110學年度 學士後醫學系招生考試

普通生物及生化概論試題封面

考試開始鈴響前，請勿翻閱本試題！

★考試開始鈴響前，請注意：

一、除准考證、應考文具及一般手錶外；行動電話、穿戴式裝置及其他物品
均須放在臨時置物區。

二、請務必確認行動電話已取出電池或關機，行動電話及手錶的鬧鈴功能必
須關閉。

三、就座後，不可擅自離開座位或與其他考生交談。

四、坐定後，雙手離開桌面，確認座位號碼、答案卡號碼與准考證號碼相
同，以及抽屜中、桌椅下或座位旁均無非考試必需用品。如有任何問
題，請立即舉手反應。

五、考試開始鈴響前，不得翻閱試題本或作答。

六、考試全程不得吃東西、喝水及嚼食口香糖。

七、違反上述規定，依「筆試規則及違規處理辦法」議處。

★作答說明：

一、考試時間：100分鐘。

二、本試題（含封面）共 **16** 頁，如有缺頁或毀損，應立即舉手請監試人員
補發。

三、本試題共 90 題，皆為單選題，共計 150 分；每題答錯倒扣，不作答不
計分。

四、答題依題號順序劃記在答案卡上，寫在試題本上無效；答案卡限用 2B
鉛筆劃記，若未按規定劃記，致電腦無法讀取者，考生自行負責。

五、試題本必須與答案卡一併繳回，不得攜出試場。

Choose one best answer for the following questions

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

1. The formation of new species occurred in populations that are geographically isolated from one another is _____.
   (A) peripatric speciation   (B) sympatric speciation   (C) allopatric speciation
   (D) parapatric speciation   (E) artificial speciation

2. If a species contains 23% adenine in its genome, what is the percentage of guanine it would contain?
   (A) 23%   (B) 46%   (C) 25%   (D) 44%   (E) 27%

3. Several butterfly species that are edible to birds have very similar color patterns to the generally inedible Monarch butterfly. This is best described as an example of _____.
   (A) Batesian mimicry   (B) Müllerian mimicry   (C) crypsis
   (D) aposematic coloration   (E) subterfuge

4. Which description about the status of action potential of voltage-gated Na^+ and K^+ channels is **FALSE**?
   (A) resting state: both Na^+ and K^+ channels close
   (B) depolarization: some Na^+ channels open and K^+ channels close
   (C) rising phase of action potential: both Na+ and K+ channels open
   (D) falling phase of action potential: Na^+ channels close and K^+ channels open
   (E) None of the above

5. In vertebrates with four-chambered hearts, the _____ receives oxygenated blood directly from the _____.
   (A) right ventricle, lungs   (B) right ventricle, right atrium
   (C) left atrium, left ventricle   (D) left ventricle, left atrium
   (E) left ventricle, lungs

6. Which description about the endocrine system is **FALSE**?
   (A) Epinephrine synthesized from tyrosine is secreted from adrenal medulla.
   (B) Posterior pituitary synthesizes and secrets antidiuretic hormone (ADH) and oxytocin.
   (C) Parathyroid hormone (PTH) raises blood Ca^{2+} level by stimulating kidneys and bones.
   (D) Glucocorticoids increase blood glucose and suppress immune system in long-term stress response.
   (E) None of the above

7. Which description about digestive system is **FALSE**?
   - (A) Pantothenic acid, a component of coenzyme A, causes fatigue in deficiency.
   - (B) Magnesium, an enzyme cofactor, causes nervous system disturbance in deficiency.
   - (C) Cholecystokinin (CCK) stimulates the release of enzyme from pancreas.
   - (D) Leptin, produced by adipose tissue, stimulates appetite.
   - (E) None of the above

8. Which description about cyclic AMP (cAMP) is **FALSE**?
   - (A) It is formed from ATP by phosphodiesterase.
   - (B) It activates protein kinase A.
   - (C) It regulates the activity of synaptic ion channels.
   - (D) It regulates the expression of *LacZ (ß-*galactosidase*)* in *E. coli.*
   - (E) None of the above

9. Which ion in plants is **NOT** matched with its function?
   - (A) Zn^{2+} -- water balance
   - (B) K^+ -- stomata operation
   - (C) Fe^{3+} -- chlorophyll synthesis
   - (D) Mg^{2+} -- component of the chlorophyll
   - (E) None of the above

10. Which one is **NOT** a common model organism in developmental genetics?
    - (A) *Mus musculus*
    - (B) *Caenorhabditis elegans*
    - (C) *Cinnamomum camphora*
    - (D) *Arabidopsis thaliana*
    - (E) None of the above

11. During the local inflammatory response, what chemical is released by mast cells that increase capillary permeability?
    - (A) proteases
    - (B) heparin
    - (C) histamine
    - (D) IgE
    - (E) complement

12. If the smooth endoplasmic reticulum was removed from the cell, which of the following processes would be mostly affected?
    - (A) protein synthesis
    - (B) packaging proteins
    - (C) secreting proteins
    - (D) lipid synthesis
    - (E) transporting proteins

13. Blockage of the common bile duct would affect _____.
    - (A) starch digestion
    - (B) cellulose digestion
    - (C) lipid digestion
    - (D) protein digestion
    - (E) nucleotide digestion

14. Which bone belongs to the appendicular skeleton?
    - (A) skull
    - (B) vertebral column
    - (C) rib cage
    - (D) femur
    - (E) sternum

15. A patient has a blood pressure of 120/75, a pulse rate of 50 beats/min, a stroke volume of 60 mL/beat, and a respiratory rate of 25 breaths/min. This person's cardiac output per minute will be _____.

    (A) 1,000 mL   (B) 1,500 mL   (C) 3,000 mL   (D) 4,500 mL   (E) 7,200 mL

16. Which of the following cell conditions involves reverse transcriptase activity?

    (A) replicate DNA lagging strand   (B) replicate DNA leading strand

    (C) replicate viral RNA   (D) replicate DNA in SV40 virus

    (E) replicate mRNA

17. Which of the following chemicals is allosteric activator of carbamoyl phosphate synthetase I?

    (A) *N*-Acetylglutamate   (B) Citrulline   (C) Ornithine

    (D) Aspartate   (E) Glutamine

18. Which of the following metabolites is produced by uracil degradation?

    (A) Uric acid   (B) β-Alanine   (C) Carbamoyl phosphate

    (D) β-Aminoisobutyrate   (E) Ammonia

19. The 5′→3′ exonuclease activity of *E. coli* DNA polymerase I is involved in _____ during DNA replication.

    (A) proofreading   (B) removal of RNA primers

    (C) sealing of nick   (D) formation of Okazaki fragments

    (E) formation of a nick at the origin

20. Glutamate is metabolically converted to α-ketoglutarate and NH_4^+ in mitochondria matrix of hepatocyte by a process described as _____.

    (A) hydrolysis   (B) transamination   (C) oxidative deamination

    (D) one-carbon transfer   (E) thiolysis

21. Posttranslational modification of proteins may include the followings **EXCEPT**

    (A) adding disulfide bridge.

    (B) adding cofactors and prosthetic groups.

    (C) cleavaging the nascent peptide.

    (D) adding a signal sequence at the N-terminus.

    (E) adding oligosaccharides in endoplasmic reticulum.

22. Which one of these characteristics is **FALSE** for the α-helix in protein?
    (A) There are 3.6 amino acids per turn.
    (B) There is a requirement for glycine in every third amino acid residue.
    (C) A H-bond forms between the carbonyl oxygen of the nth amino acid residue and the amido proton of the $(n + 4)^{th}$ amino acid residue.
    (D) Proline is typically not found in the α-helix.
    (E) A single turn of the helix extends about 5.4 Å along the long axis.

23. Which form of tetrahydrofolate is used in the enzymatic transfer of formyl group, as in purine synthesis and in the formation of formyl-methionine in prokaryotes?
    (A) N^5-Formyl-tetrahydrofolate
    (B) N^5-Formimino-tetrahydrofolate
    (C) N^{10}-Formyl-tetrahydrofolate
    (D) N^5, N^{10}-Methenyl-tetrahydrofolate
    (E) Tetrahydrofolate

24. Hydroxylation of proline residues in collagen is catalyzed by proly1 4-hydroxylase. The enzymatic action of prolyl 4-hydroxylase requires: ① Ascorbic acid; ② α-Ketoglutarate; ③ Cu^{2+}; ④ ATP; ⑤ Fe^{2+}
    (A) ①,②,③   (B) ①,②,④   (C) ①,②,⑤   (D) ①,③,④   (E) ①,④,⑤

25. Which of the following reactions requires vitamin K?
    (A) carboxylation of glutamate
    (B) ADP ribosylation of tyrosine
    (C) methylation of arginine
    (D) oxidation of cysteine
    (E) amidation of C-terminus of the polypeptide

26. Which of the following proteins plays a dual role in modulating protein folding and conformation of steroid hormone receptors in eukaryotic cells?
    (A) CroES-CroEL complex   (B) Hsp60   (C) Prefoldin
    (D) Hsp90   (E) Chaperonin

27. By completing β-oxidation of fatty acid with odd number of carbons, _____ will enter the citric acid cycle. ① acetyl-CoA; ② malate; ③ α-ketoglutarate; ④ succinyl-CoA
    (A) ①,②   (B) ①,③   (C) ①,④   (D) ②,③   (E) ③,④

28. Which of the following tools is **NOT** used to quantify the level of gene expression?
    (A) real-time RT-PCR   (B) RNase protection assay   (C) Northern blotting
    (D) Western blotting   (E) Southern blotting

29. Enzymes are potent catalysts because they _____.
    (A) are consumed in the reactions they catalyze
    (B) are very specific and the converted products cannot return to substrates
    (C) drive reactions to completion, while other catalysts drive reactions to equilibrium
    (D) increase the equilibrium constants for the reactions they catalyze
    (E) lower the activation energy for the reactions they catalyze

30. What is the major apo-lipoprotein and lipid in high-density lipoprotein (HDL)?
    (A) ApoB-48, cholesterol ester   (B) ApoB-100, phospholipid
    (C) ApoE, free cholesterol   (D) ApoA-I, phospholipid
    (E) ApoA-II, cholesterol ester

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

31. Which description about the hormones regulation in human reproduction is **FALSE**?
    (A) Inhibin inhibits anterior pituitary to secret follicle-stimulating hormone (FSH) in male.
    (B) Testosterone inhibits hypothalamus to secret gonadotropin-releasing hormone (GnRH) in male.
    (C) Low levels of estradiol inhibits anterior pituitary to secret FSH in female.
    (D) High levels of estradiol stimulates hypothalamus to secret GnRH in female.
    (E) None of the above

32. Regarding to the mitochondria, which statement is **FALSE**?
    (A) According to the concept of endosymbiotic theory, the mitochondria extracted from monkey can be transferred into human cells.
    (B) The genome size of plant mitochondria is much larger than animal's.
    (C) A cell can contain more than one mitochondria.
    (D) Mitochondria can produce ATP more quickly than glycolysis.
    (E) Mitochondria can do transcription and translation.

33. What do synaptic signaling and paracrine signaling have in common?
    (A) Cells bind a membrane bound signal on a neighboring cell.
    (B) Cells release a signal that affects cells at long distances.
    (C) Cells release a signal that affects itself and neighboring cells.
    (D) Cells release a signal that affects neighboring cells.
    (E) Cells release a signal through gap junctions to affect neighboring cells.

34. Which of the following descriptions about cell division is **FALSE**?
    (A) Animal cells form centrioles during cell division.
    (B) Animal cells form a cleavage furrow to form new daughter cells.
    (C) There is phragmoplast alignment of Golgi-derived vesicles in plant cell division.
    (D) The cell plate is the final partitioning of plant cells.
    (E) Plant cells resort to binary fission.

35. Which is a common feature of gymnosperms and angiosperms?
    (A) pollen tubes   (B) flagellated sperms
    (C) sperms carried by windborne pollen   (D) fruits
    (E) flowers

36. Which description about the immune system is **FALSE**?
    (A) Helper T cells bind antigen-presenting cells (APCs) need Class II major histocompatibility complex (MHC) and accessory protein (CD8).
    (B) APCs secret cytokines such as interleukin-1 (IL-1) and tumor necrosis factor (TNF) for T cell activation.
    (C) Cytotoxic T cell releases perforin and granzymes to kill infected cells.
    (D) Pathogens can be disposed by antibodies through neutralization, opsonization, or complement system activation
    (E) None of the above

37. Which description about virus is **FALSE**?
    (A) Provirus is the viral DNA incorporated into host cell's DNA.
    (B) The envelope of RNA virus contains the cell membrane of host and glycoproteins of virus.
    (C) Adenovirus, papillomavirus, herpesvirus, and poxvirus are DNA viruses.
    (D) Virods are DNA molecules that infect plant cells.
    (E) None of the above

38. Breakdown of the fat storage at brown fat tissue in some animals increases when _____.
    (A) torpor   (B) exercising   (C) shivering   (D) hibernation   (E) sleeping

39. In nature, population size could be controlled by a density-independent factor. Which of the followings would be a possible case?
    (A) forest fires   (B) competition   (C) parasites
    (D) predation   (E) infection disease

40. In plants, the red light can be absorbed by _____.
    (A) Pr type phytochrome
    (B) Plastoquinone (PQ) of photosystem II (PSII)
    (C) carotenoids
    (D) ribulose biphosphate (RuBP)
    (E) ATP synthase

41. Which event for muscle contraction is **FALSE**?
    (A) Binding of acetylcholine to receptors stimulates Ca^{2+} pumping into sarcoplasmic reticulum.
    (B) Binding of tropomyosin to actin covers myosin-binding site.
    (C) Binding of Ca^{2+} to troponin exposes myosin-binding site of actin.
    (D) Binding of ATP releases myosin from actin.
    (E) None of the above

42. Which description about the diseases is **FALSE**?
    (A) Severe combined immunodeficiency (SCID) is caused by adenosine deaminase deficiency.
    (B) Cystic fibrosis (CF) is caused by a Na^+ transporter gene deficiency.
    (C) Tay-Sachs disease is caused by a lipid metabolized gene deficiency.
    (D) α_1- Antitrypsin deficiency causes emphysema.
    (E) None of the above

43. Which description about the excretory system is **FALSE**?
    (A) The nasal glands of marine birds concentrate salt.
    (B) The Malpighian tubes of insects remove nitrogenous wastes.
    (C) Glucose and amino acids are reabsorbed in descending limb of the loop of Henle.
    (D) The juxtaglomerular apparatus (JGA) releases renin when blood pressure drops.
    (E) None of the above

