國立中山大學114學年度
學士後醫學系招生考試試題

科目名稱：普通生物及生化概論

－作答注意事項－

考試時間：100分鐘

- **考試開始鈴響前，不得翻閱試題，並不得書寫、畫記、作答。請先檢查答案卡之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。**
- **答案卡請以2B鉛筆劃記，不可使用修正液（帶）塗改，未使用2B鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。**
- **答案卡應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。**
- **不可使用計算機，並不得攜帶書籍、紙張(應考證不得做計算紙書寫)、具有通訊、記憶、傳輸或收發等功能之相關電子產品或其他有礙試場安寧、考試公平之各類器材入場。**
- **試題及答案卡請務必繳回，未繳回者該科成績以零分計算。**
- **試題採雙面列印，考生應注意試題頁數確實作答。**
- **違規者依本校招生考試試場規則及違規處理辦法處理。**

國立中山大學114學年度學士後醫學系招生考試試題

科目名稱：普通生物及生化概論

※本科目依簡章規定「不可以」使用計算機(選擇題)

選擇題(單一選擇題，共90題，總分150分)

壹、第1~30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. Why aren't insect tracheae associated with capillary beds?
   (A) Insect capillaries are found only around the gut.
   (B) Insects have external gills associated with hemolymph vessels.
   (C) Insects use an air sac respiratory system.
   (D) Insects have an open circulatory system.
   (E) All of the above.
   Ans: (D)

2. During the generation of an action potential, which of the following best explains the absolute refractory period at the molecular level?
   (A) The K^+ channels remain open, preventing the membrane from reaching the threshold potential.
   (B) The Na^+ channels are inactivated, preventing further depolarization despite strong stimuli.
   (C) The Na^+/K^+-ATPase pump is actively hyperpolarizing the membrane, inhibiting depolarization.
   (D) The relative permeability of Na^+ remains high, preventing K^+ efflux from dominating.
   (E) The lipid bilayer of the membrane is temporarily impermeable to all ions.
   Ans: (B)

3. Which of the following best explains why a neuron receiving a simultaneous excitatory postsynaptic potential (EPSP) and inhibitory postsynaptic potential (IPSP) may fail to reach the threshold for an action potential?
   (A) The IPSP causes a transient inactivation of voltage-gated Na^+ channels, making depolarization impossible.
   (B) The inhibitory synapse stabilizes the membrane potential at a level too positive to allow Na^+ channel activation.
   (C) The summation of EPSP and IPSP results in a net change in membrane potential that may be insufficient to reach the threshold.
   (D) The presence of an IPSP leads to immediate degradation of neurotransmitters, reducing excitatory drive.
   (E) The inhibitory synapse actively removes Na^+ from the postsynaptic cell, counteracting the excitatory input.
   Ans: (C)

4. Which of the following is a fundamental physiological difference between cardiac and skeletal muscle that prevents tetanic contractions in cardiac muscle?
   (A) Cardiac muscle lacks functional T-tubules, preventing rapid excitation-contraction coupling.
   (B) Cardiac muscle action potentials involve L-type Ca^{2+} channels, prolonging depolarization and refractory periods.
   (C) The sarcoplasmic reticulum in cardiac muscle lacks ryanodine receptors, preventing sustained Ca^{2+} release.
   (D) The pacemaker activity of cardiac muscle ensures a fixed contractile frequency, preventing summation.
   (E) Cardiac muscle myosin has a significantly lower ATPase activity, preventing repeated cross-bridge cycling.
   Ans: (B)

5. If a human red blood cell takes the shortest possible route from the right ventricle to the right atrium, then it must travel through _____ capillary beds.
(A) one (B) two (C) three (D) four (E) five
Ans: (B)

6. What will happen to a man who is unable to produce LH?
(A) His anterior pituitary is unable to produce FSH.
(B) His Leydig cells are unable to produce testosterone.
(C) He will lose the positive feedback control on FSH release.
(D) His GnRH release by the hypothalamus is decreased.
(E) He will exhibit exaggerated secondary sex characteristics.
Ans: (B)

7. Which of the following statement on the nitrogenous waste is **INCORRECTLY** matched with the benefit of its excretion?
(A) Urea has lower toxicity relative to ammonia.
(B) Uric acid can be stored and excreted as precipitate.
(C) Urea is very insoluble in water.
(D) Ammonia is highly soluble in water.
(E) Uric acid requires minimal amount of water to excrete.
Ans: (C)

8. Which of the following best describes the role of apoptosis in cell signaling?
(A) It randomly destroys cells when there is excess growth.
(B) It integrates multiple signaling pathways to systematically remove cells.
(C) It is triggered only by external signals from neighboring cells.
(D) It primarily occurs in prokaryotic cells to maintain population control.
(E) It amplifies signals by activating multiple caspase proteins.
Ans: (B)

9. Which of the following best describes a primary functional consequence of the blood–brain barrier (BBB) in regulating central nervous system homeostasis?
(A) It prevents the diffusion of small lipophilic molecules, ensuring strict metabolic control within the brain.
(B) It allows selective passive diffusion of hydrophilic neurotransmitters, facilitating rapid neuronal signaling.
(C) It restricts the entry of many circulating immune cells, limiting the brain's immune surveillance.
(D) It actively transports large plasma proteins into cerebrospinal fluid (CSF) to maintain osmotic balance.
(E) It permits the direct exchange of plasma and CSF without specialized transport mechanisms.
Ans: (C)

10. A patient is diagnosed with a rare mutation that impairs the ability of intracellular receptors to dimerize upon hormone binding. Which of the following hormonal responses would be most severely affected?

(A) insulin-mediated glucose uptake in muscle cells
(B) epinephrine-induced glycogen breakdown in hepatocytes
(C) cortisol-induced transcriptional activation in target tissues
(D) parathyroid hormone (PTH)-induced calcium mobilization
(E) growth hormone (GH)-induced IGF-1 secretion from the liver
Ans: (C)

11. _____ are a type of reversible inhibitors that resemble the typical substrate molecule of an enzyme and compete for the binding of the active site to inhibit the enzyme's action.
(A) Non-competitive inhibitors
(B) Competitive inhibitors
(C) Molecular mimics
(D) Agonists
(E) Antagonists
Ans: (B)

12. _____ is a type of cell death that is characterized by its iron dependence and the accumulation of lipid peroxides.
(A) Anoikis (B) Apoptosis (C) Necrosis (D) Ferroptosis (E) Pyroptosis
Ans: (D)

13. Which of the following characteristics would be true of an epithelium specialized for exchange by diffusion (e.g., a respiratory epithelium)?
(A) thin with a relatively large surface area
(B) thick with a relatively large surface area
(C) thin with a relatively small surface area
(D) thick with a relatively small surface area
(E) thin with a small surface area/volume ratio
Ans: (A)

14. Which of the following is **NOT** a stage of cell signaling?
(A) reception (B) transduction (C) termination (D) response (E) none of the above
Ans: (C)

15. Which of the following molecule is **NOT** considered as a second messenger?
(A) acetyl-CoA (B) inositol trisphosphate (C) nitric oxide (D) calcium ion (E) cAMP
Ans: (A)

16. Which intermediate of the urea cycle directly donates one nitrogen atom for urea synthesis?
(A) carbamoyl phosphate
(B) ornithine
(C) oxaloacetate
(D) aspartate
(E) fumarate
Ans: (D)

17. Which of the following complexes of the mitochondrial respiratory chain does **NOT** contribute to the proton gradient across the inner mitochondrial membrane?
(A) Complex I (B) Complex II (C) Complex III (D) Complex IV

(E) cytochrome c oxidase
Ans: (B)

18. What is the function of guanine deaminase in purine metabolism?
(A) conversion of guanine to xanthine
(B) conversion of inosine to guanine
(C) conversion of xanthine to uric acid
(D) synthesis of guanine from IMP
(E) recycling of guanine into GMP
Ans: (A)

19. Which of the following statements about the regulation of ketogenesis is correct?
I. High levels of insulin stimulate ketogenesis by increasing acetyl-CoA availability.
II. The liver lacks b-ketoacyl-CoA transferase, preventing ketone body utilization.
III. Glucagon promotes ketogenesis by enhancing fatty acid oxidation.
(A) I and II
(B) II and III
(C) I and III
(D) III only
(E) All of them are correct.
Ans: (B)

20. Which of the following best describes the mechanism of action of oligomycin?
(A) inhibition of Complex I
(B) blocking of ATP synthase proton channel
(C) uncoupling of oxidative phosphorylation
(D) blocking of cytochrome c function
(E) inhibition of Complex III
Ans: (B)

21. Regulation of cholesterol biosynthesis _____.
(A) involves transcriptional regulation but not covalent regulation
(B) is sensitive to insulin but not glucagon
(C) occurs in the short term primarily by regulating HMG-CoA reductase
(D) involves changes in the rate of biosynthesis of critical enzymes, but not changes in the rate of proteolysis of those enzymes
(E) All of the above are correct.
Ans: (C)

22. Which of the following statements regarding allosteric regulation of enzymes is correct?
I. Allosteric enzymes often exhibit sigmoidal (cooperative) kinetics rather than hyperbolic Michaelis-Menten kinetics.
II. The R-state of an allosteric enzyme has a lower affinity for the substrate than the T-state.
III. Feedback inhibition of a metabolic pathway often involves allosteric regulation of the first committed enzyme.
(A) I and II
(B) II and III
(C) I and III
(D) I only
(E) All of them are correct.

Ans: (C)

23. In humans, pyruvate can be converted to _____.
(A) acetyl-CoA only (B) lactate only (C) ethanol only (D) acetyl-CoA and lactate
(E) acetyl-CoA and ethanol
Ans: (D)

24. Where is the enzyme glucose-6-phosphatase located?
(A) cytosol
(B) endoplasmic reticulum
(C) mitochondria
(D) nucleus
(E) none of the above
Ans: (B)

25. Which of the following is the most distinguishing difference between a purine and a pyrimidine?
(A) Purines are double ring structures while pyrimidines have a single ring.
(B) Purines have nitrogens in the rings while pyrimidines do not.
(C) Pyrimidines have nitrogens in the rings while purines do not.
(D) Purines are found in RNA while pyrimidines are found in DNA.
(E) Purines are found in DNA while pyrimidines are found in RNA.
Ans: (A)

26. Phospholipases break down fats by _____.
(A) adding a phosphate group to them
(B) reducing the double bonds to single bonds
(C) hydrolyzing them
(D) removing acetyl-CoA units
(E) none of the above
Ans: (C)

27. Certain restriction enzymes produce cohesive (sticky) ends. This means that they _____.
(A) cut both DNA strands at the same base pair
(B) cut in regions of high GC content, leaving ends that can form more hydrogen bonds than ends of high AT content
(C) make a staggered double-strand cut, leaving ends with a few nucleotides of single-stranded DNA protruding
(D) make ends that can anneal to cohesive ends generated by any other restriction enzyme
(E) stick tightly to the ends of the DNA they have cut
Ans: (C)

28. All of the following are considered "weak" interactions in proteins, **EXCEPT**:
(A) hydrogen bonds
(B) hydrophobic interactions
(C) ionic bonds
(D) peptide bonds
(E) van der Waals forces
Ans: (D)

29. The force that drives an ion through a membrane channel depends upon _____.

(A) the charge on the membrane
(B) the difference in electrical potential across the membrane
(C) the size of the channel
(D) the size of the ion
(E) the size of the membrane
Ans: (B)

30. Which of the following is a product of the activation of fatty acids?
(A) CoA-SH
(B) ADP
(C) pyrophosphate
(D) none of the above
(E) all of the above
Ans: (C)

貳、第31～90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. If you touch a hot stove and burn your hand, the pain isn't actually in your hand—it's in your head. What evidence can you provide to substantiate this claim?
(A) A reflex arc allows the quick response between the hand and the brain; no interpretation occurs.
(B) Sensory neurons and interneurons carry the heat sensation to the brain where it is interpreted as painful.
(C) Motor neurons pull your hand away from the flame, signaling pain to the brain.
(D) Interneurons form connections directly from the burned receptor molecules to the brain.
(E) All of the above.
Ans: (B)

32. Oral rehydration solutions that contain both salt and glucose are highly effective in treating severe dehydration caused by diarrhea and vomiting. However, glucose or salt alone are not effective. Why?
(A) Glucose without sodium is broken down too quickly in the mouth by saliva.
(B) Water alone rushes through the digestive tract too quickly to be absorbed by the body tissues.
(C) Sodium transport and glucose transport are coupled in the small intestine so that glucose accelerates absorption of salt and water.
(D) ATP is required to transport sodium unless glucose is available for cotransport.
(E) None of the above.
Ans: (C)

33. How does the digestion and absorption of fat differ from that of carbohydrates?
(A) Processing of fat does not require any digestive enzymes, whereas the processing of carbohydrates does.
(B) Fat absorption occurs in the stomach, whereas carbohydrates are absorbed from the small intestine.
(C) Carbohydrates need to be emulsified before they can be digested, whereas fats do not.
(D) Most absorbed fat enters the lymphatic system, whereas carbohydrates directly enter the blood.
(E) Fat must be partially digested by bacteria in the large intestine before it can be absorbed, which is not the case for carbohydrates.
Ans: (D)

34. Which of the following physiological responses to hemorrhage is correctly described?

(A) The increase in cardiac output due to hemorrhage results in enhanced venous return, which compensates for the blood loss.
(B) Hemorrhage causes a drop in blood pressure, and the baroreceptor reflex increases sympathetic activity, leading to vasoconstriction and increased heart rate to preserve blood pressure.
(C) Blood volume expansion following hemorrhage is mediated by parasympathetic activation, which reduces vasoconstriction.
(D) The physiological response to hemorrhage primarily involves vasodilation to improve blood flow to tissues affected by low blood volume.
(E) Shock caused by hemorrhage results in complete cessation of blood flow to the brain, leading to immediate neuronal death.
Ans: (B)

35. Which of the following statements about lung compliance is true?
(A) Lung compliance is primarily determined by the strength of the diaphragm and intercostal muscles.
(B) Surfactant produced by type II cells increases lung compliance by reducing surface tension.
(C) Decreased lung compliance is associated with increased surfactant production.
(D) Compliance is solely determined by the elasticity of the thoracic cage, with no influence from lung tissue.
(E) High lung compliance always indicates optimal lung function, especially during forced expiration.
Ans: (B)

36. A patient with recurrent hypoglycemia presents with low plasma glucose and elevated plasma insulin during fasting. Which of the following pathophysiological mechanisms is the most likely cause?
(A) Insulinoma causes inappropriate insulin secretion despite fasting hypoglycemia.
(B) Adrenal insufficiency leads to excessive hepatic gluconeogenesis and hyperglycemia.
(C) Glucagon overproduction causes excessive hepatic glycogenolysis and ketogenesis.
(D) Increased cortisol levels stimulates GLUT4-mediated glucose uptake into skeletal muscle.
(E) Reduced hepatic glycogenolysis that is caused by the excessive glucagon secretion.
Ans: (A)

37. Which of the following is an example of how conjugation contributes to the spread of antibiotic resistance?
(A) A bacterium spontaneously mutates to become resistant to penicillin.
(B) An *E. coli* strain transfers a plasmid containing the blaKPC gene to a Klebsiella pneumoniae strain, making it resistant to carbapenems.
(C) A bacterium acquires resistance through exposure to gradually increasing concentration of antibiotics.
(D) A virus introduces antibiotic resistance genes into a bacterial population.
(E) Bacteria develop resistance through adaptive changes in their metabolism.
Ans: (B)

38. Which of the following is **TRUE** on a morphogen?
(A) It is a signaling molecule that is required for cell-to-cell contact within the embryo.
(B) It is a signaling molecule that induces the differentiation of cells within the embryo.
(C) It is a signaling molecule that induces blastulation of the developing embryo.
(D) It is a signaling molecule that induces implantation of the embryo into the uterus of mammals.
(E) It is a signaling molecule that separates out cytoplasmic factors to their respective cells within the developing embryo.

