

國立中興大學 115 學年度

學士後醫學系公費生招生考試

普通生物及生化概論試題

考試時間：100 分鐘

考試開始鈴響前，不得翻閱試題，且不得書寫、劃記、作答！
本考試不得使用計算機

考生請注意：

- 一、考生應確實關閉行動電話(或取出電池)及手錶之鬧鈴設定；除准考證及考試必需用品外，所有物品(含行動電話、穿戴式裝置等)均應立即放置於臨時置物區，不得發出聲響或有影響試場秩序之情形。
- 二、請確認抽屜中、桌椅下、座位旁均無其他非必要用品。如有任何問題請立即舉手反映。
- 三、坐定後，雙手離開桌面，請核對並確認准考證、座位標籤、及答案卡上之准考證號碼是否完全相同。如有錯誤，應立即舉手請監試人員處理。
- 四、考生應試時不得飲食、飲水、抽菸、嚼食口香糖。
- 五、答案卡劃記以 2B 鉛筆為佳，劃記時要粗黑、清晰，劃滿作答格，不可出格，不得折損答案卡，修正作答以軟性橡皮擦擦拭乾淨，且不得使用修正液(帶)修正，未遵照正確作答方式而致機器無法正確辨識答案者，考生自行負責，不得以任何理由補救。答案寫在試題紙上者不予計分。
- 六、本試題必須與答案卡一併繳回，不得攜出試場。

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第一大題，每題 2 分，答錯倒扣 1 分，倒扣至本大題零分為止；未作答，不給分亦不扣分。

1. Which of the following organs functions as both an endocrine and an exocrine gland?
(A) Pituitary gland (B) Ovary (C) Pancreas (D) Thyroid gland (E) Pineal gland
2. The excretory system is essential for animals for the excretion of nitrogenous wastes. Which of the following vertebrates excretes in the form of uric acid? (A) frogs (B) salmon (C) tigers (D) birds
3. Fertilization of sperm and egg occurs in which of the following female reproductive structures?
(A) ovary (B) fallopian tube (C) vagina (D) uterus
4. During glucose absorption in the small intestine, which ion is most commonly cotransported across the apical membrane of enterocytes?
(A) Sodium (B) Potassium (C) Hydrogen (D) Cobaltous
5. Steroid hormones are mainly produced in the adrenal cortex and gonads. These steroid hormones are derived from which of the following molecules? (A) tryptophan (B) tyrosine (C) glucose (D) cholesterol
6. Implantation of the blastocyst in the endometrium occurs between the 6th and 10th day after fertilization. Which hormone is secreted by the blastocyst to maintain the corpus luteum and can serve as a biomarker for pregnancy in women? (A) prolactin (B) estrogen (C) DHEAS (D) hCG
7. Sex determination is influenced by the contributing sperm. Which gene on the Y chromosome makes this fetus a boy? (A) androgen receptor (B) estrogen receptor (C) SRY (D) MIF
8. Which of the following statements is most consistent with the ionic basis of the resting membrane potential in neurons?
(A) Sodium ions are more concentrated inside the cell than outside (B) Potassium ions are evenly distributed across the membrane (C) The intracellular concentration of potassium is higher than that of sodium (D) Chloride ions actively accumulate inside the neuron (E) Calcium ions determine the resting membrane potential
9. A Ramachandran plot is mainly used to analyze:
(A) Side-chain pKa values
(B) Protein thermal stability
(C) Backbone ϕ and ψ dihedral angles
(D) Disulfide bond locations
10. Which statement about molecular chaperones is correct?
(A) They provide the final structural information for folding
(B) They catalyze peptide bond formation
(C) They prevent misfolding and aggregation
(D) They are found only in prokaryotes
11. The cooperative binding of oxygen by hemoglobin is primarily due to:
(A) Independent binding of oxygen to four heme groups
(B) Changes in secondary structure
(C) Allosteric interactions between subunits
(D) Oxidation–reduction reactions

