國立中山大學115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115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. Which of the following statements about cell junctions is correct?
   (1) Tight junctions are found in both intestinal epithelial cells and vascular endothelial cells of the blood-brain barrier.
   (2) Desmosomes provide cytoplasmic channels and can be found in muscle fibers.
   (3) Gap junctions are essential for intercellular communication and are found in cardiac muscle.
   (A) (2)
   (B) (1), (2)
   (C) (2), (3)
   (D) (1), (3)
   (E) (1), (2), (3)
   Ans: D

2. Tay-Sachs disease is a human genetic abnormality that results in cells accumulating and becoming clogged with very large and complex lipids. Which cellular organelle must be involved in this condition?
   (A) the endoplasmic reticulum
   (B) the Golgi apparatus
   (C) mitochondria
   (D) the lysosome
   (E) membrane-bound ribosomes
   Ans: D

3. Which of the following statements about histone modification is NOT correct?
   (A) Histone modifications change gene expression patterns without altering the actual nucleotide sequence of the DNA.
   (B) The addition of methyl groups to histone tails always leads to the immediate activation of the nearby gene by opening the chromatin structure.
   (C) Acetylation of histone tails generally neutralizes their positive charge, loosening the bond between histones and DNA to make the template more accessible for transcription.
   (D) Histone modifications occur primarily on the flexible N-terminal "tails" of the histone proteins that protrude outward from the core of the nucleosome.
   (E) Certain histone modifications can be inherited by daughter cells during mitosis, allowing a specific cell type to maintain its identity through successive cell divisions.
   Ans: B

4. Saffron is a spice that is derived from parts of the flower of the saffron crocus. Saffron contains a disaccharide called gentiobiose. The molecular mass of each of the monosaccharide in gentiobiose is 180. The molecular mass of the carbon, hydrogen, and oxygen is 12, 1, and 16, respectively. Which is the molecular mass of gentiobiose?
   (A) 144
   (B) 162
   (C) 342
   (D) 360
   (E) 388
   Ans: C

5. _____ in the circulatory system typically operate under lower internal pressure, carry

blood toward the heart, contain valves that prevent backflow, and have relatively thin walls with relatively less smooth muscle and elastic tissue.

(A) Arteries
(B) Veins
(C) Capillaries
(D) Lymphatic vessels
(E) Arterioles
Ans: B

6. Which products are the net effect of photosynthesis?
(A) Carbon dioxide and carbohydrates
(B) Carbon dioxide and protein
(C) Carbon dioxide and ATP
(D) Oxygen and ADP
(E) Oxygen and carbohydrates
Ans: E

7. The liver is involved in detoxification of many poisons and drugs. Which of the following structures is primarily involved in this process and therefore abundant in liver cells?
(A) rough ER
(B) smooth ER
(C) Golgi apparatus
(D) transport vesicles
(E) nuclear envelope
Ans: B

8. What is saltatory conduction?
(A) conduction of impulses across electrical synapses
(B) an action potential that skips the axon hillock in moving from the dendritic region to the axon terminal
(C) rapid movement of an action potential reverberating back and forth along a neuron
(D) jumping from one node of Ranvier to the next in a myelinated neuron
(E) jumping from one neuron to an adjacent neuron
Ans: D

9. Which organelle in the following is composed of an extensive network of membrane-bounded tubules and sacs, and when it malfunctions, results in the accumulation of misfolded proteins within cells, which has been found as a key driver in neurodegenerative diseases such as Alzheimer's and Parkinson's diseases?
(A) ribosome
(B) endoplasmic reticulum (ER)
(C) Golgi apparatus
(D) lysosome
(E) mitochondria
Ans: B

10. The following items are events in a typical signaling pathway: (1) An activated transcription factor translocates into the nucleus. (2) A growth factor binds to its receptor. (3) Transcription of a specific gene is initiated. (4) A kinase cascade is triggered. In what sequence does the signaling pathway proceed?

(A) (1) → (2) → (4) → (3)
(B) (2) → (3) → (1) → (4)
(C) (2) → (4) → (1) → (3)
(D) (3) → (1) → (4) → (2)
(E) (1) → (3) → (4) → (2)
Ans: C

11. The CRISPR-Cas9 system utilizes a specific molecule known as _____ to recognize and bind to a complementary DNA sequence, which then directs the Cas9 nuclease to create a double-strand break at a precise genomic location.
(A) transfer RNA (tRNA)
(B) DNA ligase
(C) guide RNA (gRNA)
(D) protospacer adjacent motif (PAM)
(E) trans-activating CRISPR RNA (tracrRNA)
Ans: C

12. Which of the following is NOT a hormone secreted by endocrine glands located in the human brain?
(A) vasopressin
(B) calcitonin
(C) prolactin
(D) melatonin
(E) oxytocin
Ans: B

13. Suppose a person begins breathing very rapidly while resting (hyperventilating), which of the following best describes how homeostasis is restored?
(A) Rapid breathing decreases blood CO_2 levels, thereby raising blood pH. The frontal cortex detects the change and reduces stimulation of the rib muscles and the diaphragm, thereby decreasing the breathing rate.
(B) Rapid breathing increases blood CO_2 levels, thereby causing the blood pH to drop. The hypothalamus detects the change and decreases stimulation of the rib muscles and the diaphragm, thereby reducing the breathing rate.
(C) Rapid breathing decreases blood CO_2 levels, thereby raising blood pH. The hypothalamus detects the change and reduces stimulation of the rib muscles and the diaphragm, thereby decreasing the breathing rate.
(D) Rapid breathing increases blood CO_2 levels, thereby causing the blood pH to drop. The medulla oblongata detects the change and reduces stimulation of the rib muscles and the diaphragm, thereby decreasing the breathing rate.
(E) Rapid breathing decreases blood CO_2 levels, thereby raising blood pH. The medulla oblongata detects the change and reduces stimulation of the rib muscles and the diaphragm, thereby decreasing the breathing rate.
Ans: E

14. Meiosis increases genetic variation through independent assortment and crossing over. In which stage of meiosis does crossing over occur?
(A) prophase I
(B) prophase II
(C) metaphase I
(D) metaphase II

(E) anaphase 1
Ans: A

15. What is the primary function of the kidneys in the human body?
(A) Filtration of blood and excretion of waste products
(B) Production of red blood cells
(C) Digestion of food
(D) Regulation of body temperature
(E) Generate energy
Ans: A

16. In the presence of a competitive inhibitor, which of the following changes in Michaelis-Menten enzyme kinetics is expected?
(A) V_{max} decreases, K_m decreases.
(B) V_{max} remains unchanged, K_m decreases.
(C) V_{max} decreases, K_m increases
(D) V_{max} remains unchanged, K_m increases
(E) V_{max} increases, K_m increases
Ans: D

17. In the electron transport chain, which of the following is the final electron acceptor?
(A) Cytochrome C
(B) Coenzyme A
(C) NADH
(D) O_2
(E) $FADH_2$
Ans: D

18. In muscle, the first event in glycogen breakdown after a hormone binding is_____.
(A) cytoplasmic cAMP levels rise
(B) protein kinase A phosphorylates phorsporylase kinase
(C) adenylate cyclase is activated
(D) protein kinase A is activated
(E) Gs protein is activated
Ans: E

19. Which of the following enzymatic activities is NOT possessed by *E.coli* DNA polymerase I?
(A) 5′→3′ DNA polymerase activity
(B) 3′→5′ DNA polymerase activity
(C) 5′→3′ exonuclease activity
(D) 3′→5′ exonuclease activity
(E) None of the above
Ans: B

20. Which of the following components is NOT required for the polymerase chain reaction (PCR)?
(A) Double-stranded DNA template
(B) Primer
(C) DNA polymerase
(D) dNTP
(E) Reverse transcriptase

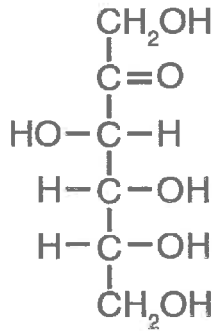
Ans: E

21. The quantitation of proteins by detecting their absorbance at ~280 nm (UV region) is due to the large absorbtivity of the _____ amino acids.
(A) anionic
(B) aromatic
(C) cleaved
(D) dansylated
(E) polar
Ans: B

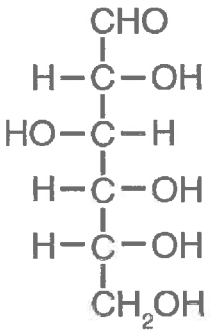
22. What is the major epigenetic modification on DNA?
(A) Methylation
(B) Phosphorylation
(C) Glycosylation
(D) Ubiquitination
(E) Acetylation
Ans: A

23. Which structure shown in the figure above is a ketohexose?

①



②



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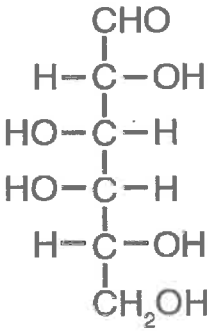

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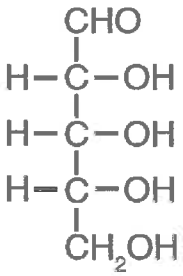


(A) ①
(B) ②
(C) ③
(D) ④
(E) None of the above
Ans: A

24. Which of the following would NOT decrease activity of the citric acid cycle overall?
(A) High concentration of citrate
(B) High concentration of NADH
(C) High concentration of Ca^{2+}
(D) High concentration of ATP
(E) All of the above
Ans: C

25. Which of the following accurately ranks lipoproteins from highest to lowest density?
(A) chylomicrons > VLDL > IDL > LDL > HDL
(B) chylomicrons > HDL > LDL > IDL > VLDL
(C) HDL > IDL > LDL > VLDL > chylomicrons

(D) HDL > LDL > IDL > VLDL > chylomicrons
(E) HDL > VLDL > LDL > IDL > chylomicrons
Ans: D

26. In a protein, the most conformationally restricted amino acid is_____; the least conformationally restricted is _____.
(A) Ala, Pro
(B) Ile, Ala
(C) Met, Cys
(D) Pro, Gly
(E) Trp, Gly
Ans: D

27. In a hepatocyte under high energy conditions, PFK-1 activity is significantly reduced. A simultaneous increase in which of the following would most effectively overcome this inhibition and reactivate glycolysis?
(A) Citrate
(B) Fructose-2,6-bisphosphate
(C) Glucose-6-phosphate
(D) ATP
(E) Fatty acids
Ans: B

28. A man taking multiple medications develops drug toxicity. Laboratory analysis reveals impaired Phase I metabolism. Which of the following reactions is most likely deficient in this patient?
(A) Hydroxylation by cytochrome P450
(B) Glucuronidation by UDP-glucuronyltransferase
(C) Sulfation by sulfotransferase
(D) Glutathione conjugation by glutathione S-transferase
(E) Acetylation by N-acetyltransferase
Ans: A

29. A researcher incubates hepatocytes with $^{15}NH_4Cl$ and observes that ^{15}N appears first in glutamate, then subsequently in aspartate. Which of the following best explains this sequential labeling?
(A) $^{15}NH_4^+$ → glutamine (by glutamine synthetase) → glutamate → aspartate (by transamination)
(B) $^{15}NH_4^+$ → glutamate (by glutamate dehydrogenase) → aspartate (by transamination with oxaloacetate)
(C) $^{15}NH_4^+$ → carbamoyl phosphate (by CPS I) → glutamate → aspartate (via urea cycle intermediates)
(D) $^{15}NH_4^+$ → glutamate (by glutamate dehydrogenase using succinate) → aspartate (by transamination with fumarate)
(E) $^{15}NH_4^+$ → glutamate (by glutamine synthetase) → aspartate (by reductive amination of oxaloacetate)
Ans: B

30. Which enzyme is responsible for the synthesis of prostaglandins and thromboxanes from arachidonic acid?
(A) Lipoxygenase
(B) Cyclooxygenase
(C) Desaturase

(D) Elongase
(E) Peroxidase
Ans: B

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 a stressful event, the body produces both immediate and long-term physiological responses. Which of the following best describes how the hypothalamus and adrenal glands work together in this stress response?
(A) The hypothalamus releases corticotropin-releasing hormone (CRH) directly into the bloodstream to stimulate the adrenal medulla to secrete glucocorticoids.
(B) The adrenal medulla secretes glucocorticoids and mineralocorticoids, which produce rapid "fight-or-flight" responses.
(C) The hypothalamus signals the pituitary gland to release adrenocorticotropic hormone (ACTH), which stimulates the adrenal cortex to secrete glucocorticoids during long-term stress.
(D) Mineralocorticoids released from the adrenal medulla primarily increase heart rate during acute stress.
(E) During the short-term stress response, the anterior pituitary releases epinephrine directly into the bloodstream to bypass the slower neural pathways of the sympathetic nervous system.
Ans: C