Ans: (B)

39. Please identify the events of mitosis in the correct order.
I. Sister chromatids align on the metaphase plate.
II. The cleavage furrow forms.
III. The nuclear membrane breaks up.
IV. Sister chromatids condense.
V. Sister chromatids separate.
(A) I, II, III, IV, V
(B) IV, III, I, V, II
(C) III, IV, I, V, II
(D) III, II, I, IV, V
(E) IV, I, III, V, II
Ans: (B)

40. Which of the following response is triggered by the activation of acetylcholine receptor on skeletal muscle, a ligand-gated channel?
(A) hyperpolarization by allowing Na^+ ions to exit the muscle fiber
(B) depolarization by allowing K^+ ions to leave the muscle fiber
(C) depolarization by allowing Cl^- ions to enter the muscle fiber
(D) repolarization by activating second messenger systems within the muscle fiber
(E) depolarization by allowing Na^+ ions to enter the muscle fiber
Ans: (E)

41. Which of the following is the correct sequence of sensory processing?
(A) sensory adaptation → stimulus reception → sensory transduction → sensory perception.
(B) stimulus reception → sensory transduction → sensory perception → sensory adaptation.
(C) sensory perception → stimulus reception → sensory transduction → sensory adaptation.
(D) sensory perception → sensory transduction → stimulus reception → sensory adaptation.
(E) stimulus reception → sensory perception → sensory adaptation → sensory transduction.
Ans: (B)

42. Which of the following is the primary function of the corpus luteum?
(A) to nourish and protect the egg cell
(B) to maintain progesterone and estrogen synthesis after ovulation has occurred
(C) to produce prolactin in the alveoli
(D) to stimulate the development of the mammary glands
(E) to support pregnancy in the second and third trimesters
Ans: (B)

43. The clonal selection theory implies that _____.
(A) related people have similar immune responses
(B) antigens activate specific lymphocytes
(C) only certain cells can produce interferon
(D) memory cells are present at birth
(E) the body selects which antigens it will respond to
Ans: (B)

44. Although the membrane of a "resting" neuron is highly permeable to potassium ions, its membrane potential does not exactly match the equilibrium potential for potassium. Why?

(A) The resting neuronal membrane is also slightly permeable to sodium ions.
(B) The resting neuronal membrane is also fully permeable to sodium ions.
(C) The resting neuronal membrane is also fully permeable to calcium ions.
(D) The resting neuronal membrane is also impermeable to sodium ions.
(E) The resting neuronal membrane is also highly permeable to chloride ions.
Ans: (A)

45. A mutation in the vasopressin receptor V2 (V2R) leads to a loss of function in the renal collecting ducts. Which of the following is the most likely clinical manifestation?
(A) Production of hyperosmotic urine due to an increased insertion of aquaporin-2 (AQP2) in the lumenal surface of the collecting duct cells.
(B) The excessive water retention by unregulated vasopressin signaling results in hypertension.
(C) Impaired water reabsorption in the collecting ducts leads to polyuria with hypoosmotic urine.
(D) Compensatory increase in aldosterone secretion that enhances sodium reabsorption in the proximal tubule.
(E) Enhanced renin-angiotensin system activation leads to the eventual increase in plasma volume.
Ans: (C)

46. Which of the following statements most accurately describes the neural regulation of gastrointestinal function?
(A) Short reflexes are entirely contained within the enteric nervous system, whereas long reflexes involve the CNS.
(B) The myenteric plexus primarily regulates secretion, while the submucous plexus controls motility.
(C) The vagus nerve primarily inhibits digestive function by releasing norepinephrine onto enteric neurons.
(D) Sensory input from stretch receptors in the GI tract directly stimulates gastric acid secretion without central processing.
(E) The enteric nervous system requires central nervous system input to regulate peristalsis.
Ans: (A)

47. Which of the following correctly describes the absorption of carbohydrates in the small intestine?
(A) Glucose and galactose enter enterocytes via sodium-glucose cotransporters (SGLT1).
(B) Fructose is absorbed via active transport, requiring ATP.
(C) Lactose is directly absorbed across the brush border without enzymatic breakdown.
(D) Sucrose absorption requires luminal amylase activity.
(E) Cellulose is digested by human enzymes into monosaccharides for absorption.
Ans: (A)

48. Which of the following statements correctly explains the relationship between lipoproteins and cardiovascular disease risk?
(A) High-density lipoproteins (HDL) facilitate the transport of triglycerides from adipose tissue to the liver.
(B) Low-density lipoproteins (LDL) are responsible for cholesterol uptake by peripheral tissues, and an elevated LDL/HDL ratio is associated with an increased risk of atherosclerosis.
(C) Very-low-density lipoproteins (VLDL) transport dietary cholesterol to skeletal muscle for metabolism.
(D) Cholesterol homeostasis is primarily regulated by renal excretion rather than hepatic processing.
(E) Increased LDL uptake by hepatocytes is directly regulated by epinephrine binding to β-adrenergic receptors.

Ans: (B)

49. Which of the following most accurately describes a mechanism leading to autoimmune disease?
(A) Clonal expansion of autoreactive T cells in the absence of regulatory T cell inhibition.
(B) Failure of macrophages to recognize bacterial pathogens, leading to autoantibody production.
(C) Excessive activation of the complement system in response to allergens.
(D) Increased function of regulatory T cells that suppress immune responses to self-antigens.
(E) Overproduction of IgA antibodies that neutralize self-antigens.
Ans: (A)

50. Which mechanism does **NOT** contribute to genome evolution?
(A) gene duplication as a result of unequal crossover
(B) epigenetic modifications
(C) genetic mutations
(D) exon duplication and shuffling
(E) movement of transposons
Ans: (B)

51. Which of the following statement on the cellular metabolism is **INCORRECT**?
(A) The net energy yield from each glucose molecule via glycolysis is 2 ATP plus 2 NADH.
(B) The conversion of pyruvate to acetyl-CoA occurs in mitochondria.
(C) The conversion of pyruvate to acetyl-CoA yields one NADH.
(D) The net energy yield from one glucose molecule via citric acid cycle is 3 NADH, 1 $FADH_2$, plus 1 ATP.
(E) The production of ATP by ATP synthase is mediated by chemiosmosis.
Ans: (D)

52. Why your immune system responds faster and stronger to the exposure of a pathogen after you have been previously vaccinated against the same pathogen?
(A) The vaccine stays in the body permanently to fight the infection.
(B) Vaccine-primed memory cells respond quickly to the subsequent pathogen exposure.
(C) The vaccine makes the pathogen weaker over time.
(D) Your body produces antibodies continuously after vaccination.
(E) The pathogen mutates to become less harmful after vaccination.
Ans: (B)

53. Which of the following mechanisms does **NOT** play a significant role in regulating gastric acid secretion?
(A) Histamine binds to H_2 receptors on the parietal cells to enhance HCl secretion.
(B) Gastrin directly stimulates the Na^+/K^+-ATPase in parietal cells.
(C) Somatostatin inhibits acid secretion by suppressing gastrin release from G cells.
(D) Acetylcholine released from vagal efferents promotes acid secretion via M_3 receptors.
(E) Carbonic anhydrase in parietal cells facilitates acid secretion by generating protons.
Ans: (B)

54. Which of the following contributes to the high efficiency of gas exchange in fish gills?
(A) The high degree of oxygen saturation of water significantly contribute to high efficiency in gas exchange.
(B) The back-and-forth movement of water maximizes oxygen uptake.

(C) Very high blood pressure in the circulatory system of fishes contributes to high efficiency in gas exchange.
(D) The co-current exchange mechanism contributes highly to the gas exchange.
(E) The countercurrent exchange mechanism contributes highly to the gas exchange.
Ans: (E)

55. The transfers of motor, sensory, and cognitive information between the brain hemispheres is facilitated by _____, the major neural connection between the right and left hemispheres of the human brain.
(A) the basal nuclei
(B) the thalamus
(C) the reticular formation
(D) the corpus callosum
(E) the motor cortex
Ans: (D)

56. Why is Taq polymerase used in a polymerase chain reaction (PCR)?
(A) Taq polymerase has proofreading activity and thus makes fewer errors than other DNA polymerases.
(B) Unlike other DNA polymerases, Taq polymerase is heat stable and survives the 94 °C denaturation step in PCR.
(C) Unlike other DNA polymerases, Taq polymerase is not inhibited by dideoxy nucleotides.
(D) Unlike other DNA polymerases, Taq polymerase can produce DNA from an RNA template.
(E) Taq polymerase is more efficient than other DNA polymerases.
Ans: (B)

57. Which is the final step of blood clotting cascade before the formation of a network of fibers?
(A) The soluble plasma protein fibrin is converted to the insoluble protein prothrombin.
(B) The soluble plasma protein thrombin is converted to the insoluble protein fibrin.
(C) The soluble plasma protein fibrinogen is converted to the insoluble protein fibrin.
(D) The soluble plasma protein fibrinogen is converted to the insoluble protein thrombin.
(E) The soluble plasma protein prothrombin is converted to the insoluble protein thrombin.
Ans: (C)

58. Which of the following is the primary cause of the second heart sound (S2)?
(A) the closure of the atrioventricular (AV) valves at the beginning of systole
(B) the opening of the aortic and pulmonary valves during ventricular ejection
(C) the closure of the aortic and pulmonary valves at the beginning of diastole
(D) the rapid filling of the ventricles during early diastole
(E) the closing of the AV valves at the end of diastole
Ans: (C)

59. Which neurotransmitter is commonly associated with the reward system and pleasure sensations in the brain?
(A) acetylcholine
(B) serotonin
(C) GABA
(D) dopamine
(E) glutamate
Ans: (D)

60. Which of the following is the feature of the ascending portion of the loop of Henle?
(A) It is permeable to water and impermeable to sodium.
(B) It is permeable to water and permeable to sodium.
(C) It is impermeable to water and permeable to sodium.
(D) It is impermeable to water and impermeable to sodium.
(E) It is the site of active transport of water.
Ans: (C)

61. The structure of NAD+ does not include _____.
(A) a flavin nucleotide
(B) a pyrophosphate bond
(C) an adenine nucleotide
(D) nicotinamide
(E) two ribose residues
Ans: (A)

62. An integral membrane protein can be extracted with _____.
(A) a buffer of alkaline or acid pH
(B) a chelating agent that removes divalent cations
(C) a solution containing detergent
(D) a solution of high ionic strength
(E) hot water
Ans: (C)

63. Which of the following statements about a plot of V_0 vs. [S] for an enzyme that follows Michaelis-Menten kinetics is **false**?
(A) As [S] increases, the initial velocity of reaction V_0 also increases.
(B) At very high [S], the velocity curve becomes a horizontal line that intersects the y-axis at K_m.
(C) K_m is the [S] at which $V_0 = 1/2\ V_{max}$.
(D) The shape of the curve is a hyperbola.
(E) The y-axis is a rate term with units of μm/min.
Ans: (B)

64. The oxidation of 3 mol of glucose by the pentose phosphate pathway may result in the production of _____.
(A) 2 mol of pentose, 4 mol of NADPH, and 8 mol of CO_2
(B) 3 mol of pentose, 4 mol of NADPH, and 3 mol of CO_2
(C) 3 mol of pentose, 6 mol of NADPH, and 3 mol of CO_2
(D) 4 mol of pentose, 3 mol of NADPH, and 3 mol of CO_2
(E) 4 mol of pentose, 6 mol of NADPH, and 6 mol of CO_2
Ans: (C)

65. An enzyme-catalyzed reaction was carried out with the substrate concentration initially a thousand times greater than the K_m for that substrate. After 9 minutes, 1% of the substrate had been converted to product, and the amount of product formed in the reaction mixture was 12 μmol. If, in a separate experiment, one-third as much enzyme and twice as much substrate had been combined, how long would it take for the same amount (12 μmol) of product to be formed?
(A) 1.5 minutes
(B) 13.5 minutes

(C) 27 minutes
(D) 3 minutes
(E) 6 minutes
Ans: (C)

66. The double-reciprocal transformation of the Michaelis-Menten equation, also called the Lineweaver-Burk plot, is given by $1/V_0 = K_m/(V_{max}[S]) + 1/V_{max}$. To determine K_m from a double-reciprocal plot, you would _____.
(A) take the x-axis intercept where $V_0 = 1/2\ V_{max}$
(B) multiply the reciprocal of the x-axis intercept by −1
(C) multiply the reciprocal of the y-axis intercept by −1
(D) take the reciprocal of the x-axis intercept
(E) take the reciprocal of the y-axis intercept
Ans: (B)

67. The inner (plasma) membrane of *E. coli* is about 75% lipid and 25% protein by weight. How many molecules of membrane lipid are there for each molecule of protein? (Assume that the average protein is Mr 50,000 and the average lipid is 750.)
(A) 1　(B) 50　(C) 200　(D) 10,000　(E) 50,000
Ans: (C)

68. The specificity of signaling pathways includes all of the following **EXCEPT**:
(A) flippase-catalyzed movement of phospholipids from the inner to the outer leaflet.
(B) migration of signal proteins into membrane rafts.
(C) phosphorylation of target proteins at Ser, Thr, or Tyr residues.
(D) the ability to be switched off instantly by hydrolysis of a single phosphate-ester bond.
(E) the assembly of large multiprotein complexes.
Ans: (A)