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12. Which of the following stages in cellular respiration produces the greatest amount of ATP?
(A) Glycolysis
(B) Fermentation
(C) Citric Acid Cycle
(D) Electron Transport Chain
13. Which statement correctly describes a key principle of electron transfer from NADH and FADH₂ to the electron transport chain during catabolism?
(A) FADH₂ donates electrons directly to oxygen
(B) Cytosolic NADH enters mitochondria via shuttles for ATP production
(C) Electrons are used to synthesize glucose
(D) All pathways terminate in acetoacetate
14. Which enzyme catalyzes glutamine synthesis in animals and provides nitrogen for downstream biosynthetic pathways such as nucleotide and amino sugar production?
(A) Glutamine synthetase
(B) Glutamate dehydrogenase
(C) Asparagine synthetase
(D) Glutamate synthase
15. In eukaryotic gene transcription, which of the following is a core promoter sequence most frequently found upstream of the transcription start site, responsible for binding general transcription factors?
(A) TATA box
(B) Shine-Dalgarno sequence
(C) Pribnow box
(D) Kozak sequence

第二大題，每題 2 分，答錯倒扣 0.5 分，倒扣至本大題零分為止；未作答，不給分亦不扣分。

16. Ventilation needs the cooperative action of the lungs and accessory muscles. During forced inhalation, which muscles are **NOT** used in inspiration? (A) diaphragm (B) internal intercostal muscles (C) external intercostal muscles (D) sternocleidomastoid
17. Heart beats are autorhythmic. Which specialized cardiac muscle cells act as a pacemaker, determining the rate of heartbeat? (A) sinoatrial node (B) atrioventricular node (C) His bundle (D) Purkinje fibers
18. Drinking alcohol often causes hangover symptoms due to dehydration. Which of the following molecules is linked to the discomfort? (A) renin (B) ADH (C) aldosterone (D) angiotensin II
19. At birth, the ovaries contain around 1-2 million primary oocytes, of which about 500 fully mature from puberty to menopause. When do these germ cells complete meiosis II? (A) at birth (B) at puberty (C) during copulation (D) after fertilization by sperm
20. *Caenorhabditis elegans* is a well-studied model organism in developmental biology. What mechanism resulted in the formation of 959 mature somatic cells from an initial 1090 primordial cells?
(A) phagocytosis (B) apoptosis (C) autophagy (D) ferroptosis
21. Hydrophilic hormones that can't pass through the plasma membrane undergo action by attaching to receptors on the cell surface, triggering a second messenger that amplifies the signal in target cells. Which mechanism is involved in insulin's action? (A) adenylate cyclase (B) phospholipase C (C) tyrosine kinase (D) G protein-coupled receptor