32. During DNA replication of an eukaryotic cell, a guanine (G) is mistakenly paired with a thymine (T) and escapes the initial proofreading by DNA polymerase. This G-T pair becomes fully incorporated into the double helix. Which of the following best describes how the cell corrects this mismatch/error?
(A) The cell utilizes DNA photolyase to break the hydrogen bonds between the mismatched bases and flip them into the correct orientation.
(B) The cell utilizes specific endonucleases to recognize the helical distortion and identify the newly synthesized strand to cut out the segment containing the incorrect nucleotide.
(C) The cell utilizes RNA primase to recognize the mismatched sites, where it initiates reverse transcription to replace the DNA segment with a temporary RNA patch.
(D) The cell utilizes DNA ligase to identify the incorrect hydrogen bonding site and uses its 5' to 3' exonuclease activity to chew back the faulty nucleotide.
(E) The cell utilizes a multi-protein complex to scan the DNA for bulky lesions and remove a 12-30 nucleotide oligomer of the damaged strand.
Ans: B

33. Long-term potentiation (LTP) represents a fundamental cellular mechanism underlying learning and memory. Which of the following best describes a critical requirement for the induction of early-phase LTP?
(A) Sustained activation of NMDA receptors leading to Ca^{2+} influx, which directly promotes rapid insertion of AMPA receptors into the postsynaptic membrane.
(B) Ca^{2+} influx through NMDA receptors following postsynaptic depolarization, which triggers the translocation of additional AMPA receptors to the postsynaptic membrane via calcium/calmodulin-dependent protein kinase II (CaMKII) signaling.
(C) Increased presynaptic glutamate release caused by enhanced vesicle docking, which by itself is sufficient to maintain persistent synaptic potentiation.
(D) Activation of postsynaptic glycine receptor chloride channels, which leads to the depolarization that relieves the Mg^{2+} block of NMDA receptors.
(E) Immediate activation of cAMP response element-binding protein (CREB)-dependent gene transcription in the absence of Ca^{2+} influx, which primes neurons for later potentiation.

Ans: B

34. The number and size of Golgi apparatus vary depending on the type of cell. How many of the following are functions of the Golgi apparatus? I. formation of extracellular enzymes II. modification of proteins III. formation of peptide bonds through condensation reactions IV. synthesis of certain polysaccharides
(A) None of the above.
(B) One of the above.
(C) Two of the above.
(D) Three of the above.
(E) All of the above.
Ans: D

35. In 2018, an organization carried out a global survey into the attitudes of people towards vaccines. Vaccines provide artificial active immunity. Which of the following is not a correct statement about how a vaccine results in active immunity?
(A) A vaccine results in active immunity by that Vaccine contains an inactive/attenuated form of the pathogen / virus / bacteria /microorganism.
(B) Macrophages engulf and display the antigen on their cell surface.
(C) Macrophages will present the antigen to T helper cells.
(D) T helper cells will activate B/T killer cells.
(E) The vaccine provides ready-made antibodies that immediately neutralize the pathogen.
Ans: E

36. If a dog is suffering from an autoimmune response. On further investigation, you find that the cells of various tissues are loosely arranged and do not have characteristic shapes, and the animal is prone to hemorrhaging because of poor blood clotting. Based on these results, the target of the autoimmune response is most likely to be _____.
(A) fibronectins
(B) laminins
(C) extensins
(D) pectins
(E) elastins
Ans: A

37. Which of the following conditions is not caused by a fungus?
(A) giardiasis
(B) athlete's foot
(C) candidiasis
(D) coccidioidomycosis
(E) ringworm
Ans: A

38. In the human genome, a variation in a single DNA base pair, such as the substitution of a cytosine (C) for a thymine (T), that occurs in more than 1% of the population is known as a _____. They serve as powerful molecular markers in genome-wide association studies (GWAS) to identify genetic predispositions to complex diseases.
(A) insertion-deletion mutation (InDel)
(B) haplotype block
(C) single nucleotide polymorphism (SNP)
(D) copy number variant (CNV)

(E) short tandem repeat (STR)
Ans: C

39. In humans, the primary nitrogenous waste product is _____, a compound that is much less toxic than _____ and more water-soluble than _____, allowing it to be safely transported in the bloodstream and excreted in urine.
(A) uric acid; ammonia; urea
(B) uric acid; urea; ammonia
(C) ammonia; urea; uric acid
(D) urea; ammonia; uric acid
(E) urea; uric acid; ammonia
Ans: D

40. Which of the following statements about the inheritance of human ABO blood types is correct?
(A) It is an example of polygenic inheritance.
(B) There are three alleles, I^A, I^B, and i, for one gene locus. Hence, it does not follow Mendelian Genetics, which only considers two alleles at a single gene locus.
(C) ABO blood types refer to glycolipids in the membrane of red blood cells.
(D) A couple with blood type AB and blood type O, individually, is not likely to have a child with blood type AB.
(E) The blood type AB follows the inheritance pattern of incomplete dominance.
Ans: D

41. Animals and plants can detect and respond to light. Rod cells respond to light by producing action potentials in the optic nerve. In which structure are rod cells located?
(A) Iris
(B) Pupil
(C) Retina
(D) Spinal cord
(E) Crystalline lens
Ans: C

42. People with lactose intolerance cannot digest lactose. Lactose intolerance is due to a lack of the enzyme lactase. Which are the products of lactose digestion?
(A) Fructose and galactose
(B) Fructose and glucose
(C) Glucose and glucose
(D) Mannose and glucose
(E) Galactose and glucose
Ans: E

43. Which of these statements correctly describes genetic engineering?
(A) Only breeding from crop plants that are resistant to pests.
(B) Using yeast to produce ethanol.
(C) Altering the DNA in crop plants so that they are resistant to herbicides.
(D) Production of insulin in the pancreas.
(E) Grafting branches from one fruit tree onto another.
Ans: C

44. In a cross of two individuals, both of whom have genotype AaBb, what proportion of the offspring are expected to have the genotype AABB?
(A) 9/16
(B) 1/8
(C) 1/16
(D) 1/4
(E) 3/16
Ans: C

45. G protein-coupled receptors (GPCRs) are the most prominent and diverse family of cell-surface receptors and are therefore targets for approximately 40% of marketed drugs. The following is a typical scenario of GPCR-mediated signaling pathway: GPCR receives extracellular signals → activated GPCR acts as a guanine nucleotide exchanger (GEF) → Galpha subunit of G protein releases GDP and binds GTP → Galpha subunit binds and activates its target enzyme upon GTP hydrolysis → a secondary messenger is generated → another protein is activated → cellular responses follow. Which of the following is a common secondary messenger used in the scenario?
(A) sodium ions (Na^+)
(B) magnesium ions (Mg^{2+})
(C) nitric oxide (NO)
(D) guanine monophosphate (GMP)
(E) cyclic adenosine monophosphate (cAMP)
Ans: E

46. The global monitoring of influenza viruses, such as H1N1 and H5N1, is a primary focus of public health biology. Influenza viruses are classified based on two primary variables, hemagglutinin (H) and neuraminidase (N). Which of the following statements about influenza viruses is correct?
(A) Influenza viruses are double-stranded DNA viruses that infect mainly humans.
(B) H5N1 is currently classified as an avian flu that mainly infects birds and can cause severe disease in humans, but usually does not spread easily between people.
(C) The "H" and "N" in H5N1 refer to the numbers of viral strains and enzymes, respectively.
(D) The Influenza B virus is responsible for most influenza pandemics.
(E) New influenza subtypes arise when small genetic mutations allow viral RNA segments to mix between different strains during infection of the same host cell.
Ans: B

47. The digestion and absorption of dietary fats require several coordinated processes in the human digestive system. Which of the following statements best describes how fats are digested and absorbed?
(A) Bile salts emulsify fats into micelles within the intestinal lumen, allowing them to be absorbed directly into the intestinal capillaries.
(B) Bile salts emulsify fats into chylomicrons within the intestinal lumen, allowing them to be absorbed directly into the hepatic portal vein.
(C) Fatty acids and monoglycerides are absorbed into intestinal epithelial cells, reassembled into triglycerides, packaged into chylomicrons, and transported through lacteals before eventually entering the bloodstream.
(D) Fatty acids and monoglycerides are absorbed into the intestinal capillaries and transported via the hepatic portal vein to the liver for storage.
(E) Fatty acids and monoglycerides are absorbed into intestinal epithelial cells, reassembled into triglycerides, packaged into micelles, and transported into the intestinal capillaries.
Ans: C

48. Helper T cells play a central role in coordinating adaptive immunity. Which of the following is NOT an outcome after a naïve helper T cell is activated by an antigen-presenting cell?
(A) Cytotoxic T cells are activated and subsequently destroy infected cells.
(B) B cells are activated and subsequently differentiate into memory B cells and antibody-secreting plasma cells.
(C) Activated helper T cells secrete cytokines and undergo clonal expansion.
(D) Natural killer cells are activated and subsequently destroy infected cells.
(E) Clonal helper T cells secrete cytokines that activate other immune cells.
Ans: D

49. The *ras* and *p53* genes encode key proteins that function in cell-signaling pathways. Mutations in *ras* occur in about 30% of human cancers, and mutations in *p53* occur in more than 50%. Based on their physiological roles in regulating the cell cycle, the *ras* gene is classified as a(n) _____, and the *p53* gene is a(n) _____.
(A) proto-oncogene; oncogene
(B) oncogene; tumor-suppressor gene
(C) proto-oncogene; tumor-suppressor gene
(D) tumor-suppressor gene; proto-oncogene
(E) tumor-suppressor gene; oncogene
Ans: C

50. The postsynaptic response at a chemical synapse depends on both the neurotransmitter released from the presynaptic neuron and the receptor present on the postsynaptic membrane. Which of the following statements about neurotransmitters is NOT correct?
(A) The magnitude of synaptic transmission can be influenced by the amount of neurotransmitter released.
(B) Released neurotransmitter molecules can be taken back up into the presynaptic neuron.
(C) A single neurotransmitter can activate both ionotropic and metabotropic receptors, producing distinct physiological effects.
(D) In the adult human brain, the amino acid gamma-aminobutyric acid (GABA) is a neurotransmitter that typically depolarizes the postsynaptic neuron, making it more likely to fire an action potential.
(E) Certain gaseous molecules, such as nitric oxide (NO), can act as retrograde neurotransmitters and are not stored in synaptic vesicles before release.
Ans: D

51. Often referred to as the "hunger hormone," _____ is a peptide hormone secreted primarily by endocrine cells of the stomach. Its concentration rises sharply before meals to stimulate appetite-regulating centers in the hypothalamus and declines following stomach distension after food intake.
(A) glucagon
(B) peptide YY (PYY)
(C) leptin
(D) ghrelin
(E) insulin
Ans: D

52. A normal heartbeat begins with spontaneous electrical activity that coordinates atrial and ventricular contraction. Which of the following describes the correct physiological sequence of electrical conduction in the human heart?
(A) signals from the sinoatrial (SA) node spreading through atria→ signals delayed in the

atrioventricular (AV) node → bundle branches passing signals to the heart apex → signals spreading upward throughout ventricles via Purkinje fibers.

(B) signals from the atrioventricular (AV) node spreading through atria→ signals delayed in the sinoatrial (SA) node → bundle branches passing signals to the heart apex → signals spreading upward throughout ventricles via Purkinje fibers.

(C) signals from the sinoatrial (SA) node spreading through ventricles → signals delayed in the atrioventricular (AV) node → bundle branches passing signals to the heart apex → signals spreading upward throughout atria via Purkinje fibers.

(D) signals from the sinoatrial (SA) node spreading through atria → bundle branches passing signals to the heart apex → signals delayed in the atrioventricular (AV) node → signals spreading upward throughout ventricles via Purkinje fibers.

(E) signals from the atrioventricular (AV) node spreading through atria→ bundle branches passing signals to the heart apex → signals delayed in the sinoatrial (SA) node → signals spreading upward throughout ventricles via Purkinje fibers.