69. During strenuous exercise, the NADH formed in the glyceraldehyde 3-phosphate dehydrogenase reaction in skeletal muscle must be reoxidized to NAD+ if glycolysis is to continue. The most important reaction involved in the reoxidation of NADH is _____.
(A) dihydroxyacetone phosphate → glycerol 3-phosphate
(B) glucose 6-phosphate → fructose 6-phosphate
(C) isocitrate → α-ketoglutarate
(D) oxaloacetate → malate
(E) pyruvate → lactate
Ans: (E)

70. The type of membrane transport that uses ion gradients as the energy source is _____.
(A) facilitated diffusion
(B) passive transport
(C) primary active transport
(D) secondary active transport
(E) simple diffusion
Ans: (D)

71. In the alcoholic fermentation of glucose by yeast, thiamine pyrophosphate is a coenzyme required by _____.

(A) aldolase
(B) hexokinase
(C) lactate dehydrogenase
(D) pyruvate decarboxylase
(E) transaldolase
Ans: (D)

72. Which of the following statements concerning signal transduction by the insulin receptor is **NOT** correct?
(A) Activation of the receptor protein kinase activity results in the activation of additional protein kinases.
(B) Binding of insulin to the receptor activates a protein kinase.
(C) Binding of insulin to the receptor results in a change in its quaternary structure.
(D) The receptor protein kinase activity is specific for tyrosine residues on the substrate proteins.
(E) The substrates of the receptor protein kinase activity are mainly proteins that regulate transcription.
Ans: (E)

73. A sequence of amino acids in a certain protein is found to be -Ser-Gly-Pro-Gly-. The sequence is most probably part of a(n) _____.
(A) antiparallel β sheet
(B) parallel β sheet
(C) α helix
(D) α sheet
(E) β turn
Ans: (E)

74. Which of the following statements regarding polysaccharides is correct?
I. Glycogen is more highly branched than amylopectin, with α(1→6) branch points occurring every 8-12 glucose residues.
II. Chitin is a linear homopolysaccharides of glucose connected by α(1→4) linkages.
III. The debranching enzyme in glycogenolysis has both transferase and glucosidase activity.
(A) I and II
(B) II and III
(C) I and III
(D) III only
(E) All of them are correct.
Ans: (C)

75. A newborn is diagnosed to have severe metabolic acidosis, ketosis, and hyperammonemia. Plasma amino acid analysis shows markedly elevated branched-chain amino acids. Which of the following statements is correct?
I. The primary defect is in the degradation of leucine, isoleucine, and valine.
II. The enzyme deficiency affects a complex that requires biotin as a cofactor.
III. Restriction of aromatic amino acids in the diet is the key step of treatment.
(A) I and II
(B) II and III
(C) I and III
(D) I only
(E) All of them are correct.

Ans: (D)

76. Steriod hormone response elements (HREs) are _____ , which, when bound to _____, alter gene expession at the level of _____.
(A) intron sequences; activated hormone receptor; translation
(B) nuclear proteins; hormone; transcription
(C) plasma membrane proteins; hormone; transcription
(D) sequences in DNA; receptor-hormone complex; replication
(E) sequences in DNA; receptor-hormone complex; transcription
Ans: (E)

77. The synthesis of both glycerophospholipids and triacylglycerols involves _____.
(A) serine
(B) phosphatidylethanolamine
(C) phosphatidic acid
(D) phosphocholine
(E) phosphatidic acid phosphatase
Ans: (C)

78. Which of the following factors contribute to increasing the melting point of a fatty acid?
(A) introducing cis-double bonds
(B) adding methylene groups
(C) introducing trans-double bonds
(D) increased number of double bonds
(E) increased fatty acid chain length
Ans: (E)

79. Which of the following statements about the synthesis of Δ^3-isopentenyl pyrophosphate (IPP) from acetate is **NOT** true?
(A) Biotin is required.
(B) Carbon dioxide is liberated.
(C) ATP is consumed.
(D) Mevalonate is an intermediate.
(E) NADPH is the electron donor.
Ans: (A)

80. Which cofactor is required for all transaminase (aminotransferase) reactions?
(A) thiamine pyrophosphate (B) pyridoxal phosphate (C) biotin
(D) folic acid (E) lipoic acid
Ans: (B)

81. Which one of the following statements about β-oxidation is true?
(A) The pathway helps to generate energy and acetyl-CoA from malonyl-CoA.
(B) The pathway produces NADPH and NADH as products.
(C) The pathway is highly activated in all tissues when glucose is available.
(D) The rate-limiting step depends on fatty acyl-CoA entering the mitochondria.
(E) All reactions in the pathway could also be used in the biosynthesis of fatty acid.
Ans: (D)

82. The component of both glycerophospholipids and sphingolipids involves _____.
(A) saturated fatty alcohol
(B) phosphatidic acid phosphatase
(C) phosphoethanolamine
(D) phosphocholine
(E) mixed-function oxidase
Ans: (D)

83. Sterol regulatory element-binding protein (SREBP) controls the gene expression of cholesterol biosynthesis. What happens when there is the presence of a high cellular concentration of cholesterol?
(A) It increases the proteolytic cleavage and releases SREBP into the nucleus.
(B) SREBP is hold in the Golgi apparatus in a complex with SREBP-cleavage-activating protein (SCAP) to produce a regulatory domain fragment.
(C) It activates SREBP by inducing the conformational change for cholesterol biosynthesis.
(D) It stabilizes the SCAP-SREBP complex by the anchoring of insulin-induced gene protein (Insig).
(E) SREBP acts as a corepressor of RXR-LXR dimer to terminate the gene expression of cholesterol biosynthesis.
Ans: (D)

84. Histones contain large amounts of which of the following amino acids?
(A) leucine (B) lysine (C) glutamic acid (D) histidine (E) tryptophan
Ans: (B)

85. Release of succinate from succinyl-CoA can be coupled to GTP synthesis because:
(A) Coenzyme A is a "high energy" compound, just like GTP.
(B) The link between succinate and CoA involves an acid anhydride to phosphate.
(C) The thioester bond between succinate and CoA has a large $-\Delta G$ of hydrolysis.
(D) The amide bond between succinate and CoA has a large $-\Delta G$ of hydrolysis.
(E) None of the above.
Ans: (C)

86. Gout is caused by high levels of uric acid. What are the possible causes?
(A) G-6-phosphatase deficiency
(B) PRPP mutation
(C) HGPRT deficiency
(D) all of the above
(E) none of the above
Ans: (D)

87. The final reduced species in the electron transport chain is _____.
(A) O_2 (B) H_2O (C) coenzyme Q (D) cytochrome c (E) none of the above
Ans: (B)

88. Which of the following statements concerning β-oxidation of fatty acids is **false**?
(A) Initiation occurs at the methyl end of the fatty acid.
(B) β-oxidation is the primary route for degradation of fatty acids.
(C) β-oxidation takes place in the mitochondrial matrix.
(D) Two-carbon units are successively eliminated with each round.
(E) None of the above.
Ans: (A)

89. Many antibiotics, especially for viruses and cancer therapy involve inhibition of folic acid reactions, especially because folic acid is essential for _____.
(A) synthesis of many amino acids
(B) conversion of uracil to thymine for DNA synthesis
(C) synthesis of deoxyribose for DNA synthesis
(D) All of these reactions above are reasons why inhibitors of folic acid act as antibiotics.
(E) None of these reactions explains the reason why inhibitors of folic acid act as antibiotics.
Ans: (B)

90. Individuals with diets high in coconut oil consume large amounts of lauric (12:0). What are the β-oxidation products of lauric acid?
(A) 6 acetyl-CoA, 6 NADH, 6 $FADH_2$
(B) 6 acetyl-CoA, 6 NADH, 5 $FADH_2$
(C) 6 acetyl-CoA, 5 NADH, 5 $FADH_2$
(D) 6 acetyl-CoA, 5 NADH, 6 $FADH_2$
(E) none of the above
Ans: (C)

國立中山大學114學年度
學士後醫學系招生考試試題

科目名稱：物理與化學

—作答注意事項—

考試時間：100分鐘

- **考試開始鈴響前，不得翻閱試題，並不得書寫、畫記、作答。請先檢查答案卡之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。**
- **答案卡請以2B鉛筆劃記，不可使用修正液（帶）塗改，未使用2B鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。**
- **答案卡應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。**
- **不可使用計算機，並不得攜帶書籍、紙張(應考證不得做計算紙書寫)、具有通訊、記憶、傳輸或收發等功能之相關電子產品或其他有礙試場安寧、考試公平之各類器材入場。**
- **試題及答案卡請務必繳回，未繳回者該科成績以零分計算。**
- **試題採雙面列印，考生應注意試題頁數確實作答。**
- **違規者依本校招生考試試場規則及違規處理辦法處理。**

國立中山大學 114 學年度學士後醫學系招生考試試題

科目名稱：物理與化學

※本科目依簡章規定「不可以」使用計算機(選擇題)

選擇題(單一選擇題，共 90 題，總分 150 分)

壹、第 1~30 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. Atmospheric pressure decreases with altitude, but not in a linear manner. It decreases according to the following formula: $P = P_0 e^{-ky}$, where the constant k is given by $k = 1.25 \times 10^{-4}\ m^{-1}$, P_0 is the atmospheric pressure at sea level, and y is the height above sea level. At what height above sea level will the atmospheric pressure be reduced to half? [ln2 = 0.69314]
   (A) 5545 m (B) 3447 m (C) 5034 m (D) 4790 m (E) 2996 m
   Ans: (A)

2. There are two tuning forks with frequencies 255 Hz and 251 Hz. When both tuning forks start vibrating, what frequency will be heard by the ear? How many times per second can a loud sound be heard?
   (A) 251 Hz, 2 times each second (B) 255 Hz, 4 times each second
   (C) 254 Hz, 3 times each second (D) 253 Hz, 4 times each second
   (E) 252 Hz, 2 times each second
   Ans: (D)

3. The method to correct hyperopia is to wear a convex lens with an appropriate focal length. Suppose a hyperopic person, at the maximum accommodation of the eye's lens (with the minimum curvature radius), can clearly see objects at a distance of 1.5 meters. What should be the focal length of the convex lens required for them to clearly see an object at a distance of 15 cm?
   (A) 14.0 cm (B) 13.5 cm (C) 22.0 cm (D) 15.0 cm (E) 16.6 cm
   Ans: (E)

4. In an adiabatic compression of an ideal gas, which of the following statements is **NOT** true?
   (A) The gas does work on its surroundings.
   (B) The internal energy of the gas increases.
   (C) The temperature of the gas increases.
   (D) The gas absorbs heat from its surroundings.
   (E) The process results in a change in the state of the gas.
   Ans: (D)

5. The method to correct myopia is to wear a concave lens with an appropriate focal length. Suppose a person has myopia, and the nearest object he/she can clearly see without the accommodation of the lens is at a distance of 45 cm. What should be the focal length of the concave lens required for the person to clearly see objects at infinity?
   (A) 22.5 cm (B) 45.0 cm (C) 90.0 cm (D) 15.0 cm (E) 60.0 cm
   Ans: (B)

6. The arterial blood pressure in the head and feet of a person standing differs from that when lying down. Suppose the difference (in magnitude) in arterial blood pressure in the head between the lying and standing positions is ΔP_1, and the difference in arterial blood pressure in the feet between these two positions is ΔP_2. Given that the density of blood is ρ and the local gravitational field strength is g, find the height of the person.
   (A) $\frac{\Delta P_1 - \Delta P_2}{2\rho g}$ (B) $\frac{\Delta P_1 + \Delta P_2}{2\rho g}$ (C) $\frac{\Delta P_1 - \Delta P_2}{\rho g}$ (D) $\frac{\Delta P_1 + \Delta P_2}{\rho g}$ (E) $\frac{\Delta P_1 \cdot \Delta P_2}{2\rho g}$
   Ans: (D)

7. If the ammeter detects a current of 10^{-8} A, how many electrons pass through the cross-section of the wire per second?
(A) 6.60×10^{10} (B) 4.25×10^{10} (C) 6.25×10^{10}
(D) 5.44×10^{11} (E) 4.98×10^{11}
Ans: (C)

8. An electrocardiogram (ECG) can detect heart activity because the heart can form an electric dipole under external stimulation. Suppose the capacitance per unit area of a cardiac myocyte (心肌細胞) is C, the total surface area of the cardiac myocyte is A, and the transmembrane voltage is V. Suppose that the thickness of the cardiac myocyte is d. What is the electric dipole moment of a single cardiac myocyte?
(A) CVAd (B) CVd (C) CVd/A (D) CV/A (E) CV
Ans: (A)

9. Nyboer theoretically discovered in 1940 that changes in impedance can be used to determine changes in the cross-sectional area of blood vessels. Impedance is the resistance of a conductor in an alternating current circuit (frequency ω). There are various substances with different resistivities within the human body, so the human body exhibits a significant capacitance. The circuit composed of resistance R and capacitance C can be divided into series and parallel configurations. In the case of resistance and capacitance in series, what is the impedance Z?
(A) $Z=\sqrt{R^2+\omega^2C^2}$ (B) $Z=\sqrt{\omega^2+\frac{1}{(RC)^2}}$ (C) $Z=\sqrt{\omega^2+(RC)^2}$
(D) $Z=\sqrt{R^2+\left(\frac{\omega}{C}\right)^2}$ (E) $Z=\sqrt{R^2+\frac{1}{(\omega C)^2}}$
Ans: (E)

10. When the observer and the sound source are stationary relative to each other, the observed frequency is f. Suppose the observer and the source are moving toward each other. If the observer's speed is 0.25v and the source's speed is also 0.25v, where v is the sound speed. What will be the observed frequency?
(A) 5f/4 (B) 3f/4 (C) 4f/3 (D) 3f/5 (E) 5f/3
Ans: (E)

11. In a scenario where a patient is sliding down a ramp during rehabilitation, and friction is present, what happens to the initial total mechanical energy?
(A) It is completely converted to kinetic energy.
(B) It is completely converted to potential energy.
(C) It remains constant.
(D) It is partially converted to thermal energy due to friction.
(E) It disappears.
Ans: (D)

12. Effectively, a nerve fiber can be considered as being composed of many individual circuits, where each circuit consists of a battery, a capacitor of capacitance C, and a resistor of resistance R connected in series which is the so-called RC circuit. What is the time constant of the RC circuit?
(A) R/C (B) 1/RC (C) RC (D) RC^2 (E) CR^2
Ans: (C)