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22. Which disease results from chronically elevated glucocorticoids and presents with clinical symptoms such as a buffalo hump, moon face, and others? (A) pheochromocytoma (B) Addison's Disease (C) Cushing's Syndrome (D) Graves' Disease
23. During an empty stomach, which hormone signals the brain to regulate hunger? (A) gastrin (B) histamine (C) somatostatin (D) ghrelin
24. Severe diarrhea may cause blood clotting problems. Which vitamin is produced in the GI tract by commensal bacteria and is necessary for making clotting factors? (A) vitamin A (B) vitamin B6 (C) vitamin C (D) vitamin K
25. Which of the following statements about diabetes is **NOT** correct? (A) characterized by chronically high blood glucose (B) type 1 diabetes is caused by an autoimmune disease targeting alpha cells (C) type 2 diabetes is caused by insulin resistance (D) may lead to kidney failure, limb amputation, blindness, and cardiovascular disease
26. During pregnancy, the oxygen affinity in RBC differs between mother and fetus. Which of the following polypeptide chains makes fetal hemoglobin obtain adequate oxygen from the mother? (A) α chain (B) β chain (C) γ chain (D) ζ chain
27. Tactile acuity is determined by the size of the receptive fields. The ability to localize a sensation is significantly increased by:
(A) Increasing the density of sensory receptors in a specific area. (B) Decreasing the number of sensory units per unit area. (C) Increasing the number of motor units. (D) Utilizing only phasic receptors for constant stimuli.
28. Damage to horizontal cells in the retina would most directly reduce which visual function?
(A) Motion detection (B) Contrast enhancement (C) Photopigment regeneration (D) Visual acuity in the fovea (E) Dark adaptation
29. Regarding the mechanisms of contraction in skeletal and smooth muscle, which of the following statements is correct?
(A) Both muscle types require influx of extracellular Ca^{2+} to initiate contraction. (B) In skeletal muscle, Ca^{2+} binds to troponin, whereas in smooth muscle, Ca^{2+} binds to calmodulin to initiate contraction. (C) Both muscle types require transverse tubules to elevate intracellular Ca^{2+} concentration. (D) Tropomyosin participates in contraction in skeletal muscle but not in smooth muscle.
30. A patient presents with hypotension, hyponatremia, and hyperkalemia. This clinical triad is most likely caused by:
(A) Elevated blood adrenocorticotrophic hormone (ACTH) levels (B) Low blood parathyroid hormone (PTH) levels (C) Low blood aldosterone levels (D) Elevated blood thyroxine levels
31. Why is glucose uptake in the brain considered to be "insulin-independent"?
(A) Brain cells lack insulin receptors (B) Brain cells rely primarily on fatty acids for energy (C) Brain Glucose uptake is mediated primarily by high-affinity glucose transporters (GLUT) such as GLUT1 and GLUT3 (D) Brain glucose uptake occurs only during the feeding state (E) Brain cells store large amounts of glycogen

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32. Which of the following correctly describes the second messenger pathway activated by epinephrine binding to a β -adrenergic receptor? (PDE = phosphodiesterase; cAMP = cyclic adenosine monophosphate; PKA = protein kinase A; AC = adenylyl cyclase)
(A) PDE activation \rightarrow cAMP formation \rightarrow PKA activation \rightarrow protein phosphorylation (B) PDE activation \rightarrow cAMP formation \rightarrow protein phosphorylation \rightarrow PKA activation (C) AC activation \rightarrow cAMP formation \rightarrow protein phosphorylation \rightarrow PKA activation (D) AC activation \rightarrow cAMP formation \rightarrow PKA activation \rightarrow protein phosphorylation
33. Deflection of stereocilia toward the kinocilium in auditory hair cells results in:
(A) K^+ efflux and hyperpolarization (B) K^+ influx and depolarization (C) Na^+ influx and depolarization (D) Cl^- influx and hyperpolarization (E) No change in membrane potential
34. Which of the following best explains why the membrane potential stops rising at the peak of an action potential?
(A) Complete closure of voltage-gated sodium channels (B) Rapid influx of chloride ions (C) Inactivation of voltage-gated sodium channels with delayed opening of potassium channels (D) Activation of the sodium-potassium ATPase (E) Sudden decrease in extracellular sodium concentration
35. Botulinum toxin causes skeletal muscle paralysis primarily because it:
(A) Blocks acetylcholine receptors on the postsynaptic membrane (B) Prevents calcium entry into the motor neuron (C) Disrupts SNARE proteins required for acetylcholine release (D) Enhances acetylcholinesterase activity (E) Inhibits depolarization of the muscle fiber membrane
36. During DNA replication and transcription, the unwinding of the double helix creates overwinding tension ahead of the replication fork. Which enzyme is responsible for altering DNA supercoiling by cleaving and rejoining the nucleic acid strands to release this tension?
(A) DNA polymerase
(B) DNA ligase
(C) DNA helicase
(D) Topoisomerase
37. During strenuous exercise, human muscle cells undergo glycolysis under anaerobic conditions to produce lactic acid. In this anaerobic metabolic pathway, what is the net yield of ATP and NADH produced from the breakdown of one molecule of glucose?
(A) 2 molecules of ATP, 0 molecules of NADH
(B) 2 molecules of ATP, 2 molecules of NADH
(C) 4 molecules of ATP, 2 molecules of NADH
(D) 36 molecules of ATP, 0 molecules of NADH
38. Regarding the thermodynamic changes during protein denaturation and refolding, which of the following statements is correct?
(A) When urea is used to denature a protein, the overall entropy of the system decreases.
(B) When a protein refolds into its native structure, the entropy of the polypeptide chain itself decreases.
(C) Protein denaturation treatments mainly destroy disulfide bonds and do not affect intermolecular hydrogen bonds.
(D) Intrinsically disordered proteins maintain an extremely compact 3D structure both before and after denaturation.

