

高雄醫學大學 106 學年度學士後醫學系招生考試試題

科目：普通生物學及生化概論

考試時間：100 分鐘

說明：一、選擇題用 2B 鉛筆在「答案卡」上作答，修正時應以橡皮擦擦拭，不得使用修正液(帶)，未遵照正確作答方法而致電腦無法判讀者，考生自行負責。
二、試題及答案卡必須繳回，不得攜出試場。

I. 【單選題】每題 1 分，共計 30 分。答錯 1 題倒扣 0.25 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。
1~15 題為普通生物學，16~30 題為生化概論。

1. _____ is to xylem as _____ is to phloem.

- (A) Sclerenchyma cell; parenchyma cell (B) Apical meristem; vascular cambium
(C) Vessel element; sieve-tube member (D) Cortex; pith
(E) Vascular cambium; cork cambium

2. What type of microscopy is used to take the following image?



- (A) Confocal microscopy (B) Transmission electron microscopy
(C) Scanning electron microscopy (D) Epifluorescence microscopy
(E) Light sheet microscopy

3. What do hagfishes and lampreys have in common with the extinct conodonts?

- (A) lungs (B) the jawless condition (C) bony vertebrae
(D) their mode of feeding (E) swim bladders

4. The advent of facile genome engineering using the bacterial RNA-guided CRISPR-Cas system in many organisms is transforming biology. Which one is **NOT** part of the class 2 CRISPR gene editing tool?

- (A) crRNA (B) Cas9 endonuclease (C) miRNA
(D) tracrRNA (E) sgRNA

5. The growth model of a logistic population, $dN/dt=rN[(K-N)/K]$, describes a population's growth when an upper limit to growth is assumed. While N numerically approaches the value of K , _____.

- (A) dN/dt increases rapidly (B) dN/dt decreases rapidly
(C) dN/dt increases slowly (D) dN/dt approaches 0
(E) the population is extincted

6. How many of the following is/are **NOT** found in extracellular matrix (ECM) of animal?

- I. Fibronectins II. Collagens III. Laminins IV. Proteoglycans V. Pectin
(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

7. How many of the following is/are antagonistic function?

- I. sympathetic and parasympathetic nerves II. biceps and triceps muscles
III. insulin and glucagon IV. thyroid and parathyroid
(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

8. In an electrocardiogram (ECG), there are three major signals. The first one is called P wave, the second one is QRS complex, and the third one is T wave. Which part of the ECG represents the delay of the activation of the atrioventricular node?

- (A) P wave (B) Interval between P wave and QRS complex
(C) QRS complex (D) Interval between QRS complex to T wave
(E) T wave

9. What is **NOT** a criterion for evolution to happen in a natural population?

- (A) Natural selection occurs
(B) Traits are inheritable
(C) Random mating happens
(D) Phenotypic difference exists
(E) Organisms produce more offspring than the environment can support