13. High-frequency electromagnetic fields are typically used in medicine to heat internal tissues or organs of the body, such as in surgical cutting. For microwaves with a frequency of 3×10^{11} Hz, what is their wavelength? Can they be seen with the naked eye? [speed of light is 3×10^{8} m/s]
(A) 10^{-3} m; invisible (B) 10^{-3} m; visible (C) 10^{-2} m; invisible
(D) 10^{-2} m; visible (E) 10^{-4} m; invisible
Ans: (A)

14. X-rays are a commonly used electromagnetic wave in medical imaging technology. Using an X-ray tube to generate X-rays, the shortest wavelength λ_{min} that can be produced is inversely proportional to the voltage V of the tube. This relationship can be expressed by the following equation. λ_{min} = Q/V. What is the value of the constant Q in the equation? Planck constant, an electric charge, and the speed of light are denoted as h, e, and c, respectively.
(A) hc (B) e/h (C) e/(hc) (D) hc/e (E) e^2/h
Ans: (D)

15. The dimensions of stress are _____.
(A) $[M/TL]$ (B) $[M/T^2L]$ (C) $[MT/L]$ (D) $[M/L]$ (E) $[MTL]$
Ans: (B)

16. For the Arrhenius equation, $k = \exp(-E_a/RT)$, which of the following statement is **CORRECT**?
(A) The effect of an enzyme is to increase the magnitude of A.
(B) The exp $(-E_a/RT)$ term represents the fraction of molecules with a kinetic energy larger than E_a.
(C) The reaction rate k is linearly proportional to temperature T.
(D) The activation energy E_a is associated with the collision frequency of the reactants.
(E) The steric factor of reaction affects the magnitude of E_a.
Ans: (B)

17. Which of the following are state functions?
(A) work, heat, enthalpy (B) heat, enthalpy, energy (C) enthalpy, energy
(D) work, heat, enthalpy, energy (E) work, heat
Ans: (C)

18. The mass of a sample of calcium carbonate powder is measured using weight by difference. If a vial containing calcium carbonate powder has an initial mass of 87.36 ± 0.03 g and a final mass of 76.99 ± 0.03 g, what mass of calcium carbonate was taken?
(A) 10.37 ± 0.04 g (B) 10.37 ± 0.03 g (C) 10.370 ± 0.042 g
(D) 10.370 ± 0.004 g (E) 10.370 ± 0.005 g
Ans: (A)

19. Which of the following ionic compounds has (in absolute values) the largest lattice energy; that is, which has the lattice energy most favorable to a stable lattice?
(A) LiF (B) LiI (C) CsF (D) MgO (E) CsI
Ans: (D)

20. What is the key step in the Heck reaction?
(A) radical generation (B) carbocation formation
(C) palladium-catalyzed oxidative addition and reductive elimination
(D) nucleophilic substitution (E) decarboxylation
Ans: (C)

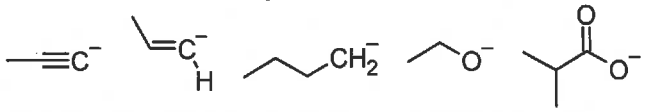
21. _____ is the upward force exerted on an object in a gaseous or liquid fluid. The mass measured by an analytical balance in air is _____ its actual mass.
(A) Buoyancy; heavier than　(B) Buoyancy; lighter than
(C) Electromagnetic force; heavier than　(D) Electromagnetic force; lighter than
(E) Tare; equal to
Ans: (B)

22. How many electrons in an atom can have the quantum numbers $n = 4$, $l = 2$?
(A) 18　(B) 32　(C) 2　(D) 6　(E) 10
Ans: (E)

23. Which of the following options shows the molecules in the order from most polar to least polar? ("=" indicates that two molecules are similarly polar)
(A) $CF_2Cl_2 > CF_2H_2 > CCl_2H_2 > CH_4 = CCl_4$
(B) $CF_2H_2 > CCl_2H_2 > CF_2Cl_2 > CH_4 = CCl_4$
(C) $CH_4 > CF_2Cl_2 > CF_2H_2 > CCl_4 > CCl_2H_2$
(D) $CF_2Cl_2 > CF_2H_2 > CCl_4 > CCl_2H_2 > CH_4$
(E) $CH_4 > CF_2H_2 > CF_2Cl_2 > CCl_4 > CCl_2H_2$
Ans: (B)

24. Lead(II) nitrate reacts with sodium chloride in aqueous solution to form a precipitate. What is the net ionic equation for the precipitation process?
(A) $Na^+(aq) + Cl^{2-}(aq) \rightarrow Na_2Cl(s)$　(B) $Na^+(aq) + NO_3^-(aq) \rightarrow NaNO_3(s)$
(C) $Pb^{2+}(aq) + 2NO_3^-(aq) \rightarrow Pb(NO_3)_2(s)$　(D) $Na^+(aq) + Cl^-(aq) \rightarrow NaCl(s)$
(E) $Pb^{2+}(aq) + 2Cl^-(aq) \rightarrow PbCl_2(s)$
Ans: (E)

25. Which of the following anions is the strongest base?



(A)　(B)　(C)　(D)　(E)
Ans: (C)

26. Polystyrene is an addition polymer of styrene. What would be the effect, if some divinylbenzene were added to styrene and then polymerized?
(A) The polymer would be more flexible. Divinylbenzene acts as a plasticizer.
(B) The polymer would be less flammable than pure polystyrene.
(C) There would be an effect, but it cannot be predicted.
(D) There would be no effect on the properties of the polymer.
(E) Divinylbenzene would act as a cross-linking agent, making the polymer stronger.
Ans: (E)


styrene


divinylbenzene

27. Which of the following quantum model is most adequate as an approximation to describe an π-electron moving in β-carotene?
(A) a particle in a one-dimensional box　(B) harmonic oscillator
(C) a freely moving particle　(D) rotation in two dimensions
(E) a rigid rotor
Ans: (A)

28. Consider the reaction $2NO_2(g) \rightarrow 2NO(g) + O_2(g)$. The concentration of NO_2 was measured to be 0.0038 mol/L after 200 s and 0.0033 mol/L after 250 s. Calculate the reaction rate for NO_2.
(A) 2.0×10^{-3} mol L^{-1} s^{-1} (B) 1.0×10^{-4} mol L^{-1} s^{-1} (C) 2.0×10^{-5} mol L^{-1} s^{-1}
(D) 2.0×10^{-4} mol L^{-1} s^{-1} (E) 1.0×10^{-5} mol L^{-1} s^{-1}
Ans: (E)

29. A liquid above the packed solid following a centrifugation is called the _____.
(A) solvonatant (B) analyte (C) serum (D) decanted (E) supernatant
Ans: (E)

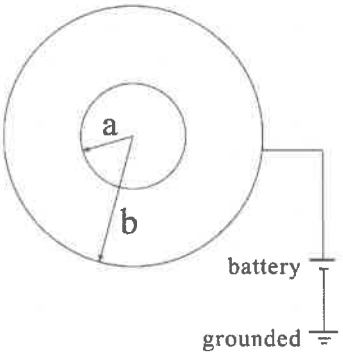
30. Which of the options below shows an **INCORRECT** chemical formula for the named compound?
(A) iron(II) oxide FeO (B) potassium sulfate K_2SO_4
(C) sodium sulfide NaS (D) zinc nitrate $Zn(NO_3)_2$
(E) calcium carbonate $CaCO_3$
Ans: (C)

貳、第 31～90 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。

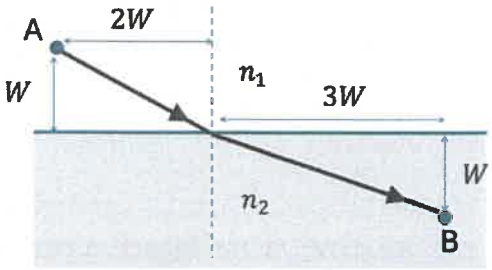
31. During the heart's beating process, the activity of cardiomyocytes generates a magnetic field in space. In 1963, Baule and others first recorded the magnetic field generated by the electrical currents in the human heart, leading to the development of magnetocardiography (MCG). Using the Biot-Savart law to estimate the magnetic field. Suppose that $I = 10^{-5}$ A is the total current generated by myocardial activity and r = 0.1 m is the distance to the measurement point, what is the order of magnitude of the magnetic field generated by the heart in T? The permeability of free space is $\mu_0 = 1.26 \times 10^{-6}$ (T·m/A).
(A) 10^{-9} T (B) 10^{-1} T (C) 10^{-12} T
(D) 10^{-5} T (E) 10^{-7} T
Ans: (C)

32. A particle moving in circular motion on a plane with a radius r has an angular momentum L and mass m. Which of the following expressions represents the centripetal force F of this circular motion?
(A) $F = mr^2L$ (B) $F = \frac{1}{2}mL^2$ (C) $F = rmL$
(D) $F = \frac{L}{mr^2}$ (E) $F = \frac{L^2}{mr^3}$
Ans: (E)

33. Two concentric conducting spheres have an inner sphere of radius a and an outer sphere of radius b. One terminal of a battery is connected to the outer sphere, while the other terminal is grounded (see **Figure**). What is the capacitance of this system?
(A) $C = 4\pi\epsilon_0(\frac{1}{a} - \frac{1}{b})$ (B) $C = 4\pi\epsilon_0(a+b)$
(C) $C = 4\pi\epsilon_0 \frac{ab}{b-a}$ (D) $C = 4\pi\epsilon_0 b$ (E) $C = 4\pi\epsilon_0 a$
Ans: (D)

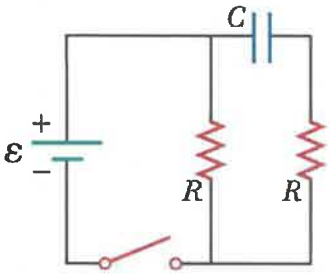


34. A beam of light traveling from point A to point B (see **Figure**) undergoes refraction as the figure shows. If the refractive indices of the top and bottom media are n_1 and n_2, respectivly, what is the ratio $\frac{n_2}{n_1}$?



(A) 2/3　(B) 3/2　(C) $\sqrt{8}/3$
(D) $3/\sqrt{8}$　(E) $\sqrt{2}/1$
Ans: (C)

35. Consider the circuit in the **Figure** and assume the battery has no internal resistance. Just after the switch is closed, what is the current in the battery?



(A) 0　(B) ε/2R　(C) 2ε/R
(D) ε/R　(E) ε/3R
Ans: (C)

36. For any given scattering angle θ, this equation

$$\lambda' - \lambda_0 = \frac{h}{m_e c}(1 - \cos\theta)$$

gives the same value for the Compton shift for any wavelength. Keeping that in mind, for which of the following types of radiation is the fractional shift in wavelength at a given scattering angle the largest?
(A) radio waves　(B) microwaves　(C) visible light
(D) x-rays　(E) infrared
Ans: (D)

37. A fancy sports car passes Big Ben at a speed of 0.600c. What time interval will the driver measure for a one-second interval on the large clock?
(A) 1.67 s　(B) 0.600 s　(C) 0.800 s　(D) 1.00 s　(E) 1.25 s
Ans: (E)

38. The correct form of the Ampère-Maxwell law is
(A) $\oint \boldsymbol{B} \cdot d\boldsymbol{s} = 0$
(B) $\oint \boldsymbol{B} \cdot d\boldsymbol{s} = I_{enclosed}$
(C) $\oint \boldsymbol{B} \cdot d\boldsymbol{s} = \mu_0 I_{enclosed}$
(D) $\oint \boldsymbol{B} \cdot d\boldsymbol{s} = \mu_0 I_{enclosed} + \mu_0 \varepsilon_0 \frac{d\Phi_E}{dt}$
(E) $\oint \boldsymbol{B} \cdot d\boldsymbol{s} = \mu_0 I_{enclosed} + \mu_0 \varepsilon_0 \frac{d\Phi_E}{dt} - \frac{\varepsilon_0}{\mu_0{}^2} \frac{d\Phi_B}{dt}$
Ans: (D)

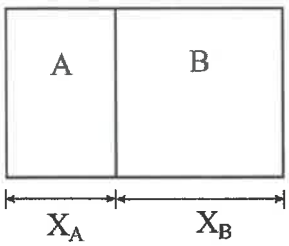
39. When a driver is traveling at a speed of v_1, they hear the frequency of a distant whistle as f_1. When they reduce their speed to v_2, the frequency of the whistle is heard as f_2. The car is moving toward the sound source. Assuming the sound source is stationary relative to the ground, what is the speed of sound?
(A) $\frac{f_2 v_1 - f_1 v_2}{f_1 - f_2}$　(B) $\frac{f_1 v_1 + f_2 v_2}{f_1 + f_2}$　(C) $\frac{f_2 v_1 - f_1 v_2}{f_1 + f_2}$　(D) $\frac{f_1 v_1 + f_2 v_2}{f_1 - f_2}$　(E) $\frac{v_1}{v_2}(f_1 + f_2)$
Ans: (A)

40. A moving hydrogen atom absorbs a photon and then comes to rest. Assume that the kinetic energy of the hydrogen atom can be neglected. Find the maximum possible wavelength of this photon. The ground state energy of the hydrogen atom is -13.6 eV. [hc=1240 eV·nm]

(A) 121.6 nm (B) 243.2 nm (C) 178.6 nm (D) 289.1 nm (E) 342.5 nm

Ans: (A)

41. As shown in the **Figure**, a partition divides the space into two sections, A and B. The molar mass of the gas in section A is 14 g, while the molar mass of the gas in section B is 32 g. Assuming the total mass of the gases in A and B is the same, what is the ratio X_A/X_B of their lengths when equilibrium is reached?



(A) 13/5 (B) 13/2 (C) 17/4 (D) 14/3 (E) 16/7

Ans: (E)

42. A parallel-plate capacitor has plates of area A = 8 m^2 and separation d = 1.5 mm. A dielectric sheet of the same area and thickness is placed between the plates. The dielectric constant is $\varepsilon = 4.2$. Determine the capacitance filled with the dielectric.