44. Which description about the circulatory and respiratory systems is **FALSE**?
    (A) The spike (QRS complex) of electrocardiogram (ECG) represents the signal passing from atrioventricular (AV) node to heart apex.
    (B) Individuals with a high ratio of LDL/HDL have risk for atherosclerosis.
    (C) The diaphragm contracts during inhalation in human.
    (D) Medulla can detect the decreased blood pH.
    (E) None of the above

45. Which description about the nervous system is **NOT** matched with its function?
    (A) Acetylcholine stimulates heart muscle.
    (B) Reticular formation regulates arousal and sleep.
    (C) Parasympathetic nerves stimulate stomach activity.
    (D) Amygdala controls emotional memory.
    (E) None of the above

46. Which assumption is **NOT** the basis for Hardy-Weinberg equilibrium?
    (A) random mating
    (B) natural selection
    (C) large population with genetic drift
    (D) no gene migration of alleles into or out of the population
    (E) no mutation

47. What is the primary original source of genetic variation in a population?
    (A) mutation
    (B) genetic drift
    (C) inbreeding
    (D) cloning
    (E) None of above

48. Which protist is **NOT** matched with its disease?
    (A) *Plasmodium* - malaria
    (B) *Trichomonas* - sexual transmitted disease
    (C) *Leishmania* - skin disease
    (D) *Trypanosoma* - intestinal infection
    (E) None of the above

49. Which description about fungi is **FALSE**?
    (A) Athlete's foot and ringworm are caused by fungi.
    (B) *Candida albicans* is a fungi to infect vagina.
    (C) Forming buds instead of spores are more effectively in sticking to lung cells.
    (D) Coccidioidomycosis is treated with antibiotics.
    (E) None of the above

50. Which description about the reproductive system is **FALSE**?
    (A) Spermatheca is used to store sperms in female fruit fly.
    (B) Epididymis is used to store sperms in men.
    (C) Oogenesis begins at embryonic development of women.
    (D) Hypothalamus is stimulated by combinations of high levels estradiol and progesterone.
    (E) None of the above

51. Which of the following animals has the largest basic metabolic rate (BMR) per body mass?

    (A) 500 kg horse   (B) 60 kg human   (C) 60 kg alligator

    (D) 0.5 kg lizard   (E) 0.5 kg rat

52. Which is the **WRONG** description about sexual reproduction of fungi?

    (A) Fungi release pheromones to find the correction mating type.

    (B) After plasmogamy, nuclei of two mycelia fuse immediately.

    (C) A zygote is formatted after karyogamy.

    (D) A heterokaryon contains two coexisting, genetically different nuclei.

    (E) A heterokaryon can be extended hours, days, or even years.

53. In a large population of a plant species, which of the following situations is the least likely to change allele frequencies within the population?

    (A) A forest fire destroys most of individuals in the population

    (B) Radioactive fallout from an accident at a nuclear power plant

    (C) Microhabitats within the range of the population where certain phenotypes have a better chance of surviving

    (D) The preference of a pollinator for a certain flower color

    (E) Wind pollination of the flowers

54. Which of the following is **NOT** related to the parasympathetic nervous system?

    (A) Lacrimal glands that produce tears

    (B) Fight or flight responses

    (C) Nerves in the stomach and trunk

    (D) Nerves that go to the bladder

    (E) Nerves and blood vessels responsible for the male erection

55. Which of the followings is **NOT** a steroid hormone?

    (A) progesterone   (B) testosterone

    (C) mineralocorticoid   (D) estradiol

    (E) follicle-stimulating hormone

56. A patient **CANNOT** form new long-term memories after a serious brain damage of _____.

    (A) somatosensory cortex   (B) motor cortex   (C) frontal lobe of cortex

    (D) thalamus   (E) hippocampus

57. Which is **NOT** a function of the pigment epithelium in retina?
   (A) absorption of scattered light
   (B) phagocytizing shed outer discs
   (C) isomerize the all-trans retinal to the 11-cis form
   (D) delivery of nutrients to the photoreceptors
   (E) creating the dark current of the photoreceptors

58. The form and function of nephrons in vertebrate kidney have a different adaptation to meet their requirements for osmoregulation. Which one is **CORRECT**?
   (A) Freshwater fishes conserve salt in their proximal tubules and excrete large volumes of dilute urine.
   (B) Amphibians conserve water on land by reabsorbing water from collecting duct.
   (C) Mammals that inhabit in fresh water have relatively long loops of Henle.
   (D) Birds have shorter loops of Hendle.
   (E) Most reptiles excrete uric acid by juxtamedullary nephron.

59. Which organ or tissue is differentiated from mesoderm?
   (A) epidermis of skin   (B) nervous system   (C) adrenal medulla
   (D) dermis of skin   (E) thymus

60. _____ are **NOT** derived from myeloid stem cell.
   (A) Basophils   (B) Erythrocytes   (C) Lymphocytes
   (D) Monocytes   (E) Platelets

61. Ribonucleotide reductase catalyzes the reduction of ribonucleotides to deoxyribonucleotides. Which of the following cofactors are essential for the activity of ribonucleotide reductase?
   ① NADPH; ② Thioredoxin; ③ NADH; ④ Glutaredoxin; ⑤ Tetrahydrofolate
   (A) ①,②,⑤   (B) ①,②,④   (C) ①,③,⑤   (D) ②,③,⑤   (E) ②,③,④

62. In eukaryotic matured mRNA, which one of the following statements is **FALSE**?
   (A) Both 5' and 3' ends contain a free 3-OH group on ribose.
   (B) Intron is removed in the matured RNA.
   (C) Poly(A) tail is added to 3' end in matured RNA.
   (D) Methylation can be found on 5' end.
   (E) Splicing needs snRNAs.

63. A cell that is unable to synthesize or obtain tetrahydrofolate would probably be deficient in the biosynthesis of _____.
   (A) dGMP   (B) dCMP   (C) dAMP   (D) dTMP   (E) dUMP

64. Pompe disease is a glycogen storage disease caused by defect in _____.
    (A) glycogen phosphorylase
    (B) lysosomal α-1,4-glucosidase
    (C) glycogen branching enzyme
    (D) glucose-6-phosphatase
    (E) phosphorylase kinase

65. Which of the following statements about allosteric regulation are **CORRECT**? ① Substrate is a heterotropic allosteric modulator. ② Allosteric regulation can increase or decrease the catalytic activity of enzymes. ③ Allosteric enzymes typically have oligomeric structure. ④ The activity of some allosteric enzymes is regulated by feedback inhibition. ⑤ Allosteric modulators cannot induce conformational change of allosteric enzymes.
    (A) ①,②,③　(B) ①,②,④　(C) ①,③,④　(D) ①,③,⑤　(E) ②,③,④

66. Which of the following statements about ribozyme are **CORRECT**? ① Peptidyl transferase is a ribozyme. ② Aminoacyl-tRNA synthetase is a ribozyme. ③ The substrate of ribozyme is RNA. ④ Hammerhead ribozyme is involved in trans-splicing reaction. ⑤ RNase P is a ribozyme.
    (A) ①,②,③　(B) ①,③,④　(C) ①,④,⑤　(D) ①,③,⑤　(E) ②,④,⑤

67. Which of the following statements about microRNAs (miRNAs) are **CORRECT**? ① miRNAs originate from exogenous dsRNA. ② miRNAs form a perfect complementary to its target mRNA. ③ Some miRNAs can functionally inhibit mRNA translation. ④ Some miRNAs can promote mRNA decay. ⑤ miRNAs are transcribed by RNA polymerase III.
    (A) ①,⑤　(B) ②,③　(C) ③,④　(D) ②,④　(E) ③,⑤

68. Which of the following statements about glycogen is **FALSE**?
    (A) Glucose-6-phosphate is released from nonreducing ends of the glucose polymer by the action of the enzyme glycogen phosphorylase.
    (B) In glycogen breakdown, it involves sequential phosphorolytic cleavages of α(1→4) bonds.
    (C) Glycogen is the storage polysaccharide in skeletal and liver cells.
    (D) Glycogen is a polymer of glucose in α(1→4) linkages with α(1→6) linked branches.
    (E) The breakdown of glycogen in skeletal muscle ultimately enters glycolysis to generate ATP.

69. Which of the following statements for Shine-Dalgarno sequence are **CORRECT**?
    ① Shine-Dalgarno sequence is found in prokaryotic mRNA. ② Shine-Dalgarno sequence is a purine-rich sequence. ③ Shine-Dalgarno sequence can base-pair with a sequence of tRNA. ④ Shine-Dalgarno sequence is involved in DNA replication. ⑤ Shine-Dalgarno sequence can base-pair with a sequence of 16S rRNA.
    (A) ①,②,③　(B) ①,②,⑤　(C) ①,③,④　(D) ①,④,⑤　(E) ①,②,④,⑤

70. Which of the following statements about nitric oxide (NO) are **CORRECT**? ① Cellular NO is produced from lysine. ② Nitroglycerine is an NO donor. ③ Nitric oxide synthase is involved in the production of NO. ④ Adenyl cyclases are receptors for NO. ⑤ NO production in endothelial cells leads to vasodilation.

    (A) ①,②,③   (B) ②,③,④   (C) ③,④,⑤   (D) ①,③,④   (E) ②,③,⑤

71. Which of the following statements about oxidative phosphorylation are **CORRECT**?
① Oxidative of NADPH occurs in mitochondria. ② The production of ATP is driven by electron transport and proton gradient. ③ The process of chemiosmotic coupling is involved in the synthesis of ATP in mitochondria. ④The production of ATP is mediated by a substrate-level phosphorylation of ADP. ⑤ The electron transport is inhibited by 2,4-dinitrophenol.

    (A) ①,③,⑤   (B) ①,②,③   (C) ②,③   (D) ③,④,⑤   (E) ③,⑤

72. Which of the following statements about *lac* operon is **CORRECT**? ① The repressor is the protein product of *lac* Z gene. ② The *lac* operon can be turned on by β-galactoside. ③ Repressor binds to the operator and blocks the binding of RNA polymerase to promoter. ④ Isopropyl-β-D-thiogalactoside can bind to Lac repressor to turn on protein expression. ⑤ In the *lac* operon model, the genes within the operon will be expressed if lactose is present in *E. coli.*

    (A) ①,②,③   (B) ①,②,④   (C) ②,③,④   (D) ③,④,⑤   (E) ②,③,④,⑤

73. Which of the following statements about glutathione are **CORRECT**? ① Glutathione is an antioxidant. ② Glutathione is a tetrapeptide. ③ Glutathione is not involved in detoxification of xenobiotics. ④ The biosynthsis of glutathione synthesis occurs as a part of γ-glutamyl cycle. ⑤ Oxidized glutathione is reduced by glutathione reductase.

    (A) ①,②,③   (B) ①,③,④   (C) ①,④,⑤   (D) ②,③,④   (E) ①,②,⑤

74. Which of the following statements about citric acid cycle is **FALSE**?
    (A)   The first reaction is to synthesize citric acid.
    (B)   In addition to CTP, NADH and QH_2 are also produced in citric acid cycle.
    (C)   The acetyl group of acetyl-CoA is released in the form of CO_2 when it enters citric acid cycle.
    (D)   The product of the last step, oxaloacetate, is also the reactant of the first step.
    (E)   It occurs in mitochondrial matrix.

75. Which of the following statements about amino acids is **CORRECT**? ① Methionine is sulfur-containing amino acids. ② The UV absorbance of phenylalanine at 280 nm is lower than that of tyrosine. ③ Disulfide bond can be reduced by performic acid. ④ The side chain of histidine is an imidazole ring. ⑤ The pI value of arginine is lower than that of lysine.

    (A) ①,②,③   (B) ①,③,④   (C) ②,③,④   (D) ①,②,④   (E) ②,③,⑤

76. Which of the following enzymes are aspartate protease ? ① Subtilisin; ② Cathepsin D; ③ HIV-protease; ④ Thrombin; ⑤ Pepsin
    (A) ①,②,③   (B) ①,②,④   (C) ①,②,⑤   (D) ②,③,④   (E) ②,③,⑤

77. Which of the following statements for the structure of proteins are **CORRECT**? ① A bond between amino acids is peptide bond. ② Disulfide bonds in proteins are formed by serine. ③ The amino acid sequence is the primary structure of proteins. ④ The coil-coiled motif is the tertiary structure of proteins. ⑤ The quaternary structure of proteins contains two or more polypeptide chains.
    (A) ①,③,⑤   (B) ②,③,④   (C) ②,③,⑤   (D) ①,③,④   (E) ①,②,③

78. In order to infect cells, the hemagglutinin of the influenza virus binds with _____ in the cell surface glycoproteins or glycolipids.
    (A) sialic acid   (B) gluconic acid   (C) *N*-acetylmuramic acid
    (D) uronic acid   (E) muramic acid

79. In electron-transport chain, the transferring sequence of the electrons passing from NADH to oxygen is:
    (A) Complex I→Complex III→Complex IV→Complex V
    (B) Complex I→Complex II→Complex III→cytochrome c→Complex IV
    (C) Complex I→Q→Complex II→Complex III→cytochrome c→Complex IV
    (D) Complex I→Complex II →Complex III →Complex IV
    (E) Complex I→Q→Complex III→cytochrome c→Complex IV

80. Which of the following **BEST** explains the "wobble" hypothesis proposed by Francis Crick?
    (A) The genetic code is degenerate in that most amino acids have more than one codon.
    (B) The genetic code is ambiguous in that each codon can specify more than one amino acid.
    (C) The anticodon can pair with any part of the corresponding codon.
    (D) The 5'-base of the anticodon can make non Watson-Crick hydrogen bonds with several different bases at the 3'-position of the codon.
    (E) Inosine can pair up with C, G, or U.

81. Phospholipids show asymmetric distribution on membrane of erythrocytes. Which of the following phospholipids prefer to distribute on the outer leaflet of erythrocyte membrane?
    ① phosphatidylcholine; ② phosphatidylserine; ③ phosphatidylinositol;
    ④ sphingomyelin; ⑤ phosphatidylethanolamine
    (A) ①,②   (B) ①,③   (C) ①,④   (D) ②,③   (E) ②,⑤

82. Mammalian phosphofructokinase, the major flux-controlling enzyme of glycolysis, is regulated by ① allosteric activator, fructose 2, 6-bisphosphate; ② allosteric inhibitor, ATP; ③ allosteric activator, AMP; ④ allosteric inhibitor, ADP; ⑤ allosteric activator, Citrate

   (A) ①,②,③   (B) ①,③,④   (C) ①,②,⑤   (D) ①,③,⑤   (E) ①,④,⑤

83. Misfolding of protein causes a broad range of disease. Which of the following human diseases linked to misfolding of proteins are **CORRECT**? ① Alzheimer's disease, β-Amyloid peptide；② Creutzfeldt-Jakob disease, Prion protein；③ Cystic fibrosis, Superoxide dismutase I; ④ Hungtington's disease, α-Synuclein; ⑤ Familial amyloidotic polyneuropathy, Transthyretin.