10. Which interaction between species would decrease the fitness of both species?
 (A) Parasitism (B) Mutualism (C) Herbivory (D) Altruism (E) Competition
11. Protists are _____.
 (A) larger prokaryotes
 (B) the organisms first found by Antoni van Leeuwenhoek
 (C) multicellular groups of eukaryotes
 (D) the groups of organisms do not have Golgi apparatus but have mitochondria in cell
 (E) the groups of organisms that lack cytoskeleton in cell
12. What are the levels of biodiversity?
 (A) Phenotypic diversity, species diversity, ecosystems diversity
 (B) Genetic diversity, species diversity, ecosystems diversity
 (C) Genetic diversity, habitat diversity, ecosystems diversity
 (D) Phenotypic diversity, species diversity, trophic-level diversity
 (E) Genetic diversity, species diversity, trophic-level diversity
13. Mutations in which of the following genes lead to transformations in the identity of entire body parts?
 (A) segmentation genes (B) inducers (C) homeotic genes
 (D) egg-polarity genes (E) none of the above
14. Which organelle contains single membrane?
 (A) ribosome (B) chloroplast (C) mitochondrion (D) nucleus (E) peroxisome
15. The uptake of low-density lipoproteins is through _____.
 (A) pinocytosis (B) facilitated transport (C) receptor-mediated endocytosis
 (D) simple diffusion (E) ion channel guided mechanism
16. What complex can be inhibited by hydrogen cyanide (HCN)?
 (A) Complex I (B) Complex II (C) Complex III (D) Complex VI (E) Complex V
17. The linking number of supercoiled DNA can be changed by _____.
 (A) DNA polymerase (B) Histone acetylase (C) DNA ligase (D) Topoisomerase (E) Ribozyme
18. What is the main place for fatty acid biosynthesis in cells?
 (A) Mitochondria (B) Peroxisome (C) Cytosol
 (D) Endoplasmic reticulum (E) Golgi
19. What following compounds is **NOT** required for purine biosynthesis?
 (A) CO₂ (B) Glutamate (C) Aspartate
 (D) N⁵, N¹⁰-Methenyl tetrahydrofolate (E) N¹⁰-Formyl tetrahydrofolate
20. Binding of insulin to its receptor, which one of the following statements is correct?
 (A) occurs on the β-subunit
 (B) induces autophosphorylation
 (C) reduces binding of cytosolic substrate proteins
 (D) leads to the formation of cGMP
 (E) produces DAG and IP₃
21. A lipid derived from isoprenoid precursors is _____.
 (A) palmitate (B) cholesterol (C) arachidonate (D) prostaglandin E (E) sphingosine
22. The biological function of the pentose phosphate pathway is to _____.
 (A) act as a source of ADP biosynthesis (B) supply energy (C) supply NADH
 (D) supply ribose and NADPH (E) supply NAD
23. What is the direct product of pyruvate carboxylase?
 (A) Acetyl-CoA (B) Citrate (C) Lactate (D) Phosphoenolpyruvate (E) Oxaloacetate
24. Which of the following enzymes of the citric acid cycle listed below results in the formation of a high energy phosphate compound?
 (A) Succinate dehydrogenase (B) Succinyl-CoA synthetase (C) Isocitrate dehydrogenase
 (D) Citrate synthase (E) α-Ketoglutarate dehydrogenase
25. Which of the following amino acids is a key gluconeogenic amino acid that is synthesized in muscle by transamination of glucose-derived pyruvate, released into the bloodstream, and taken up by the liver?
 (A) Gly (B) Val (C) Ala (D) Leu (E) Pro
26. Fatty acid synthesis uses which unit for each stepwise addition?
 (A) Acetyl-CoA (B) Malonyl-CoA (C) Methylglutaryl-CoA
 (D) Methylmalonyl-CoA (E) Hydroxybutyryl-CoA

27. Which compound represents the most highly concentrated form of stored biological energy?
 (A) Protein (B) Carbohydrate (C) Fatty acid (D) Nucleic Acid (E) Collagen
28. What following amino acid residues in some proteins can be hydroxylated?
 (A) Serine (B) Tyrosine (C) Proline (D) Methionine (E) Glutamine
29. What following compounds can enhance inorganic iron absorption from our meal?
 (A) Vitamin C (B) Vitamin A (C) Thiamine (D) Vitamin B₁₂ (E) Vitamin B₆
30. If the isoelectric point (pI) of a protein is 5.8 at buffer pH=7.5, how is the protein electrically charged?
 (A) positively-charged (B) negatively-charged
 (C) electrically neutral (D) Not sure, depending on the size of the protein
 (E) Not sure, depending on the buffer composition

II. 【單選題】每題 2 分，共計 120 分。答錯 1 題倒扣 0.5 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。
 31~60 題為普通生物學，61~90 題為生化概論。