Ans: A

53. Many predatory animals produce toxins to disable their prey. Some of these toxins inhibit nervous communication. Nerve impulses are transmitted along axons. Some axons are myelinated. Which type of cell produces myelin?

(A) Neurone
(B) Rod cell
(C) Schwann cell
(D) Astrocyte
(E) Lymphocyte

Ans: C

54. In cells, energy can be released from substrates by anaerobic and aerobic respiration. Most eukaryotic cells can respire anaerobically. Which of the following describes a step in the process of anaerobic respiration?

(A) decarboxylation of lactate
(B) phosphorylation of hexoses
(C) oxidation of pyruvate
(D) removal of phosphate groups from glucose
(E) decarboxylation of pyruvate to form acetyl-CoA

Ans: B

55. According to the description, which statement about sodium ions (Na^+) is NOT correct?

(A) Na^+ influx into nerve cells drives depolarization during impulse conduction.
(B) Slow Na^+ influx into the SA node generates regular heart impulses.
(C) Na^+ gradient powers co-transport of glucose/amino acids into intestinal cells.
(D) The Na^+/K^+ pump directly causes depolarization by moving Na^+ into cells.
(E) Na^+ movement is essential for initiating cardiac muscle contractions.

Ans: D

56. Tumour necrosis factor (TNF) is a protein that can be released by several types of cell. It plays an important part in the immune response. This protein binds to specific receptors on the surface of cell membranes stimulating chemical reactions inside the cell. As a result, a number of responses may occur that include inflammation and the stimulation of phagocytosis by macrophages. Antibodies to TNF are used to treat rheumatoid arthritis. According to the text, why are antibodies to TNF used to treat rheumatoid arthritis?

(A) They increase TNF-induced phagocytosis by macrophages.
(B) They promote the release of TNF to strengthen the immune response.
(C) They reduce inflammation caused by TNF activity.
(D) They block TNF receptors on cell membranes.
(E) They decrease the risk of bacterial infections in joints.
Ans: C

57. Polytene chromosomes of Drosophila salivary glands each consist of multiple identical DNA strands that are aligned in parallel arrays. How could these arise?
(A) malfunction of the Topoisomerase
(B) replication without separation
(C) meiosis followed by mitosis
(D) fertilization by multiple sperm
(E) special association with histone proteins
Ans: B

58. Cyanide poisons mitochondria by blocking the final step in the electron transport chain. Human red blood cells placed in an isotonic solution containing cyanide are likely to_____.
(A) retain the normal cell shape, but the mitochondria will be poisoned
(B) lyse as the cyanide concentration increases inside the cell
(C) switch to anaerobic metabolism
(D) become unable to carry oxygen
(E) be unaffected
Ans: E

59. In an immunologically naive mammal, a bacterial infection would most rapidly trigger its_____.
(A) Toll-like receptors that bind to lipopolysaccharides
(B) memory cells to produce antibodies
(C) plasma cells to produce antigens
(D) cytotoxic T cells
(E) humoral immune responses
Ans: A

60. Radish flowers may be red, purple, or white. A cross between a red-flowered plant and a white-flowered plant yields all-purple offspring. The part of the radish we eat may be oval or long, with long being the dominant characteristic. If true-breeding red long radishes are crossed with true-breeding white oval radishes, which of the following phenotypic ratios would be expected in the F2 generation?
(A) 9:3:3:1
(B) 9:4:3:1
(C) 4:1:1:4
(D) 4:1:1:3:1:1
(E) 6:3:3:2:1:1
Ans: E

61. In a person who eats three regular meals per day, which of the following is the primary source of blood glucose before lunch?
(A) Protein
(B) Muscle glycogen
(C) Glucose from adipose tissue
(D) Liver glycogen

(E) Lipid
Ans: D

62. Which of the following mechanisms involved in signal transduction is irreversible?
(A) Receptor conformational change
(B) Protein phosphorylation
(C) Complex formation
(D) Proteolytic cleavage
(E) All of the above
Ans: D

63. Which of the following statements regarding RNA is correct?
(A) Eighty percent (80%) of RNA can be translated into protein.
(B) Non-coding RNA has no function in cells.
(C) siRNA consists of approximately 21–23 nucleotides.
(D) rRNA is the least abundant RNA in the cell.
(E) Guide RNA binds to double-stranded RNA.
Ans: C

64. To recombine DNA fragments from two plasmids, which of the following enzymes would most likely be used?
(A) Restriction enzyme
(B) RNA polymerase
(C) Reverse transcriptase
(D) Polynucleotide kinase
(E) None of the abobe
Ans: A

65. Which of the following mutations causes premature termination of protein synthesis during translation?
(A) In-frame insertion mutation
(B) Missense mutation
(C) In-frame gene fusion mutation
(D) Nonsense mutation
(E) None of the above
Ans: D

66. In eukaryotes, mitochondrial DNA may have higher mutation rate (5-10 times) than nuclear DNA due to_____.
(A) a small circular DNA
(B) genetical code differs from the standard code
(C) no histone protection
(D) contained untranslated sequence
(E) all of the above
Ans: C

67. Which of the following experimental methods cannot be used to analyze protein-protein interactions?
(A) Co-immunoprecipitation
(B) Yeast two-hybrid assay
(C) Chromatin immunoprecipitation (ChIP assay)

(D) Fluorescence Resonance Energy Transfer (FRET)
(E) Tandem Affinity Purification
Ans: C

68. Which of the following hormones requires a cell membrane receptor to exert its effects?
(A) Glucocorticoid
(B) Insulin
(C) Estrogen
(D) Thyroid hormone
(E) None of the above
Ans: B

69. Which of the following statements about histones is NOT correct?
(A) Histones are basic proteins.
(B) Histones are rich in lysine and arginine residues.
(C) Histones help package DNA into nucleosomes.
(D) Histones are negatively charged at physiological pH.
(E) Histones undergo post-translational modifications.
Ans: D

70. Sickle-cell anemia is caused by_____.
(A) a decreased production of α chains of hemoglobin.
(B) a substitution of a Glu residue for a Phe residue at the β6 position.
(C) the loss of the heme group because the proximal His is oxidized.
(D) a substitution of a Val residue for a Glu residue at the β6 position.
(E) a substitution of Glu residue for His at the C-terminal of the α chain.
Ans: D

71. Which statement about insulin is correct?
(A) Insulin is composed of two polypeptides, the A chain and the B chain.
(B) Insulin contains an intrachain disulfide bond.
(C) Insulin contains interchain disulfide bonds.
(D) The A chain and the B chain of insulin are encoded by a single gene.
(E) All of the above.
Ans: E

72. An enzyme-linked immunosorbent assay requires _____.
(A) a radioactive substrate
(B) a radioactive standard for binding to the antibody
(C) a catalytic antibody
(D) an antibody that binds the protein of interest
(E) aromatic amino acids
Ans: D

73. Which of the following is an example of a heteropolysaccharide?
(A) Cellulose
(B) Chitin
(C) Glycogen
(D) Hyaluronic acid
(E) Starch

Ans: D

74. Rank the melting points of the following fatty acids from highest to lowest:
① *cis*-oleic (18:1)
② *trans*-oleic (18:1)
③ linoleic (18:2)
④ steraic (18:0)
⑤ palmitic (16:0)
(A) ⑤ > ④ > ② > ① > ③
(B) ④ > ⑤ > ② > ① > ③
(C) ③ > ② > ① > ④ > ⑤
(D) ⑤ > ③ > ② > ① > ④
(E) ③ > ② > ① > ⑤ > ④
Ans: B

75. Which of the following correctly rank the steps in erythrocyte glucose transport by GLUT1?
① The transporter reverts to initial conformation.
② Glucose binds to the transporter on one side of the membrane.
③ Glucose binding results in a conformational change, opening the binding site on the opposite side of the membrane.
④ The glucose disassociates.
(A) ①②③④
(B) ②③④①
(C) ③④②①
(D) ④①②③
(E) ④③②①
Ans: B

76. Enzyme activity in cells is controlled by which of the following?
(A) allosteric effectors
(B) covalent modifications
(C) feedback inhibition
(D) modulation of expression levels
(E) all of the above
Ans: E

77. The enzymes that catalyze glycolysis are located in the _____.
(A) cytosol
(B) endoplasmic reticulum
(C) inner mitochondrial membrane
(D) mitochondrial matrix
(E) outer mitochondrial membrane
Ans: A

78. The β cells of the islets of Langerhans secrete_____ in response to_____ glucose levels in the muscle and/or adipose tissue.
(A) glucagon; low
(B) glucagon; elevated

(C) insulin; low
(D) insulin; elevated
(E) somatostatin; elevated
Ans: D

79. Increased levels of epinephrine in the blood will _____.
(A) activate adenylate cyclase in liver and muscle cells
(B) inhibit glycolysis in the muscle cell
(C) stimulate glycogen synthesis
(D) stimulate gluconeogenesis in the muscle cell
(E) all of the above
Ans: A

80. RNA interference is a mechanism of posttranscriptional RNA-dependent _____.
(A) apoptosis
(B) chromatin-remodeling
(C) coactivation
(D) gene silencing
(E) histone methylation
Ans: D

81. In quantitative RT-PCR for SARS-CoV-2 detection, two patient samples are analyzed. Sample A has a Ct value of 22, while Sample B has a Ct value of 30. Assuming equal amplification efficiency, which statement best describes the relative viral loads in these samples?
(A) Sample A has approximately 2-fold higher viral load than Sample B
(B) Sample A has approximately 8-fold higher viral load than Sample B
(C) Sample B has approximately 100-fold higher viral load than Sample A
(D) Sample A has approximately 256-fold higher viral load than Sample B
(E) Viral loads cannot be compared using Ct values
Ans: D

82. A researcher studying epigenetic changes in colorectal cancer identifies hypermethylation of the MLH1 gene promoter, leading to loss of DNA mismatch repair function. This methylation occurs at the 5-position of cytosine residues within CpG dinucleotides. Which molecule serves as the methyl group donor for this reaction?
(A) Methylcobalamin
(B) N^5-Methyl-THF
(C) S-Adenosylmethionine
(D) Betaine
(E) Choline
Ans: C

83. Human somatic cells in culture stop dividing after approximately 50 to 60 population doublings, known as the Hayflick limit. This replicative senescence is associated with the progressive shortening of the ends of chromosomes. Which enzymatic activity is normally suppressed in most somatic cells but reactivated in cancer cells and could prevent this shortening?
(A) DNA ligase
(B) Primase
(C) Topoisomerase
(D) 3' to 5' exonuclease activity of DNA polymerase

(E) Reverse transcriptase activity of telomerase
Ans: E

84. Isoform A of LDH has K_m = 0.1 mM and k_{cat} = 500 s^{-1}. Isoform B has K_m = 0.5 mM and k_{cat} = 1000 s^{-1}. When substrate concentration is 10 mM, which statement is correct?
(A) Isoform A is more efficient because k_{cat}/K_m is higher.
(B) Isoform B is faster because both enzymes are saturated and Isoform B has higher kcat.
(C) Isoform A is faster because it reaches saturation at lower substrate concentration.
(D) Both isoforms have equal reaction rates because substrate is in excess.
(E) Efficiency cannot be compared without knowing enzyme concentrations.
Ans: B

85. Researchers used CRISPR-Cas9 to generate a gene knockout clone in mammalian cells. After transfection with Cas9 and sgRNA targeting exon 3 of a gene of interest, they observed frameshift mutations in the target region. Which DNA repair pathway is primarily responsible for generating these frameshift mutations?
(A) Base excision repair
(B) Nucleotide excision repair
(C) Mismatch repair
(D) Homology-directed repair
(E) Non-homologous end joining
Ans: E

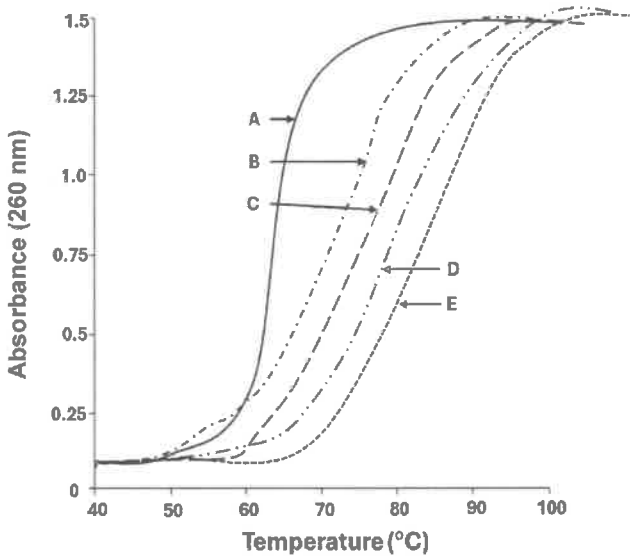
86. Mechanical strain in the heart leads to the transcriptional activation of the NPPB gene. This process involves the recruitment of specific transcription factors to the promoter region. Which of the following best describes the initial event in this biochemical signaling cascade?
(A) Activation of mechanosensitive ion channels and protein kinase signaling
(B) Direct binding of sodium ions to the DNA promoter
(C) Inhibition of RNA polymerase II
(D) Dephosphorylation of histone tails
(E) Export of mature mRNA through nuclear pores
Ans: A