   (A) ①,②,③   (B) ①,②,④   (C) ②,③,⑤   (D) ③,④,⑤   (E) ①,②,⑤

84. Which of the following statements about the inhibition of enzyme activity is **FALSE**?
    (A) Transition state analogs can be used as competitive inhibitor.
    (B) Irreversible inhibition can be analyzed using Michaelis-Menten equation.
    (C) Increasing substrate concentration can counteract the effect of competitive inhibitor.
    (D) An uncompetitive inhibition does not affect the slope of the Lineweaver-Burk plot.
    (E) The irreversible inhibitor is covalently linked with the catalytic residue at the active site of the enzyme.

85. Which of the following enzymes are involved in the purine salvage pathways? ① GMP synthetase; ② Adenine phosphoribosyl transferase; ③ Purine nucleoside phosphorylase; ④ Hypoxanthine-guanine phosphoribosyltransferase; ⑤ Adenylosuccinate lyase

   (A) ①,②   (B) ②,③   (C) ③,④,⑤   (D) ②,④   (E) ②,③,④

86. Which of the following statements for cholesterol are **CORRECT**? ① Cholesterol is a precursor of lanosterol. ② Cholesterol is a component of cell membrane in human erythrocyte. ③ Cholesterol is a precursor of bile acids. ④ Cholesterol is terpene-based lipid. ⑤ Cholesterol reduces the transition temperature of phospholipids in cell membrane.

   (A) ①,②,③   (B) ①,③,⑤   (C) ①,②,④   (D) ②,③,④   (E) ②,④,⑤

87. Which of the following statements is **CORRECT** in DNA repair?
    (A) AlkB is involved in base-excision repair.
    (B) AP endonuclease is involved in mismatch repair.
    (C) ABC excinuclease is involved in nucleotide-excision repair.
    (D) DNA photolyase is involved in direct repair.
    (E) Dam methylase is involved in methyl-directed repair.

88. A peptide is digested by chymotrypsin, and the resulting peptides are shown as following: Gly-Asn; Asp-Met-Leu-Phe; Leu-Lys-Trp; Met-Arg-Ala-Tyr. The C-terminal amino acid of the starting peptide (the one cleaved with chymotrypsin) is

   (A)   Asn   (B)   Phe   (C)   Trp   (D)   Tyr   (E)   Gly

89. Which of the followings inhibit fatty acid synthesis: ① malonyl CoA;   ② glucagon;   ③ citrate; ④ phosphorylated acetyl-CoA carboxylase

   (A)   ①,②,③   (B)   ①,②,④   (C)   ①,③,④   (D)   ②,③,④   (E)   ①,②,③,④

90. Which of the following statements about pentose phosphate pathway is **FALSE**?

   (A)   The major pathway is to produce five-carbon sugars.
   (B)   The major products are two molecules of NADPH and one molecule of ribulose-5-phosphate.
   (C)   Oxidation of glucose 6-phosphate to 6-phosphoglucono-δ-lactone is the first reaction.
   (D)   It provides ribose-5-phosphate for nucleotide biosynthesis.
   (E)   It occurs exclusively in the mitochondria.

110學年度 學士後醫學系招生考試

物理及化學試題封面

考試開始鈴響前，請勿翻閱本試題！

★考試開始鈴響前，請注意：

一、除准考證、應考文具及一般手錶外；行動電話、穿戴式裝置及其他物品均須放在臨時置物區。

二、請務必確認行動電話已取出電池或關機，行動電話及手錶的鬧鈴功能必須關閉。

三、就座後，不可擅自離開座位或與其他考生交談。

四、坐定後，雙手離開桌面，確認座位號碼、答案卡號碼與准考證號碼相同，以及抽屜中、桌椅下或座位旁均無非考試必需用品。如有任何問題，請立即舉手反應。

五、考試開始鈴響前，不得翻閱試題本或作答。

六、考試全程不得吃東西、喝水及嚼食口香糖。

七、違反上述規定，依「筆試規則及違規處理辦法」議處。

★作答說明：

一、考試時間：100分鐘。

二、本試題（含封面）共17頁，如有缺頁或毀損，應立即舉手請監試人員補發。

三、本試題共90題，皆為單選題，共計150分；每題答錯倒扣，不作答不計分。

四、答題依題號順序劃記在答案卡上，寫在試題本上無效；答案卡限用2B鉛筆劃記，若未按規定劃記，致電腦無法讀取者，考生自行負責。

五、試題本必須與答案卡一併繳回，不得攜出試場。

Choose one best answer for the following questions

【單選題】每題 1 分，共計 30 分，答錯 1 題倒扣 0.25 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。1~15 題為物理，16~30 題為化學。

1. If the diameter of the hydrogen atom is scaling up to the 400 m track playground, what would the size of its nucleus be?

    Hint: Radius of hydrogen is 0.053 nano meter. Radius of its nucleus is 0.85 femto meter.

    (A)   a few-mm sand grain   (B)   a ping-pong ball   (C)   a base ball

    (D)   a bowling ball   (E)   a basketball

2. Since 2019, the magnitudes of all SI units have been defined by declaring exact numerical values for *defining constants* when expressed in terms of their SI units. Which one of the following constants is not included?

    (A)   the speed of light in vacuum, c (B)   the Planck constant, h

    (C)   the Coulomb constant, k_e (or $1/4\pi\varepsilon_0$)   (D)   the Boltzmann constant, k (or k_B)

    (E)   the Avogadro constant, N_A

3. The graph below shows the angular acceleration α of a bicycle tire. During the four-second time interval for which this graph is drawn, we can conclude that _____.
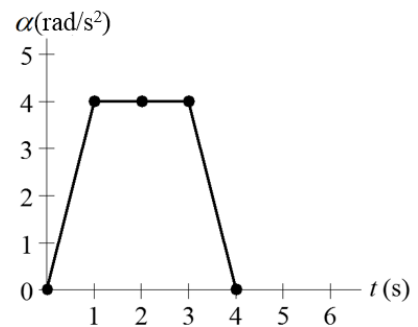
    (A)   the angular velocity of the wheel did not change

    (B)   the angular momentum of the wheel about an axis through its center did not change

    (C)   the angular velocity of the wheel increased by 8 rad/s

    (D)   the angular velocity of the wheel increased by 12 rad/s

    (E)   the angular velocity of the wheel increased by 16 rad/s

4. A ball rolls down and leaves a slope at an angle of 30º above the horizontal direction. The ball hits the ground 10 seconds later at a point 20 meters below the leaving point, as shown below. How far does the ball travel horizontally when it hits the ground (from point B to point C)? (Gravitational acceleration g = 10 m/s²)
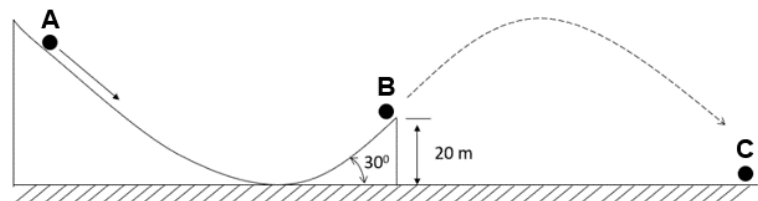
    (A)   623   (B)   835   (C)   936   (D)   1019   (E)   2021

5. Newton's coefficient of restitution is defined by

$$\text{Coefficient of restitution } (e) = \frac{|\text{Relative velocity after collision}|}{|\text{Relative velocity before collision}|}$$

For a completely inelastic collision in a head-on collision of two objects, what would the value of e would be?

(A) 0   (B) 1/2   (C) 1

(D) 2   (E) Information not enough to determine it.

6. The ballistic pendulum has mass 10 kg. A bullet of 300 g moves at the speed of v_0 right before hitting the pendulum. How much is the height h that the pendulum can swing upward and rest momentarily? (Gravitational acceleration g = 10 m/s^2)
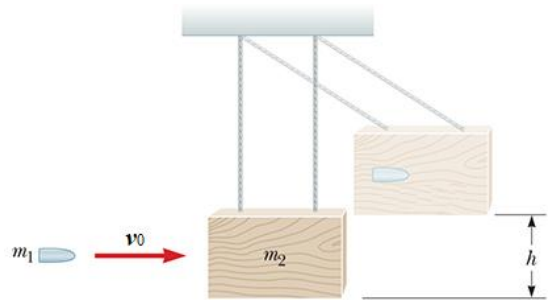
(A) $6.7 \times 10^{-5} v_0^2$ (B) $4.2 \times 10^{-5} v_0^2$ (C) $3.3 \times 10^{-5} v_0^2$

(D) $2.3 \times 10^{-5} v_0^2$ (E) $5.7 \times 10^{-5} v_0^2$

7. Compared to the graph below, which graph in choices shows that the amplitude and the frequency are doubled?
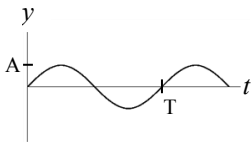
(A) a   (B) b   (C) c   (D) d   (E) e

8. A tube with three openings has three different cross-sectional areas (A1:A2:A3 = 2:1:3), as shown in the figure. The pressure difference is 25 Pa between A1 and A2. If v_1 = 0.125 (m/s), find the density of the fluid (kg/m^3).
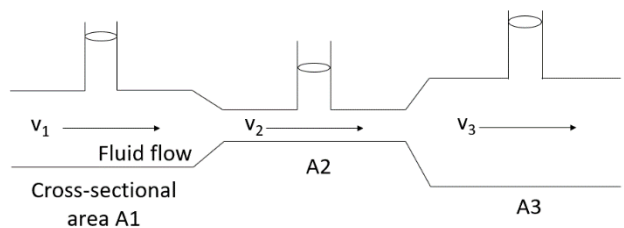
(A) 561   (B) 982   (C) 1067   (D) 1534   (E) 1698

9. Which of the following answers is a correct description of the corresponding process as indicated in the figure?
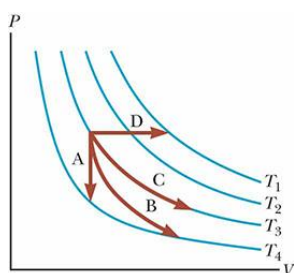
    (A)   Isobaric   (B)   Adiabatic   (C)   Isovolumetric

    (D)   Isothermal   (E)   None of the above is correct.

10. Two waves traveling in opposite directions interfere to produce a standing wave described by $y = 3 \sin(2x) \cos(5t)$ where x is in m and t is in s. What is the wavelength of the interfering waves?

    (A) 3.14 m   (B) 1.00 m   (C) 2.00 m   (D) 6.28 m   (E) 12.00 m

11. When the same temperature increase in a system, the change in entropy, ΔS, is the largest in a reversible _____.

    (A)   constant-volume process   (B)   constant-pressure process

    (C)   adiabatic process   (D)   process in which no heat is transferred

    (E)   process in which no work is performed

12. Four capacitors are connected as shown in the figure. How much is the total charges stored in capacitors if $\Delta V_{ab} = 15$ V.
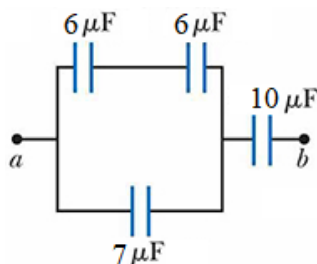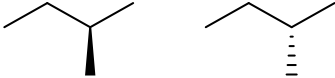
    (A) 30 μC   (B) 45 μC   (C) 60 μC   (D) 75 μC   (E) 90 μC

13. Which of the following is correct for visible light through a prism?
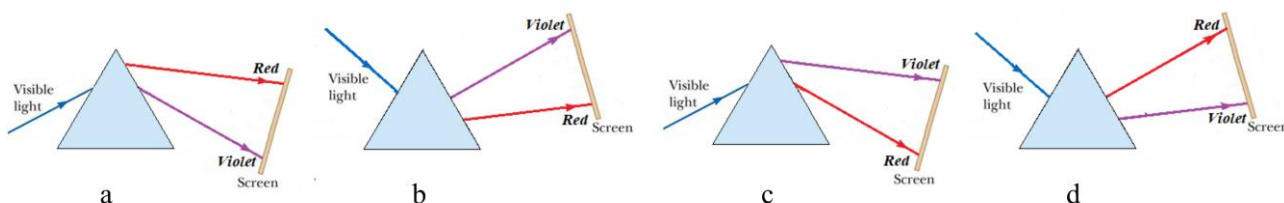

    (A)   a and d   (B)   c and b   (C)   c and d

    (D)   a and b   (E)   None of these

14. In an atom, how many electrons can be contained at most at the 4th orbit?

    (A) 9   (B) 18   (C) 32   (D) 162   (E) 324

15. An energy of 13.6 eV is needed to ionize an electron from the ground state of a hydrogen atom. What is the longest photon wavelength needed to accomplishes this task? (Plank constant = 6.62×10^{-34} $m^2 \cdot kg/s$, speed of light = 3×10^8 m/s, 1 eV = 1.6×10^{-19} J)

    (A) 60 nm   (B) 70 nm   (C) 80 nm   (D) 90 nm   (E) 100 nm

16. For the process $Co(NH_3)_5Cl^{2+} + Cl^- \rightarrow Co(NH_3)_4Cl_2^+ + NH_3$, what would be the ratio of *cis* to *trans* isomers in the product?

    (A) 1:1   (B) 4:1   (C) 2:1   (D) 1:4   (E) 1:2

17. Which of the solvents shown below could best dissolve KBr?

    (A) C_6H_{14} (hexane)   (B) CH_3CH_2OH (ethanol)

    (C) C_6H_6 (benzene)   (D) CCl_4 (carbon tetrachloride)

    (E) C_6H_{12} (cyclohexane)

18. Which of the following options best describes the relationship between the following two compounds?

    (A) Constitutional isomers

    (B) Stereoisomers

    (C) Identical

    (D) Not isomers, different compounds entirely.

    (E) Conformers

19. Please calculate the specific heat capacity of a metal if 15.0 g of it requires 169.6 J to change the temperature from 25.00°C to 32.00°C?

    (A) 0.619 J/g°C   (B) 11.3 J/g°C

    (C) 24.2 J/g°C   (D) 1.62 J/g°C

    (E) 275 J/g°C

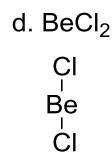20. Which of the following structures contains the central atom which has a formal charge of +2?
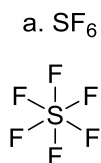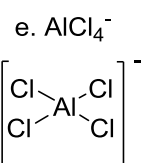

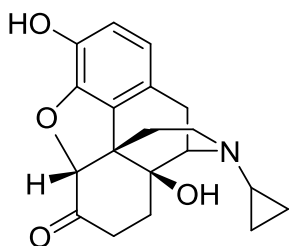   (A) a   (B) b   (C) c   (D) d   (E) e
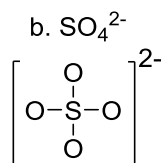
21. What is the molecular shape of IF_3 using the VSEPR theory?