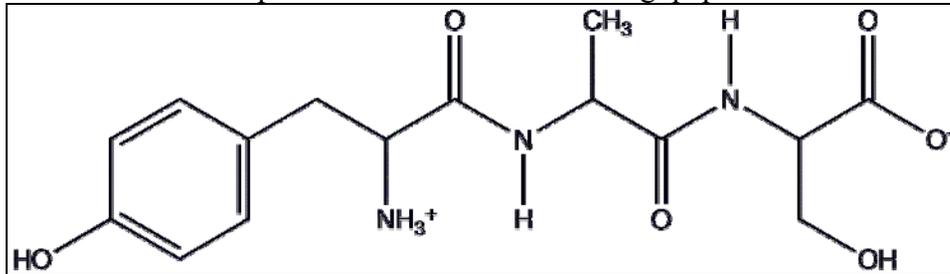
31. Which structure is common to both gymnosperms and angiosperms?
 (A) stigma (B) carpel (C) ovule (D) ovary (E) anthers
32. Which plant hormone is **NOT** correctly paired with its function?
 (A) auxin — promotes stem growth through cell elongation
 (B) cytokinins — initiate programmed cell death
 (C) gibberellins — stimulate seed germination
 (D) abscisic acid — promotes seed dormancy
 (E) ethylene — inhibits cell elongation
33. Tidal volume in respiration is analogous to what measurement in cardiac physiology?
 (A) cardiac output (B) heart rate (C) stroke volume (D) systolic pressure (E) diastolic pressure
34. Which combination of hormones helps a mother to produce milk and nurse her baby?
 (A) prolactin and calcitonin
 (B) oxytocin and prolactin
 (C) follicle-stimulating hormone and luteinizing hormone
 (D) luteinizing hormone and oxytocin
 (E) oxytocin, prolactin, and luteinizing hormone
35. There are two main types of diabetes mellitus: type 1 and type 2. Each is marked by high blood glucose levels, but with different causes. Which of the following statement is **NOT** correct?
 (A) Type 1 diabetes also called insulin-dependent diabetes.
 (B) Type 2 diabetes is an autoimmune disorder in which immune system destroys the beta cells of pancreas.
 (C) Insulin injections can control type 1 diabetes.
 (D) Excess body weight and lack of exercise significantly increase the risk of developing type 2 diabetes.
 (E) The majority of people have diabetes are type 2.
36. According to Hamilton's rule, kin selection causes genes to increase when $C < Br$, where C is the reproductive cost to the individual performing the act, B is the additional reproductive benefit gained by the recipient of the altruistic act, and r is the _____.
 (A) genetic relatedness of the recipient to the actor (B) frequency of the altruistic allele
 (C) inbreeding coefficient (D) rate of recombination
 (E) return on investment
37. Sponges are composed of several distinct types, the activities of which are coordinated. Which of the following cell types of a sponge possesses a flagellum?
 (A) Amoebocyte (B) Choanocyte (C) Epithelial (D) Spicule (E) Nematocyte
38. In a special population, 16 out of every 900 people has a cancer caused by a completely recessive allele, b . Assuming the population is in Hardy-Weinberg equilibrium, which of the following is the predictable percentage of individuals who carry the b allele but are **NOT** expected to develop the cancer?
 (A) 4/900 (B) 32/900 (C) 208/900 (D) 676/900 (E) 884/900
39. Lichens have been the model organisms of symbiosis. What kind(s) of organisms is/are involved in the symbiosis?
 (A) Ascomycete (B) Alga or cyanobacteria (C) Basidiomycete yeast
 (D) A and B (E) A, B and C
40. How many of the following neurotransmitters is/are neuropeptide(s)?
 I. Acetylcholine II. Gamma-aminobutyric acid (GABA) III. Norepinephrine
 IV. Dopamine V. Serotonin VI. Endorphin
 (A) 0 (B) 1 (C) 2 (D) 3 (E) 4