87. A researcher is purifying a 150 kDa protein complex using size-exclusion chromatography. The column is calibrated with standard proteins: thyroglobulin (669 kDa), ferritin (440 kDa), aldolase (158 kDa), and ovalbumin (44 kDa). The void volume (Vo) is 8 mL and the total column volume (Vt) is 24 mL. If the target complex elutes at 14 mL, which statement is correct?
(A) The complex is eluted near the Vo, indicating it is larger than 669 kDa.
(B) The complex elutes at a volume consistent with its 150 kDa mass, confirming it is in its monomeric/native form.
(C) The complex elutes later than ovalbumin (44 kDa), suggesting it is a small peptide.
(D) The complex is completely excluded, meaning it is larger than the pore size of the gel.
(E) The elution at 14 mL indicates the column is packed incorrectly.
Ans: B

88. Glucose-6-phosphatase is a key regulatory enzyme localized in the endoplasmic reticulum membrane. In von Gierke disease, the deficiency of this enzyme prevents the hydrolysis of glucose-6-phosphate. Which of the following biochemical pathways is/are directly impaired by this deficiency during fasting?
(A) Glycogenesis only

(B) Glycogenolysis only
(C) Gluconeogenesis only
(D) Both glycogenolysis and gluconeogenesis
(E) The pentose phosphate pathway
Ans: D

89. The figure below shows the absorbance curve at 260 nm of five 100 bp double-stranded DNA fragments (samples A to E) when subjected to heat. DNA denaturation produces a hyperchromic effect. Which sample has the highest G-C content, according to this graph?



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

90. A researcher purified a specific protein and performed structural analysis using two different techniques. The data are as follows: (1) Size-Exclusion Chromatography: Under native (non-denaturing) conditions, the protein elutes at a position corresponding to a molecular weight of 200 kDa ; (2) SDS-PAGE (with β-mercaptoethanol): After boiling the sample in SDS and a reducing agent, a single sharp band appears at 50 kDa. Which of the following best describes the native structure of this protein?
(A) A monomeric 200 kDa protein that is non-specifically degraded into 50 kDa fragments during electrophoresis
(B) A homotetramer composed of four 50 kDa subunits held together by non-covalent interactions or disulfide bonds
(C) A homodimer composed of two 100 kDa subunits that were incorrectly measured during chromatography
(D) A heterotetramer composed of two 75 kDa subunits and two 25 kDa subunits.
(E) A 200 kDa protein that consists of a single polypeptide chain containing four internal protease cleavage sites
Ans: B

國立中山大學115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115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. Which statement about sound waves in the air is incorrect?
   (A) Sound waves can not travel through the vacuum space.
   (B) Louder sound travels faster than softer sound.
   (C) Sound waves can undergo interference.
   (D) The speed of sound depends on temperture.
   (E) The molecular displacements in the medium are parallel to the wave velocity.
   Ans: (B)

2. Which statement is true for an ideal gas undergoing an quasistatic adiabatic expansion?
   (A) No work is done by the gas.
   (B) The temperature of the gas decreases.
   (C) The temperature of the gas increases.
   (D) The internal energy of the gas remains constant.
   (E) The pressure of the gas remains constant.
   Ans: (B)

3. Which of the following statements regarding electromagnetic waves is incorrect?
   (A) The electric and magnetic field vectors are perpendicular to each other.
   (B) The electric field vector is perpendicular to the direction of wave propagation.
   (C) Electromagnetic waves require a material medium, such as air or water, to travel through space.
   (D) Every electromagnetic wave travels at the same constant speed regardless of its frequency.
   (E) Electromagnetic waves can be produced by the accelerating electric charges.
   Ans: (C)

4. Which of the following properties is fundamentally defined and rendered measurable by the Zeroth Law of Thermodynamics?
   (A) Work
   (B) Temperature
   (C) Mass
   (D) Heat
   (E) Internal energy
   Ans: (B)

5. Which of the following statements is true for a system undergoing a thermodynamically reversible process?
   (A) The system cannot perform work on its surroundings.
   (B) The process can only occur at absolute zero.
   (C) The total entropy of the universe decreases.
   (D) The internal energy of the system must remain constant.
   (E) The total entropy of the universe remains unchanged.
   Ans: (E)

6. According to the principles of the photoelectric effect, if the intensity of incident light is doubled while the frequency remains constant and above the threshold, what happens to the maximum kinetic energy of the emitted photoelectrons?
   (A) It remains unchanged.
   (B) It doubles.

(C) It increases by a factor of four.
(D) It decreases slightly.
(E) None of the above.
Ans: (A)

7. Which of the following statements best describes the phenomenon of quantum tunneling?
(A) A particle crossing a barrier that it classically lacks the energy to overcome.
(B) A particle gaining thermal energy to jump over a physical barrier.
(C) A particle disappearing and instantly reappearing on the other side of a gap.
(D) A particle absorbing a photon to reach a higher energy level.
(E) All of the above.
Ans: (A)

8. An object is placed in front of a concave spherical mirror at a distance less than the focal length. The resulting image is _____.
(A) virtual, erect, and larger than the object
(B) real, inverted, and smaller than the object
(C) virtual, erect, and smaller than the object
(D) real, inverted, and larger than the object
(E) none of the above
Ans: (A)

9. A conducting sphere is charged such that the electric potential on its surface is 100 volt (V) (relative to infinity). If the radius of the sphere were doubled, but the total charge on the sphere remained the same, what would be the new potential on the surface relative to infinity?
(A) 400 V
(B) 200 V
(C) 100 V
(D) 50 V
(E) 25 V
Ans: (D)

10. What is the maximum theoretical efficiency of a Carnot heat engine operating between a heat source at 500 K and a heat sink at 300 K?
(A) 20%
(B) 30%
(C) 40%
(D) 50%
(E) 60%
Ans: (C)

11. A musician can identify a 2 kilo-Hz pure tone in 8 milli-seconds. How many periods of the sound wave is this?
(A) 16
(B) 20
(C) 24
(D) 28
(E) 30
Ans: (A)

12. A pitcher throws a ball of mass m at an angle such that the ball can travel a maximum distance R. Find the initial kinetic energy K_0 of the ball. The gravitational acceleration is denoted as g. (Ignore the height of the pitcher)
(A) $K_0=2mgR$
(B) $K_0=mgR$
(C) $K_0=(1/2)\,mgR$
(D) $K_0=(1/4)\,mgR$
(E) $K_0=(1/8)\,mgR$
Ans: (C)

13. The human heart acts as a biological pump, generating pressure to circulate blood throughout the body. The human heart could pump about 80 cm^3 of blood per contraction, and this quantity is called the stroke volume. Assume that mean arterial pressure is 120 mm-Hg and the heart beat rate is 70/min. Calculate the average power output of the heart in watt (W). [1 atm=760 mm-Hg= 1.013×10^5 Pa]
(A) 2.7 W
(B) 1.5 W
(C) 3.2 W
(D) 0.8 W
(E) 4.2 W
Ans: (B)

14. Babies are naturally more sensitive to some pitched sounds differently than adults. This is due to the difference in the length of the ear canal. Calculate the fundamental resonant frequency f_1 of the 1.27 cm long ear canal of a baby. Calculate the fundamental resonant frequency f_2 of the 2.6 cm long ear canal of an adult. The answer is written in the form (f_1, f_2). The speed of sound in air is 344 m/s.
(A) (7343 Hz, 4370 Hz)
(B) (3543 Hz, 6880 Hz)
(C) (6771 Hz, 3307 Hz)
(D) (3443 Hz, 7698 Hz)
(E) (9371 Hz, 5890 Hz)
Ans: (C)

15. A hearing aid increases the sound intensity level by 20 decibels (dB). By what factor does this increase the actual sound intensity?
(A) 800
(B) 400
(C) 200
(D) 100
(E) 2
Ans: (D)

16. Which reagent can reduce *2*-butanone to *n*-butane?
(A) $NaBH_4$
(B) $LiAlH_4$
(C) PCC
(D) Zn(Hg), HCl
(E) $KMnO_4$
Ans: (D)

17. The ground state term symbol for the neutral oxygen atom (O) is relevant to discussions of reactive oxygen species or atomic oxygen in biochemical contexts. What is the ground state term symbol for O?
(A) ^{1}S
(B) ^{1}P
(C) ^{1}D
(D) ^{3}P
(E) ^{3}D
Ans: (D)

18. Which statement about the Hartree-Fock (HF) method is correct?
(A) The HF method gives the exact electronic energy because it includes full electron correlation.
(B) The HF method approximates the many-electron wavefunction as a single Slater determinant, enforcing antisymmetry.
(C) The HF method treats electron-electron repulsion only as a constant and ignores exchange effects.
(D) In the HF method, the orbitals are fixed and never optimized; only the total energy is minimized.
(E) The HF method is a semi-empirical method because it requires experimental parameters.
Ans: (B)

19. In a gravimetric determination of nickel using dimethylglyoxime (DMG), a student performed three replicate trials. In each trial, the student weighed the nickel-DMG precipitate before it had reached a constant mass (i.e., the precipitate was still slightly damp with residual solvent). Which of the following statements best describes this error?
(A) It is a random error that can be minimized by increasing the number of replicate measurements.
(B) It is a systematic error that results in a positive bias, leading to a consistently higher calculated nickel content.
(C) It is an indeterminate error that primarily affects the precision of the data set rather than its accuracy.
(D) It is a systematic error that results in a negative bias, leading to a consistently lower calculated nickel content.
(E) It is a random error caused by the inherent fluctuations in the ambient humidity of the laboratory.
Ans: (B)

20. Consider the reaction:

$$A + B \underset{k_3\ (\text{fast})}{\overset{k_1\ (\text{fast})}{\rightleftharpoons}} I \xrightarrow{k_2\ (\text{slow})} P$$

Using the steady-state approximation for the intermediate I, which expression for the rate of product formation $\frac{d[P]}{dt}$ is correct?
(A) $\frac{d[P]}{dt} = k_2[I]$, with $[I] = \frac{k_1[A][B]}{k_2}$
(B) $\frac{d[P]}{dt} = \frac{k_1 k_2[A][B]}{k_2+k_3}$
(C) $\frac{d[P]}{dt} = \frac{k_1 k_3[A][B]}{k_2+k_3}$
(D) $\frac{d[P]}{dt} = k_1[A][B]$
(E) $\frac{d[P]}{dt} = \frac{k_2[A][B]}{k_1+k_3}$

Ans: (B)

21. In instrumental analysis, the internal standard method is often preferred over external calibration when sample loss or injection variability is expected. Which of the following statements regarding the properties and selection of an internal standard is correct?
(A) The internal standard should be a substance that is already present in the original sample matrix to ensure compatibility.
(B) The primary purpose of an internal standard is to compensate for matrix effects that suppress or enhance the analyte's signal.
(C) An ideal internal standard should have a chemical structure and physical properties similar to the analyte, but its signal must be well-resolved from the analyte's signal.
(D) Adding a higher concentration of the internal standard will directly increase the sensitivity (slope) of the calibration curve for the analyte.
(E) If the instrument's sensitivity drops by 20% during a run, the internal standard method will fail because the response factor is no longer constant.
Ans: (C)

22. In clinical biochemistry and medical imaging, the color of metal-containing species used in diagnostics (e.g., contrast agents, blood analytes) often arises from d-d transitions or charge-transfer (CT) transitions. Which of the following species has a color that is not primarily due to charge-transfer?
(A) $Mn^{2+}_{(aq)}$
(B) $KMnO_4$
(C) $[Cu(NH_3)_4]^{2+}$
(D) Fe_3O_4
(E) $KFeFe(CN)_6$
Ans: (A)

23. In human blood, the bicarbonate buffer system is the primary mechanism for maintaining physiological pH (≈7.40). Which of the following changes would most strongly drive the equilibrium below to the right, increasing blood acidity?

$$CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$$

(A) Hyperventilation (rapid breathing)
(B) Hypoventilation (slow or shallow breathing)
(C) Increased renal excretion of H^+
(D) Intravenous administration of bicarbonate
(E) Decreased CO_2 concentration in blood
Ans: (B)

24. Assume a (hypothetical) planet where the temperature is so high, so the ground state of an electron in the hydrogen atom is $n = 4$. What is the ratio of the hydrogen IE on this planet to that on earth?
(A) 1:16
(B) 1:4
(C) 4:1
(D) 16:1
(E) 1:1
Ans: (A)

25. In analytical spectroscopy, different regions of the electromagnetic spectrum interact with matter by inducing specific quantum transitions. Which of the following pairs correctly matches the spectral region with its corresponding quantum transition and reflects the correct energy relationship?