 (A) Trigonal bipyramidal (B) See-saw   (C) T-shaped

 (D) Linear   (E) Square pyramidal

22. What are the hybridization state and geometry of the nitrogen atom in the following chemical structure?

 (A) *sp* hybridized and linear geometry (B) *sp^2* hybridized and trigonal pyramidal

 (C) *sp^3* hybridized and trigonal pyramidal (D) *sp^3* hybridized and trigonal planar

 (E) *sp^3* hybridized and bent

23. How many asymmetric carbons are presented in the compound below?
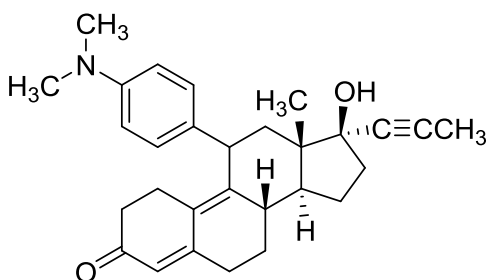
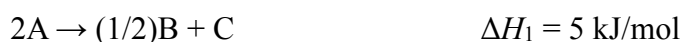

 (A) 2   (B) 3   (C) 4   (D) 5   (E) 6

24. The chemical compound "ethylenediaminetetraacetic acid, EDTA" is a chelating agent to coordinate several metallic ions, such as ferric, cupper, and calcium ions. In the living organism, which amino acid is usually used as a chelating agent?

 (A) Cysteine   (B) Glycine   (C) Leucine

 (D) Tryptophan   (E) Proline

25. Which one of the following molecules has a dipole moment but without polarity?

 (A) O_3 (B) PH_3 (C) NH_3 (D) PCl_5 (E) H_2O_2

26. Consider the following processes:

 $2A \rightarrow (1/2)B + C$ $\Delta H_1 = 5$ kJ/mol

 $(3/2)B + 4C \rightarrow 2A + C + 3D$ $\Delta H_2 = -15$ kJ/mol

 $E + 4A \rightarrow C$ $\Delta H_3 = 10$ kJ/mol

 Calculate ΔH for: $C \rightarrow E + 3D$

 (A) 0 kJ/mol (B) 10 kJ/mol (C) -10 kJ/mol (D) -20 kJ/mol (E) 20 kJ/mol

27. CdS can be described as cubic closest packed anions with the cations in tetrahedral holes. What fraction of the tetrahedral holes is occupied by the cations?

    (A) 0.125   (B) 0.25   (C) 0.50   (D) 0.75   (E) 1.0

28. For the reaction $3A(g) + 2B(g) \rightarrow 2C(g) + 2D(g)$, the following data was collected at constant temperature. Determine the correct rate law for this reaction.

Trial	Initial [A] (mol/L)	Initial [B] (mol/L)	Initial Rate (mol/(L·min))
1	0.200	0.100	6.00×10^{-2}
2	0.100	0.100	1.50×10^{-2}
3	0.200	0.200	1.20×10^{-1}
4	0.300	0.200	2.70×10^{-1}

    (A) Rate = $k[A][B]$ (B) Rate = $k[A][B]^2$ (C) Rate = $k[A]^3[B]^2$

    (D) Rate = $k[A]^{1.5}[B]$ (E) Rate = $k[A]^2[B]$

29. What is the number of the half-lives required for a radioactive element to decay to about 6% of its original activity? (please choose the nearest number)

    (A) 2   (B) 3   (C) 4   (D) 5   (E) 6

30. Identify the element of Period 2 which has the following successive ionization energies, in kJ/mol.

    IE_1, 1314 IE_2, 3389 IE_3, 5298 IE_4, 7471

    IE_5, 10992 IE_6, 13329 IE_7, 71345 IE_8, 84087

    (A) Li   (B) B   (C) O

    (D) Ne   (E) None of these

【單選題】每題 2 分，共計 120 分，答錯 1 題倒扣 0.5 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。31~60 題為物理，61~90 題為化學。

31. Based on an order-of-magnitude estimate, what is the radius of the Earth in the unit of kilometer (km)?

    Hint: The meter was originally defined in 1793 as one ten-millionth of the distance from the equator to the North Pole along a great circle.

    (A) 2   (B) 4   (C) 6   (D) 8   (E) 10

32. A part of the square that has sides of length L is removed from one corner. The center of mass of the remainder moves from C to C'. The displacement of the x coordinate of the center of mass (from C to C') is _____.
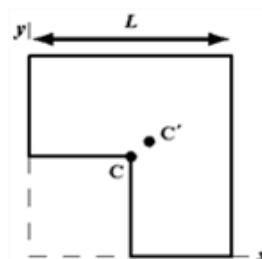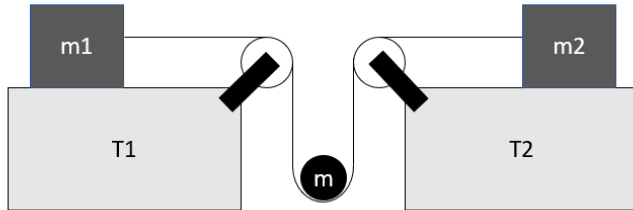

    (A) (2/3)L   (B) (1/6)L   (C) (1/8)L   (D) (1/10)L   (E) (1/12)L

33. The string and the pulley are massless, and the coefficient of static and kinetic frictions are 0.2 and 0.1, respectively, for both table 1 (T1) and 2 (T2). If m1 = 2 kg, m2 = 3 kg, and m = 1.5 kg, find the acceleration of m. (Gravitational acceleration g = 10 m/s^2)

    (A) 7.7 m^2/s   (B) 8.7 m^2/s   (C) 9.7 m^2/s   (D) 10.7 m^2/s   (E) 11.7 m^2/s

34. Aluminum Rod #1 has a length L and a diameter d. Aluminum Rod #2 has a length 2L and a diameter 2d. If Rod #1 is under tension T and Rod #2 is under tension 2T, how do the changes in length of the two rods compare?
    (A) They are the same.
    (B) Rod #1 has double the change in length that Rod #2 has.
    (C) Rod #2 has double the change in length that Rod #1 has.
    (D) Rod #1 has quadruple the change in length that Rod #2 has.
    (E) Rod #2 has quadruple the change in length that Rod #1 has.

35. A toy car is running on a banked circular track of radius 10 m, as shown below. If the car weighs 5 kg and on wet ice, find the maximum velocity for the car to keep on the track without skid. (Gravitational acceleration g = 10 m/s^2, cos30º = 0.87, cos60º = 0.5)
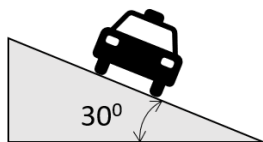
    (A) 5.4 m/s   (B) 7.6 m/s   (C) 9.4 m/s   (D) 12.6 m/s   (E) 15.7 m/s

36. A small block of mass m rests on the sloping side of a triangular block of mass M which itself rests on a horizontal table as shown in the figure below. Assuming all surfaces are frictionless, determine the magnitude of the force **F** that must be applied to M so that m remains in a fixed position relative to M.
    Hint: 1. Take *x* and *y* axes horizontal and vertical. 2. Focus at the object m.

    (A) mg sinθ   (B) mg tanθ   (C) (m+M)g tanθ
    (D) (m+M)g sinθ   (E) None of these

37. The four tires of an automobile are inflated to a gauge pressure of 2.0×10^5 N/m^2 (29 psi). Each of the four tires has an area of 0.024 m^2 that is in contact with the ground. Determine the weight of the auto.

   (A) 4.80×10^3 N (B) 1.92×10^4 N (C) 7.68×10^4 N

   (D) 8.33×10^6 N (E) 2.08×10^7 N

38. A 2-kg block slides down a frictionless incline from point A to point B. A force (magnitude P = 3 N) acts on the block between A and B, as shown in the figure Points A and B are 2 m apart. If the kinetic energy of the block at A is 10 J, what is the kinetic energy of the block at B? (Gravitational acceleration g = 10 m/s^2)
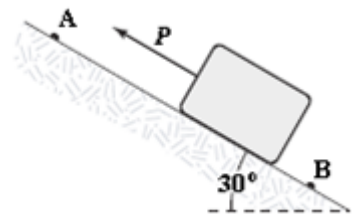
   (A) 17 J (B) 20 J (C) 24 J (D) 27 J (E) 37 J

39. On a bridge, a man (weight = 70 kg) plays bungee jumping by tying himself to one end of an elastic rope. The rope has a length of 100 m, and the height of the bridge is 500 m. After jumping, the man begins to bounce back 10 seconds later. What is the effective weight of the man at the bouncing point? (Gravitational acceleration g = 10 m/s^2)

   (A) 83 kg (B) 95 kg (C) 102 kg (D) 117 kg (E) 127 kg

40. How much energy is required to move a mass m object from the Earth's surface to an altitude twice the Earth's radius R_E?

   (A) $(-1/2)mgR_E$ (B) $(1/2)mgR_E$ (C) $(-2/3)mgR_E$ (D) $(2/3)mgR_E$ (E) $(1/4)mgR_E$

41. A styrofoam container used as a picnic cooler contains a block of ice at 0°C. If 225 g of ice melts in 1 hour, how much heat energy (Joule) per second is passing through the walls of the container? (The heat of fusion of ice is 3.33×10^5 J/kg).

   (A) 20.8 (B) 124.8 (C) 1800.0 (D) 7492.5 (E) 749250.0

42. How much is the internal energy change of a gas that expands from i to f as indicated in the figure if there is also a frictional heat loss of 10 J?
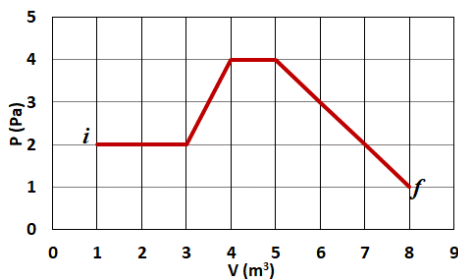
   (A) -34.5 J (B) 22.5 J (C) -18.5 J (D) -28.5 J (E) 36.5 J

43. A solid melt at 100°C by absorbing 2450 kJ heat. How much is the entropy change in this melting process?

    (A) 8.23 kJ/K   (B) 4.32 kJ/K   (C) 7.43 kJ/K   (D) 6.57 kJ/K   (E) 5.69 kJ/K

44. What is the efficiency if a Carnot engine transfers 9.5×10^3 J of energy from a hot reservoir during a cycle and dumps 2×10^3 J heat to a cold reservoir?

    (A) 0.69   (B) 0.84   (C) 0.79   (D) 0.65   (E) 0.72

45. Water pressurized to 3.5×10^5 Pa is flowing at 5.0 m/s in a horizontal pipe which contracts to 1/3 its former area. What are the pressure and flow speed of the water after the contraction?

    (A) 2.5×10^5 Pa, 15 m/s   (B) 3.0×10^5 Pa, 10 m/s   (C) 3.0×10^5 Pa, 15 m/s

    (D) 4.5×10^5 Pa, 1.5 m/s   (E) 5.5×10^5 Pa, 1.5 m/s

46. A hydraulic jack with two pistons is shown in the figure. The radii are 10 cm and 5 cm, and the weights are 40 kg and 1 kg for the left and right piston, respectively. A ball weighs 9 kg is placed on the right piston. Find the height difference between two pistons in equilibrium status. (Gravitational acceleration g = 10 m/s^2)
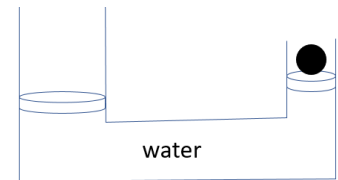
    (A) 0 cm   (B) 10 cm   (C) 1 m   (D) 10 m   (E) 20 m

47. A car approaches a stationary police car at 36 m/s. The frequency of the siren (relative to the police car) is 500 Hz. What is the frequency (in Hz) heard by an observer in the moving car as he approaches the police car? (Assume the velocity of sound in air is 343 m/s.)

    (A) 220   (B) 383   (C) 448   (D) 526   (E) 552

48. A mass-spring system is shown in the figure where the spring constant $k = 100$ N/m and the mass is 4 kg. Assuming the initial velocity is 3.5 m/s, what is the amplitude of the motion?
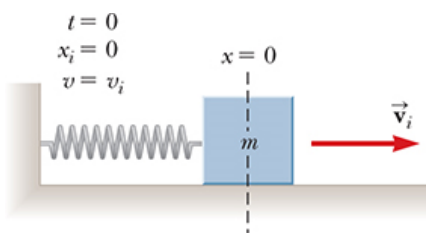
    (A) 0.5 m   (B) 0.7 m   (C) 0.8 m   (D) 0.9 m   (E) 1.2 m

49. A block (m1) with a weight of 10 kg was placed on a wooden bar with a weight of 2 kg. The left end of the bar was attached firmly to a triangle. How much force (F) does it take to keep the system in horizontal equilibrium? (Gravitational acceleration g = 10 m/s^2)
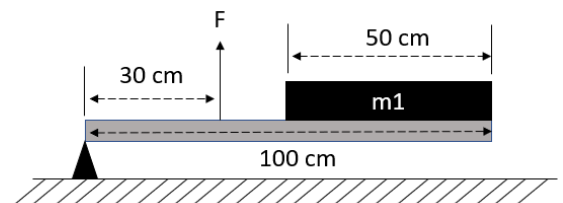
    (A) 165 N   (B) 224 N   (C) 283 N   (D) 318 N   (E) 361 N

50. Halley's comet moves about the Sun in an elliptical orbit with its closest approach to the Sun being 0.59 A.U. and its farthest distance being 35 A.U. If the comet's speed at closest approach is 54 km/s, what is its speed when it is farthest from the Sun? [1 Astronomical Unit (A.U.) is the Earth-Sun distance.]