41. About plant endosperm, which statement is **NOT** correct?
 (A) Endosperm is produced by the union of a central cell with a sperm cell.
 (B) In angiosperms, an endosperm formed by the union of a sperm with three polar nuclei during double fertilization.
 (C) The endosperm provides nourishment to the developing embryo in angiosperm seeds.
 (D) The endosperm is a nutrient source for the embryo.
 (E) Wheat endosperm is ground into flour for bread.
42. How many of the following about bacterial gene regulation is/are correct?
 I. Tryptophan acts as a repressor in *trp* operon.
 II. Allolactose acts as an activator in *lac* operon.
 III. Catabolite activator protein (CAP) is activated by allolactose.
 IV. The *lac* operon is turned on by an increase in glucose and an increase in cAMP.
 (A) 0 (B) 1 (C) 2 (D) 3 (E) 4
43. The Nobel Prize winners provide great contribution to human. How many of the following people is/are Nobel Prize winner(s)?
 I. Rosalind Franklin — provided X-ray photo of DNA for Watson and Crick.
 II. Shinya Yamanaka — established induced pluripotent stem cells.
 III. Brenner, Horvitz and Sulston — used *Caenorhabditis elegans* to study apoptosis.
 IV. Barbara McClintock — found transposon.
 V. Earl W. Sutherland — discovered signal transduction.
 (A) 1 (B) 2 (C) 3 (D) 4 (E) 5
44. DNA double-strand breaks can lead to genome instability. Which DNA repair mechanism is error-free system to repair this kind of lesion in the growth phase of the G2 phase cell cycle?
 (A) Homologous recombination
 (B) Non-homologous end-joining
 (C) Microhomology-mediated end joining
 (D) Base mismatch repair
 (E) Excision repair
45. How many of the following about the virus(es) is/are correct?
 I. Papillomavirus — cause warts and cervical cancer; belong to dsDNA virus.
 II. Poxvirus — cause cowpox; belong to dsDNA virus.
 III. Picornavirus — cause hepatitis A; belong to ssRNA virus serves as mRNA.
 IV. Coronavirus — cause SARA; belong to ssRNA virus serves as mRNA.
 V. Paramyxovirus — cause measles and mumps; belong to ssRNA virus serves as template for mRNA synthesis.
 (A) 1 (B) 2 (C) 3 (D) 4 (E) 5
46. What is the most appropriate genetic marker to measure the genetic variation within human populations using the comparative genomic methods?
 (A) Ultra-conserved elements
 (B) Single nucleotide polymorphisms
 (C) Targeted enriched DNA fragments
 (D) Protein-coding genes
 (E) Transcriptomes
47. What is **NOT** an effect of genetic drift?
 (A) Genetic drift is more significant in small populations.
 (B) Genetic drift causes allele frequency to change and to fix in a population randomly.
 (C) Genetic drift prefers advantageous alleles to fix in a population.
 (D) Genetic drift could cause the loss of genetic variation in a population.
 (E) Genetic drift may be one of the reasons that a harmful allele becoming fix in a population.
48. All animals are considered as a monophyletic clade that originated around 770 million years ago. In terms of their biology and diversity, which one below is **NOT** true?
 (A) All animals have true tissues.
 (B) Most of the diversity in animals occurs in Bilateria clade.
 (C) In Bilateria, invertebrates do not share a common ancestor.
 (D) In Bilateria, vertebrates share a common ancestor.
 (E) Sponges are basal of all animals.
49. The elytron colors of ground beetles are polygenically inherited. If one male ground beetle was genotyped as AaBbCc and a female was genotyped as AaBbCc. The uppercase letters in the genotype are the dark-color alleles, and the lowercase letters are the light-color alleles. What is the probability of second darkest colored elytra in their immediate offspring?
 (A) 6/64 (B) 15/64 (C) 20/64 (D) 12/64 (E) 1/64