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39. To avoid neurotoxicity, the toxic ammonia generated from amino acid metabolism in muscle tissue is primarily converted into which of the following amino acid forms (via a cycle linked to glucose metabolism) to transport the ammonia into the liver for urea cycle metabolism?
- (A) Alanine
 - (B) Arginine
 - (C) Lysine
 - (D) Serine
40. Glycosylation is a common post-translational modification of proteins. In N-linked glycosylation, to which amino acid side chain on the protein does the carbohydrate molecule primarily attach?
- (A) Serine
 - (B) Tyrosine
 - (C) Asparagine
 - (D) Threonine
41. If a competitive inhibitor is added to an enzymatic reaction, what changes will occur to the enzyme kinetic parameters maximum reaction velocity (V_{max}) and Michaelis constant (K_m)?
- (A) V_{max} remains unchanged, K_m increases
 - (B) V_{max} decreases, K_m remains unchanged
 - (C) V_{max} decreases, K_m increases
 - (D) V_{max} remains unchanged, K_m decreases
42. Under aerobic conditions, pyruvate produced by glycolysis enters the mitochondria and must be catalyzed by which of the following enzyme complexes to be converted into acetyl-CoA and enter the Krebs cycle?
- (A) Pyruvate carboxylase
 - (B) Pyruvate dehydrogenase complex
 - (C) Pyruvate kinase
 - (D) Phosphoenolpyruvate carboxykinase
43. Calcium ion (Ca^{2+}) is an important secondary messenger inside the cell and often binds to Calmodulin to regulate various enzyme activities. What is the specific stereochemical structural feature in the Calmodulin molecule that is primarily responsible for binding calcium ions?
- (A) EF hand domain
 - (B) Leucine zipper
 - (C) Zinc finger domain
 - (D) Helix-loop-helix
44. D-glucose in an aqueous solution undergoes mutarotation. This is primarily a dynamic equilibrium achieved through an open-chain structure between which two stereoisomers?
- (A) D-glucose and L-glucose
 - (B) D-glucose and D-fructose
 - (C) D-glucose and D-galactose
 - (D) α -D-glucose and β -D-glucose