    (A) 3203 m/s   (B) 910 m/s   (C) 15 m/s   (D) 13 m/s   (E) 7011 m/s

51. A rod of 0.3 m carries a current of $I = 48.0$ A in the direction shown in the figure and rolls along the rails with a constant speed. A uniform magnetic field of magnitude 0.25 T is directed perpendicular to the rod and the rails. What is the force acting on the rod?
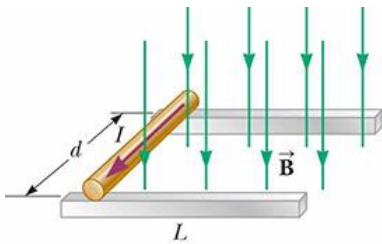
    (A) 3.6 N ($\rightarrow$)   (B) 2.4 N ($\leftarrow$)   (C) 1.2 N ($\leftarrow$)   (D) 3.6 N ($\leftarrow$)   (E) 1.2 N ($\rightarrow$)

52. Three point charges align along the x-axis as shown in the figure. What is the equilibrium position x of the charge q_2. (The electrical constant is k_e).
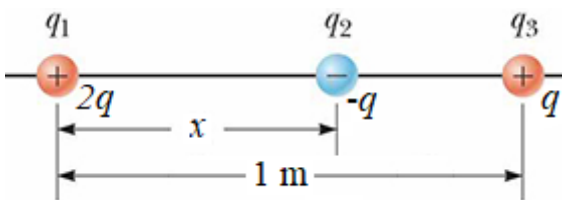
    (A) 0.45 m   (B) 0.62 m   (C) 0.36 m   (D) 0.78 m   (E) 0.59 m

53. Two parallel thin planes of charge electrical charge density 2.5×10^8 C/m^2. What is the electric field in the region between the two planes? Assume that the vacuum electric permittivity is $\varepsilon_0 = 8.9 \times 10^{-12}$ C^2/N·m^2.

    (A) 2.8×10^{18} N/C   (B) 5.6×10^{19} N/C   (C) 1.4×10^{18} N/C
    (D) 2.8×10^{19} N/C   (E) 4.2×10^{19} N/C

54. The voltage across a parallel-plate capacitor is measured to be 92.5 V. When a dielectric is inserted between the plates, the voltage drops to 23.4 V. What is the dielectric constant of the inserted material? Assume that the vacuum electric permittivity is $\varepsilon_0 = 8.9 \times 10^{-12}$ C^2/N·m^2.

    (A) 0.26   (B) 2.64   (C) 0.62   (D) 3.95   (E) 1.82

55. An AC generator consists of 6 turns of a wire. Each turn has an area of 0.040 m^2. The loop rotates in a uniform field ($B = 0.20$ T) at a constant frequency of 50 Hz. What is the maximum induced emf?

   (A) 2.4 V   (B) 3.0 V   (C) 4.8 V   (D) 13 V   (E) 15 V

56. It is known that the magnetic field of 0.17 T can cause an O_2^+ ion to move in a circular orbit of radius 2 m. Find the radius of circular orbit of a Na^{2+} ion with identical velocity in the same magnetic field. (Ion moves in direction perpendicular to the magnetic field.)

   (A) 0.12 m   (B) 0.25 m   (C) 0.34 m   (D) 0.52 m   (E) 0.72 m

57. What is the electric flux through a surface in between two parallel planes shown in the figure if
    $w = 2$ cm, $l = 5$ cm, $E = 500$ N/C and $\theta = 30°$?
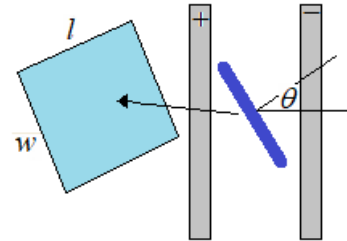
    (A) 0.52 N·m²/C   (B) 0.26 N·m²/C   (C) 0.81 N·m²/C
    (D) 0.43 N·m²/C   (E) 0.36 N·m²/C

58. A solenoid with 200 turns of copper wires is operated by a 1000 V power supply and must be 25 cm long. What is the magnitude of magnetic field that is created in the solenoid? (The resistance of Cu wire is 0.2 Ω and the permeability $\mu_0 = 4\pi \times 10^{-7}$ T·m/A)
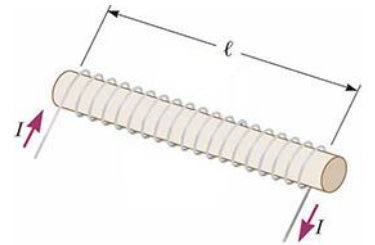
    (A) 5.03 T   (B) 3.21 T   (C) 7.84 T   (D) 4.58 T   (E) 4.36 T

59. For a convex mirror with radius of curvature $R = 10$ cm, if an object is placed 15 cm in front the mirror, what is the magnification of the image and is it a real or virtual? Upright or inverted? (mirror's equation: $1/p + 1/q = 2/R$)
    (A) 3.75 cm (virtual behind mirror) and M = 0.25, inverted
    (B) 7.50 cm (virtual behind mirror) and M = 0.5, upright
    (C) 3.75 cm (real in front mirror) and M = 0.5, inverted
    (D) 7.50 cm (real in front mirror) and M = 0.25, inverted
    (E) 3.75 cm (virtual behind mirror) and M = 0.25, upright

60. For a bi-concave thin lens, the radii of curvature are 10 and 20 cm. If an object is placed 15 cm in front of the mirror, what is the magnification of the image and is it a real or virtual? Upright or inverted? (thin lens' equation: $1/p + 1/q = (n-1)(1/R_1 - 1/R_2)$, the refractive index of glass is 1.5).
    (A) 9.72 cm (virtual behind mirror) and M = 0.64, inverted
    (B) 11.64 cm (virtual behind mirror) and M = 0.58, inverted
    (C) 10.91 cm (virtual in front mirror) and M = 0.73, upright
    (D) 8.69 cm (real in front mirror) and M = 0.25, inverted
    (E) 12.45 cm (virtual behind mirror) and M = 0.53, upright

61. Select the answer with the correct number of decimal places for the following sum:

    13.914 *cm* + 243.1 *cm* + 12.00460 *cm* =
    - (A) 269.01860 *cm*
    - (B) 269.0186 *cm*
    - (C) 269.019 *cm*
    - (D) 269.02 *cm*
    - (E) 269.0 *cm*

62. Detection of radiation by a Geiger-Müller counter depends on _____.
    - (A) the emission of a photon from an excited atom
    - (B) the ability of an ionized gas to carry an electrical current
    - (C) the emission of a photon of light by the radioactive particle
    - (D) the ability of a photomultiplier tube to amplify the electrical signal from a phosphor
    - (E) the detection of the sound made by decay particles

63. Please calculate the ΔS if ΔH_{vap} is 66.8 kJ/mol, and the boiling point is 83.4°C at 1 atm, when the substance is vaporized at 1 atm.
    - (A) -187 J/K mol
    - (B) 187 J/K mol
    - (C) 801 J/K mol
    - (D) -801 J/K mol
    - (E) 0

64. Which of the following values is based on the Third Law of Thermodynamics?
    - (A) $\Delta H°_f = 0$ for Al(s) at 298 K
    - (B) $\Delta G°_f = 0$ for H_2(g) at 298 K
    - (C) $S° = 51.446$ J/(mol·K) for Na(s) at 298 K
    - (D) $q_{sys} < 0$ for H_2O(l) → H_2O(s) at 0°C
    - (E) None of these

65. What are the values of bond order belonging to O_2^- and O_2^+, respectively?
    - (A) 1.5, 2.5
    - (B) 2.5, 1.5
    - (C) 2, 3
    - (D) 3, 2
    - (E) 2, 2

66. The lattice energy of NaI(s) is -686 kJ/mol, and its heat of solution is -7.6 kJ/mol. Calculate the hydration of energy of NaI(s) in kJ/mol.
    - (A) -678
    - (B) -694
    - (C) +678
    - (D) +694
    - (E) +15.2

67. According to molecular orbital, which of the following molecules is diamagnetic?
    - (A) HF
    - (B) O_2
    - (C) NO
    - (D) N_2^+
    - (E) N_2^-

68. Consider the figure, which shows $\Delta G°$ for a chemical process plotted against absolute temperature. Which of the following is an incorrect conclusion, based on the information in the diagram?
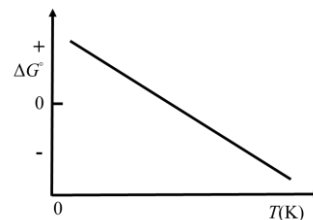
    (A) $\Delta H° > 0$
    (B) $\Delta S° > 0$
    (C) The reaction is spontaneous at high temperatures.
    (D) $\Delta S°$ increases with temperature while $\Delta H°$ remains constant.
    (E) There exists a certain temperature at which $\Delta H° = T\Delta S°$.

69. Acetone can be easily converted to isopropyl alcohol by addition of hydrogen to the carbon-oxygen double bond. Calculate the enthalpy of reaction using the bond energies given.
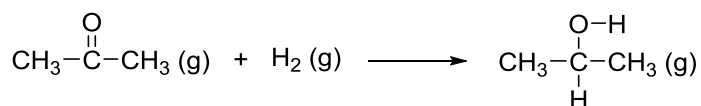
Bond:	C=O	H-H	C-H	O-H	C-C	C-O
Bond energy (kJ/mol):	745	436	414	464	347	351

    (A) -484 kJ   (B) -366 kJ   (C) -48 kJ   (D) +48 kJ   (E) +366 kJ

70. How many of the following molecules exhibit resonance: NO_2^-, O_3, OCl_2, NF_3, N_2O, CCl_4, CNO^-, O_2F_2?

    (A) 1   (B) 2   (C) 3   (D) 4   (E) 5

71. One mole of X(g) and one mole of Y(g) are mixed in a closed reactor in the presence of catalysts, and Z(g) is generated. The reaction is a X + b Y → c Z, where a, b, and c are the coefficients in the balanced equation. At a certain time, the mixture contains 1.8 moles of gases while the ratio of their partial pressures is P_X:P_Y:P_Z = 7:9:2. What are the values of a, b, and c?

    (A) $a = 1, b = 2, c = 3$ (B) $a = 3, b = 1, c = 2$ (C) $a = 7, b = 9, c = 2$
    (D) $a = 3, b = 1, c = 8$ (E) $a = 2, b = 9, c = 7$

72. Consider an adiabatic and reversible expansion process from state I to state II. Which of the following statements is true?

    (A) $P_1V_1 = P_2V_2$
    (B) $T_1V_1^\gamma = T_2V_2^\gamma$, $\gamma = C_p/C_v$
    (C) The final temperature will be higher than the initial temperature.
    (D) The final volume of the gas is much greater than the expansion were carried out isothermally.
    (E) The work delivered to the surrounding is much smaller than the expansion were carried out isothermally.

73. When a 1.00 mL of the 3.55×10^{-4} M solution of organic acid is diluted with 9.00 mL of ether, forming solution A and then 2.00 mL of the solution A is diluted with 8.00 mL of ether, forming solution B. What is the concentration of solution B?

    (A) 3.55×10^{-6} M (B) 9.86×10^{-6} M (C) 7.10×10^{-5} M

    (D) 7.89×10^{-5} M (E) 7.10×10^{-6} M

74. What is the volume of $O_2(g)$ generated when 22.4 g of $KClO_3$ is decomposed at 153°C under 0.820 atm? ($KClO_3$: 122.55 g/mol)

    (A) 0.09 L (B) 3.00 L (C) 4.20 L (D) 7.79 L (E) 11.7 L

75. What is the appropriate representation of the repeating unit of the following polymer?
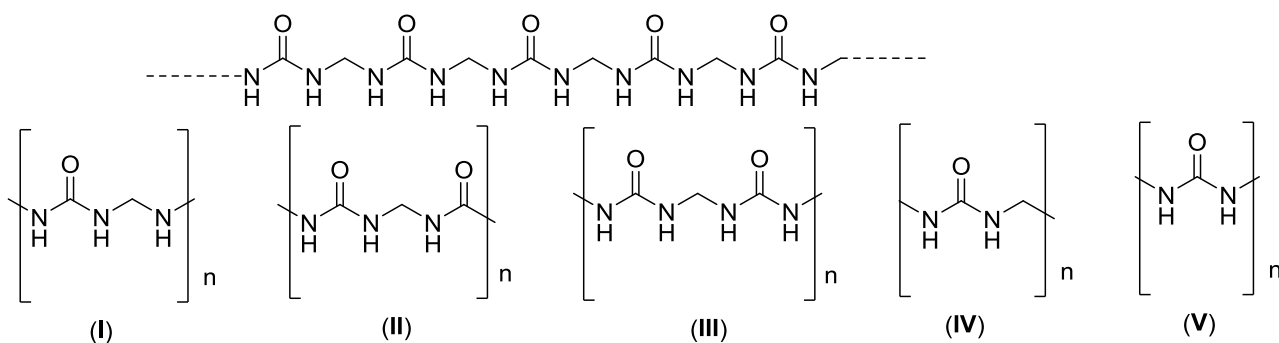
    (A) I (B) II (C) III (D) IV (E) V

76. Which of the following structures is the major form of the lysine at the pH = 14?
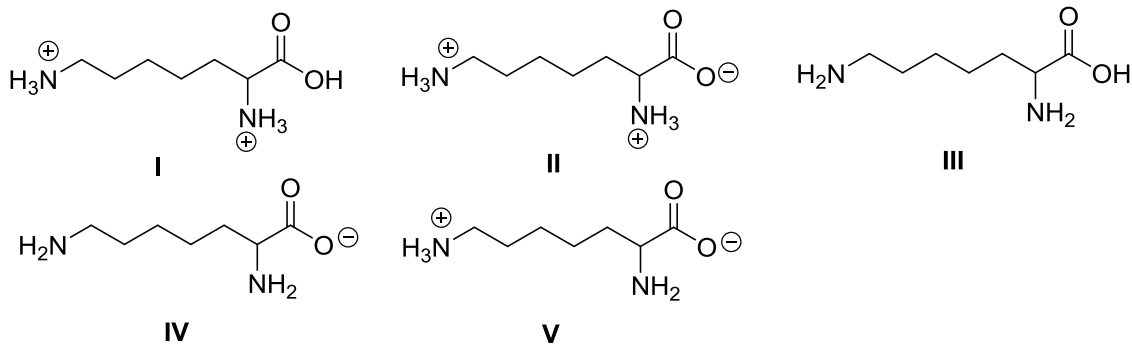
    (A) I (B) II (C) III (D) IV (E) V

77. Which of the followings is a correct set of quantum numbers for an electron in a $3d$ orbital?

    (A) $n = 3, l = 0, m_l = -1$ (B) $n = 3, l = 1, m_l = 3$ (C) $n = 3, l = 2, m_l = 3$

    (D) $n = 3, l = 3, m_l = 2$ (E) $n = 3, l = 2, m_l = -2$

78. Which of the following complexes will absorb visible radiation of the shortest wavelength?

    (A) $[Co(H_2O)_6]^{3+}$ (B) $[Co(I)_6]^{3-}$ (C) $[Co(OH)_6]^{3-}$

    (D) $[Co(en)_3]^{3+}$ (E) $[Co(NH_3)_6]^{3+}$

79. Please choose the most stable cation?
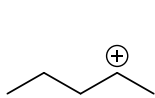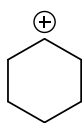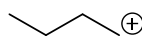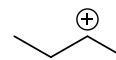
(A) I   (B) II   (C) III   (D) IV   (E) V

80. Which of the following statements about "The Bohr Model" and "Particle in a Box" is TRUE?

    (A) For an electron trapped in a one-dimensional box, as the length of the box increases, the spacing between energy levels will increase.