50. Why do some social bees sacrifice their chance of reproduction and help the individuals in a group that are not their offspring? Which one below is **NOT** true about the evolution of this altruistic behavior?
- (A) It is best explained by kin selection.
 (B) The operating theory is called Hamilton's rule.
 (C) The accounting of the fitness is called inclusive fitness.
 (D) When the benefit to the recipient of altruism weighted by the relatedness of the individuals is smaller than the cost of fitness of altruist, altruism in the system would evolve.
 (E) The coefficient of relatedness equals the fraction of genes that share among individuals.
51. What listed below can **NOT** lead to speciation?
- (A) Allopatric distribution of two populations (B) Sexual selection among phenotypes
 (C) Panmictic population (D) Polyploidy of the local species
 (E) Hybridization of two species
52. During the history of the Earth, what is the time sequence of originations (from old to young) of the animals below?
- (A) trilobites, dragonflies, reptiles, dinosaurs, primates
 (B) trilobites, reptiles, dragonflies, dinosaurs, primates
 (C) trilobites, dragonflies, dinosaurs, reptiles, primates
 (D) dragonflies, trilobites, reptiles, dinosaurs, primates
 (E) dragonflies, trilobites, dinosaurs, reptiles, primates
53. What is correct about the haploid or diploid of the cells during human gametogenesis?
- (A) Spermatogonium is haploid. (B) Primary spermatocyte is haploid. (C) Oogonium is haploid.
 (D) Primary oocyte is haploid. (E) Primary oocyte is diploid.
54. Which one could be the pollinator of the flower that has long floral tube?
- (A) Bats (B) Flies (C) Bees (D) Hawk moths (E) Ants
55. Choose the correct match of glial cell type and function.
- (A) Oligodendrocytes produce the myelin sheaths of myelinated neurons in the peripheral nervous system.
 (B) Schwann cells provide nutritional support to non-myelinated neurons.
 (C) Radial glia is the source of immunoprotection against pathogens.
 (D) Astrocytes metabolize neurotransmitters and modulate synaptic effectiveness.
 (E) None of the above.
56. Which plant group is **NOT** vascular plant?
- (A) Ginkgo (B) Mosses (C) Conifers (D) Angiosperms (E) Ferns
57. Which protein is **NOT** involved in the fusion and fission process of mitochondria?
- (A) COX (B) Drp1 (C) Opa1 (D) Mfn1 (E) Fis1
58. Olfactory receptors in mammals belong to _____.
- (A) receptor tyrosine kinases (B) ion channels (C) G protein-coupled receptors
 (D) proton pumps (E) small GTPase
59. HIV is the virus that causes AIDS. In the mid-1990s, researchers discovered an enzyme in HIV called protease. Once the enzyme's structure was known, researchers began looking for drugs that would fit into the active site and block it. If this strategy for stopping HIV infections were successful, it would be an example of what phenomenon?
- (A) allosteric regulation (B) competitive inhibition (C) vaccination
 (D) denaturation (E) synergistic effect
60. The Nobel Prize in physiology or medicine was awarded to Dr. Yoshinori Ohsumi for his discovery of mechanisms for _____.
- (A) apoptosis (B) mitochondrial fusion and fission (C) vesicular transport
 (D) signal transduction in the nervous system (E) autophagy
61. In replication, which of the followings is used for polymerization of both leading strand and lagging strand?
- (A) DNA ligase (B) DNA polymerase I (C) DNA polymerase III (D) Gyrase (E) DNA helicase
62. Many coenzymes are derived from vitamins. Which of the following statements are correct?
- ① FAD is derived from vitamin B₆.
 ② Pyridoxal phosphate is derived from vitamin B₁.
 ③ Coenzyme A is derived from pantothenic acid.
 ④ 5'-Deoxyadenosyl cobalamin is derived from vitamin B₁₂.
 ⑤ NAD is derived from nicotinic acid.
- (A) ①②③ (B) ②③④ (C) ③④⑤ (D) ①④⑤ (E) ①③⑤

