylyl cyclase
- Phospholipase C
- ATP

46. What is the rate-limiting step of mitochondrial fatty acid β -oxidation in mammalian cells?

- Activation of fatty acids to acyl-CoA
- Transport of fatty acyl-CoA into mitochondria
- First oxidation by acyl-CoA dehydrogenase
- Thiolytic cleavage of β -ketoacyl-CoA

47. Which protein is uniquely responsible for the thermogenic function of brown adipose tissue?

- ATP synthase
- Carnitine palmitoyltransferase I
- Hormone-sensitive lipase
- Uncoupling protein 1 (UCP1)

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48. Which statement best explains why pentose phosphate pathway activity increases during oxidative stress?

- NADPH directly activates ribose-5-phosphate synthesis
- NADP⁺ accumulation activates glucose-6-phosphate dehydrogenase
- ATP depletion stimulates the oxidative phase
- Glutathione directly activates transketolase

49. Why are red blood cells particularly vulnerable to defects in the pentose phosphate pathway?

- They lack mitochondria and β -oxidation
- They cannot regenerate NAD⁺
- They lack alternative sources of NADPH
- They depend exclusively on oxidative phosphorylation

50. Insulin promotes fatty acid synthesis by increasing the activity of which enzyme?

- Carnitine palmitoyltransferase I
- Hormone-sensitive lipase
- Acetyl-CoA carboxylase
- Acyl-CoA dehydrogenase

51. Which enzyme pair represents the key reciprocal regulatory point between glycolysis and gluconeogenesis?

- Hexokinase and glucose-6-phosphatase
- Pyruvate kinase and pyruvate carboxylase
- Aldolase and triosephosphate isomerase
- Phosphofructokinase-1 and fructose-1,6-bisphosphatase

52. In hepatocytes, glucagon promotes gluconeogenesis primarily by decreasing the concentration of:

- Fructose-1,6-bisphosphate
- Fructose-2,6-bisphosphate
- Pyruvate
- Oxaloacetate

53. Type I glycogen storage disease is caused by deficiency of which enzyme?

- Glycogen phosphorylase
- Glucose-6-phosphatase
- Debranching enzyme
- Phosphofructokinase-1

54. Which structural feature most directly explains why cellulose is indigestible by humans?

- Its highly branched structure
- The presence of α -1,4 glycosidic bonds
- The β -1,4 glycosidic linkages between glucose units
- Its association with amylopectin

55. Which allosteric effector activates isocitrate dehydrogenase and thereby accelerates the TCA cycle?

- ATP
- NADH
- ADP
- GTP

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56. Which monosaccharide is classified as a reducing sugar?
A. Glucose B. Methyl- α -D-glucopyranoside C. Sucrose D. Trehalose

57. Which type of genetic alteration most commonly converts a proto-oncogene into an oncogene?
A. Gain-of-function mutation B. Frameshift deletion
C. Loss-of-function mutation D. Gene silencing by methylation

58. How does mutation of the RAS oncogene typically alter cellular signaling?
A. By preventing GTP binding B. By increasing GTPase activity
C. By locking RAS in the active GTP-bound state D. By blocking growth factor receptor binding

59. Which epigenetic modification commonly leads to functional loss of tumor suppressor genes in cancer?
A. Histone acetylation B. DNA hypomethylation
C. Promoter hypermethylation D. Increased mRNA splicing

60. Which tissue relies almost exclusively on glycolysis for ATP production?
A. Liver B. Brain C. Skeletal muscle D. Red blood cells

61. Polyubiquitin chains that target proteins for proteasomal degradation are most commonly linked through which lysine residue of ubiquitin?
A. Lys6 B. Lys11 C. Lys48 D. Lys63

62. Which major chaperone family binds nascent polypeptide chains as they emerge from the ribosome?
A. Hsp90 B. Hsp60 (chaperonins) C. Hsp70 D. Small heat shock proteins