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45. The operational rate of the Krebs cycle (TCA cycle) is strictly regulated by the cellular energy and redox states. Which of the following enzymes is considered the most critical rate-limiting step in the cycle, being allosterically inhibited by high concentrations of ATP and NADH, and significantly activated by ADP?
- (A) Citrate synthase
 - (B) α -ketoglutarate dehydrogenase complex
 - (C) Isocitrate dehydrogenase
 - (D) Succinate dehydrogenase
46. Which of the following is an important common intermediate used in both the de novo synthesis and salvage pathways of purine and pyrimidine nucleotides?
- (A) 5-phosphoribosylamine (PRA)
 - (B) Glycinamide ribonucleotide (GAR)
 - (C) 5-phospho- α -D-ribose-1-pyrophosphate (PRPP)
 - (D) Formylglycinamide ribonucleotide (FGAR)
47. During glycolysis, which of the following intermediate metabolites can directly generate ATP through substrate-level phosphorylation?
- (A) Glucose-6-phosphate
 - (B) Fructose-1,6-bisphosphate
 - (C) 1,3-bisphosphoglycerate
 - (D) 3-phosphoglycerate
48. In the mitochondrial electron transport chain, as Complex III and Complex IV participate in electron transfer, which of the following important ion transfer phenomena occurs simultaneously?
- (A) Protons (H^+) are transferred from the mitochondrial matrix to the intermembrane space.
 - (B) Protons (H^+) are pumped from the intermembrane space into the mitochondrial matrix.
 - (C) Calcium ions (Ca^{2+}) are pumped from the intermembrane space into the mitochondrial matrix.
 - (D) Potassium ions (K^+) are pumped from the mitochondrial matrix to the cytoplasm.
49. The primary biochemical mechanism of action of the commonly used clinical anticancer chemotherapy drug 5-fluorouracil (5-FU) is to bind and inhibit which of the following enzymes, thereby blocking DNA synthesis?
- (A) Dihydrofolate reductase
 - (B) Ribonucleotide reductase
 - (C) Thymidylate synthase
 - (D) Topoisomerase
50. Disulfiram, a drug used clinically to treat alcoholism, primarily acts by inhibiting which of the following enzymes, leading to an accumulation of acetaldehyde in the patient and causing discomfort?
- (A) Aldehyde dehydrogenase
 - (B) Alcohol dehydrogenase
 - (C) Catechol-O-methyltransferase (COMT)
 - (D) Dopa decarboxylase

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51. During gene transcription, *E. coli* RNA polymerase exists in both core enzyme and holoenzyme states. Which of the following statements about the transcription elongation phase is most correct?
(A) The σ (sigma) factor must remain bound to the DNA during transcription elongation.
(B) The core enzyme contains only a single protein subunit and can independently complete all transcription steps.
(C) The σ factor dissociates after transcription initiation, and the core enzyme continues to participate and is responsible for transcription elongation.
(D) The transcription elongation phase requires the assistance of TFIIF of RNA polymerase II.
52. Hormones can regulate fatty acid synthesis and breakdown. When intracellular insulin levels rise, the concentration of which key metabolite increases, thereby inhibiting CPT-1 (Carnitine palmitoyltransferase I) and blocking fatty acids from entering the mitochondria for oxidation?
(A) Citrate
(B) Acetyl-CoA
(C) Malonyl-CoA
(D) Succinyl-CoA
53. The telomeres at the ends of chromosomes contain single-stranded DNA sequences rich in guanine. What spatial configuration do these special sequences tend to fold into to protect the ends of the chromosomes?
(A) α helix
(B) Hairpin loop
(C) G-quadruplex
(D) Cruciform structure
54. The "Holliday Model" describes a series of steps for homologous recombination. What is the correct term for the "crossed-strand intermediate" structure formed during this process?
(A) Replication Fork.
(B) Holliday Junction.
(C) DNA Bubble.
(D) Primosome.
55. Which enzyme in the ubiquitination pathway is primarily responsible for substrate specificity, ensuring that only selected proteins are targeted for proteasomal degradation?
(A) E1 (Ubiquitin-activating enzyme)
(B) E2 (Ubiquitin-conjugating enzyme)
(C) E3 (Ubiquitin-protein ligase)
(D) 26S proteasome

第三大題，每題 2 分，答錯倒扣 0.25 分，倒扣至本大題零分為止；未作答，不給分亦不扣分。

56. Certain bacterial toxins and pharmacologic agents cause diarrhea without damaging the intestinal epithelium. This type of diarrhea is most commonly caused by:
(A) Inhibition of potassium absorption (B) Increased $\text{Na}^+\text{-K}^+$ cotransport into enterocytes (C) Increased secretion of Na^+ and Cl^- into the intestinal lumen (D) Increased potassium secretion in the colon
57. A postsynaptic neuron receives input from three neurons (X, Y, and Z). Simultaneous activation of X and Y results in an action potential. However, when X and Z are activated together, the membrane potential fails to reach the threshold and remains near the resting level. Given that X alone produces a subthreshold EPSP, what is the most likely nature of Y and Z?
(A) Y is inhibitory; Z is excitatory. (B) Y is excitatory; Z is inhibitory. (C) Both Y and Z are excitatory.
(D) Both Y and Z are inhibitory.