63. Vitamin B₁ (thiamine) is the precursor to the coenzyme thiamine pyrophosphate (TPP). Thiamine deficiency would decrease which one of the following enzyme activities?
- (A) Fumarase (B) Isocitrate dehydrogenase (C) Malate dehydrogenase
(D) Succinate dehydrogenase (E) α -Ketoglutarate dehydrogenase

64. Which one of the representations describes the oligopeptide shown below?



- (A) Tyr-Ala-Thr (B) Tyr-Ala-Ser (C) Phe-Ala-Thr (D) Phe-Gly-Cys (E) Phe-Ala-Tyr

65. Which of the following statements regarding Michaelis-Menten kinetic analyses of enzyme action are correct?

- ① The total enzyme concentration studied at each substrate concentration is fixed in analysis of enzyme kinetics.
② Formation of enzyme-substrate complex does not appreciably decrease the concentration of substrate.
③ k_{cat} reduces with competitive inhibition.
④ Maximal velocity is reached when the enzyme-substrate complex is equal to the total concentration of enzyme present.
⑤ The initial reaction velocity should be measured because most of the substrate has not been converted to product.

- (A) ①②③④ (B) ①②③⑤ (C) ①②④⑤ (D) ②③④⑤ (E) ①③④⑤

66. The high free energy change for the hydrolysis of a thiol ester, as found in acetyl-CoA, compared with that for the hydrolysis of a simple ester, is partly due to _____.

- (A) the greater resonance stability in a simple ester due to better π -electron overlap in a CO linkage than in a CS linkage
(B) the gain in resonance energy in the product, acetate
(C) the high value for the bond energy in S-C bond
(D) reduction of the unfavorable electrostatic interaction in the acetyl-CoA
(E) the high value for the bond energy in S-P bond

67. Phosphate (Pi) is transported into the mitochondria from the cytosol by a phosphate carrier which is driven by the _____.

- (A) hydrolysis of ATP
(B) simultaneous transport of H⁺ into the mitochondrion
(C) simultaneous transport of ADP into the mitochondrion
(D) simultaneous transport of H⁺ out of the mitochondrion
(E) simultaneous transport of ATP out of the mitochondrion

68. Which of the following statements regarding metabolism is **NOT** correct?

- (A) The metabolism can be classified as either catabolic or anabolic reactions.
(B) Enzymes are usually required for cells to carry out reaction under condition of moderate temperature, pressure, and pH.
(C) Glucose, fatty acids, and some amino acids are reduced to form acetyl-CoA, which enters the citric acid cycle.
(D) The energy of metabolism is used to synthesize ATP from ADP and Pi.
(E) Reactions occur spontaneously only when the free energy change is negative.

69. Which of the following statements about membrane proteins are correct?

- ① Membrane proteins can be extracted from cell membrane using sodium dodecyl sulfate.
② Integral proteins can span the membrane with α -helical structure or β -sheet structure.
③ Estrogen receptor is a membrane protein.
④ The membrane proteins are not associated with membrane through glycosylphosphatidylinositol anchor.
⑤ The transmembrane helix of membrane proteins can be predicted from hydrophobic index of amino acid sequence.

- (A) ①②③ (B) ①②⑤ (C) ①②④ (D) ②④⑤ (E) ①③④

70. Which following post-translational modifications would **NOT** be found in histone?

- (A) Acetylation (B) ADP-ribosylation (C) Farnesylation (D) Methylation (E) Monoubiquitylation

71. In order to analyze transcription factor-DNA interaction in gene expression, the following experiments can be conducted.