    (B) The total probability of finding a particle in a one-dimensional box (length is L) in energy level $n = 4$ between $x = L/4$ and $x = L/2$ is 50%.

    (C) If the wavelength of light necessary to promote an electron from the ground state to the first excited state is λ in a one-dimensional box, then the wavelength of light necessary to promote an electron from the first excited state to the third excited state will be 3λ.

    (D) A function of the type $A \cos(Lx)$ can be an appropriate solution for the particle in a one-dimensional box.

    (E) Assume that a hydrogen atom's electron has been excited to the $n = 5$ level. When this excited atom loses energy, 10 different wavelengths of light can be emitted.

81. Which of the following statements concerning a face-centered cubic unit cell and the corresponding lattice, made up of identical atoms, is incorrect?

    (A) The coordination number of the atoms in the lattice is 8.

    (B) The packing in this lattice is more efficient than for a body-centered cubic system.

    (C) If the atoms have radius r, then the length of the cube edge is $\sqrt{8} \times r$.

    (D) There are four atoms per unit cell in this type of packing.

    (E) The packing efficiency in this lattice and hexagonal close packing are the same.

82. Which of the followings will give a solution with a pH > 7, but is not an Arrhenius base in the strict sense?

    (A) CH_3NH_2 (B) $NaOH$ (C) CO_2 (D) $Ca(OH)_2$ (E) CH_4

83. Pentane, C_5H_{12}, boils at 35°C. Which of the followings is true about kinetic energy, E_k, and potential energy, E_p, when liquid pentane at 35°C is compared with pentane vapor at 35°C?

    (A) $E_k(g) < E_k(l)$; $E_p(g) \approx E_p(l)$ (B) $E_k(g) > E_k(l)$; $E_p(g) \approx E_p(l)$

    (C) $E_p(g) < E_p(l)$; $E_k(g) \approx E_k(l)$ (D) $E_p(g) > E_p(l)$; $E_k(g) \approx E_k(l)$

    (E) $E_p(g) \approx E_p(l)$; $E_k(g) \approx E_k(l)$

84. Five molecules are shown as below. Which one has the highest ionic strength?

    (A) $B(OH)_3$ (B) HNO_3 (C) Na_2HPO_4 (D) $CaCO_3$ (E) $BaSO_4$

85. Hydroxylamine nitrate contains 29.17 mass % N, 4.20 mass % H, and 66.63 mass % O. Determine its empirical formula.
    (A) HNO   (B) H_2NO_2 (C) HN_6O_{16} (D) $HN_{16}O_7$ (E) H_2NO_3

86. Given the following two standard reduction potentials,
$$Fe^{3+} + 3\ e^- \rightarrow Fe \qquad\qquad E° = -0.036\ V$$
$$Fe^{2+} + 2\ e^- \rightarrow Fe \qquad\qquad E° = -0.44\ V$$
    determine for the standard reduction potential of the half-reaction
$$Fe^{3+} + e^- \rightarrow Fe^{2+}$$
    (A) 0.40 V   (B) 0.77 V   (C) -0.40 V   (D) -0.11 V   (E) 0.11 V
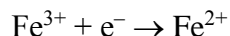
87. The rate law for a reaction is found to be Rate = $k[A]^2[B]$. Which of the following mechanisms gives this rate law?

    I. $A + B \rightleftharpoons E$ (fast)   II. $A + B \rightleftharpoons E$ (fast)   III. $A + A \rightarrow E$ (slow)
        $E + B \rightarrow C + D$ (slow) $E + A \rightarrow C + D$ (slow) $E + B \rightarrow C + D$ (fast)
    (A) I   (B) II   (C) III   (D) I & II   (E) II & III

88. When the redox reaction in basic solution: $NO_2^-(aq) + Al(s) \rightarrow NH_3(aq) + AlO_2^-(aq)$ is balanced using the smallest whole-number coefficients, the coefficient of H_2O is x and the sum of all coefficients is y. What is the sum of x and y, $(x + y)$?
    (A) 9   (B) 10   (C) 11   (D) 12   (E) 13

89. Which of the followings is the best representation of the titration curve which will be obtained in the titration of a weak acid (0.10 mol L^{-1}) with a strong base of the same concentration?
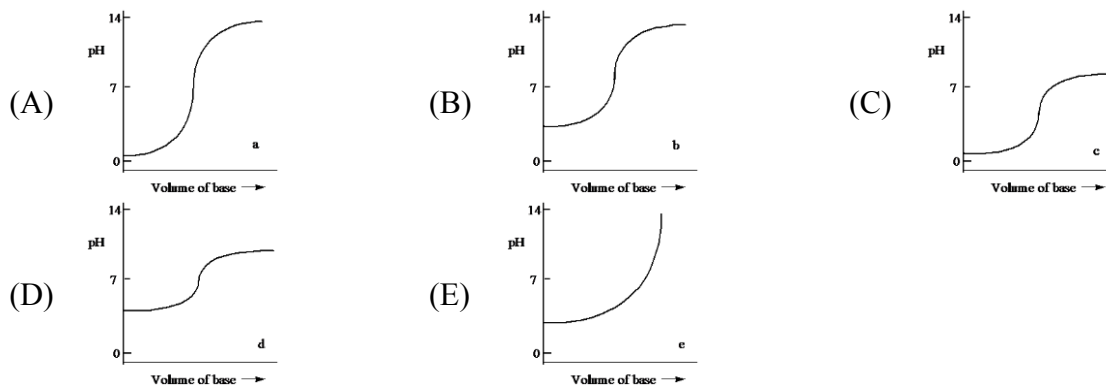
90. The students used salicylic acid and acetic anhydride to synthesize aspirin in the experiment of "The Preparation of Aspirin". The chemical reaction is shown as below:
    Which compound will react with FeCl$_3$ to become a purple complex?
    (A) Salicylic acid   (B) Acetic anhydride   (C) Aspirin
    (D) Acetic acid   (E) 18 M sulfuric acid

110學年度 學士後醫學系招生考試

計算機概論與程式設計試題封面

考試開始鈴響前，請勿翻閱本試題！

★考試開始鈴響前，請注意：

一、除准考證、應考文具及一般手錶外；行動電話、穿戴式裝置及其他物品
均須放在臨時置物區。

二、請務必確認行動電話已取出電池或關機，行動電話及手錶的鬧鈴功能必
須關閉。

三、就座後，不可擅自離開座位或與其他考生交談。

四、坐定後，雙手離開桌面，確認座位號碼、答案卡號碼與准考證號碼相
同，以及抽屜中、桌椅下或座位旁均無非考試必需用品。如有任何問
題，請立即舉手反應。

五、考試開始鈴響前，不得翻閱試題本或作答。

六、考試全程不得吃東西、喝水及嚼食口香糖。

七、違反上述規定，依「筆試規則及違規處理辦法」議處。

★作答說明：

一、考試時間：100分鐘。

二、本試題(含封面)共 11 頁，如有缺頁或毀損，應立即舉手請監試人員補發。

三、本試題單選題共 30 題、申論題 4 題，共計 100 分；每題單選題答錯倒
扣，不作答不計分。

四、單選題答題依題號順序劃記在答案卡上，寫在試題本上無效；答案卡限用
2B 鉛筆劃記，若未按規定劃記，致電腦無法讀取者，考生自行負責。

五、申論題部分以「答案卷」作答，作答時不得使用鉛筆，違者該科答案卷
不予計分；限用黑色或藍色墨水的筆書寫。

六、試題本必須與答案卡一併繳回，不得攜出試場。

【單選題】每題 **2** 分，共計 **60** 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。

1. Hashing is used to create a hash table for integer keys. Let the hash table be a vector indexed from 0 to 6, the hash function be $f(x) = x\%7$ where x denotes an integer key and % is the modulo operator, and collision be solved with the linear open addressing strategy. Suppose the four integer keys: 19, 33, 8, and 54, are processed sequentially. Where is 33 placed in the hash table?
   - (A) The position indexed 2
   - (B) The position indexed 3
   - (C) The position indexed 4
   - (D) The position indexed 5
   - (E) The position indexed 6

2. Suppose a computer has a RAM of 1 GB. Let one addressable word consist of 4 bytes. How many address bits are required to access all the words in the RAM?
   - (A) 28
   - (B) 29
   - (C) 30
   - (D) 31
   - (E) 32

3. Let x=00001111 and y=11111011 be two 8-bit 2's complement binary numbers. What happens for $x + y$?
   - (A) The result is -12 in decimal representation.
   - (B) The result is 12 in decimal representation.
   - (C) The result is -10 in decimal representation.
   - (D) The result is 10 in decimal representation.
   - (E) Overflow occurs.

4. What is bootstrap?
   - (A) an I/O device
   - (B) a memory device
   - (C) an interrupt handler
   - (D) a processor
   - (E) a small initiation program to start up computers

5. CPU scheduler selects the next process for execution. There are several basic scheduling methods, such as first-in-first-out (FIFO), shortest job first (SJF), and round-robin (RR). Regarding to these methods, which of the following comments is **INCORRECT**?
   - (A) With FIFO, the waiting time of a process may depend on the arriving order of the processes.
   - (B) Starvation won't occur with FIFO.
   - (C) Theoretically, SJF is an optimal scheduling algorithm in terms of average waiting time.
   - (D) Starvation won't occur with SJF.
   - (E) RR is a preemptive scheduling algorithm.

6. Virtual Memory is a storage allocation scheme in which secondary memory can be addressed as though it were part of main memory. Virtual memory can be implemented using Demand Paging. Several steps are performed in the demand paging scheme:

   Step 1: Operating system (OS) puts the process in the blocking state.

   Step 2: CPU is notified and the interrupted process is put in the ready state.

   Step 3: The required page is brought into the memory with the page replacement algorithm.

   Step 4: CPU generates an interrupt, indicating a page fault.

   Step 5: Page table is updated accordingly.

   Which of the following is the **CORRECT** sequence of steps performed by demand paging?

   (A) 1, 2, 3, 4, 5   (B) 2, 4, 3, 1, 5   (C) 3, 2, 5, 1, 4

   (D) 4, 1, 3, 5, 2   (E) 5, 3, 1, 2, 4

7. Assume there are four frames in main memory. Consider the following page reference string:
   2, 1, 6, 4, 1, 2, 5, 3, 1, 2, 1, 6, 7, 3, 6, 1, 2, 1, 6, 3. How many page faults occur for the OPT (Optimal Page-replacement Algorithm) replacement? Notes: All frames are initially empty, so the first unique pages will all cost one fault.

   (A) 7   (B) 8   (C) 9   (D) 10   (E) 11

8. Consider the execution of the following set of processes on a single-core processor.

Process	Creation Time	Required Execution Time
P_1	0	30
P_2	10	10
P_3	20	20
P_4	20	10
P_5	80	10

   Assume we use preemptive SJF (Shortest-Job-First) scheduling. What is the average waiting time?

   (A) 10   (B) 12   (C) 14   (D) 16   (E) 18

9. Suppose computers A and B have IP addresses 10.105.1.113 and 10.105.1.91, respectively, and they both use the same netmask N. Which of the values of N given below should be used if A and B belong to the same network?

   (A) 255.255.255.255   (B) 255.255.255.250

   (C) 255.255.255.240   (D) 255.255.255.224

   (E) 255.255.255.192

10. Assume a network device sends out data at the rate of 4,000 bps. How long does it cost to send a file of 100,000 characters?

    (A) 100 seconds   (B) 200 seconds

    (C) 300 seconds   (D) 400 seconds

    (E) 50 seconds

11. The following code snippets have security flaws. Which of the choices below can be used as **id** to achieve the SQL Injection attack?

> String query = "SELECT * FROM accounts WHERE custID='" + request.getParameter("**id**") + "'";

    (A) '1'='1'   (B) custID = 1 or 1

    (C) ' or '1'='1'   (D) id = 0 or 1

    (E) ' or '1'='0'

12. Suppose we have two tables, named TABLE-A and TABLE-B, respectively, as shown below.

A-ID	Name
1	yellow
2	green
3	pink

TABLE-A

ID	Size	Color-ID
1	seven	2
2	eight	2
3	nine	1
4	seven	3

TABLE-B

Consider the following SQL query:

> SELECT * FROM TABLE-B
> JOIN TABLE-A ON TABLE-A.A-ID = TABLE-B.Color-ID

Regarding to the result of executing this query, which of the following comments is **CORRECT?**

    (A) The result is a table of 7 records.

    (B) There are 5 columns in the resulting table.

    (C) Green appears in three records of the resulting table.

    (D) Eight appears in two records of the resulting table.

    (E) JOIN cannot be performed for these two tables.

13. In a 3-level memory hierarchy system, the hit time for each level is

     T1 = 5 ns (L1-cache)

     T2 = 200 ns (L2-cache)

     T3 = 600 ns (Main memory)

   The local hit rate in each level is H1 = 0.9 (L1-cache), H2 = 0.8 (L2-cache), and H3 = 1 (It is assumed that we can always find the data in main memory). If the average access time (ns) of this memory is K. What is the value of "**{Round(K*123)} mod 5**" ?

   (A) 0   (B) 1   (C) 2   (D) 3   (E) 4

14. Let AB*CD-/E+ be an postfix expression. If A=6, B=3, C=4, D=5, and E=8. What is the result of this postfix expression after evaluation?

   (A) -10   (B) -8   (C) 8   (D) 9   (E) 10

15. Let the height of a tree be the number of nodes along the longest path from the root node to the leaf nodes. Consider the integers 30, 41, 25, 29, 94, 37, 70, 23, 65, 75 in the specified order to develop a binary search tree. Which of the following is **TRUE**?

   (A)   The node for 37 is an internal node.

   (B)   The root node is 41.

   (C)   The node for 70 has only one child.

   (D)   The height of the tree is 5.

   (E)   The node for 75 is a child of the node for 94.

16. What will be the output of the following C code ?

```
#include <stdio.h>
int main()
{
            int A[5] = {1, 2, 3, 4, 5};
            int * p = A + 3;
            printf("%d\n", p[1]);
}
```

   (A) 2   (B) 3

   (C) 4   (D) 5

   (E)   None of the above

17. Consider the following instruction mix for a processor:

    ALU operations: 40%, uses 4 cycles.