[vacuum permittivity is $\varepsilon_0 = 8.85\times10^{-12}$ C/N·m^2]

(A) 3.22×10^{-7}F (B) 1.72×10^{-7}F (C) 1.98×10^{-7}F

(D) 2.77×10^{-7}F (E) 4.20×10^{-7}F

Ans: (C)

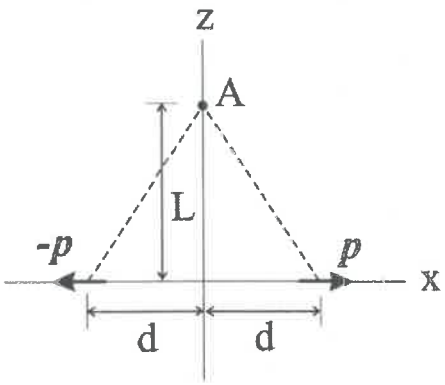
43. Suppose a coil has a magnetic dipole moment $\vec{M} = IA(\hat{i}+\hat{j})/\sqrt{2}$ and is placed in a uniform magnetic field $\vec{B} = B_0(\hat{j}-\hat{k})/\sqrt{2}$, where I and A are the current and area of the coil, respectively. What is the torque experienced by the coil? The vectors $\hat{i}, \hat{j}, \hat{k}$ are unit vectors corresponding to the x, y, and z axes, respectively.

(A) $IAB_0(2\hat{j}-\hat{k})/7$ (B) $IAB_0(\hat{i}+2\hat{j}-\hat{k})/2$ (C) $IAB_0\hat{k}$

(D) $IAB_0(-\hat{i}+\hat{j}+\hat{k})/2$ (E) $IAB_0(\hat{i}-\hat{k})/5$

Ans: (D)

44. Two electric dipoles are placed horizontally along the x-axis, but one of them is oriented in the opposite direction, as shown in the **Figure**. Both electric dipoles have the same magnitude p. What is the electric potential V at point A on the z-axis at a distance L?



(A) $V = \frac{1}{4\pi\epsilon_0}\frac{-2pd}{(d^2+L^2)^{3/2}}$ (B) $V = \frac{1}{4\pi\epsilon_0}\frac{-2pd}{(d^2+L^2)^{1/2}}$

(C) $V = \frac{1}{4\pi\epsilon_0}\frac{-pd}{(d^2+L^2)^{1/2}}$ (D) $V = \frac{1}{4\pi\epsilon_0}\frac{-pd}{(d^2+L^2)^{3/2}}$

(E) $V = \frac{1}{4\pi\epsilon_0}\frac{-4pd}{(d^2+L^2)^{3/2}}$

Ans: (A)

45. During human respiration, oxygen passes through the alveoli (肺泡) into the bloodstream. Suppose an alveolus is approximated as a sphere with a volumn $V = 4.46\times10^{-11}\ m^3$ and an internal pressure $P = 1.2\times10^5$ Pa. The oxygen content inside the alveolus is 25 %. If air is treated as an ideal gas and the human body temperature is 37 °C (310 K), what is the number N oxygen molecules in a single alveolus? [Boltzmann constant $k = 1.38\times10^{-23}$ J/K]
(A) $N = 1.89\times10^{15}$ (B) $N = 2.15\times10^{14}$ (C) $N = 1.24\times10^{15}$
(D) $N = 3.13\times10^{14}$ (E) $N = 4.71\times10^{15}$
Ans: (D)

46. The sound intensity level is defined as $L = 10\cdot\log_{10}(I/I_0)$ with the unit dB, where I is the sound intensity in units of W/m^2 and $I_0 = 10^{-12}\ W/m^2$. If a machine generates a noise level of 84 dB, what will be the noise level if an additional identical machine is turned on? [$\log_{10}2 = 0.301$]
(A) 84 dB (B) 168 dB (C) 90 dB (D) 190 dB (E) 87 dB
Ans: (E)

47. Two stars of masses *M* and 2*M* are in a binary star system, orbiting a common center of mass. Which of the following statements is true about their orbital periods?
(A) The star with mass *M* has a longer orbital period.
(B) The star with mass 2*M* has a longer orbital period.
(C) Both stars have the same orbital period.
(D) The orbital periods depend on the distance between the stars.
(E) The orbital periods are independent of the masses of the stars.
Ans: (C)

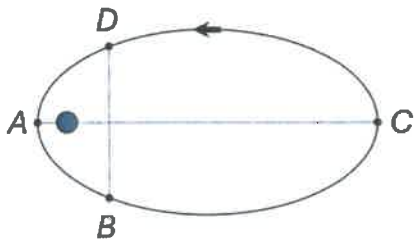
48. A sample of gas is held in a container at a constant pressure. If the volume is halved, how will the rms (root-mean-square)-speed of the molecules change compared with the original rms-speed?
(A) $\sqrt{2}$ times smaller (B) $\sqrt{2}$ times greater (C) the same
(D) 2 times greater (E) 2 times smaller
Ans: (A)

49. A person with a volume of 0.08 m^3 floats in fresh water (density = 1000 kg/m^3). What is the buoyant force acting on the person? (Assume the acceleration due to gravity g is 10 m/s^2)
(A) 8000 N (B) 800 N (C) 80 N (D) 8 N (E) 0 N
Ans: (B)

50. A steam of water with a constant flow at 1 kg/s cools a machine. The water enters the machine at 10 °C and leaves at 80 °C. How much thermal energy is removed every minute? The specific heat capacity of water is 4.186 kJ/kg·K.
(A) 17.6 MJ (B) 15.1 MJ (C) 251.2 kJ (D) 25.1 kJ (E) 2.5 MJ
Ans: (A)

51. A hot object at temperature 500 K is moved to contact with a cool object at 300 K, and a heat of 50 kJ flows irreversibly from one to the other. Assume that neighter object changes its temperature. How much is the entropy of the universe changed?
(A) 1000 J/K (B) 40 MJ/K (C) 66.7 J/K
(D) 62.5 J/K (E) none of the above
Ans: (C)

52. The **Figure** shows a planet moving about the sun in an elliptical orbit. Its speeds at the following four points shown in the **Figure** are v_A, v_B, v_C, and v_D, repsectively. Which of the following statement is correct?



(A) $v_A > v_B > v_C > v_D$
(B) $v_A < v_B < v_C < v_D$
(C) $v_A > v_B = v_D > v_C$
(D) $v_A < v_B = v_D < v_C$
(E) none of the above
Ans: (C)

53. A patient is undergoing radiation therapy. A radioactive isotope decays and emits an α particle with an initial velocity of 2×10^7 m/s. The α particle is slowed down by the Coulomb force from a nearby nucleus, experiencing a deceleration of 5×10^{14} m/s². How far will the α particle travel before coming to a stop?
(A) 0.1 meters (B) 0.2 meters (C) 0.3 meters
(D) 0.4 meters (E) 0.5 meters
Ans: (D)

54. A patient's prosthetic leg, weighing 5 kg, is sliding across the floor with a coefficient of kinetic friction of 0.2. What is the force of friction acting against the leg? ($g = 9.8 m/s^2$)
(A) 9.8 N (B) 1 N (C) 49 N (D) 1.96 N (E) 245 N
Ans: (A)

55. How long will it take for an oscillator at a frequncy of 2.5 Hz to make 100 vibrations?
(A) 250 s (B) 40 s (C) 25 s (D) 4 s (E) 0.025 s
Ans: (B)

56. Cobalt $^{60}_{27}Co$ has a half-life of 5 years. If there was sample of that isotope with an initial mass of 240 g, how much of the sample remains after 30 years?
(A) 30 g (B) 15 g (C) 7.5 g (D) 3.75 g (E) 0.89 g
Ans: (D)

57. Unpolarized light of the intensity I_0 passes through two polaroids. The axis of the first polaroid is vertical. The second polariod is at 30° to the vertical. Find the intensity of the transmitted light.
(A) $(3/4)I_0$ (B) $(3/8)I_0$ (C) $(1/4)I_0$ (D) $(1/8)I_0$ (E) $(1/2)I_0$
Ans: (B)

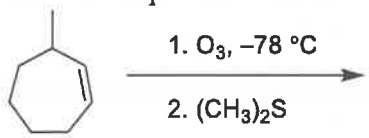
58. The following equation shows the decay process of uranium-238 through the emission of an α-particle: $^{238}_{92}U \rightarrow {}^{A}_{Z}X + {}^{4}_{2}He$. Which of the following is the element X?
(A) $^{234}_{90}Th$ (B) $^{206}_{80}Pb$ (C) $^{210}_{82}Po$ (D) $^{104}_{51}Sb$ (E) $^{81}_{35}Br$
Ans: (A)

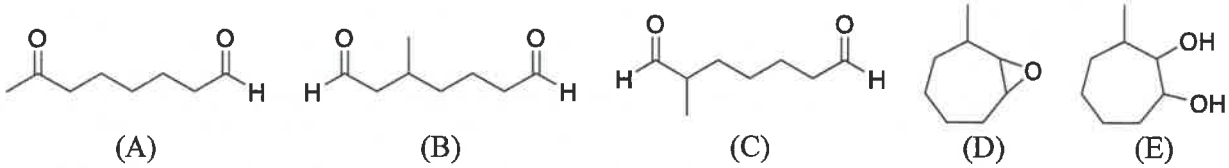
59. Suppose a healthy bone can withstand compressive stress of 181 N/mm² before breaking. If the cross-sectional area of the bone is 3.2 cm², how much weight (in kg) can it support? (gravitational acceleration $g = 9.8 m/s^2$)
(A) 2790 kg (B) 3240 kg (C) 5910 kg (D) 2072 kg (E) 4790 kg
Ans: (C)

60. The light intensity incident on a metallic surface produces photoelectrons with a maximum kinetic energy of 2 eV. The light intensity is doubled. Determine the maximum kinetic energy of the photoelectrons (in eV).
(A) 4 eV (B) 2 eV (C) $\sqrt{2}$ eV (D) 1 eV (E) 8 eV
Ans: (B)

61. Arrange the steps below in the order required to perform a Kjeldahl Nitrogen Analysis.
I Distillation of ammonia into standard hydrochloric acid.
II Neutralize ammonium to release ammonia.
III Digest the organic sample with boiling sulfuric acid to convert nitrogen to ammonium.
IV Titrate unreacted standard hydrochloric acid with sodium hydroxide.
(A) III, II, I, IV (B) II, I, IV, III (C) I, IV, III, II (D) IV, III, II, I (E) III, I, IV, II
Ans: (A)

62. What is the product of the following reaction?





(A) (B) (C) (D) (E)
Ans: (C)

63. Stray light is a problem for spectrophotometers that are not tightly sealed. What is the main impact of stray light on the recorded absorbance?
(A) The apparent absorbance is greater than the true absorbance and increases as the amount of stray light increases.
(B) The apparent absorbance is greater than the true absorbance and decreases as the amount of stray light increases.
(C) The apparent absorbance is less than the true absorbance and increases as the amount of stray light decreases.
(D) The apparent absorbance is less than the true absorbance and decreases as the amount of stray light decreases.
(E) It is impossible to determine effect of stray light on measured absorbance.
Ans: (C)

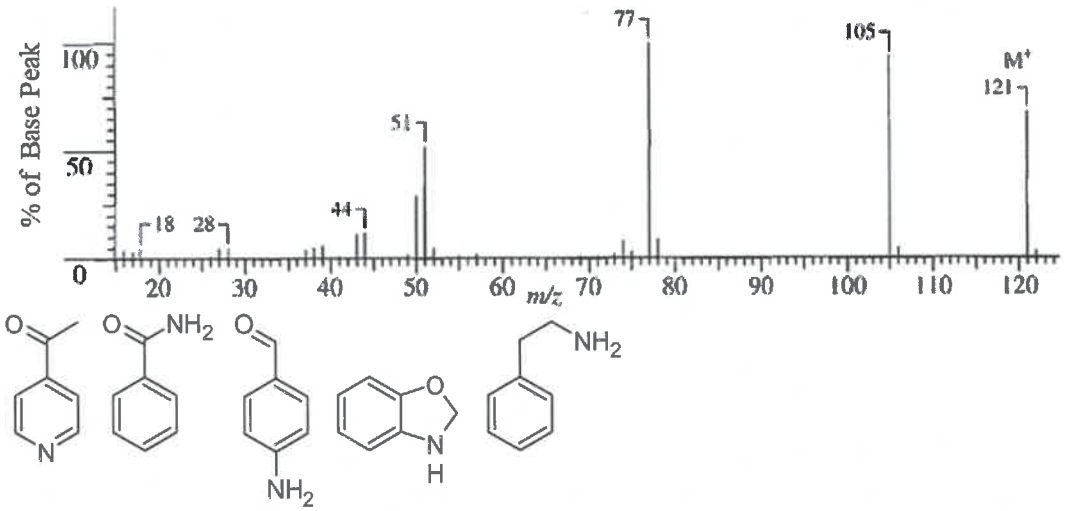
64. How many unpaired electrons are there in an atom of oxygen in its ground state?
(A) 1 (B) 2 (C) 4 (D) 0 (E) 3
Ans: (B)

65. A crystal of NaCl is _____ .
(A) hard, high-melting, and a poor electrical conductor
(B) hard, high-melting, and a good electrical conductor
(C) soft, low-melting, and a good electrical conductor
(D) soft, high-melting, and a poor electrical conductor
(E) soft, low-melting, and a poor electrical conductor
Ans: (A)

66. Which of the following chemical or physical changes is an endothermic process?
(A) the evaporation of water　(B) the mixing of sulfuric acid and water
(C) the freezing of water　(D) the combustion of gasoline
(E) none of the above
Ans: (A)

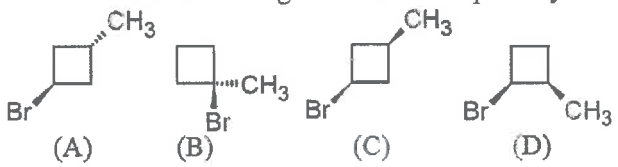
67. The _____ is the electrode at which the reaction of interest occurs.
(A) auxillary electrode　(B) counter electrode　(C) anode
(D) cathode　(E) working electrode
Ans: (E)

68. Which of the shown molecules fits the fragmentation pattern of the mass spectrum below the best?



(A)　(B)　(C)　(D)　(E)
Ans: (B)

69. Which of the following molecules is optically active?



(A)　(B)　(C)　(D)　(E) none of the above
Ans: (D)

70. Rank the following compounds according to increasing solubility in water.
I　$CH_3–CH_2–CH_2–CH_3$　　II　$CH_3–CH_2–O–CH_2–CH_3$
III　$CH_3–CH_2–OH$　　IV　$CH_3–OH$
(A) I < II < IV < III　(B) I < III < IV < II
(C) I < II < III < IV　(D) III < IV < II < I
(E) None of the above is correct.
Ans: (C)