- ① Promoter luciferase activity assay
② Electrophoretic mobility shift assay
③ Southern blotting
④ Chromatin immunoprecipitation
⑤ DNA affinity purification

- (A) ①③④⑤ (B) ①②③④ (C) ①②③⑤ (D) ①②④⑤ (E) ②③④⑤

72. Which of the following descriptions regarding DNA transcription is **NOT** correct?
 (A) DNA transcription is catalyzed by RNA polymerase consisting of a multi-subunit core and a σ factor.
 (B) The most common σ factor is σ^{70} that binds at the promoter sequence.
 (C) The consensus sequence of the promoter includes a TATA box 10 base pairs upstream of the transcription start site.
 (D) Termination of RNA synthesis can be either rho-dependent or rho-independent.
 (E) RNA polymerase catalyzes mononucleotide transfer to the 5'-end.
73. Which of the following statements regarding lipids is **NOT** correct?
 (A) Lipids are usually water soluble.
 (B) Fatty acids are relatively long-chain monocarboxylic acids with even carbon numbers ranging from 12 to 20.
 (C) Fatty acids are generally stored as complex lipids called triacylglycerols.
 (D) Glycerophospholipids are the major amphipathic lipid components of biological membranes.
 (E) Cis-form unsaturated fatty acids can change the membrane fluidity a lot.
74. Which of the following statements regarding lipid metabolism is **NOT** correct?
 (A) The degradation pathway consists of oxidation, hydration, further oxidation, and thiolysis.
 (B) Before that, fatty acids are activated by esterification to coenzyme A.
 (C) Fatty acid degradation produces large amounts of ATP.
 (D) Fatty acids are degraded to acetyl-CoA by the sequential removal of two-carbon fragments, a process called α -oxidation.
 (E) Fatty acids are usually synthesized from the acetyl-CoA.
75. Which of the followings is on the surface of a lipoprotein particle?
 (A) Cholesterol and phospholipids (B) Cholesterol and triacylglycerol
 (C) Cholesteryl ester and triacylglycerol (D) Cholesteryl ester and phospholipids
 (E) Triacylglycerol and phospholipids
76. DNA polymerase I synthesizes new DNA with very high fidelity, due to its _____.
 (A) high processivity (B) 3'→5' exonuclease activity
 (C) helicase association with the primase (D) 5'→3' exonuclease activity
 (E) all of the above
77. Which of the following statements about urea cycle are correct?
 ① Urea is the end product of the urea cycle.
 ② Inherited defects in urea cycle cause hyperammonemia.
 ③ The synthesis of fumarate by the urea cycle can be used as a precursor for glucose synthesis.
 ④ The urea cycle begins with the formation of ornithine in mitochondria.
 ⑤ ATP is not consumed in urea cycle.
 (A) ②③④ (B) ②③⑤ (C) ①②③ (D) ①④⑤ (E) ③④⑤
78. Which of the following statements is correct regarding the blood glucose level of non-insulin dependent diabetics tend to compare to that of normal individuals?
 (A) Blood glucose levels of diabetics tend to be very stable, but at a higher level.
 (B) Blood glucose levels of diabetics tend to be variable and higher.
 (C) Blood glucose levels decrease more rapidly following a meal, often dropping lower than is tolerable.
 (D) Blood glucose levels average the same level in diabetics, but reach higher peaks for short periods.
 (E) None of the above.
79. One turn of the citric acid cycle generates _____.
 (A) 2 FADH₂, 3 ATP, 1 NADH (B) 1 NAD⁺, 2 FADH₂, 1 ATP (C) 1 GTP, 3 NADH, 1 FADH₂
 (D) 1 FAD, 2 ATP, 3 NADH (E) 1 FADH₂, 1 GTP, 2 NADH
80. Which of the following statements about citric acid cycle are correct?
 ① Pyruvate dehydrogenase links glycolysis to the citric acid cycle.
 ② The products of citric acid cycle are not used for the production of ATP in cells.
 ③ The product of glycolysis forms acetyl-CoA for entering citric acid cycle.
 ④ Its intermediates are not used by other metabolic reactions.
 ⑤ The citric acid cycle is also called as the Krebs cycle or the tricarboxylic cycle.
 (A) ①②③ (B) ①②④ (C) ①②⑤ (D) ①③④ (E) ①③⑤
81. β -oxidation of fatty acids, which one of the following reactions is correct?
 (A) Two NADH are produced for each acetyl-CoA.
 (B) Oxidation of an 18-carbon fatty acid produces six molecules of propionyl-CoA.
 (C) Uses only even-chain, saturated fatty acids as substrates.
 (D) Uses NADP⁺.
 (E) Occurs by a repeated sequence of four reactions.