63. Which statement correctly distinguishes coenzymes from prosthetic groups?
A. Coenzymes bind transiently; prosthetic groups are tightly or covalently bound
B. Prosthetic groups are inorganic; coenzymes are organic
C. Coenzymes are permanently bound; prosthetic groups are transient
D. Prosthetic groups do not participate in catalysis

64. Which enzymatic cleavage sequence leads to the formation of amyloidogenic A β peptides?
A. α -secretase followed by γ -secretase B. β -secretase followed by γ -secretase
C. γ -secretase followed by β -secretase D. α -secretase followed by β -secretase

65. Which enzyme catalyzes the ATP-dependent attachment of ubiquitin to a target protein?
A. Proteasomal β -subunit B. E1 ubiquitin-activating enzyme
C. E2 ubiquitin-conjugating enzyme D. E3 ubiquitin ligase

66. Which statement best describes lipid asymmetry in biological membranes?
A. Both leaflets have identical lipid composition
B. Glycolipids are predominantly found in the cytosolic leaflet
C. Phosphatidylserine is normally localized to the inner leaflet
D. Cholesterol exists only in the outer leaflet

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67. Lipid rafts are best described biochemically as membrane microdomains enriched in:

- Unsaturated phospholipids and glycerol
- Cholesterol, sphingolipids, and specific proteins
- Triacylglycerols and fatty acids
- RNA and glycolytic enzymes

68. Which membrane protein defect would most likely impair maintenance of electrochemical gradients?

- Loss of aquaporins
- Defective Na^+/K^+ -ATPase
- Inactivated GPCR
- Reduced integrin expression

69. Which membrane transport process directly couples substrate movement to ATP hydrolysis?

- Facilitated diffusion
- Secondary active transport
- Primary active transport
- Simple diffusion

70. Which condition would most strongly inhibit secondary active transport of glucose in intestinal epithelial cells?

- Absence of ATP
- Loss of Na^+ gradient across the membrane
- Decreased glucose concentration in the lumen
- Increased membrane cholesterol content

71. What is the stoichiometry of ion transport per ATP hydrolyzed by the Na^+/K^+ pump?

- 3 Na^+ out / 2 K^+ in
- 2 Na^+ out / 2 K^+ in
- 2 Na^+ out / 3 K^+ in
- 3 Na^+ out / 3 K^+ in

72. Which DNA topoisomerase is primarily responsible for introducing negative supercoils in bacteria?

- DNA Topoisomerase I
- DNA Topoisomerase II
- Topoisomerase IV
- DNA gyrase

73. Topoisomerase inhibitors used in cancer chemotherapy are cytotoxic primarily because they:

- Block DNA synthesis permanently
- Prevent ATP generation
- Stabilize the DNA-topoisomerase cleavage complex
- Inhibit nucleotide biosynthesis

74. Which glycolytic reaction requires inorganic phosphate (P_i) but does NOT directly consume ATP?

- Hexokinase reaction
- Phosphoglycerate kinase reaction
- Glyceraldehyde-3-phosphate dehydrogenase reaction
- Pyruvate kinase reaction

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75. Which general transcription factor possesses ATP-dependent helicase activity required for promoter melting?
A. TFIIB B. TFIIF C. TFIIE D. TFIIH

76. The TATA-binding protein (TBP) functions as part of which transcription factor complex?
A. TFIIB B. TFIIA C. TFIID D. Mediator

77. Telomerase is best described biochemically as which type of enzyme?
A. RNA-dependent DNA polymerase B. DNA-dependent DNA polymerase
C. DNA-dependent RNA polymerase D. ATP-dependent helicase

78. Which amino acid directly supplies one of the nitrogen atoms in urea?
A. Aspartate B. Alanine C. Glutamine D. Serine

79. BRCA1 and BRCA2 proteins play a central biochemical role in which DNA repair pathway?
A. Base excision repair B. Nucleotide excision repair
C. Mismatch repair D. Homologous recombination repair

80. The assembly of the pre-replication complex (pre-RC) occurs exclusively during which cell-cycle phase?
A. S phase B. G₁ phase C. G₂ phase D. M phase