71. Nitrogen gas (N_2) reacts with hydrogen gas (H_2) to form ammonia (NH_3). At 200°C in a closed container, 1.2 atm of nitrogen gas is mixed with 2.3 atm of hydrogen gas. At equilibrium, the total pressure is 2.1 atm. Calculate the partial pressure of hydrogen gas at equilibrium.
(A) 2.3 atm (B) 0.0 atm (C) 1.8 atm (D) 0.20 atm (E) 0.92 atm
Ans: (D)

72. The corrosion of which transition metal results in a characteristic green patina?
(A) lead (B) copper (C) chromium (D) silver (E) iron
Ans: (B)

73. EDTA is an example of a(n) _____ ligand.
(A) hexadentate (B) bidentate (C) octadentate (D) tetradentate (E) tridentate
Ans: (A)

74. When a molecule absorbs a photon, the molecule is promoted to an excited state M^*. The rate at which M^* is created is proportional to the concentration of M. There are three pathways that M^* may take to return to the ground state. Which statement about these three pathways below is wrong?
(A) The rate at which the excited state returns to the ground state is independent of the pathway to the ground state and the concentration of excited state molecules.
(B) The three possible pathways to return to the ground state are emission, deactivation, and quenching.
(C) Quenching occurs when a second molecule, the quencher Q, collides with M^* and energy is transferred from M* to Q: $M^* + Q \rightarrow M + Q^*$.
(D) Deactivation returns M^* to the ground state by colliding with other molecules and releasing energy in the form of heat: $M^* \rightarrow M + \text{heat}$.
(E) Emission returns M^* to the ground state by emitting a photon: $M^* \rightarrow M + h\nu$.
Ans: (A)

75. A novel analytical method named _____ may enhance the fluorescence of immunoassays by a factor of 100 by measuring the fluorescence of Eu^{3+} 200 μs after excitation with a laser pulse.
(A) time-resolved fluorescence immunoassay
(B) time-dependent fluorescence immunoassay
(C) immunoassay fluorescence over time immunoassay
(D) weakly bound time fluorescence immunoassay
(E) europium-bound fluorescence immunoassay
Ans: (A)

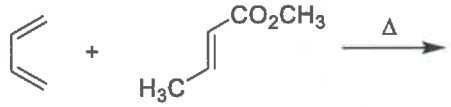
76. Given that S = 131 J/K · mol for $H_2(g)$, estimate the value of $\Delta S°$ for the reaction: $Ti(s) + H_2(g) \rightarrow TiH_2(s)$
(A) 0 J/K (B) 131 J/K (C) –131 J/K (D) 262 J/K (E) –262 J/K
Ans: (C)

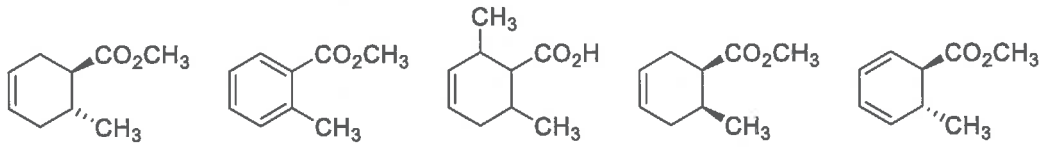
77. Which of the following exhibits the correct (increasing) orders for the atomic radius r and the ionization energy (IE), respectively?
(A) r: F < S < O, IE: O < S < F (B) r: F < O < S, IE: S < O < F
(C) r: S < O < F, IE: F < O < S (D) r: S < F < O, IE: S < F < O
(E) none of the above
Ans: (B)

78. The entropy change of a system (ΔS) is_____ for exothermic reactions and _____ for endothermic reactions.
(A) unfavorable, unfavorable (B) favorable, unfavorable (C) favorable, favorable
(D) unfavorable, favorable (E) none of the above
Ans: (E)

79. Using a 400 MHz ^{1}H NMR instrument, if a hydrogen atom shows a quartet at δ = 4.06, 4.03, 4.00, 3.97 ppm, please calculate it's coupling constant. And where will this triplet peak shows up at a 600 MHz ^{1}H NMR instrument?
(A) 12 Hz; δ: 4.035, 4.015, 3.995, 3.975 ppm (B) 12 Hz; δ: 4.045, 4.025, 4.005, 3.985 ppm
(C) 12 Hz; δ: 4.025, 4.005, 3.985, 3.965 ppm (D) 6 Hz; δ: 4.045, 4.025, 4.005, 3.985 ppm
(E) 6 Hz; δ: 4.035, 4.015, 3.995, 3.975 ppm
Ans: (B)

80. What is the product of the following reaction?





(A) (B) (C) (D) (E)
Ans: (A)

81. There are many types of noise in instrumental analysis. Which of the following descriptions about the different noise types is **INCORRECT**?
(A) line noise – noise that occurs at discrete frequencies
(B) drift noise – low frequency noise caused by flickering or drifting of light intensity
(C) Gaussian noise – noise amplitude is dependent on frequency
(D) Johnson noise – random fluctuations of electrons in electronic devices
(E) shot noise – noise that arises from random variation in the number of photons reaching the detector or small number of electrons and holes generated in a semiconductor
Ans: (C)

82. One of the optical components of a spectrophotometer that selects the wavelength to irradiate the sample can be called the _____.
(A) polychromator (B) monochromator (C) beam splitter
(D) light source (E) optode
Ans: (B)

83. What is the key functional group present in penicillins that is essential for their antibacterial activity?
(A) amide (B) carboxyl group (C) β-lactam ring
(D) ether (E) thiophene group
Ans: (C)

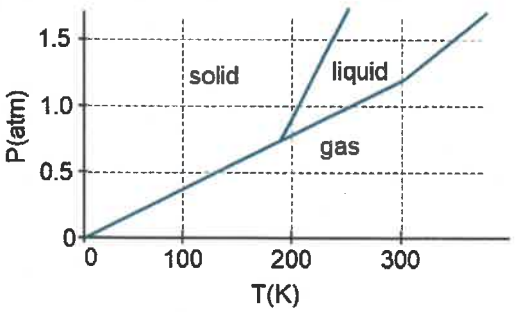
84. Indium has atomic number 49 and atomic mass 114.8 g. Naturally occurring indium contains a mixture of indium-112 and indium-115 in an atomic ratio of approximately_____.
(A) 25/75 (B) 75/25 (C) 50/50 (D) 94/6 (E) 6/94
Ans: (E)

85. The OH radical disproportionates according to the elementary chemical reaction $OH + OH \rightarrow H_2O + O$. This reaction is second order in OH. The rate constant for the reaction is 2.1×10^{-12} cm^3/molecule·s at room temperature. If the initial OH concentration is 1.6×10^{13} molecules/cm^3, what is the first half-life for the reaction?
(A) 3.3×10^{11} s (B) 0.030 s (C) 3.8×10^{24} s (D) 3.9 s (E) 6.0 s
Ans: (B)

86. The equilibrium process $CaCO_3 \leftrightharpoons Ca^{2+} + CO_3^{2-}$ can be split into several equilibrium processes to give a more complete picture of calcium carbonate's solubility. Which of the following equilibrium equations does not play a role for calcium carbonate's solubility?
(A) $CO_3^{2-} + H_2O \leftrightharpoons HCO_3^- + OH^-$ $K_1=[HCO_3^-][OH^-]/[CO_3^{2-}]$
(B) $HCO_3^- + H_2O \leftrightharpoons H_2CO_3 + OH^-$ $K_2=[H_2CO_3][OH^-]/[HCO_3^-]$
(C) $Ca^{2+} + H_2O \leftrightharpoons CaOH^+ + H^+$ $K_3=[CaOH^+][H^+]/[Ca^{2+}]$
(D) $Ca^{2+} + CO_3^{2-} \leftrightharpoons CaCO_3$ $K_4=[CaCO_3]/\{[Ca^{2+}][CO_3^{2-}]\}$
(E) $Ca^{2+} + H^+ \leftrightharpoons CaH^{3+}$ $K_5=[CaH^{3+}]/\{[Ca^{2+}][H^+]\}$
Ans: (E)

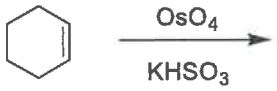
87. For the reaction, $CO_2(g) + 2H_2O(g) \rightarrow CH_4(g) + 2O_2(g)$, $\Delta H^\circ = 803$ kJ, which of the following will increase K?
(A) increasing the temperature of system
(B) decreasing the number of moles of methane
(C) increasing the volume of system
(D) increasing the number of moles of CO_2
(E) none of the above
Ans: (A)

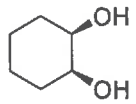
88. The **Figure** on the right shows the phase diagram for a compound X. You wish to purify a sample of X that was collected at P = 1.0 atm and T = 100 by subliming it. In order to sublime the sample, you should _____.
(A) increase T to 300 K and then lower P to 0.5 atm
(B) abandon the attempt to sublime X
(C) lower P to 0.5 atm and then increase T to 200 K
(D) increase P to 1.5 atm and then increase T to 300 K
(E) increase T to 300 K, keeping P = 1.0 atm
Ans: (C)



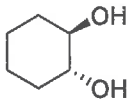
89. How many of the following electron configurations for the species in their ground state are correct?
Ca $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ V [Ar] $3s^2 3d^3$ P $1s^2 2s^2 2p^6 3p^5$
Br $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$ As [Ar] $4s^2 3d^{10} 4p^2$
(A) 1 (B) 2 (C) 3 (D) 4 (E) none
Ans: (E)

90. What is the product of the following reaction?

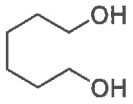




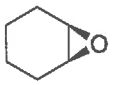
(A)



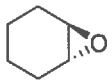
(B)



(C)



(D)



(E)

Ans: (A)

國立中山大學114學年度
學士後醫學系招生考試試題

科目名稱：計算機概論與程式設計

—作答注意事項—

考試時間：100分鐘

- **考試開始鈴響前，不得翻閱試題，並不得書寫、畫記、作答。**請先檢查答案卡之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- 答案卡請以**2B**鉛筆劃記，不可使用修正液（帶）塗改，未使用2B鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。
- 答案卡應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- **不可使用計算機，並不得攜帶書籍、紙張(應考證不得做計算紙書寫)、具有通訊、記憶、傳輸或收發等功能之相關電子產品或其他有礙試場安寧、考試公平之各類器材入場。**
- **試題及答案卡請務必繳回，未繳回者該科成績以零分計算。**
- **試題採雙面列印，考生應注意試題頁數確實作答。**
- **違規者依本校招生考試試場規則及違規處理辦法處理。**

國立中山大學114學年度學士後醫學系招生考試試題

科目名稱：計算機概論與程式設計

※本科目依簡章規定「不可以」使用計算機(選擇題)

選擇題(單一選擇題，共 50 題，總分 150 分)

【單選題】每題 3 分，答錯 1 題倒扣 0.75 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。

1. Let $G = (V, E)$ be a weighted undirected graph, where $V = \{1, 2, 3, 4\}$ and $w(i, j)$ denotes the weight of edge $(i, j) \in E$. Suppose that $w(1, 2) = 5$, $w(1, 3) = 6$, $w(2, 3) = 7$, $w(2, 4) = 8$, $w(3, 4) = 9$, and $w(1, 4) = 10$. What is the total weight of the minimum spanning tree of G?
   (A) 18
   (B) 19
   (C) 20
   (D) 21
   (E) 22

   Ans: **(B)**

2. Which of the following statements is true about Branch Prediction in modern processors?
   (A) Branch prediction eliminates all the need for pipeline stalls.
   (B) Branch prediction always guarantees correct predictions for all branches in a program.
   (C) Static branch prediction is more effective than dynamic branch prediction.
   (D) Branch prediction boosts performance by speculatively executing instructions before branch resolution.
   (E) Branch prediction does not apply to out-of-order execution.

   Ans: **(D)**

3. What is the function of the SQL GROUP BY clause?
   (A) To change the order of query results
   (B) To filter records based on conditions
   (C) To aggregate data into groups based on specified columns
   (D) To remove duplicate rows from a query result
   (E) None of the above

   Ans: **(C)**

4. Which file system is optimized for storing high-resolution MRI images?
   (A) FAT32
   (B) NTFS
   (C) Ext4
   (D) ZFS
   (E) HDFS

   Ans: **(D)**

5. What is the purpose of a DNS server in a network?
   (A) Assign IP addresses to devices.
   (B) Translate domain names into IP addresses.
   (C) Check whether the data are transmitted correctly.
   (D) Encrypt data sent over the network.
   (E) Monitor network bandwidth usage.
   Ans: **(B)**

6. What is printed by the following C program?

```
int k = 18;
printf("%d \n", k | (-k));   //   |  is bitwise OR
```

(A) 0
(B) 1
(C) -1
(D) 2
(E) -2

Ans: (E)

7. What does ACID stand for in database transactions?
(A) Aggregation, Control, Integrity, Data
(B) Atomicity, Consistency, Isolation, Durability
(C) Access, Caching, Indexing, Deletion
(D) All of the above
(E) None of the above

Ans: (B)

8. Which of the following best describes the behavior of `std::vector`?
(A) The size of a `std::vector` is always equal to its capacity.
(B) `std::vector` can only store objects that have a default constructor.
(C) The `push_back` function always has $O(1)$ time complexity.
(D) The `reserve()` function changes the vector's size.
(E) The `std::vector` container provides contiguous storage, making it compatible with C-style arrays.

Ans: (E)

9. The sequence 46, 45, 48, 42, 41 is inserted sequentially into an AVL tree. Suppose the root is at level 1, and the level of each lower node increases by 1. Which one is correct?
(A) 42 is at level 2, and 42 is the left child of 46.
(B) 41 is at level 4, and 41 is the left child of 42.
(C) 45 is at level 3, and 45 is the left child of 46.
(D) 48 is at level 2, and 48 is the right child of 45.
(E) 45 is at level 2, and 45 is the right child of 42.

Ans: (A)

10. What is the main purpose of using ensemble learning in medical AI?
(A) To combine multiple models for better prediction accuracy
(B) To train models faster
(C) To increase overfitting
(D) To reduce the number of required data samples
(E) All of the above

Ans: (A)

11. What is printed by the following C program?

```
int f(int &x, int y) {
   x = y * 2;   y = x + 3;   return (x+y);
}
int main( ) {
   int a = 4, b = 1;   printf("%d  %d  %d \n", f(a,b), a, b);
}
```

(A) 7 2 1
(B) 7 2 5
(C) 5 4 1
(D) 7 4 1
(E) 9 2 7

Ans: (**A**)

12. Which type of neural network is most suitable for analyzing sequential medical data?
(A) Convolutional Neural Network (CNN)
(B) Feedforward Neural Network
(C) K-Nearest Neighbors (KNN)
(D) Recurrent Neural Network (RNN)
(E) None of the above

Ans: (**D**)

13. What is the time complexity of merging two sorted lists of patient IDs?
(A) $O(n)$
(B) $O(n\log n)$
(C) $O(n^2)$
(D) $O(1)$
(E) $O(\log n)$

Ans: (**A**)

14. Which of the following statements is true about Real-time Transport Protocol (RTP)?
(A) RTP provides end-to-end delivery services for real-time data such as audio and video.
(B) RTP guarantees in-order delivery.
(C) RTP is a transport-layer protocol that runs directly on top of IP.
(D) RTP is responsible for media synchronization and bandwidth control.
(E) RTP is used exclusively in circuit-switched networks and not in packet-switched networks.