(A) X-ray: transitions of valence electrons; higher energy than UV radiation.
(B) Ultraviolet-Visible (UV-Vis): transitions of inner-shell electrons; lower energy than Infrared radiation.
(C) Infrared (IR): changes in the configuration of nuclear spins; used for functional group identification.
(D) Microwave: transitions between rotational energy levels of molecules; longer wavelength than Infrared radiation.
(E) Radio wave: vibrational transitions within a molecule; used in Nuclear Magnetic Resonance (NMR) spectroscopy.
Ans: (D)

26. For an atom with one valence electron in a *p*-subshell ($l = 1, s = 1/2$), which statement about spin-orbit coupling is correct?
(A) Spin-orbit coupling splits the *p*-level into $j = \frac{1}{2}$ and $j = \frac{3}{2}$ states.
(B) The only allowed total angular momentum is $j = \frac{1}{2}$ because $s = \frac{1}{2}$.
(C) Spin-orbit coupling does not occur unless the atom is placed in an external magnetic field.
(D) The degeneracy of the $j = \frac{1}{2}$ level is 4 and the degeneracy of the $j = \frac{3}{2}$ level is 2.
(E) Spin-orbit coupling combines *n* and *l* into a new quantum number *j* while leaving *s* unchanged.
Ans: (A)

27. How many electrons can be described by the quantum numbers $n = 3, l = 1, m_l = -1$?
(A) 14
(B) 6
(C) 10
(D) 0
(E) 2
Ans: (E)

28. $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$, $\Delta H = -1.37 \times 10^3$ kJ
Which of the following statement(s) is(are) true for the combustion of ethyl alcohol as described in the above equation?
I. The reaction is exothermic.
II. The enthalpy change would be different if gaseous water were produced.
III. The reaction is not a redox reaction.
IV. The products of the reaction occupy a larger volume than the reactants.
(A) I, II
(B) I, III, IV
(C) I only
(D) III, IV
(E) I, II, III
Ans: (A)

29. From the following list of observations, choose the one that most clearly supports the conclusion that the mass of the atom is mainly located in the nucleus.
(A) the emission spectrum of hydrogen
(B) the photoelectric effect
(C) diffraction
(D) the scattering pattern of α particles by metal foil

(E) cathode "rays"

Ans: (D)

30. In UV-Vis spectroscopy, the absorption characteristics of a molecule can be altered by the presence of certain functional groups. Which of the following statements correctly describes the roles of chromophores and auxochromes?
(A) A chromophore is a saturated functional group that does not absorb radiation but increases the absorption intensity of the entire molecule.
(B) An auxochrome is a functional group, such as $-OH$ or $-NH_2$, which does not itself absorb significantly in the UV region but can cause a bathochromic shift and a hyperchromic effect when attached to a chromophore.
(C) The addition of an auxochrome to a conjugated system typically leads to a hypsochromic shift (blue shift) because it increases the energy gap between the π and π^* orbitals.
(D) Chromophores are only capable of undergoing $n \rightarrow \sigma^*$ transitions, while auxochromes are responsible for $\pi \rightarrow \pi^*$ transitions.
(E) The intensity of absorption is determined solely by the chromophore, and auxochromes only affect the wavelength of the maximum absorption.
Ans: (B)

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. The motion of a car can be described by the equation $x(t)=15t-2t^2$, where x and t are in meters and seconds, respectively. What is the acceleration of the car after 3 seconds?
(A) 27 m/s^2
(B) 12 m/s^2
(C) 4 m/s^2
(D) -4 m/s^2
(E) -12 m/s^2
Ans: (D)

32. A solid cylinder and a thin hoop of the same mass m and radius R are released from rest (at the same moment) at the top of an incline. If they roll without slipping, which object will have a greater translational velocity at the bottom of the incline?
(A) The solid cylinder.
(B) The thin hoop.
(C) They will have the same velocity.
(D) The velocity depends on the angle of the incline.
(E) None of the above.
Ans: (A)

33. Two blocks of equal mass m are connected by a spring with the spring constant k and placed on a frictionless surface. If the right block is given an initial velocity v while the left block is at rest, what is the minimum kinetic energy of the system during the subsequent oscillation?
(A) 0
(B) $(1/8)mv^2$
(C) $(1/4)mv^2$
(D) $(1/2)mv^2$
(E) mv^2
Ans: (C)

34. An ice cube is floating in a glass of pure water. The system remains at 0°C as the ice melts. How does the water level change?
(A) It increases.
(B) It decreases.
(C) It remains exactly the same.
(D) It depends on the size of the ice cube.
(E) None of the above.
Ans: (C)

35. A cylindrical water tank with a height of 1 meter (m) and a base area of 0.1 m^2 contains 50 kg of pure water. A mass of 10 kg of salt is added to the water and allowed to dissolve completely. What is the gauge pressure at the bottom of the tank? (Assume gravitational acceleration g = 10 m/s^2 for simplicity). [unit: pascal (Pa)]
(A) 400 Pa
(B) 600 Pa
(C) 4000 Pa
(D) 5000 Pa
(E) 6000 Pa
Ans: (E)

36. Two people with masses of 60 kg and 80 kg are initially at rest on a frictionless level surface, separated by a distance of 20 meter (m). They both pull on opposite ends of a massless rope to move toward one another. If the total distance between them decreases by 14 m, how far has the 80-kg person traveled?
(A) 10 m
(B) 8 m
(C) 6.4 m
(D) 6 m
(E) 3.6 m
Ans: (D)

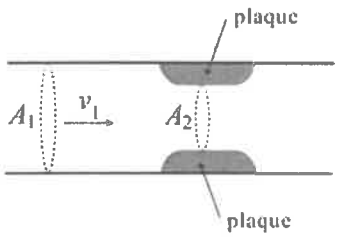
37. A pulley with a radius of 3.0 cm and a rotational moment of inertia of $I = 9.0 \times 10^{-3}$ kg·m^2 is suspended from a ceiling. A massless, non-slip rope passes over the pulley, supporting two blocks with masses of 1.0 kg and 3.0 kg. Determine the total kinetic energy of the system at the instant the 1.0 kg block reaches a speed of 1.0 m/s. [unit: joule (J)]
(A) 1.0 J
(B) 2.0 J
(C) 7.0 J
(D) 14 J
(E) 28 J
Ans: (C)

38. We would like to estimate the energy consumed to run the left ventricle. Given that the rate at which the left ventricle does mechanical work is 1.046 watt. Nevertheless, the efficiency of converting the metabolic energy into mechanical energy is approximately 25%. Calculate the energy consumed to run the left ventricle per day. [1 calorie (cal) = 4.184 joules (J)]
(A) 5.40×10^4 (cal/day)
(B) 4.18×10^4 (cal/day)
(C) 2.62×10^4 (cal/day)
(D) 8.64×10^4 (cal/day)

(E) 9.62×10^{4} (cal/day)
Ans: (D)

39. The human brain is approximately 56 cm above the heart. The average blood pressure in the major arteries near the heart is 95 mm-Hg. Assume that the density of blood is the same as that of water. What is the blood pressure in the brain in major arteries? [1mm-H_2O = 0.0736 mm-Hg]
(A) 136.2 mm-Hg
(B) 95.0 mm-Hg
(C) 53.8 mm-Hg
(D) 42.8 mm-Hg
(E) 33.2 mm-Hg
Ans: (C)

40. Atherosclerosis occurs when a deposit forms on an arterial wall, as shown in the figure. Suppose that the cross-sectional area becomes A_2/A_1=1/4, and this leads to a faster blood flow speed. The pressure in the region without plaque is P_1, and the pressure in the region with plaque is P_2. Use Bernoulli's equation to calculate the pressure drop $P_2 - P_1$. The blood density is ρ and the blood speed in the region without plaque is v_1.



(A) $-(3/2)\rho v_1^2$
(B) $-(15/2)\rho v_1^2$
(C) $-(17/2)\rho v_1^2$
(D) $-(19/2)\rho v_1^2$
(E) None of the above
Ans: (B)

41. A perfect Carnot engine operates between a hot reservoir at 800 K and a cold reservoir at 400 K. If the engine performs 200 joule (J) of work in each cycle, how much heat is exhausted to the cold reservoir in each cycle?
(A) 800 J
(B) 600 J
(C) 400 J
(D) 200 J
(E) 100 J
Ans: (D)

42. An ambulance siren emits a frequency of 620 Hz and the speed of sound is 340 m/s. Which statement below is correct?
(A) A stationary observer always hears a frequency of 620 Hz.
(B) When the ambulance moves towards a stationary observer at 30 m/s, the observer hears a frequency of 310 Hz.
(C) When the ambulance moves away from a stationary observer at 30 m/s, the observer hears a frequency of 680 Hz.
(D) When the ambulance moves towards a stationary observer at 30 m/s, the observer hears a frequency of 680 Hz.
(E) When the ambulance moves away from a stationary observer at 30 m/s, the observer hears a frequency of 310 Hz.
Ans: (D)

43. A sealed room has a volume of 50 m^3 and an initial relative humidity of 90%. How much water vapor must be removed to reduce the relative humidity to 50%? Assume the saturation vapor density is 20 g/m^3 and water density 1 kg/L. (Note: 1 L = 1 m^3).
(A) 20 mL
(B) 0.4 L
(C) 2 L
(D) 8 L
(E) 20 L
Ans: (B)

44. Material A has a specific heat of 0.03 cal/g·°C, and Material B has a specific heat of 0.09 cal/g·°C. A 3-kg block of Material A at 10°C is placed in thermal contact with a 2-kg block of Material B at 100°C. Assuming the system is isolated, what is the final equilibrium temperature?
(A) 30 °C
(B) 40 °C
(C) 50 °C
(D) 60 °C
(E) 70 °C
Ans: (E)

45. A laser beam of wavelength $\lambda = 4\times10^{-7}$ meter normally incidents on a black plate and produces a force of 1.5×10^{-5}N. The mass of the plate is 12 g and its specific heat capacity is 500 ($J\cdot kg^{-1}\cdot K^{-1}$). Assume that there is no heat loss to the surroundings. Find the rate at which the temperature of the plate rises. [unit: newton (N), kelvin (K)]
(A) 572 K/s
(B) 682 K/s
(C) 750 K/s
(D) 823 K/s
(E) 912 K/s
Ans: (C)

46. What happens to the capacitance of a parallel-plate capacitor if the distance between the two plates is doubled while keeping all other factors constant?
(A) It is halved.
(B) It remains unchanged.
(C) It doubles.
(D) It quadruples.
(E) None of the above.
Ans: (A)

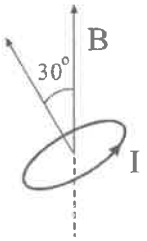
47. A solid nonconducting sphere of radius R carries a total charge Q distributed uniformly throughout its volume. At a distance $r<R$ from the center, the magnitude of the electric field is E. If the radius of the sphere were doubled to $2R$ while keeping the total charge Q distributed uniformly and the point r the same, what would be the new magnitude of the electric field?
(A) E
(B) $E/2$
(C) $E/4$
(D) $E/6$
(E) $E/8$

Ans: (E)

48. A circular coil with an area of 0.50 m^2 is placed in a uniform magnetic field that is perpendicular to the plane of the coil. The magnetic field magnitude decreases at a constant rate of 0.40 tesla/s. What is the magnitude of the induced electromotive force (EMF) in the coil?
(A) 2.00 V
(B) 0.20 V
(C) 0.40 V
(D) 0.80 V
(E) None of the above
Ans: (B)