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58. During the resting membrane potential of a typical neuron, which ion movement is favored by both its concentration gradient and electrical gradient?
(A) Potassium ions leaving the cell (B) Sodium ions entering the cell (C) Chloride ions leaving the cell (D) Potassium ions entering the cell
59. A patient presents with blurred vision, tachycardia, and dry skin after ingesting a plant alkaloid. Pupils are dilated. Which best explains these findings?
(A) Activation of α -adrenergic receptors (B) Blockade of muscarinic acetylcholine receptors (C) Inhibition of acetylcholinesterase (D) Activation of nicotinic receptors (E) Excess epinephrine release
60. A cat tracks prey in a dimly lit environment. Which sequence represents the visual pathway?
(A) Rod photoreceptors \rightarrow Bipolar cells \rightarrow Ganglion cells \rightarrow Optic nerve \rightarrow Lateral geniculate nucleus \rightarrow Primary visual cortex (B) Cone photoreceptors \rightarrow Bipolar cells \rightarrow Ganglion cells \rightarrow Optic nerve \rightarrow Lateral geniculate nucleus \rightarrow Primary visual cortex (C) Rod photoreceptors \rightarrow Bipolar cells \rightarrow Ganglion cells \rightarrow Optic nerve \rightarrow Superior colliculus \rightarrow Visual cortex (D) Cone photoreceptors \rightarrow Bipolar cells \rightarrow Ganglion cells \rightarrow Optic nerve \rightarrow Pretectal area \rightarrow Visual cortex (E) Rod photoreceptors \rightarrow Ganglion cells \rightarrow Bipolar cells \rightarrow Optic nerve \rightarrow Lateral geniculate nucleus \rightarrow Visual cortex
61. Which type of cell helps in the transport of gas? Which enzyme is essential for establishing the chloride shift by reversible conversion of CO_2 in peripheral tissues and the lung? (A) red blood cells, carbonic anhydrase (B) lymphocyte, carbonic anhydrase (C) red blood cells, catalase (D) lymphocyte, catalase
62. Obese patients are suffering from metabolic disorders. In recent years, Mounjaro, developed and manufactured by pharmaceutical company Eli Lilly, has shown promising efficacy for weight loss. The molecular mechanism of this drug mimics which hormone (s) action? (A) ghrelin (B) insulin (C) GIP and GLP-1 (D) leptin
63. Viagra is a drug used to treat patients with erectile dysfunction. Which of the following enzymes is the target of Viagra and prevents which molecule from depletion? (A) phosphodiesterase 5, cAMP (B) phosphodiesterase 5, cGMP (C) ribonuclease, cAMP (D) ribonuclease, cGMP
64. Formation of the vertebrate limb depends on specific inductive signals during the arrangement of tissues and organs. Which signaling molecule is associated with extra toes in humans? (A) BMP-4 (B) FGF (C) sonic hedgehog (D) Hox
65. After complete degradation in the body, which of the following amino acids is purely ketogenic and prone to cause ketosis when excessively metabolized?
(A) Alanine
(B) Serine
(C) Glutamate
(D) Leucine
66. Many proteins must fold into specific three-dimensional structures to function, but there is a class of proteins that lack a fixed 3D structure even under physiological conditions, yet still possess important biological functions. What are these proteins called?
(A) Intrinsically disordered proteins
(B) Chaperones
(C) Fibrous proteins
(D) Membrane proteins