Ans: (**A**)

15. What graph algorithm optimizes ambulance routes for minimal travel time?
(A) Depth-First Search
(B) Dijkstra's Algorithm
(C) Kruskal's Algorithm
(D) Apriori Algorithm
(E) Bubble Sort

Ans: **(B)**

16. Which optimization algorithm is commonly used to minimize loss in deep learning models?
(A) Gradient Descent
(B) K-means
(C) Support Vector Machines
(D) Decision Trees
(E) None of the above

Ans: **(A)**

17. What is the purpose of a UPS in a hospital server room?
(A) Speed up data processing
(B) Prevent data loss during power outages
(C) Encrypt backups
(D) Cool servers
(E) Block malware

Ans: **(B)**

18. What is the correct order of the following layers in the TCP/IP model from top to bottom?
1. internet layer　2. transport layer　3. application layer　4. data link layer
(A) 2, 3, 1, 4
(B) 3, 2, 1, 4
(C) 2, 3, 4, 1
(D) 3, 2, 4, 1
(E) 3, 1, 2, 4

Ans: **(B)**

19. What is printed by the following C program?

```
int x = 6;   int y = 23;   int z = ++x + y--;
printf("%d  %d  %d\n", x, y, z);
```

(A) 6 22 29
(B) 6 23 29
(C) 7 22 29
(D) 7 22 30
(E) 7 23 29

Ans: **(D)**

20. In SQL, which statement is used to remove all records from a table but keep the structure?
(A) TRUNCATE TABLE
(B) DROP TABLE
(C) DELETE FROM
(D) ALTER TABLE
(E) None of the above

Ans: (**A**)

21. What is the purpose of Huffman code?
(A) To increase data transmission speed
(B) To provide an encryption mechanism
(C) To enhance video quality
(D) To provide an error detection mechanism
(E) To reduce data storage space

Ans: (**E**)

22. How do diffusion models contribute to medical AI?
(A) By replacing CNN-based classifiers
(B) By eliminating the need for labeled datasets
(C) By improving image quality through denoising
(D) By increasing model interpretability
(E) All of the above

Ans: (**C**)

23. Which of the following is true regarding the Merge Sort algorithm?
(A) Merge Sort has the worst-case time complexity of $O(n^2)$.
(B) Merge Sort is a stable sorting algorithm.
(C) Merge Sort is an in-place sorting algorithm.
(D) Merge Sort is best suited for linked lists but inefficient for arrays.
(E) Merge Sort is an adaptive algorithm that improves performance when the input is nearly sorted.

Ans: (**B**)

24. Which one is NOT correct for an **NP**-complete problem?
(A) It has no solutions.
(B) It can be verified in polynomial time.
(C) Every **NP** problem can be reduced to an **NP**-complete problem.
(D) It can be solved in polynomial time if **P** = **NP**.
(E) It is **NP**-hard.

Ans: (**A**)

25. The sequence 29, 28, 23, 26, 27 is inserted sequentially into a min-heap, where the root stores the minimum value. Suppose the root is at level 1, and the level of each lower node increases by 1. Which one is correct?
(A) 27 is at level 2, and 27 is the right child of 26.
(B) 28 is at level 2, and 28 is the right child of 23.
(C) 29 is at level 2, and 29 is the left child of 23.
(D) 27 is at level 3, and 28 is the right child of 27.
(E) 26 is at level 2, and 27 is the left child of 26.

Ans: **(B)**

26. The input sequence 4, 8, 2, 5, 1 is sorted in increasing order using the bubble sort algorithm. How many swap (exchange) operations are performed?
(A) 4
(B) 5
(C) 6
(D) 7
(E) 8

Ans: **(D)**

27. Why is federated learning important for medical AI?
(A) It increases training speed by using only local datasets.
(B) It enables AI models to learn from decentralized patient data without sharing sensitive information.
(C) It eliminates the need for model validation.
(D) It simplifies neural network architecture.
(E) All of the above.

Ans: **(B)**

28. The following four statements describe a Hamiltonian circuit in a graph:
1. The graph has a Hamiltonian circuit if it is a complete graph.
2. The Hamiltonian circuit decision problem is **NP**-complete.
3. The Hamiltonian circuit problem is a special case of the traveling salesperson problem.
4. In a Hamiltonian circuit, each edge is visited exactly once.

Which one is correct?
(A) 1 and 4 are correct.
(B) 2 and 4 are correct.
(C) 1 and 2 are correct.
(D) 3 is correct, 2 is not correct.
(E) 4 is correct, 2 is not correct.

Ans: **(C)**

29. What is the main purpose of indexing in databases?
(A) To store metadata
(B) To increase disk usage
(C) To reduce the need for joins
(D) To speed up query execution
(E) None of the above

Ans: (**D**)

30. Which of the following statements is true regarding C++ Standard Template Library (STL) containers?
(A) `std::map` allows duplicate keys.
(B) `std::unordered_map` has faster lookups than `std::map` for large datasets.
(C) `std::vector` provides $O(1)$ complexity for inserting elements in the middle of a container.
(D) `std::set` guarantees insertion order.
(E) `std::list` is more memory efficient than `std::vector`.

Ans: (**B**)

31. Which of the following best describes the role of Backpropagation in neural networks?
(A) Backpropagation is a data preprocessing technique that normalizes inputs before training.
(B) Backpropagation is only applicable to convolutional neural networks (CNNs).
(C) Backpropagation finds the optimal hyperparameters for a neural network.
(D) Backpropagation occurs before training starts.
(E) Backpropagation uses the chain rule to compute gradients and update weights.

Ans: (**E**)

32. In a hospital scheduling system, which process scheduling algorithm minimizes patient wait times for urgent surgeries?
(A) FCFS
(B) Round Robin
(C) Priority Preemptive
(D) Shortest Job First
(E) Multilevel Feedback Queue

Ans: (**C**)

33. Which traversal method prints hospital room numbers in ascending order from a binary search tree?
(A) Pre-order
(B) Post-order
(C) In-order
(D) Level-order
(E) Reverse Post-order

Ans: (**C**)

34. What is NOT true for a stack?
(A) A stack works in the Last In, First Out (LIFO) mechanism.
(B) The push operation adds an element to the top of the stack.
(C) A stack can be efficiently accessed at any index.
(D) Stacks can be implemented by a linked list.
(E) A stack can be used for function call management in recursion.

Ans: **(C)**

35. Which of the following statements is true about the Rivest-Shamir-Adleman (RSA) cryptosystem?
(A) RSA relies on the difficulty of solving the Discrete Logarithm Problem (DLP).
(B) The security of RSA is based on the assumption that prime numbers are difficult to find.
(C) RSA decryption and signing use the private key, while encryption and verification use the public key.
(D) RSA is immune to timing attacks and other side-channel attacks.
(E) RSA can be implemented using Elliptic Curve Cryptography (ECC).

Ans: **(C)**

36. In supervised learning, what does the loss function measure?
(A) The complexity of the model
(B) The difference between predicted and actual values
(C) The number of neurons used in a network
(D) The dataset size
(E) None of the above

Ans: **(B)**

37. Which activation function is commonly used in deep learning for binary classification?
(A) ReLU
(B) Softmax
(C) Sigmoid
(D) Tanh
(E) None of the above

Ans: **(C)**

38. Which sorting algorithm has a time complexity of $O(n\log n)$ in the worst case?
(A) Bubble sort
(B) Shell sort
(C) Insertion sort
(D) Selection sort
(E) Heap sort

Ans: **(E)**

39. What is the purpose of the Transport Layer in the TCP/IP model?
(A) Compress data to improve transmission efficiency.
(B) Encapsulate data with addresses and ensure proper packet routing.
(C) Provide application layer services such as HTTP and FTP.
(D) Establish a physical connection between devices.
(E) Split data into packets and ensures reliable end-to-end transmission.

Ans: (**E**)

40. In federated learning for hospital data privacy, what is shared across institutions?
(A) Raw patient data
(B) Trained model parameters
(C) Database schemas
(D) Encryption keys
(E) Hardware resources

Ans: (**B**)

41. What is the correct order of access time from slowest to fastest?
(A) Disk, RAM, Cache, Register
(B) Disk, RAM, Register, Cache
(C) Disk, Cache, RAM, Register
(D) RAM, Disk, Cache, Register
(E) RAM, Disk, Register, Cache

Ans: (**A**)

42. What is printed by the following C program?

```
int a = 12, b = -2;
printf("%d  \n", a & b);     // & is bitwise AND
```

(A) 0
(B) 1
(C) -2
(D) 12
(E) -24

Ans: (**D**)

43. Which technique reduces noise in EEG signal data while preserving critical waveforms?
(A) Fourier Transform
(B) High-pass Filtering
(C) Huffman Encoding
(D) Run-Length Encoding
(E) Checksum Calculation

Ans: (**A**)

44. What is printed by the following C program?

```
int a = 17, b = -2;
printf("%d  \n", (a + b) >> 2);
```

(A) 0
(B) 1
(C) 2
(D) 3
(E) 15

Ans: **(D)**

45. Which machine learning technique is commonly used for anomaly detection in medical imaging?
(A) Decision Trees
(B) K-Means Clustering
(C) Autoencoders
(D) Naive Bayes
(E) None of the above

Ans: **(C)**

46. In the ASCII code, 'A' is encoded as decimal 65. What is the ASCII code of 'W'?
(A) 87
(B) 88
(C) 89
(D) 90
(E) 91

Ans: **(A)**

47. What is the primary advantage of using reinforcement learning in personalized treatment plans?
(A) It eliminates the need for human intervention.
(B) It adapts treatment strategies based on patient responses.
(C) It always increases accuracy.
(D) It reduces computational cost.
(E) None of the above.

Ans: **(B)**

48. Why is transfer learning beneficial in medical AI?
(A) Eliminates bias in datasets
(B) Requires no additional training
(C) Only applies to text-based AI
(D) Reduces training time and data requirements
(E) None of the above

Ans: **(D)**

49. What is printed by the following C/C++ program?

```
int a[]={3, -5, 2, -7, -3, 4, 3};
int n=0;
for (int i = 0; i < 7; i++) {
   if (a[i] > 0)
      n += a[i];
}
cout << n;
```

(A) -3
(B) 0
(C) 4
(D) 7
(E) 12

Ans: (**E**)

50. What is the purpose of batch normalization in deep learning?
(A) To increase model depth
(B) To stabilize and speed up training
(C) To reduce model size
(D) To improve model interpretability
(E) None of the above

Ans: (**B**)

國立中山大學114學年度
學士後醫學系招生考試試題

科目名稱：英文

—作答注意事項—

考試時間：80分鐘

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- **試題及答案卡請務必繳回，未繳回者該科成績以零分計算。**
- **試題採雙面列印，考生應注意試題頁數確實作答。**
- **違規者依本校招生考試試場規則及違規處理辦法處理。**

國立中山大學114學年度學士後醫學系招生考試試題

科目名稱：英文

※本科目依簡章規定「不可以」使用計算機(選擇題)

選擇題(單一選擇題，共 50 題，總分 100 分)

【單選題】每題 2 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。

I. Please choose the most suitable answer for each question.

1. The doctors said that the patient _____ his vaccine booster to avoid catching the flu. As a result, his recovery took longer than expected.
   (A) should have had
   (B) must have
   (C) was having
   (D) having had
   Ans: (A)

2. What does "vital signs" refer to in a medical context?
   (A) indicators such as heart rate, blood pressure, and temperature
   (B) signs of terminal illness
   (C) early symptoms of a disease
   (D) medical test results
   Ans: (A)

3. The phrase "double-blind study" in medical research means the fact that _____
   (A) only the researchers know which patients received treatment.
   (B) neither the patients nor the researchers know who received the treatment.
   (C) patients know whether they received the treatment, but the researchers do not.
   (D) the study is conducted without a placebo group.
   Ans: (B)

4. The phrase "correlation does not imply causation" is important in medical research because _____
   (A) it warns against assuming a direct cause-and-effect relationship between two variables.
   (B) it means that correlation always leads to causation.
   (C) it confirms that variables affecting each other must have a causal link.
   (D) it states that only controlled experiments can establish any relationship.
   Ans: (A)

5. The phrase "placebo-controlled" in clinical trials means the fact that _____
   (A) the treatment is given to all participants.
   (B) the patients receive treatment only when needed.
   (C) the study does not use a control group.
   (D) the control group receives an inactive substance instead of the real treatment.
   Ans: (D)

6. Which of the following would be considered an example of "triage" in an emergency setting?
   (A) treating only life-threatening conditions and ignoring minor injuries
   (B) giving the same level of care to all patients regardless of urgency
   (C) prioritizing patients based on the severity of their condition
   (D) conducting detailed diagnostic tests before attending to emergency patients
   Ans: (C)

7. The term "contraindication" refers to _____.
(A) a condition that supports the use of a particular drug
(B) a condition that makes a treatment inadvisable
(C) a medical condition with no known cure
(D) the primary cause of a disease
Ans: (B)

8. Due to the increasing number of flu cases, that hospital is now accepting 1.5 times more emergency patients than usual. In some cases, older adults and those with chronic diseases are being hospitalized long-term there. Its _____ of about 550 beds is currently under strain.
(A) opacity
(B) activity
(C) capacity
(D) incapacity
Ans: (C)

9. A common symptom of iron deficiency anemia is _____, a condition where the patient experiences a craving for non-nutritive substances like ice, dirt, or paper.
(A) cachexia
(B) dysphagia
(C) pica
(D) jaundice
Ans: (C)

10. An experimental trial of gene therapy at an early age has helped four _____ born blind gain improvements to their sight, according to doctors at Moorfield Eye Hospital in London and further work presented in a study in *The Lancet* in February, 2025. The participants are children aged 1 to 3 years with rare and aggressive eye conditions before the therapy.
(A) toddlers
(B) teenagers
(C) adolescents
(D) elders
Ans: (A)