49. The electrostatic force between two rest point charges q and Q separated by a distance r is f. If the distance between the ions is doubled while the charges remain the same, what is the new force between them?
(A) $2f$
(B) $f/2$
(C) $(q+Q)f/2$
(D) $2(q+Q)f$
(E) None of the above
Ans: (E)

50. A circular loop having a diameter of 10 cm carries a current of 0.1 ampere. The loop is placed in a magnetic field of B = 0.5 tesla with its axis inclined at 30° to the direction of the B-field as shown in the figure. Calculate the torque exerted on the current loop. [unit: newton (N)]



(A) 1.96×10^{-4} N·m
(B) 3.97×10^{-4} N·m
(C) 5.43×10^{-4} N·m
(D) 7.22×10^{-4} N·m
(E) 9.16×10^{-4} N·m
Ans: (A)

51. During ventricular fibrillation, the myocardial cells do not stop beating; instead, they fall into a state of extreme chaos and rapid twitching, which the heart cannot pump blood effectively. An Automated External Defibrillator (AED 自動體外心臟電擊去顫器) acts to reboot the heart by forcing a powerful electric current through it. The AED must generate high voltage to deliver a current of approximately 20 Amperes into the body within a short duration of about 0.01 seconds. The energy setting for a modern AED is 300 Joules. Estimate the voltage V required for this device and the average chest wall impedance R during a shock. Assuming all processes satisfy Ohm's Law.
(A) 2100 Volt, 105 Ohm
(B) 1900 Volt, 90 Ohm
(C) 1700 Volt, 85 Ohm
(D) 1500 Volt, 75 Ohm
(E) 1300 Volt, 65 Ohm
Ans: (D)

52. Which of the following is not a fundamental characteristic of laser light?
(A) high monochromaticity

(B) high energy conversion efficiency
(C) high collimation
(D) high directionality
(E) high coherence
Ans: (B)

53. A light beam of wavelength λ is travelling along a direction making an angle of 60° with a positive x-axis and 30° with a positive y-axis. Find the phase difference between two points ($\sqrt{3}$,1,2) and (0,0,0).
(A) $\sqrt{3}\pi/\lambda$
(B) $2\sqrt{3}\pi/\lambda$
(C) $3\sqrt{3}\pi/\lambda$
(D) $4\sqrt{3}\pi/\lambda$
(E) $5\sqrt{3}\pi/\lambda$
Ans: (B)

54. In the context of the Bohr model of the hydrogen atom, what happens when an electron transitions from a higher energy level to a lower energy level?
(A) A photon is emitted.
(B) The mass of the atom decreases significantly.
(C) The electron stops moving.
(D) A photon is absorbed.
(E) All of the above.
Ans: (A)

55. An electron is trapped in an one-dimensional box of finite width whose walls are perfectly rigid (infinite deep square well potential). A photon with energy E_a is emitted when the electron transitions from the $n = 4$ to $n = 2$, and a photon with energy E_b is emitted when the electron transitions from the $n = 3$ to $n = 1$. What is the ratio of E_a / E_b?
(A) 2/3
(B) 3/2
(C) 1
(D) 4/3
(E) It depends on the width of the potential well.
Ans: (B)

56. A patient is injected with a radioactive tracer that has a physical half-life of 6 hours. If the initial activity of the tracer in the patient's body is 400 MBq, what will the activity be after 24 hours? (Assume no biological clearance occurs during this time). [unit: becquerel (Bq)=1decay/second]
(A) 400 MBq
(B) 200 MBq
(C) 100 MBq
(D) 50 MBq
(E) 25 MBq
Ans: (E)

57. A drug has a half-life of 4 hours. The minimum effective concentration is 25 mg and the toxic threshold is 150 mg. If each tablet contains 100 mg, what is the dosing window to ensure the patient stays within the therapeutic range?
(A) every 2 to 4 hours

(B) every 4 to 8 hours
(C) every 8 to 12 hours
(D) every 12 to 16 hours
(E) every 16 to 24 hours
Ans: (B)

58. Consider hydrogen-like atoms (atomic number = Z) that are at excited state with some principal quantum number n. It is found that the emission spectrum has 6 different lines. Furthermore, the most energetic photon in the emission spectrum has an energy of 51 eV. Find the atomic number Z. [Hydrogen atom $E_n = -13.6/n^2$ (eV)]
(A) 5
(B) 4
(C) 3
(D) 2
(E) 1
Ans: (D)

59. According to the Beer-Lambert Law, how many half-value layers are required to reduce the intensity of X-rays to 1/80 of their original intensity? [$\log_{10} 2 = 0.301$]
(A) 4
(B) 5
(C) 6
(D) 7
(E) 8
Ans: (D)

60. Positron Emission Tomography is a highly advanced imaging technology in modern medicine. PET is primarily used to observe cellular metabolism; this is especially useful for cancer. After the isotope in the radiopharmaceutical (放射性藥物) enters the body, it migrates to the lesion site and emits a positron. As the positron moves through the tissue, it strikes an electron within the body. When the two collide, annihilation occurs, converting matter into energy and emitting two gamma rays of equal energy. The detectors then use these two rays to calculate the precise location of the lesion. Assume that both the electron and the positron carry a kinetic energy $K=0.23m_0c^2$, where m_0 is the rest mass of an electron and c is the speed of light. What is the wavelength of the gamma rays produced after a head-on collision? [Compton wavelength is $\lambda_0=h/(m_0c)$, where h is Planck's constant]
(A) $\lambda = 2.83\,\lambda_0$
(B) $\lambda = 1.62\,\lambda_0$
(C) $\lambda = 0.81\,\lambda_0$
(D) $\lambda = 0.40\,\lambda_0$
(E) $\lambda = 0.25\,\lambda_0$
Ans: (C)

61. If (S)-1-bromo-2-methylbutane undergoes radical bromination at the chiral center, is the obtained major product (or mixture of products) optically active?
(A) Yes, (S)
(B) Yes, (R)
(C) No, racemic
(D) No, due to symmetry
(E) Depends on temperature
Ans: (C)

62. How many of the following electron configurations for the species in their ground state are correct?
Ca: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$　　Br: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$　　V: [Ar] $3s^2 3d^3$
As: [Ar] $4s^2 3d^{10} 4p^2$　　P: $1s^2 2s^2 2p^6 3p^5$

(A) 1
(B) 2
(C) 3
(D) 4
(E) None of the above
Ans: (E)

63. Which of the following techniques is best for determining the molecular weight?
(A) IR
(B) UV-Vis
(C) Mass Spectrometry
(D) NMR
(E) CD
Ans: (C)

64. In the ground state, the diatomic molecule O_2 is paramagnetic due to the unpaired electrons in its molecular orbitals. How many unpaired electrons does O_2 have in its ground state?
(A) 1
(B) 2
(C) 3
(D) 4
(E) None of the above
Ans: (B)

65. What is the product of the Beckmann Rearrangement?
(A) Amine
(B) Amide
(C) Ketone
(D) Carboxylic acid
(E) Nitrile
Ans: (B)

66. Calcium fluoride (CaF_2), known as fluorite, is used in dental products (e.g., fluoride treatments and varnishes) to promote enamel remineralization and prevent caries. In its crystal structure (fluorite type), the coordination number for the Ca^{2+} cations is 8. The coordination number for the F^- anions in this crystal is ____ .
(A) 2
(B) 4
(C) 6
(D) 8
(E) 10
Ans: (B)

67. What is the rearrangement product of 3,3-dimethyl-1-butene reacting with HCl?
(A) 3-chloro-2,2-dimethylbutane

(B) 1,2-dichloro-3,3-dimethylbutane
(C) 1-chloro-3,3-dimethylbutane
(D) 2-chloro-3,3-dimethylbutane
(E) 2-chloro-2,3-dimethylbutane
Ans: (E)

68. Which of the following exhibits the correct (increasing) orders for atomic radius and ionization energy, respectively?
(A) Atomic radius: F, S, O; ionization energy: O, S, F
(B) Atomic radius: F, O, S; ionization energy: S, O, F
(C) Atomic radius: S, O, F; ionization energy: F, O, S
(D) Atomic radius: S, F, O; ionization energy: S, F, O
(E) None of the above
Ans: (B)

69. To determine the calcium carbonate ($CaCO_3$) content in a 500.0 mg solid sample, a chemist prepared two identical flasks (sample flask and blank flask), each containing exactly the same volume and concentration of hydrochloric acid (HCl). For sample flask, 500.0 mg sample was added, allowing the $CaCO_3$ to react completely with the HCl. For the blank flask, no sample was added; this flask represents the total initial amount of HCl. After the reaction completed, the acid in both flasks was titrated with 0.1000 M NaOH. The blank flask required 45.00 mL of NaOH, while the sample flask required 25.00 mL of NaOH. What is the mass of $CaCO_3$ in the sample? (Molar mass of $CaCO_3$ = 100.0 g/mol)
(A) 50.0 mg
(B) 100.0 mg
(C) 200.0 mg
(D) 250.0 mg
(E) 450.0 mg
Ans: (B)

70. In an E2 reaction, what geometric relationship must exist between the leaving group and the β-hydrogen?
(A) Syn-periplanar
(B) Gauche
(C) Anti-periplanar
(D) Forming a 90° dihedral angle
(E) Can be randomly oriented
Ans: (C)

71. A quartet and a triplet (area ratio 2:3) in ^{1}H-NMR most likey indicates the presence of a(n) ____.
(A) Ethyl group
(B) Isopropyl group
(C) *tert*-Butyl group
(D) Propyl group
(E) Vinyl group
Ans: (A)

72. A chemist uses the standard addition method to determine the concentration of copper (Cu^{2+}) in a river water sample to account for matrix interferences. Two 25.0 mL aliquots of the river water are processed as follows:

Solution A: 25.0 mL of the sample is diluted to a final volume of 50.0 mL with distilled water. The measured absorbance is 0.25.
Solution B: 25.0 mL of the sample plus 1.00 mL of a 500 ppm Cu^{2+} standard solution is diluted to a final volume of 50.0 mL. The measured absorbance is 0.50.
Assuming the absorbance is directly proportional to the Cu^{2+} concentration, what is the concentration of Cu^{2+} in the original river water sample?
(A) 5.0 ppm
(B) 10.0 ppm
(C) 20.0 ppm
(D) 25.0 ppm
(E) 40.0 ppm
Ans: (C)

73. At a certain temperature, the half-life of a zero-order reaction is 40.0 minutes. How long will it take for the reactant concentration to be reduced by 75%?
(A) 40.0 min
(B) 60.0 min
(C) 80.0 min
(D) 120.0 min
(E) 160.0 min
Ans: (B)

74. Which of the following molecules can undergo the Cannizzaro reaction?
(A) Acetaldehyde
(B) Benzaldehyde
(C) Acetone
(D) Cyclohexanone
(E) Propionaldehyde
Ans: (B)

75. An analyst uses a HPLC method to determine a pesticide residue. A 1.00 ppm standard solution of the pesticide produces a peak height (signal) of 40.0 mV. When a blank solution is injected, the standard deviation of the baseline noise is measured to be 0.20 mV. Using the common IUPAC criterion of S/N = 3, what is the Limit of Detection (LOD) for this method (assuming the signal is directly proportional to the analyte concentration)?
(A) 0.005 ppm
(B) 0.015 ppm
(C) 0.045 ppm
(D) 0.060 ppm
(E) 0.150 ppm
Ans: (B)

76. A compound with the sum formula C_3H_6O has an IR peak at 1715 cm^{-1} and only one singlet in ^1H-NMR. The compound is _____.
(A) Propionaldehyde
(B) Acetone
(C) Allyl alcohol
(D) Propylene oxide
(E) Methyl vinyl ether
Ans: (B)

77. In mass spectrometry, a molecule with one bromine atom shows M and M+2 peaks in a ratio of approximately _____.
(A) 1:1
(B) 3:1
(C) 1:3
(D) 9:6:1
(E) 1:2:1
Ans: (A)

78. Which of the following statements about the isoelectric point (pI) of amino acids is correct?
(A) At pH < pI, it is negatively charged.
(B) Solubility is highest at pH = pI.
(C) At pH = pI, the net charge is zero.
(D) All amino acids have a pI of 7.
(E) pI is independent of the side chain.
Ans: (C)