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67. After synthesis, several coagulation factors in the human body (such as prothrombin) require the carboxylation of specific glutamate residues in their structure to gain the ability to bind calcium ions. This post-translational modification reaction most critically requires the participation of which vitamin?
- (A) Vitamin A
(B) Vitamin D
(C) Vitamin E
(D) Vitamin K
68. In the eukaryotic DNA repair mechanism, which of the following enzymes is responsible for catalyzing the first step of base excision repair by removing the damaged base?
- (A) DNA polymerase
(B) AP endonuclease
(C) DNA glycosylase
(D) DNA ligase
69. Peptidyltransferase catalyzes the formation of the peptide bond. According to the structural analysis mentioned in the text, how does this catalysis occur?
- (A) A conserved AMP residue in the 23S rRNA abstracts a proton from the amino group of the A-site aminoacyl-tRNA, making it a better nucleophile.
(B) The reaction requires the hydrolysis of at least four ATP molecules to activate the carboxyl group of the C-terminal amino acid.
(C) A protein subunit within the 50S ribosome acts as a general acid-base catalyst to stabilize the tetrahedral intermediate.
(D) The attacking nucleophile in the formation of a peptide bond is a water molecule provided by the surrounding cytoplasm.
(E) Peptide bond formation occurs by transferring the growing polypeptide chain from the P-site tRNA to the aminoacyl-tRNA in the A site.
70. Which of the following statements regarding the activation and signal transduction mechanism of protein kinase A (PKA) is correct?
- (A) PKA must bind cyclic GMP (cGMP) to be activated.
(B) PKA must bind cyclic AMP (cAMP) to be activated.
(C) Activation of PKA primarily increases intracellular fatty acid biosynthesis.
(D) PKA activation is triggered by direct linkage to calcium channels on the cell membrane surface.
71. When a G protein-coupled receptor on the cell membrane activates Phospholipase C (PLC), PLC hydrolyzes PIP₂ on the cell membrane to directly produce which two important secondary messengers?
- (A) cAMP and cGMP
(B) Calcium ions (Ca²⁺) and NO
(C) AMP and PPi
(D) IP₃ (Inositol 1,4,5-trisphosphate) and DAG (Diacylglycerol)
72. In amino acid metabolic pathways, the transamination reaction catalyzed by aminotransferases most heavily requires the participation of which of the following coenzymes?
- (A) Thiamine pyrophosphate (TPP)
(B) Pyridoxal phosphate (PLP)
(C) Coenzyme A (CoA)
(D) Flavin adenine dinucleotide (FAD)

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73. Regarding energy conversion and the electron transport chain, human brown adipose tissue can utilize the intracellular proton concentration gradient to generate heat instead of synthesizing ATP. This thermogenic mechanism is mainly attributed to which specific protein on the inner mitochondrial membrane?
- (A) TP synthase
 - (B) Thermogenin/UCP-1
 - (C) Complex IV
 - (D) Hexokinase
74. Mature red blood cells lack mitochondria. In addition to relying on glycolysis for ATP production, the pentose phosphate pathway (PPP) is also extremely important. What is the most important physiological significance of this pathway for red blood cells?
- (A) Produces a large amount of ATP for cell membrane pumps.
 - (B) Produces NADPH to maintain glutathione in its reduced state, protecting the cell from oxidative damage.
 - (C) Produces ribose-5-phosphate for de novo nucleic acid synthesis.
 - (D) NADH to be used by lactate dehydrogenase.
75. In diabetes treatment, the long-acting insulin glargine can provide stable basal insulin levels. Compared to native human insulin, what changes were made to its amino acid sequence that reduce its solubility at subcutaneous physiological pH to form microprecipitates, thereby prolonging its duration of action?
- (A) The last three amino acids of the B chain were removed.
 - (B) Asparagine (Asn) at position 21 of the A chain is replaced with glycine (Gly), and two arginines (Arg) are added to the C-terminus of the B chain.
 - (C) The proline (Pro) at position 28 and the lysine (Lys) at position 29 of the B chain were swapped.
 - (D) The linkage positions of the disulfide bonds were altered to hide the receptor-binding region.