82. Which of the following is correct regarding the reaction shown below?
 $\text{pyruvate} + \text{HCO}_3^- + \text{ATP} \rightarrow \text{oxaloacetate} + \text{ADP} + \text{Pi}$
- ① It requires the direct transport of oxaloacetate across the membrane.
 - ② It utilizes the malate-aspartate shuttle in some species.
 - ③ It is essential for gluconeogenesis.
 - ④ Its reactants require the function of enzymes which are only found in the cytosol.
- (A) ①② (B) ②③ (C) ③④ (D) ①③ (E) ②④
83. In the process of glycolysis, several reactions take place. Which of the following statements related to them are correct?
- ① Two molecules of pyruvate are produced by glycolysis.
 - ② Under anaerobic condition, pyruvate can be oxidized to CO_2 , generating more ATP molecules.
 - ③ Hexokinase is involved in glycolysis.
 - ④ Fructose-1,6-biphosphate is not generated from glucose-1,6-biphosphate.
 - ⑤ 1,3-Bisphosphoglycerate is generated from glycolysis.
 - ⑥ Eight ATP molecules are generated from the conversion of glucose to pyruvate.
- (A) ②④⑤⑥ (B) ①②③④ (C) ②③④⑥ (D) ①③④⑤ (E) ①②④⑥
84. Which of the following descriptions regarding genetic code is **NOT** correct?
- (A) The genetic code is degenerate, and many codes can specify a certain amino acid.
 - (B) The first two positions of a codon are more important, and mutation in the third position often does not change the sense of the codon.
 - (C) One codon consists of three bases.
 - (D) Missense mutation changes only one codon and sometimes does not cause phenotypic change.
 - (E) Frameshift mutations can be suppressed by a suppressor tRNA molecule.
85. What moiety can **NOT** be found in a sphingomyelin?
- (A) Sphingosine (B) Acetylcholine (C) Ceramide (D) Fatty acid (E) Phosphoric acid
86. Which of the following compounds is **NOT** derivative of cholesterol?
- (A) Bile acids (B) Estrogens (C) Androgens (D) Glucocorticoids (E) Prostaglandins
87. Which of the following statements regarding gluconeogenesis is **NOT** correct?
- (A) Gluconeogenesis is the pathway for glucose synthesis from noncarbohydrate precursors such as lactate and pyruvate.
 - (B) Conversion of pyruvate to phosphoenolpyruvate requires pyruvate carboxylase and phosphoenolpyruvate carboxykinase and is spontaneous.
 - (C) Pyruvate carboxylase is mainly located in mitochondria.
 - (D) Glycogen is the glucose-storage polymer of animals.
 - (E) Pentose phosphate pathway provides an alternative pathway for glucose metabolism.
88. Collagen is the most abundant protein with over 28 distinct types in the animal world. What are the three necessary amino acids that exist in the mature collagens?
- (A) Methionine, cysteine, glycine (B) Alanine, glutamate, arginine
 - (C) Glycine, proline, lysine (D) Methionine, phenylalanine, cysteine
 - (E) Serine, glycine, cysteine
89. What two amino acids can be directly converted each other by a single biochemical reaction?
- (A) Glutamine and asparagine (B) Glycine and serine (C) Leucine and isoleucine
 - (D) Alanine and glycine (E) Phenylalanine and alanine
90. Which of the following statements about proteins is correct?
- (A) Hydrogen bonds are not important in the structure of proteins.
 - (B) Hydrophobic amino acids generally are arranged on the surface.
 - (C) In water soluble proteins, hydrophobic amino acids are generally buried.
 - (D) Globular proteins are generally very loosely structured.
 - (E) Proteins consist of amino acids linked by disulfide bonds.