79. ^{19}F-NMR spectroscopy is increasingly used in medicine for non-invasive imaging and monitoring of fluorinated pharmaceuticals (e.g., fluorinated anesthetics, anticancer drugs like 5-fluorouracil, or perfluorocarbons as artificial blood substitutes/oxygen carriers). Consider the compound PCl_2F_3 (a model phosphorus chlorofluoride with trigonal bipyramidal geometry, relevant to understanding dynamic processes in fluorinated compounds or analogs in bioinorganic/organofluorine chemistry). In a solution of PCl_2F_3 in isopentane at -22°C, how many peaks are observed in the ^{19}F-NMR spectrum?
(A) 0
(B) 1
(C) 2
(D) 3
(E) 4
Ans: (B)

80. Consider the reaction $CO_2(g) + 2H_2O(g) \rightarrow CH_4(g) + 2O_2(g)$ with $\Delta H° = 803$ kJ. Which of the following options 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)

81. Metal carbonyl complexes are studied in the context of potential therapeutic CO delivery in medicine as carbon monoxide-releasing molecules (CORMs). Predict which CO ligand in the following complexes has the highest CO stretching frequency (νCO in IR spectroscopy).
(A) bridging CO of $Fe_2(CO)_9$
(B) $[Mn(CO)_6]^+$
(C) $(CO)_5Cr{=}C(OMe)Ph$ (a Fischer carbene complex)
(D) $[V(CO)_6]^-$
(E) *fac*-$Cr(CO)_3(NH_3)_3$
Ans: (B)

82. Bio-organometallic carbonyl complexes can release CO *in vivo* for therapeutic effects, such as reducing inflammation, pain, and oxidative stress. Which property makes a metal carbonyl complex suitable as a therapeutic CORM?
(A) Extreme kinetic inertness, preventing CO release
(B) The ability to release CO under physiological conditions (triggered by light or ligand exchange)
(C) High toxicity due to rapid metal dissociation
(D) Strong irreversible metal-protein binding
(E) The presence of only organic ligands and no metal ions
Ans: (B)

83. Which point group best describes the symmetry of the staggered conformation of ferrocene (an organometallic scaffold sometimes explored in drug design)?
(A) D_{5d}
(B) D_{5h}
(C) S_5
(D) C_{5v}
(E) D_5
Ans: (A)

84. In medicinal chemistry, the stereochemistry of coordination complexes can strongly influence their biological activity. Consider the complex $[Co(en)_2Cl_2]^+$, where en = ethylenediamine, a ligand often used in metal-based drug design. How many stereoisomers are possible for the complex $[Co(en)_2Cl_2]^+$? For this question, treat the chelate ring formed by the en ligand as planar.
(A) 1
(B) 2
(C) 3
(D) 4
(E) 5
Ans: (C)

85. A sample solution is analyzed using a UV-Vis spectrophotometer. Under specific experimental conditions, 80.0% of the incident light is either absorbed or scattered and fails to reach the detector. What is the absorbance (A) of this solution (given log2≒ 0.30; log4≒ 0.60; log6≒ 0.78; log8≒0.90)?
(A) 0.100
(B) 0.200
(C) 0.700
(D) 0.800
(E) 0.400
Ans: (C)

86. Rhenium complexes, including those with metal-metal bonds, are widely studied in medicinal inorganic chemistry for applications in nuclear medicine (e.g., ^{186}Re and ^{188}Re radioisotopes for cancer radiotherapy) and as potential redox-active therapeutic agents. When $[Re_2Cl_8]^{2-}$ is reduced by one electron, what is the metal-metal (Re-Re) bond order of the new complex?
(A) 3
(B) 3.5
(C) 4
(D) 4.5
(E) None of the above

Ans: (B)

87. In infrared (IR) spectroscopy, a specific absorption peak is observed at a wavelength of 2.50 μm. What are the corresponding wavenumber in cm^{-1} and frequency in Hz for this radiation (Speed of light, $c=3.00\times10^8$ m/s)?
(A) 400 cm^{-1} and 1.20×10^{13} Hz
(B) 4000 cm^{-1} and 1.20×10^{14} Hz
(C) 4000 cm^{-1} and 7.50×10^{14} Hz
(D) 2500 cm^{-1} and 1.20×10^{14} Hz
(E) 40000 cm^{-1} and 1.20×10^{15} Hz
Ans: (B)

88. Choose the correct statement.
(A) Exothermic reactions are always spontaneous.
(B) A reaction that exhibits a negative value of ΔS may be spontaneous.
(C) Free energy is independent of temperature.
(D) At constant pressure and temperature, a decrease in free energy ensures an increase in the entropy of the system.
(E) None of the above.
Ans: (B)

89. EPR spectroscopy is used in medicine to study radical species and metal ions with unpaired electrons. Which metal center is EPR active under physiological conditions?
(A) Cu(I)
(B) Fe(III)
(C) Zn(II)
(D) Mg(II)
(E) Pt(II)
Ans: (B)

90. Manganese-based complexes are sometimes studied as potential MRI contrast agents because Mn^{2+} is paramagnetic. For the $[Mn(H_2O)_6]^{2+}$ complex, the ligand field stabilization energy (LFSE) is ____.
(A) 0 Dq
(B) 2 Dq
(C) 4 Dq
(D) 6 Dq
(E) 8 Dq
Ans: (A)

國立中山大學115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

- **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115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)

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. Choose the most appropriate answer for each question.

1. The director of the Taiwan Movement Disorders Society (TMDS) said exercise is essential for Parkinson's patients. He points out that _____ is more important than intensity or duration.
   (A) concentration (B) consistency (C) communication
   (D) confirmation (E) confrontation
   Ans: (B)

2. "GPT-4 is _____. Like humans, it makes mistakes, despite often showing brilliance," said the author of *The AI Revolution in Medicine* (p. 164).
   (A) formidable (B) faithful (C) fateful
   (D) fearful (E) fallible
   Ans: E

3. As modern lifestyles increasingly compress sleep time, the findings of the research project _____ a simple but powerful message: protecting your sleep may help protect your heart.
   (A) underscores (B) tones down (C) understates
   (D) denounces (E) kicks off
   Ans: A

4. Penicillin saved the lives of Allied soldiers in the Second World War who would otherwise _____ from sepsis and made complex surgeries safe.
   (A) die (B) be dead (C) have died
   (D) be dying (E) have dyed
   Ans: C

5. Due to the constantly evolving nature of influenza viruses, WHO continues to stress the importance of year-round global _____ to detect and monitor emerging or circulating influenza viruses.
   (A) trade (B) market (C) surveillance
   (D) vaccination (E) war
   Ans: C

6. The zoo said it would ask the Veterinary Medical Teaching Hospital at National Pingtung University of Science and Technology to conduct _____ to determine the cause of Ali the elephant's death.
   (A) an autopsy (B) a biopsy (C) a biogenesis
   (D) an aliment (E) an alienation
   Ans: A

7. In 2023 alone, the WHO estimated that 1.25 million people died from TB, while another 10.8 million _____ the disease.
   (A) caught up (B) became infected (C) converted
   (D) contacted (E) contracted
   Ans: E

8. According to a recent article in February 2026 Diabetologia, aerobic activities decreased glucose more during exercise sessions than anaerobic exercise and yielded a larger acute hypoglycemia risk.
_____, anaerobic activities provide better 24-hour glycemic control.
(A) Conversely (B) Therefore (C) Properly
(D) Similarly (E) Finally
Ans: A

9. The 2025 Nobel Prize in Physiology or Medicine has been awarded in part to Dr Shimon Sakaguchi, Professor emeritus of Kyoto University. Professor Kawamoto, the Director of the Institute for Life and Medical Sciences, remarks: "Dr. Sakaguchi's strong commitment to achieving his research goals, in spite of at times facing daunting **headwinds**, no doubt has led to his great achievement." What does "**headwinds**" mean here?
(A) headaches (B) obstacles (C) environmental issues
(D) financial difficulties (E) supervisors
Ans: B

10. National Doctors' Day in Taiwan is celebrated annually on November 12 to honor the dedications and contributions of medical professionals to public health. It _____ the birthday of Dr. Sun Yat-sen, who had been a qualified medical doctor before becoming a revolutionary leader.
(A) coincides with (B) sees to (C) comes across
(D) holds back from (E) deviates from
Ans: A

11. The famous English novelist Jane Austen published four novels anonymously in her lifetime and two more after her death. Her _____ reputation has never stopped growing. People around the world celebrated the 250th anniversary of her birth in 2025.
(A) menopause (B) postpartum (C) postnuptial
(D) posthumous (E) posthuman
Ans: D

12. The Harvard anesthesiologist Henry Beecher in his article entitled "Ethics and Clinical Research" published in the New England Journal of Medicine in 1966 _____ doctors and biomedical scientists who had patients as experimental subjects without their consent.
(A) veils (B) consipires (C) conceals
(D) compliments (E) blows the whistle on
Ans: E

13. "The smell of the dissection room ____ deep into every single fibre of cotton or polyester and never, ever leaves. It hits you afresh" states Adam Kay, the writer and former junior doctor in his bestselling memoir, *Undoctored: The Story of a Medic Who Ran out of Patients* (2022).
(A) performs (B) sinks (C) wrings out
(D) drains (E) permeates
Ans: E

14. "Wear the white coat with dignity and pride—it is an honor and _____ to get to serve the public as a physician, " said Bill H. Warren, MD.
(A) performance (B) preference (C) privilege
(D) personality (E) position

Ans: C

15. Had the attending physician been notified earlier, the patient's condition ___ so rapidly.
(A) wouldn't deteriorate
(B) hadn't deteriorated
(C) wouldn't have deteriorated
(D) didn't deteriorate
(E) would have been deteriorating
Ans: C

16. A medication is described as "contraindicated" when it _____.
(A) is proven effective in randomized trials
(B) should not be used because it may cause harm
(C) must be taken with food to avoid nausea
(D) is available only in intravenous form
(E) requires a gradual dose increase
Ans: B

17. The patient was told to take the antibiotic exactly as prescribed; otherwise, the infection might _____.
(A) relapse (B) regress (C) remit
(D) collapse (E) recede
Ans: A

18. The hospital implemented a new protocol to minimize "nosocomial infections," meaning infections acquired _____.
(A) through contaminated food
(B) during international travel
(C) in a healthcare setting
(D) from inherited genetic mutations
(E) exclusively from insect bites
Ans: C

19. Choose the sentence with the most appropriate formal tone for a medical report.
(A) The patient felt kinda dizzy and didn't sleep well.
(B) The patient reports intermittent dizziness and poor sleep quality.
(C) The patient was super tired and sort of light-headed.
(D) The patient was dizzy, like, a lot of the time.
(E) The patient was not okay and had bad sleep.
Ans: B

20. The most significant risk factor for the development of pressure ulcers in a bedridden patient is ___.
(A) infrequent repositioning.
(B) a high-protein diet.
(C) the use of a specialized mattress.
(D) adequate skin hydration.
(E) regular active range-of-motion exercises.
Ans: A

21. A first-year medical student is learning how to take a patient's history. Which of the following questions is an example of a "leading question" that should generally be avoided?
(A) "Can you describe the pain in your chest?"
(B) "When did you first notice this rash?"
(C) "The pain doesn't radiate to your left arm, does it?"
(D) "What were you doing when the dizziness started?"
(E) "On a scale of 1 to 10, how would you rate your pain?"
Ans: C

22. A new mother is concerned because her baby has a yellowish tint to the skin. The pediatrician explains that this is physiological _____, a common condition in newborns caused by the immaturity of the infant's liver enzymes.
(A) bile duct (B) jaundice (C) anemia
(D) arthritis (E) pneumonia
Ans: B

23. A patient's blood work shows a high concentration of low-density lipoprotein (LDL) and a low concentration of high-density lipoprotein (HDL). This profile is a well-established risk factor for atherosclerosis. The role of LDL in this process is primarily to _____ cholesterol in the walls of arteries.
(A) remove (B) transport (C) deposit (D) annihilate (E) unsaturate
Ans: C

24. In the management of a patient with status asthmaticus, a doctor administers supplemental oxygen, nebulized albuterol (a beta-2 agonist), and intravenous corticosteroids. The primary mechanism of action of the corticosteroids in this acute setting is to reduce airway _____ and prevent late-phase reaction.
(A) infantry (B) histamine (C) inflammation (D) stress (E) secretions
Ans: C

25. The antibiotic vancomycin is often referred to as a "drug of last resort" for serious Gram-positive infections. Its bactericidal effect is primarily achieved by _____ cell wall synthesis by binding to D-Ala-D-Ala precursors.
(A) herborizing (B) resorting (C) habitating (D) inhibiting (E) exhibiting
Ans: D

26. A medical study finds a strong statistical association between daily coffee consumption and a reduced risk of developing Parkinson's disease. However, the study cannot prove that coffee drinking causes the reduction in risk. By which epidemiological maxim is this limitation of the study best summarized?
(A) Correlation does not imply causation. (B) The dose makes the poison.
(C) The population is the patient. (D) A random sample is the best sample.
(E) The plural of anecdote is not data.
Ans: A

27. Hospitals increasingly rely on interdisciplinary teams to improve patient outcomes. Effective teamwork depends not only on individual expertise but also on shared mental models and clear role definitions. _____ When roles are poorly specified, tasks may be duplicated or neglected, and responsibility becomes diffuse. Communication failures are especially likely

during handoffs, when critical details can be lost between shifts. Structured tools, such as SBAR, can reduce omissions by standardizing what information is conveyed.