    Branch operations: 30%, uses 4 cycles.

    Memory references: 30%, uses 5 cycles.

    The un-pipelined processor has a clock cycle time of 1 ns. The pipelined processor has a clock cycle time of 1.2 ns. Suppose that we ignore any latency and hazards, and assume that the pipelined processor has an ideal CPI (cycles per instruction) of 1. How much speedup can be achieved when comparing the un-pipelined processor and the pipelined processor?

    (A) 3.28   (B) 3.35   (C) 3.58   (D) 3.86   (E) 3.98

18. Perform a DFS (Depth-First Search) traversal of this graph by starting at node 1 and going in the order of numbers in Arabic when picking which neighbor to visit first. Which of the following is the **CORRECT** traversal order?
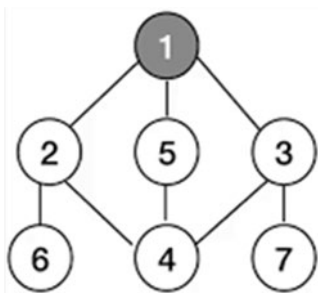
    (A) 1, 2, 6, 4, 5, 3, 7   (B) 1, 2, 4, 6, 5, 3, 7
    (C) 1, 2, 4, 5, 6, 3, 7   (D) 1, 2, 4, 3, 7, 5, 6
    (E) 1, 2, 4, 5, 3, 7, 6

19. Consider the following C code:

```
int x = 4;
for (int a = 1; a < 5; a ++)
    for (int b = 1; b < 10; b += 3)
        x += 2;
```

    When the code is executed, what is the final value of x?

    (A) 20   (B) 24   (C) 28   (D) 32   (E) 36

20. What will be the output of the following C code?

```c
#include <stdio.h>
int x=6;
void a()
{
        printf("%d ", x);
}
void b()
{
        x = 9;
        a();
}
int main()
{
        int x = 3;
        b();
        printf("%d ", x);
}
```

(A) 36   (B) 39   (C) 93   (D) 63   (E) 96

21. In machine learning, one of the most common problems that will occur when we are training a model is **overfitting.** There are some techniques that could ease or even solve this problem. Which of the following technique does **NOT** alleviate overfitting problem?
    (A) Adding dropout between layers.
    (B) Increasing training epochs.
    (C) Data augmentation.
    (D) Early stopping while training model.
    (E) Using L1/L2 regularization.

22. Consider the following C program code and statements (1)~(5).

```c
#include <stdio.h>
#include <math.h>
int main(void) {
    struct listnode{
    int num;
    struct listnode *ptr;
    };
    int i,index;
    struct listnode node[10];
    for(i=0;i<20;i++){
        index = i%10;
        node[index].num = pow(i,2);
        if((index) != 9)
            node[index].ptr = &node[index+1];
        else
            node[index].ptr = &node[0];
    }
    return 0;

}
```

      (1) node[1].num = 0

      (2) node[1].num = 1

      (3) node[2].ptr->num = 9

      (4) node[9].ptr->ptr->num = 121

      (5) node[9].ptr->num = 100

Which of the following statements is **CORRECT**?

    (A)   (1)(3)(4)(5)   (B)   (1)(3)   (C)   (2)(3)

    (D)   (2)(3)(4)(5)   (E)   (4)(5)

23. The following is a C program code:

```
#include <stdio.h>
#include <stdlib.h>
#define func1(X,Y) ((X) <= (Y) ? (X) : (Y))
#define func2(n) n*n
int main(void){
    int num=a, x=b, y=c;
    printf("A=%d ",func2(num+1));
    printf("B=%d ",func1(x,y));
}
```

Which one of the following statements is **CORRECT**?
(A) When a=8, b=5, c=6, then A is 81, B is 5.
(B) When a=8, b=5, c=6, then A is 81, B is 6.
(C) When a=8, b=5, c=6, then A is 17, B is 5.
(D) When a=8, b=5, c=6, then A is 17, B is 6.
(E) When a=8, b=5, c=6, then A is 16, B is 6.

24. Suppose there are 16 users in the system, and they use symmetric encryption to achieve confidential communication, how many keys need to be managed?
(A) 125   (B) 256   (C) 120   (D) 128   (E) 160

25. Let a, b, c be three 8-bit operands to a carry-save adder and their values be a = 00010110, b = 01101101 and c = 01001110. What are carry outputs of this carry-save adder?
(A) 01001110   (B) 00110101
(C) 01010110   (D) 00111010
(E) 01101101

26. Which of the following activation functions can avoid the vanishing gradient problem?
(A) ReLU   (B) tanh
(C) Sigmoid   (D) ELU
(E) None of the above

27. What is the status of a process if the process stops because its time slot is over?

(A) Waiting

(B) Running

(C) Ready

(D) Sleeping

(E) Terminated

28. In machine learning, a confusion matrix is a table that is often used to describe the performance of a classification model on a set of test data for which the true values are known. One can use the matrix to calculate the evaluation metrics, such as accuracy, precision, recall, and F1 score. Suppose a confusion matrix contains TP (true positive) = 900, FN (false negative) = 100, FP (false positive) = 50, and TN (true negative) = 950. What is the value of precision for the model?

(A) 1850/2000　　　(B) 900/1000　　　(C) 900/2000

(D) 50/950　　　(E) 900/950

29. Suppose there is a two-input neuron with weights $w_1 = 3$, $w_2 = 2$, and bias $b = 1.2$. Let the activation function f be the ReLU (Rectified Linear Unit) function, defined as $f(x) = max(0, x)$. Given the inputs $p_1 = -5$ and $p_2 = 6$. What is the output of this neuron?

(A) 0　　　(B) 1.2　　　(C) 2.4　　　(D) -1.5　　　(E) -1.8

30. For a Generative Adversarial Network (GAN) that can produce images of cars, which of the following statements is **TRUE**?

(1) The generator aims to learn the distribution of car images.

(2) After training the GAN, the discriminator loss eventually reaches a constant value.

(3) The generator can produce unseen images of cars.

(4) The discriminator can be used to classify images as car vs. non-car.

(A) (1) and (2)　　　(B) (2) and (3)　　　(C) (1), (2) and (3)

(D) (2), (3) and (4)　　　(E) (1), (2), (3) and (4)

【申論題】每題 10 分，共計 40 分。未作答或作答錯誤，不給分亦不扣分。

1. A binary tree has ten nodes. The inorder and preorder traversals of the binary tree are shown as follows.

    Inorder: FKCGJBDEAI

    Preorder: GFCKDJBIEA

    Draw the tree.

2. In machine learning, information gain is applied for attribute selection in building a decision tree. Suppose a data set has 10 instances, each of which belongs to one of two classes, including class C1 and class C2. Among the 10 instances, 6 belong to class C1 and 4 belong to class C2. Let A be an attribute with two attribute values a1 and a2. The number of instances having A = a1 and belonging to class C1 is 2, the number of instances having A = a2 and belonging to class C1 is 4, the number of instances having A = a1 and belonging to class C2 is 4, and the number of instances having A = a2 and belonging to class C2 is 0.

    a. Determine the entropy of the data set. (4 points)

    b. Determine the average entropy of the resulting subsets obtained by splitting on attribute A. (4 points)

    c. How much information gain is obtained if attribute A is selected for the root node of the decision tree? (2 points)

    Note: Please use the values: $\log_2 3 = 1.6$ and $\log_2 5 = 2.3$.

    Hint: Entropy $= -\sum_{i=1}^{n} P_i * \log_2(P_i)$, where P_i is distribution for event *i*.

3. To transmit text across a network, an English character is usually encoded in 8 bits in which bits 0~6 are the ASCII code and bit 7 is used for parity checking. Suppose a string of 5 characters, **infni**, is to be transmitted and odd-parity checking is adopted. Let the ASCII code of i be 1101001, the ASCII code of n be 1101110, and the ASCII code of f be 1100110. What is the sequence of 40 bits encoded for the 5-character string? Please show the sequence in hexadecimal (base 16) form.

4. Suppose we have an array A containing 9 integers: 240, 119, 682, 341, 225, 556, 122, 661, 245, i.e. A = [240, 119, 682, 341, 225, 556, 122, 661, 245] with the first index being 0. Please convert the array A into a maxheap and show the content of A after conversion. Note that the conversion should be done in-place.

110學年度 學士後醫學系招生考試

英文試題封面

考試開始鈴響前，請勿翻閱本試題！

★考試開始鈴響前，請注意：

一、除准考證、應考文具及一般手錶外；行動電話、穿戴式裝置及其他物品均須放在臨時置物區。

二、請務必確認行動電話已取出電池或關機，行動電話及手錶的鬧鈴功能必須關閉。

三、就座後，不可擅自離開座位或與其他考生交談。

四、坐定後，雙手離開桌面，確認座位號碼、答案卡號碼與准考證號碼相同，以及抽屜中、桌椅下或座位旁均無非考試必需用品。如有任何問題，請立即舉手反應。

五、考試開始鈴響前，不得翻閱試題本或作答。

六、考試全程不得吃東西、喝水及嚼食口香糖。

七、違反上述規定，依「筆試規則及違規處理辦法」議處。

★作答說明：

一、考試時間：80分鐘。

二、本試題(含封面)共 **11** 頁，如有缺頁或毀損，應立即舉手請監試人員補發。

三、本試題單選題共 50 題、寫作 1 題，共計 90 分；每題單選題答錯倒扣，不作答不計分。

四、單選題答題依題號順序劃記在答案卡上，寫在試題本上無效；答案卡限用 2B 鉛筆劃記，若未按規定劃記，致電腦無法讀取者，考生自行負責。

五、寫作部分以「答案卷」作答，作答時不得使用鉛筆，違者該科答案卷不予計分；限用黑色或藍色墨水的筆書寫。

六、試題本必須與答案卡一併繳回，不得攜出試場。

I. Vocabulary: 20 points

【單選題】每題 1 分，共 20 題，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。

A. Please choose the word underlined closest in meaning to each underlined word.

1. Everyone is extremely pleased at the **scrupulous** way in which inspection is being carried out on the security of the vaccines.
    (A) economical   (B) conscientious   (C) innovative   (D) efficient   (E) immaterial

2. This film marked the **pinnacle** of her acting career.
    (A) artefact   (B) caveat   (C) heyday   (D) impunity   (E) reverence

3. There is a **paucity** of information on the ingredients of many cosmetics.
    (A) dearth   (B) elasticity   (C) interim   (D) plateau   (E) tabloid

4. Environmental factors can **accelerate** the development of certain cancers.
    (A) warrant   (B) quicken   (C) precede   (D) obscure   (E) complicate

5. If we focus too much on **peripheral** issues, we will lose sight of the goal.
    (A) arduous   (B) immediate   (C) trivial   (D) previous   (E) tedious

6. The pandemic had **exacerbated** the longstanding city budget problems the last administration did too little to address.
    (A) aggravated   (B) contributed   (C) moderated   (D) negotiated   (E) stimulated

7. The top of the museum has the classic center ring **reminiscent** of the 60's era.
    (A) advocative   (B) evocative   (C) provocative   (D) reciprocative   (E) suffocative

8. Everything that happened that day was **obliterated** from his memory.
    (A) fabricated   (B) expunged   (C) revamped   (D) preserved   (E) mended

9. The plastic surgery really **enervated** him for weeks afterwards.
    (A) fortified   (B) galvanized   (C) debilitated   (D) invigorated   (E) strengthened

10. The legislation was drafted and **promulgated** at the end of 2020.
    (A) announced   (B) confounded   (C) repented   (D) proposed   (E) unraveled

B. Please choose the best answer to complete each sentence.

11. Health systems can add genetic testing into care regimens to gain a more _____ image of patients' health risks.
    (A) circumscribed   (B) abrasive   (C) comprehensive   (D) abbreviated   (E) restrictive

12. Gabriel García Márquez was one of the most _____ and accomplished writers of his age.
    (A) versatile   (B) dull   (C) inept   (D) amateur   (E) inflexible

13. When the two universities to which Lisa had applied accepted her, she had no direction and was in _____ as to which one she should attend.
    (A) perplexity   (B) assurance   (C) placidity   (D) tranquility   (E) quietude

14. The theory _____ two reasons for the spread of the disease.
    (A) perishes   (B) perspires   (C) postpones   (D) postulates   (E) precipitates

15. They're only proposing the law to _____ attention from important issues.
    (A) digress   (B) dilate   (C) derail   (D) decry   (E) divert

16. Paris is a city of gourmet with hundreds of restaurants which will surely _____ your appetite for delicious food.
    (A) penetrate   (B) nurture   (C) circumvent   (D) satiate   (E) quench

17. She tried to _____ my confidence by telling me that I had a special talent.
    (A) validate   (B) sanction   (C) garnish   (D) expedite   (E) bolster

18. The _____ plan would involve investment in high-tech manufacturing, clean energy, and transportation systems designed for electric vehicles.
    (A) cyberstructure   (B) infrastructure   (C) microstructure
    (D) neurostructure   (E) paleostructure

19. Loss of memory is a natural _____ of old age.
    (A) concomitant   (B) dominant   (C) indignant   (D) repugnant   (E) stagnant

20. Some private investors are not fully _____ of the benefits that environmental investments can yield to them.
    (A) cognitive   (B) cognizant   (C) conspicuous   (D) consistent   (E) contradictory

II. Grammar and Structure: 10 points
【單選題】每題 1 分，共 10 題，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。

A. Please choose the <u>best</u> answer to complete each sentence.

21. If she _____ carefully, she would not have had that terrible accident.
    (A) drives   (B) drove   (C) has driven
    (D) had driven   (E) would have driven

22. The *Winged Victory* statue lacks a head, _____ it is considered one of the world's most beautiful sculptures.

   (A) nevertheless   (B) still   (C) despite   (D) yet   (E) therefore

23. Not only _____ in the field of psychology, but animal behavior is explored as well.

   (A) human behavior

   (B) is studied human behavior

   (C) is human behavior studied

   (D) human behavior is studied

   (E) human behavior is studying

24. _____ of vision or smell might, without realizing it, affect who we choose as friends has been advised.

   (A) Our sense that   (B) That our sense   (C) Sense

   (D) For our sense   (E) Because our sense

25. His friends recommended _____ the course.

   (A) John has to take   (B) that John takes   (C) that John take

   (D) that John to take   (E) John taking

B. For each sentence, please choose ONE underlined part that contains ungrammatical use of English.

26. Before the pandemic grounded <u>most flights</u>, commercial aviation <u>accounted for</u> about 2.5% of
                        (A)   (B)
global emissions of carbon dioxide. It sounds like <u>it is a small proportion</u> of the whole, but it is
                                        (C)
more than <u>those of Germany</u>, and this is not <u>the whole story</u>.
         (D)   (E)

27. <u>Neither</u> the archaeological data <u>unearthed</u> in Taiwan <u>nor</u> the documental evidence <u>preserved</u> in
  (A)   (B)   (C)   (D)
China <u>indicating</u> that Taiwan had ever been ruled by the Chinese earlier than that time.
      (E)

28. A coral reef <u>consists in</u> millions of tiny coral polyps, which <u>are</u> <u>a</u> form of small <u>animal</u> <u>related to</u>
        (A)   (B) (C)   (D)   (E)
biocomposites of calcium carbonate.