11. The _____ is a small gland in the brain responsible for regulating growth and hormone production.
(A) pineal gland
(B) adrenal gland
(C) pituitary gland
(D) thyroid gland
Ans: (C)

12. A doctor tells a patient: "Your condition is benign." What does this mean?
(A) The disease is highly contagious.
(B) The condition is not harmful or life-threatening.
(C) The illness will get worse over time.
(D) The condition requires immediate surgery.
Ans: (B)

13. Famous for creating the _____ detective Sherlock Holmes, Sir Arthur Canon Doyle has more other achievements including serving as a medic in the Boer War and pioneering skiing.
(A) invaluable
(B) indistinctive
(C) indistinguishable
(D) inimitable
Ans: (D)

14. The Hippocratic Oath is an ethical guideline traditionally taken by _____.
(A) medical doctors
(B) pharmacists
(C) physical therapists
(D) laboratory technicians
Ans: (A)

15. The _____ is the part of the brain responsible for regulating balance and coordination.
(A) cerebrum
(B) cerebellum
(C) medulla oblongata
(D) hypothalamus
Ans: (B)

16. The term "palliative care" refers to _____.
(A) therapy used exclusively for chronic conditions
(B) a type of emergency surgery
(C) a treatment that guarantees a cure
(D) medical treatment focused on relieving symptoms rather than curing disease
Ans: (D)

17. In a case study, the term "prognosis" refers to _____.
(A) the initial diagnosis of a condition
(B) the immediate treatment required
(C) the expected outcome of a disease
(D) the symptoms observed in the patient
Ans: (C)

18. The human body's first line of defense against pathogens is the _____.
(A) immune system
(B) circulatory system
(C) skin
(D) endocrine system
Ans: (C)

19. Which of the following conditions is best described as "asymptomatic"?
(A) an infection that does not cause noticeable symptoms
(B) a disease with severe and sudden symptoms
(C) a disorder requiring long-term treatment
(D) a condition that requires immediate surgery
Ans: (A)

20. Barbara Wagner, 70, hit her stride after retirement and started moving houses, arguing with family, making task list longer, while she could not finish anything including making her bed. Her doctor diagnosed her with _____.
(A) ADHD
(B) leukemia
(C) anemia
(D) hypertension
Ans: (A)

21. Which of the following procedures is considered "minimally invasive"?
(A) open-heart surgery
(B) laparoscopic surgery
(C) total knee replacement
(D) craniotomy
Ans: (B)

22. A sphygmomanometer is an instrument used to measure _____.
(A) body temperature
(B) lung function
(C) blood pressure
(D) glucose levels
Ans: (C)

23. Which neurotransmitter is primarily associated with motivation and reward?
(A) Serotonin
(B) Dopamine
(C) Cortisol
(D) Melatonin
Ans: (B)

24. Which psychological phenomenon occurs when people believe they have less control over events than they actually do?
(A) Selective perception
(B) Confirmation bias
(C) Cognitive restructuring
(D) Learned helplessness
Ans: (D)

25. In medical ethics, the term "informed consent" means the fact that _____
(A) the patient agrees to any treatment given by the doctor.
(B) the patient has fully understood and voluntarily agreed to a proposed treatment.
(C) the doctor decides on the best course of treatment without consulting the patient.
(D) the patient refuses all medical intervention.
Ans: (B)

26. The Renaissance was a period of cultural and intellectual revival that saw significant advancements in art, science, and humanism, often described as the _____ of classical knowledge.
(A) resurgence
(B) dissolution
(C) stagnation

(D) eradication
Ans: (A)

II. Cloze Test. Please choose the most suitable answer for each blank.

Medical humanities is a __27__ field that draws together methods and insights from the humanities, arts, and social sciences to address questions around human experiences of health and illness. Recognising that such experiences cannot meaningfully be dissociated __28__ the personal, social, cultural, environmental, and political contexts in which they emerge, medical humanities researchers challenge assumptions about how the "normal" should be distinguished from the __29__ celebrate interdisciplinary entanglements among researchers from different backgrounds and realworld areas of expertise, and __30__ engagement with those who use, provide, and shape health-care services.
The four Art of Medicine essays in *The Lancet* represent a vibrant cross-section of the work going on in this __31__ and burgeoning field.
(from Charles Fernyhough, "Entanglements in the Medical Humanities," *The Lancet*, Vol. 403, Issue 10428, 710, 24 Feb. 2024)

27. (A) parallel (B) novel (C) multidisciplinary (D) complicated
Ans: (C)

28. (A) from (B) with (C) in (D) by
Ans: (A)

29. (A) "logical," (B) "healthy," (C) "psychological," (D) "pathological,"
Ans: (B)

30. (A) prioritise (B) prioritised (C) prioritising (D) prioritises
Ans: (A)

31. (A) life (B) lively (C) living (D) lived
Ans: (B)

III. Discourse Structure. In the following passage, there are four sentences missing. Please choose the most suitable sentence from the sentences provided below to complete the passage. Use each sentence provided once only.

Despite the turn to insects in mainstream robotics, research on android robots continues.__32__. Others are "social," or "Companion" robots, designed for home used by elderly and/or disabled people. These are intended less as fetch-and-carry slaves than as autonomous personal assistants. Some appear "cute," having long eyelashes and seductive voices. They can make eye contact with users, and recognize individual faces and voices. Also, they can—up to a point—hold unscripted conversations, interpret the user's emotional state, and generate "emotional" responses (human-like facial expressions and/or speech patterns) themselves.

Although some robots are large (for handling heavy loads and/or traversing rough ground), most are small. Some—for use inside blood vessels, for example—are very small.__33__. Whenever multiple robots are involved in a task, questions arise about how (if at all) they communicate, and how that enable the group to do things that couldn't be done individually.

__34__. Such species exemplify "distributed cognition" in which knowledge (and appropriate action) is spread across entire group rather than being available to any one animal.

If robots are extremely simple, their developers may speak of "swarm intelligence," and analyse cooperative robot systems as cellular automata (Cas).__35__. The overall pattern of a CA's behaviour may be surprisingly complex. The basic analogy is living cells cooperating in multicellular organisms. The many AI versions include the flocking algorithms used for crowds of bats or dinosaurs in Hollywood animations.
(from Margaret A. Boden, *Artificial Intelligence: A Very Short Introduction*, 93-94)

(A) For answers, roboticists often consider social insects, like ants and bees
(B) Often, they are sent to work in large numbers
(C) Some are mere toys
(D) A CA is a system of individual units, each taking one of a finite number of states by following simple rules, which depend on the current state of its neighbours

32. Ans: (C)
33. Ans: (B)
34. Ans: (A)
35. Ans: (D)

IV. Reading Comprehension. In this part, there are three reading passages. Read each of the following passages and answer the corresponding questions.

Read the following passage and answer questions 36-39.

Digestion is important because your body needs nutrients from food and drink to work properly and stay healthy. The digestive system is made up of the gastrointestinal tract—also called the GI tract or digestive tract. Our stomach is responsible for relaxing to let food enter, and mixing food with digestive juice. The stomach acid and digestive enzymes help break down food particles of protein. Small intestine digestive juice divides starches, proteins, and carbohydrates. The muscles of the small intestine mix food with digestive juices from the pancreas, liver, and intestine, and push the mixture forward for further digestion. The walls of the small intestine absorb water and the digested nutrients into your bloodstream. As peristalsis continues, the waste products of the digestive process move into the large intestine. Waste products from the digestive process include undigested parts of food, fluid, and older cells from the lining of your GI tract. The large intestine absorbs water and changes the waste from liquid into stool.

36. The digestive system is made up of the gastrointestinal tract, also called the GI tract or _____ tract.
(A) endocrine
(B) respiratory
(C) digestive
(D) excretory
Ans: (C)

37. The stomach is responsible for _____ food with digestive juice to aid digestion.
(A) dissolving
(B) mixing
(C) absorbing
(D) preventing
Ans: (B)

38. The small intestine absorbs water and _____ nutrients into the bloodstream.
(A) divides
(B) releases
(C) transfers
(D) digests
Ans: (C)

39. As peristalsis continues, the waste products of digestion move into the _____ intestine.
(A) large
(B) upper
(C) middle
(D) central
Ans: (A)

Read the following passage and answer questions 40-44.

No doctor in the history of the IMCS [Imperial Maritime Customs Service] made as great a contribution to field of medicine as Patrick Manson. In 1866, aged just 22, Manson took up his post in south Taiwan. The 16 Western residents of Takao (as Kaohsiung was then known) were his first priority, but he also showed a keen interest in the ailments that blighted many Taiwanese.

From 1871 to 1878, Manson (a Scotsman like James. L. Maxwell) worked in Xiamen, where he treated multiple cases of elephantiasis, a condition seldom encountered in Taiwan. After examining blood samples through a microscope, he concluded that mosquitoes hosted the responsible parasite – a breakthrough that eventually led, not only to Ross's discovery, but also the realization that the mosquito is the vector of other ailments, including Japanese encephalitis and dengue fever.

In the UK, Manson is remembered for founding the London School of Hygiene and Tropical Medicine, the second oldest institution in the world devoted to researching tropical medicine. (The Liverpool School of Tropical Medicine was established half a year earlier, in late 1898.)

The name of another Manson appears in local medical history. Patrick Manson's younger brother David, also a doctor, died of sunstroke in Xiamen in 1878. Those who had known him raised funds and a year later the David Manson Memorial Hospital was established on the hill at the western end of Qijin Island, less than 500 meters from where James L. Maxwell had practiced medicine a decade earlier.

The hospital was considered state-of-the-art but functioned for less than two decades. Even its precise location is uncertain, and can only be inferred from a few photographs. Much of what is known about the David Manson Memorial Hospital is shared in the Museum of Kaohsiung Medical University Historical Archives and Southern Taiwan Medical History. It features a re-creation of one of the hospital's consulting rooms, plus various medical instruments and extracts from reports. (from Steven Crook, "Leaving Pestilence in the Past," posted at

https://topics.amcham.com.tw/2018/07/leaving-pestilence-in-the-past/)

40. According to the article, when Patrick Manson first came to Taiwan, _____
(A) he only cared for 16 westerners in the IMCS office at Takao.
(B) he was only 22 years old.
(C) he tried to learn about how to treat elephantiasis.
(D) there was no any doctor in Takao.
Ans: (B)

41. Regarding David Manson Memorial Hospital, which of the following is true?
(A) Patrick Manson's younger brother, David Manson, raised funds to build it.
(B) It was built by Patrick Manson to treat cases of elephantiasis in Xiamen.
(C) Dr. James L. Maxwell had practiced medicine there.
(D) It was built in Qijin after David Manson died.
Ans: (D)

42. What was the breakthrough Patrick Manson made in medical science?
(A) He examined Ross's medical discovery about the vector of ailments such as Japanese encephalitis and dengue fever.
(B) There were many cases of elephantiasis in Taiwan.
(C) He built a microscope to examine blood samples.
(D) The mosquito could host the kind of parasite to transmit human ailments.
Ans: (D)

43. Why does the author consider the hospital "state-of-the-art"?
(A) Because there were many consulting rooms and outdated medical instruments.
(B) Because it looked artistic.
(C) Because it was advanced at the time.
(D) Because all of the doctors mentioned in the article came from Scotland.
Ans: (C)

44. According to this article, what can be done if one would like to know about the Mansons and early medical history of Kaohsiung?
(A) Trace the precise location of the David Manson Memorial Hospital.
(B) Visit the Museum of Kaohsiung Medical University.
(C) Read about James L. Maxwell who had also practiced medicine in Taiwan.
(D) Visit the two Schools of Tropical Medicine in the UK.
Ans: (B)

Read the following passage and answer questions 45-50.

I flipped through the CT scan images, the diagnosis obvious: the lungs were matted with innumerable tumors, the spin deformed, a full lobe of the liver obliterated. Cancer, widely disseminated. I was a neurosurgical resident entering my final year of training. Over the last six years, I'd examined scores of such scans, on the off chance that some procedure might benefit the patient. But this scan was different: it was my own…. I knew a kit about back pain—its anatomy, its physiology, the different words patients used to describe different kinds of pain—but I didn't know what it *felt* like.

Maybe that's all this was. Maybe. Or maybe I didn't want the jinx. Maybe I just didn't want to say the word *cancer* out loud…. I received the plastic arm bracelet all patients wear, put on the familiar light blue hospital gown, walked past the nurses I knew by name, and was checked in to a room—the same room where I had seen hundreds of patients over the years. In this room, I had sat with patients and explained terminal diagnoses and complex operations; in this room, I had congratulated patients on being cured of a disease and seen their happiness at being returned to their lives; in this room, I had pronounced patients dead. I had sat in the chairs, washed my hands in the sink, scrawled instructions on the marker board. Exhaustion, longed to die down in this bed and sleep. Now I lay there, wide awake. (from Paul Kalanithi "Prologue," *When Breath Becomes Air*, 2016)

45. Judging from the above passages, the narrator (the author Paul Kalanithi himself), **was not** _____
(A) a medical student.
(B) a physician.
(C) a neurosurgeon.
(D) a psychiatrist.
Ans: (D)

46. According to the CT scan images the narrator was seeing, _____
(A) he discovered a special kind of cancer that might benefit the patient suffering back pain.
(B) the scans showing lungs with tumor, deformed, and a full lobe of the liver obliterated could let him find out more cancer patients in the hospital.
(C) he could tell the spread of his own cancer.
(D) he was able to diagnose a rare case of cancer.
Ans: (C)

47. What does the narrator mean by saying he "didn't know what back pain *felt* like"?
(A) Because he was a healthy person.
(B) Because he had not enough knowledge about anatomy, physiology and different languages.
(C) Because he did not have the same illness.
(D) Because he was not listening to his patients.
Ans: (C)

48. The doctor was in a room _____
(A) where he used to play the role of doctor.
(B) where hundreds of his patients died after complex operations.
(C) where his patients were checked in, received the plastic arm bracelets and put on blue hospital gowns.
(D) all of the above.
Ans: (A)

49. Why does the narrator said: "Maybe I just didn't want to say the word *cancer* out loud…"?
(A) Because he needed to check more scans to be sure.
(B) Because the fact was hard to accept.
(C) Because it would ruin the patient's confidence.
(D) Because it was more suitable to keep his voice down in the hospital.
Ans: (B)

50. Which of the following statements can best describe the narrator?
(A) He was suicidal.
(B) He was energetic and lay awake in bed.
(C) He was waiting for his treatment and feeling frustrated.
(D) He was confused if he was a doctor or a patient.
Ans: (C)