(A) Consequently, a hospital cafeteria should offer diverse meal options.
(B) For instance, a pharmacist may focus on medication safety while a nurse monitors bedside changes.
(C) However, laboratory machines are more accurate than clinicians.
(D) In contrast, patients rarely ask questions during consultations.
(E) Therefore, randomized trials should always be double-blinded.

Ans: B

28. Public health messaging aims to change behavior at a population level, but it must avoid oversimplifying risk. If messages are alarmist, audiences may become desensitized or distrustful; if messages are too reassuring, people may underestimate danger. _____ During outbreaks, uncertainty is inevitable, yet communicators can build trust by explaining what is known, what is unknown, and what actions are recommended.

(A) A balanced message should be accurate, actionable, and transparent about limitations.
(B) A balanced message should always promise zero risk.
(C) A balanced message should avoid mentioning evidence.
(D) A balanced message should replace scientific terms with jokes.
(E) A balanced message should be delivered only to physicians.

Ans: A

29. In research ethics, informed consent is not merely a signed document; it is a process of communication. Participants should understand the purpose of the study, potential risks and benefits, and their right to withdraw without penalty. _____ This is particularly important when participants are vulnerable due to illness, stress, or limited health literacy.

(A) Therefore, consent is valid only when comprehension is assessed and questions are welcomed.
(B) Therefore, consent is unnecessary if the study is interesting.
(C) Therefore, consent should be replaced by verbal persuasion.
(D) However, consent is identical to coercion and questions are answered.
(E) Therefore, consent is irrelevant in clinical trials.

Ans: A

II. Close Test: Questions 30-34 are based on the following passage. For each question, choose the most appropriate answer that fills in the blank in its context.

Precision medicine is an **30** approach to patient care that allows doctors to select treatments that are most likely to help patients based on a genetic or molecular understanding of their disease. While this field has made **31** strides in oncology, its implementation remains uneven across global healthcare systems. Ethical concerns often arise regarding data privacy and the potential for genetic discrimination, suggesting that the scientific benefits cannot be viewed in **32** from the legal and social frameworks that govern them. Furthermore, researchers must ensure that the datasets used to train diagnostic algorithms are diverse, as a lack of representation can lead to **33** outcomes for marginalized populations. As we move forward, the medical community must **34** equity to ensure that the fruits of biotechnological innovation are accessible to all.

30. (A) archaic (B) emerging (C) stagnant (D) uniform (E) redundant
Ans: B

31. (A) marginal (B) superficial (C) significant (D) trivial (E) negligible
Ans: C

32. (A) isolation (B) tandem (C) accordance (D) collaboration (E) conjunction
Ans: A

33. (A) optimal (B) desirable (C) impartial (D) transparent (E) skewed
Ans: E

34. (A) debunk (B) alleviate (C) pacify (D) prioritize (E) obfuscate
Ans: D

III. Discourse Structure: Questions 35-38.
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.

Type 2 Diabetes Mellitus (T2DM) has reached epidemic proportions globally, with over 800 million people living with the condition as of the mid-2020s. Unlike Type 1 diabetes, which is an autoimmune condition, Type 2 is characterized by insulin resistance. **35** As a result, the pancreas works harder to produce more insulin until it can no longer keep up, leading to hyperglycemia (high blood sugar).

The modern lifestyle—marked by sedentary behavior and the consumption of ultra-processed foods—is a primary driver of this trend. **36** AI-driven "digital twins" now allow doctors to simulate how a specific patient's body might react to different diets or medications like Metformin or GLP-1 agonists before they are even prescribed.

37 High glucose levels act like "shards of glass" in the blood, damaging delicate capillaries in the eyes (retinopathy), kidneys (nephropathy), and nerves (neuropathy). **38** Through weight loss and 150 minutes of weekly aerobic exercise, many individuals can achieve remission, effectively halting the progression of the disease without lifelong reliance on exogenous insulin.

(A) This means the body's cells do not respond effectively to insulin, the hormone responsible for moving glucose (sugar) from the bloodstream into the cells for energy.
(B) Management in 2026 emphasizes early detection during the "prediabetes" stage, where blood sugar is elevated but not yet at diabetic levels.
(C) However, 2026 has seen a shift toward P4 Medicine: Predictive, Preventive, Personalized, and Participatory.
(D) Untreated hyperglycemia causes systemic damage.

35. Ans: A

36. Ans: C

37. Ans: D

38. Ans: B

IV. Reading comprehension: Questions 39-50.

Passage 1 (Questions 39-41)

A research team evaluated a new checklist intended to reduce medication errors during hospital discharge. Before the checklist was introduced, clinicians often relied on memory to reconcile prescriptions, which increased the likelihood of omissions and duplications. The checklist required verification of drug names, dosages, indications, and potential interactions, as well as confirmation that patients understood how and when to take each medication. After six months, the team reported fewer documented discrepancies in discharge summaries. Nevertheless, the researchers cautioned that documentation may not perfectly reflect real-world adherence: some patients left the hospital with correct instructions but later altered schedules due to side effects, cost, or misunderstanding. The team recommended combining the checklist with follow-up calls and simplified written instructions to strengthen continuity of care.

39. The checklist was primarily designed to _____.
(A) reduce viral transmission in hospitals
(B) alleviate hospital cafeteria complaints
(C) reduce surgical complications during operations
(D) reduce diagnostic delays in emergency rooms
(E) minimize medication errors at discharge
Ans: E

40. Why did the researchers caution against overinterpreting the documentation results? It is because _____.
(A) adherence can change after discharge for multiple reasons
(B) fewer discrepancies always imply perfect adherence
(C) checklists eliminate the need for patient education
(D) discharge summaries are never written in hospitals
(E) side effects cannot affect medication schedules
Ans: A

41. The team recommended adding follow-up calls mainly to _____.
(A) replace written instructions entirely
(B) increase hospital admission rates
(C) improve continuity of care and support correct medication use
(D) discourage patients from reporting side effects
(E) reduce the number of prescribed medications to zero
Ans: C

Passage 2 (Questions 42-45)

Antimicrobial resistance (AMR) represents one of the most pressing existential threats to modern medicine. AMR occurs when bacteria, viruses, fungi, and parasites evolve over time and no longer respond to medicines, making infections harder to treat and increasing the risk of disease spread, severe illness, and death. The primary driver of this phenomenon is the persistent misuse and overuse of antimicrobials in both human healthcare and agricultural sectors.

In 2026, the clinical focus has shifted toward "Stewardship Programs," which aim to optimize the use of existing drugs while incentivizing the development of novel antibiotics. Without effective antimicrobials, the success of major surgery and cancer chemotherapy would

be compromised. Furthermore, the global nature of trade and travel means that a resistant strain emerging in one region can rapidly become a pandemic concern. Healthcare providers are now increasingly relying on rapid diagnostic tests to differentiate between viral and bacterial infections before prescribing medication, thereby **mitigating** the acceleration of resistance.

42. What is the goal of "Stewardship Programs"?
(A) To ban all antibiotics
(B) To increase agricultural production
(C) To optimize current drug use
(D) To lower the cost of surgery
(E) To develop herbal alternatives
Ans: C

43. Why is the success of cancer chemotherapy threatened by AMR?
(A) Chemotherapy causes bacteria to grow.
(B) Chemotherapy requires effective antibiotics to manage secondary infections.
(C) Chemotherapy is a type of antimicrobial.
(D) AMR makes chemotherapy drugs toxic.
(E) AMR prevents the growth of cancer cells.
Ans: B

44. The word "**mitigating**" in the text most nearly means____.
(A) ignoring (B) lessening (C) enhancing
(D) observing (E) advocating
Ans: B

45. How does global trade affect AMR?
(A) It facilitates the rapid spread of resistant strains.
(B) It provides better medicine.
(C) It reduces the need for antibiotics.
(D) It increases the price of diagnostics.
(E) It restricts the development of new drugs.
Ans: A

Passage 3 (Questions 46-50)

Big data are large data sets, which include information both publicly available and also from the private sector, used by companies to gain further insights into performance, such as innovation, promotion and customer satisfaction. According to The Royal Society, big data is believed to influence the business world to such an extent that it is known as 'the new oil', whose impacts on society are as huge as those of carbon emissions.

As the amount of data gathered from around the world has become **unprecedented**, coupled with the increase in the number of electronic devices per person, it is crucial to protect personal information. Data protection and privacy not only involve how data is retrieved, but also how it is stored, shared and later put to use. As stated by Privacy International, though a consumer may initially consent to access of their data, once big data analytics generate this isolated information through algorithms and then combine it in larger data sets, the eventual use of this data is not always explicitly stated. Data misuse, in addition to excessive data collection and data breaches, raise ethical issues such as discrimination and misinformation, and substantial security risks such as fraud and identity theft.

Since the millennium, several steps have been taken to ensure data is handled appropriately. The introduction of laws such as the Data Protection Act and the General Data Protection Regulation (GDPR), in addition to initiatives put forward by the Information Commissioner's Office (ICO) can assist organizations with data protection compliance and also help individuals understand how they are affected by the decisions a company makes. Furthermore, guides such as the Data Ethics Framework and the National Statistician's Data Ethics Advisory Committee promote responsible data use and enable companies, governing bodies and researchers to consider the ethics behind their use of the data collected. Finally, tools such as Cloud Edge Secure Access and Attribute Exchange provide secure environments to access and share data, together with data **anonymisation**, which requires that identities are removed or distorted in such a way that they cannot be revealed.

Despite these measures, more needs to be done to protect privacy in digitalized world. A recent Digital and Consumer Trends survey revealed that only a quarter of UK residents are worried about their data. This lack of concern could be due to scarce understanding of how it is uploaded, processed and shared. In addition, although websites display a privacy policy, users rarely intently study the often lengthy and complex terms and conditions. Thus, it is vital that the scope of an individual's data, from how it is collected and utilized to how it affects the individual, is transparent, and that companies commit to ensuring data is sufficiently safeguarded by allowing individuals to engage with the system, which is where governments play a key role, according to Deloitte, by shaping policies that are as sophisticated as the technology, at the same pace as the rate of change. Overall, big data should lead to enhanced efficiency, productivity, and ultimately happier customers, and not bigger problems for society. (by C. Watts (2022))

46. Which statement is true according to his passage?
(A) Big data is simply large amounts of data collected and open to the public.
(B) "Big data" is termed as "the new oil" because it emits carbon as huge as oil does.
(C) Data protection only concerns the retrieval of the data sources.
(D) Big data is valuable information available that can be used by companies to assess how well they perform and how they could improve.
(E) The advantage of data leveraging is meeting customer needs.
Ans: D

47. What is the meaning of "**unprecedented**" in the second paragraph?
(A) increasing　(B) enormous　(C) unparalleled
(D) scarce　(E) unscrupulous
Ans: C

48. What is data anonymisation?
(A) coding identities
(B) removing identities
(C) confirming identities
(D) maintaining original identities
(E) faking identities
Ans: B

49. Why are so few UK residents concerned about how their data is used?
(A) There is a lack of understanding surrounding data.
(B) Their data is not generally used.
(C) They have implicit confidence in the uses of their data.

(D) The privacy policies have been succinctly written for the ease of reading.
(E) Data has been safeguarded by approprite measures.
Ans: A

50. Which is NOT mentioned in the passage regarding what companies must commit to moving forward?
(A) Transparency of the scope of using peronal data.
(B) They should comply with the policies.
(C) They should specify how data may affect the individuals.
(D) Ethical issues should be taken into consideration.
(E) They need to enact policies that are as sophisticated as the technology.
Ans: E