29. Those <u>charging</u> stations and USB devices can be <u>easily</u> <u>modified</u> to give criminals <u>accessed</u> to
     (A)   (B)   (C)   (D)
your phone, including <u>installing</u> software on the phone.
          (E)

30. While studies have suggested <u>almost all</u> Caucasian men will eventually face <u>some degree of</u> male
<div align="center">(A)   (B)</div>

  pattern baldness – and around half can <u>expect to lose</u> their hair by middle age – Asian men, and
<div align="center">(C)</div>

  East Asians <u>in particular</u>, have historically experienced the lowest incidence of hair loss in the
<div align="center">(D)</div>

  world. In northeast China, men usually don't experience hair loss <u>in their 20's</u>.
<div align="center">(E)</div>

III. Reading Comprehension: 40 points

【單選題】每題 2 分，共 20 題，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。

Please read the following excerpts/passages closely and then choose the best answer for each question according to the contents.

In a recent research, 71 volunteers with metabolic syndrome were recruited, and they were divided into two groups at random. Both groups followed the DASH (Dietary Approach to Stop Hypertension) diet for three months, which is designed to combat high blood pressure. This Mediterranean-style diet includes lots of fruit and vegetables, whole-wheat products, nuts, fish, and lean white meat. One of the two groups started a fast before the DASH diet, while the other group stuck to their regular diet before the experiment. The researchers used stool samples to examine the effects of the fast on the gut microbiome. Gut bacteria work in close contact with the immune system. Some strains of bacteria metabolize dietary fiber into anti-inflammatory short-chain fatty acids that benefit the immune system. The composition of the gut bacteria ecosystem changes drastically during fasting. Health-promoting bacteria that help to reduce blood pressure multiply. The following is particularly noteworthy: "Body mass index (BMI), blood pressure, and the need for antihypertensive medication remained lower in the long run among volunteers who started the healthy diet after a fast," explains one of the researchers. Some of these changes remain even after resumption of food intake. This result is thrilling; blood pressure normally shoots back up again when even one antihypertensive tablet is forgotten. The leading researcher of this study concludes that____35____.

31. Which is NOT a selection from the DASH diet?

  (A) oranges   (B) mutton   (C) salmon   (D) almonds   (E) broccoli

32. Participants were divided into two groups to examine whether _____.

  (A) Mediterranean-style diet helps combat depression

  (B) their gut bacteria are under the influence of the immune system

  (C) fasting before DASH diet makes a difference

  (D) DASH diet helps combat metabolic syndrome

  (E) immune systems react to dietary fiber

33. What did the doctor examine in order to measure the effect?
    (A) fruit, vegetables, nuts, fish, and lean white meat
    (B) a questionnaire given to the participants
    (C) samples of blood and urine
    (D) samples of the food that is not digested
    (E) samples of solid waste released from the body

34. Why is the result thrilling?
    (A) The effects last longer than expected.
    (B) It controls both BMI and blood pressure.
    (C) It takes effect very quickly.
    (D) Antihypertensive tablets are abandoned.
    (E) It is the most effective diet than others.

35. Which is the most likely conclusion of the leading researcher?
    (A) Switching to a healthy diet has a positive effect on blood pressure.
    (B) Other factors such as regular exercise should also be taken into account.
    (C) Some strains of bacteria play mysterious role in human immune systems.
    (D) If a healthy diet is preceded by a fast, the positive effect is intensified.
    (E) The DASH diet is by far the healthiest way of living attested by science.

Known locally as "water monsters," **axolotls have somewhat polarizing looks**. For some, they are considered adorable for the appearance of a perpetual smile; for others, these four-toed amphibians are just plain odd. Scientists are particularly interested in axolotls' ability to regenerate cells and body parts and seeking to apply such a quality to heal injuries, illnesses, or human organs.

Some axolotl species transform themselves into earth-walking salamanders by losing their tadpole-like tails and gills from their heads. However, those who never transform into salamanders will keep the tail and live completely underwater. In fact, there is little reason to undergo transformation because they have fewer predators and more food in the water.

Because of their nature to change form, axolotls are recognized as a representation of Xolotl, god of the underworld in Aztec culture. Legend has it that when various gods were asked to make a sacrifice to create the world, Xolotl fled into the water. For his cowardice and reluctance to help, he was damned to live forever in the water and denied transcendence into a higher realm.

The axolotl, though gaining attraction as a symbol of Mexico City, is nearly extinct in the wild due to water pollution in the city's troubled canals and increases in invasive fish species which feed on young axolotls. Environmental threats to axolotls include agricultural waste, pollution from industrial fertilizers, as well as non-native plants and fish species such as carp and tilapia, which were introduced by the government to supply food to rural areas. While keeping axolotls as pets around the world is legal, it may not help the species. As they live in still water lakes and lagoons, the

temperatures tend not to fluctuate as quickly as they can in captivity, and thus making captivity a serious undertaking.

36. What does the underlined sentence in Paragraph 1 mean?
    (A) Axolotls have various appearances.
    (B) Axolotls have mysterious appearances.
    (C) Axolotls may change appearances with the environment.
    (D) People are curious about axolotls' appearances.
    (E) People have completely opposite opinions about axolotls' appearances.

37. According to the article, which is NOT the cause of axolotls' extinction?
    (A) farming waste
    (B) pollution in the canals
    (C) chemicals to help plants grow
    (D) droughts in Mexico City
    (E) exotic species

38. Why is keeping axolotls as pets not a good idea?
    (A) The cost is too high.
    (B) It is illegal in many countries.
    (C) They may gain popularity as a symbol of Mexico City.
    (D) Water temperature is more stable in the wild.
    (E) They may stop breeding in captivity.

39. Which of the following is TRUE?
    (A) Xolotl created the underworld.
    (B) Xolotl transcended into a higher realm.
    (C) Xolotl offered to change form to make a sacrifice.
    (D) Xolotl was rewarded to be a god for his bravery in the water.
    (E) Axolotls are associated with the god of the underworld in Aztec culture.

40. What is the best title for this article?
    (A) Axolotls: An Alternative Solution to Food Supply
    (B) Keeping and Caring for Axolotls as Pets
    (C) Axolotls: God of the Underworld
    (D) A Search for the Key to Eternal Youth
    (E) Mexico City's Walking Fish

Psychologist Adam Grant claims that people with original ideas may look nothing like we expected. Originals are people who stand out and speak up. They not only have new ideas but take action to champion them. Originals drive creativity and changes in the world.

Originals are not normally associated with procrastinators. **Procrastinating is a vice when it comes to productivity, but it can be a virtue for creativity.** According to research, people who wait until the last minute to do a task are so busy goofing off that they rarely have new ideas, while people who rush to do everything early tend to be too anxious that they don't have original thoughts either. There seems to be a sweet spot where originals live – moderate procrastination is found to boost creativity. Moderate procrastination allows more time to consider divergent ideas, to think in nonlinear ways, and to make unexpected leaps.

Another misconception about originals is that they are always first-movers. Many originals are quick to start but slow to finish. To be original, you don't have to be first; you just have to be different and better. It's much easier to improve other's idea than it is to create something new from scratch. For example, Facebook waited to build a social network years after Myspace and Friendster.

On the surface, original people may appear confident, but actually they feel the same fear and doubt that we do. They just manage it differently. Professor Grant thinks that there are two kinds of doubt: self-doubt and idea doubt. **The former is paralyzing; it leads people to freeze**, but the latter is energizing; it motivates people to test, to experiment, and to refine new ideas. Originals also have fear. They are afraid of failing, but they are even more afraid of failing to try. The greatest originals are the ones who fail the most, because they try the most. Classical composers, Bach, Beethoven, and Mozart, had to generate hundreds and hundreds of compositions before they could come up with a much smaller number of masterpieces. Originals procrastinate, they feel fear and doubt, and they have bad ideas. Professor Grant concludes that the reason why originals succeed is not their disregard for those qualities but because of them.

41. What does the underlined sentence in Paragraph 2 mean?
    (A) People with virtue dislike procrastination.
    (B) People with creativity are usually procrastinators.
    (C) Procrastination allows more time to incubate ideas.
    (D) Productivity and creativity are mutually exclusive.
    (E) Productivity and creativity go hand in hand.

42. What does the underlined sentence in Paragraph 4 mean?
    (A) Idea-doubt makes people stop making efforts.
    (B) Idea-doubt makes people stop believing in themselves.
    (C) Self-doubt is caused by weather.
    (D) Self-doubt makes people stop making efforts.
    (E) Self-doubt encourages people to go a long way.

43. What does Professor Grant's conclusion mean?
    (A) Originals are held back by these qualities.
    (B) Originals are the lucky few who were born without these qualities.
    (C) Originals are so talented that their minor imperfections can be overlooked.
    (D) Originals manage to use these qualities to their own advantage.
    (E) These qualities are irrelevant to originals' success.

44. According to the article, which of the following is TRUE?
    (A) Originals always have the first-mover advantage.
    (B) Originals are no different from ordinary people.
    (C) People procrastinate because they are afraid of failing.
    (D) People are encouraged to doubt themselves to make progress.
    (E) Classical composers succeed because they focus entirely on few compositions.

45. What is the best title for this article?
    (A) The Power of Productivity
    (B) The Surprising Habits of Original Thinkers
    (C) How to Kick the Bad Habit of Procrastination?
    (D) Do Schools Kill Originality?
    (E) Why Every Business Needs Original Thinkers?

What We Know and Don't Know about Sleep

Why do we sleep? Up until today, researchers are still trying to find out. Sleep is regarded as one of the greatest unsolved mysteries of science, even though all animals do it in one form or another. Theories range from brain maintenance to reversing damage from stress suffered while awake, to promoting longevity. However, "**none of these theories are well-established, and many are mutually exclusive,**" according to University of California, Los Angeles (UCLA).

Hibernation, a phase during which animals spend the winter in a deep sleep, is one example of an activity that regulates behavior for survival. A small animal can't migrate to a warmer climate in winter, Siegel says. "So it hibernates, effectively cutting its energy consumption and thus its need for food, remaining secure from predators by **burrowing** underground." Sleep duration, then, is determined in each species by its behavioral patterns such as time requirements of eating, migration needs, care of young, and other factors. "However, unlike hibernation...," says Siegel, "sleep is rapidly reversible – that is, animals can wake up quickly, a unique mammalian adaptation that allows for a relatively quick response to sensory signals."

Humans fit into this analysis as well. The human brain, albeit just two percent of total body weight, consumes 20 percent of total energy used when a person is resting – an amazing ratio. So the energy savings achieved during sleep have considerable significance. Sleep also has survival benefits

for humans which include, according to Siegel, "a reduced risk of injury, reduced resource consumption and, from an evolutionary standpoint, reduced risk of detection by predators."

Some people try to ignore the body's sleep demands. In her fast-paced job as a reporter for a southern California newspaper, Gwendolyn Driscoll says she "**blasts through the day.**" Arriving home late in the evening, she has little time for housework or catching up on her reading, and even less for sleep. Most nights, she gets about six and half hours. "I could definitely do with another hour," says 35-year-old Driscoll. "But sleep just isn't a priority."

Perhaps it should be. Sleep experts say the average adult requires seven to eight hours of sleep per night. Anything less may harm his or her health. Sleep deprivation could affect mental alertness and increase the risk for diseases. "Sleep is just as important to our overall health as are exercise and a healthy diet," says Carl Hunt, the director of the National Center on Sleep Disorders Research in Bethesda, Maryland. Sleep is a biological need, much like food and water. If totally deprived of sleep, humans ultimately die. Yet millions of Americans are increasingly getting too little sleep. Today, Americans on average sleep one hour less per night than they did 20 to 30 years go.

Sleep deprivation has a very negative impact on mental function, creativity, alertness, and the ability to participate effectively in everyday interactions. It has been shown to negatively affect language skills, decision-making, and memory. "Without sufficient amounts of sleep, we feel drowsy and are unable to concentrate," Hunt says. He noted that with enough sleep deprivation, some people can develop mood changes and can even begin to hallucinate, all of which can lead to reduced quality of life.

Not surprisingly, there is also a strong link between sleep deprivation and traffic accidents. What most people don't realize, researchers say, is that sleep deprivation also accumulates over time. People who don't get enough sleep build up a "sleep debt," which can't be eliminated by getting a little extra sleep on the weekend. "Most people are carrying a fairly large sleep debt and are in fact impaired and do not seem to know it," Dement and colleagues have published a study that documented the results of lowering the sleep debt. "Some of the improvements in performance, in mood, in mental ability, and in energy were really dramatic, almost superhuman," they say.

46. What is the best paraphrase for the underlined sentence in Paragraph 1?
    (A) All of these theories resulted from careful research, but they aren't yet proven.
    (B) Some of these theories make sense, and they should be considered.
    (C) These theories are not proven, and they contradict each other.
    (D) These theories are similar to each other and are believed by many people.
    (E) All of these theories resulted from careful research are proven effective.

47. In Paragraph 2, the word **<u>burrowing</u>** means _____.
    (A) burying   (B) eating   (C) searching   (D) breeding   (E) digging

48. What is the best replacement for the phrase "**blasts through the day**" in Paragraph 4?
    (A) doesn't stop working all day
    (B) feels like the day goes by quickly
    (C) feels angry all day long
    (D) enjoys what she does all day
    (E) dislikes what she does all day

49. The main idea of Paragraph 5 is that _____.
    (A) people should probably sleep more than they do
    (B) Americans on average sleep less than they did 20 to 30 years ago
    (C) people die if they don't get enough sleep
    (D) people get sick because they don't sleep enough
    (E) people need enough food and exercise as much as they need sleep

50. Which of the following is NOT mentioned as a result of sleep deprivation?
    (A) increased risk of traffic accidents
    (B) reduced mental alertness
    (C) memory loss
    (D) poor performance in language skills
    (E) reduced awareness of being full

IV. Essay Writing: 20 points
    Write an essay of at least 200 words in an appropriate style on the following topic.
    The Ministry of Health and Welfare has set a goal to vaccinate 60% of the population with a COVID-19 vaccine. Do you agree or disagree with the goal set by the Ministry? Use specific reasons to support your answer(s).