國立中山大學 111 學年度
學士後醫學系招生考試試題

科目名稱：物理與化學

－作答注意事項－

考試時間：100 分鐘

- **考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卡之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。**

- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。

- 答案卡應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。

- **不可使用計算機，並不得攜帶具有通訊、記憶或收發等功能或其他有礙試場安寧、考試公平之各類器材、物品（如鬧鈴、行動電話、電子字典等）入場。**

- 試題及答案卡請務必繳回，未繳回者該科成績以零分計算。

- 試題採雙面列印，考生應注意試題頁數確實作答。

- 違規者依本校招生考試試場規則及違規處理辦法處理。

※選擇題(單一選擇題，共 90 題，總分 150 分)
壹、第 1~30 題每題 1 分，共 30 分，每題答錯倒扣四分之一。

1. Two balls, projected at different times so they don't collide, have trajectories A and B, as shown below. Which statement is correct?
   (A) v_{0B} must be greater than v_{0A}.
   (B) Ball A is in the air for a longer time than ball B.
   (C) Ball B is in the air for a longer time than ball A.
   (D) Ball B has a greater acceleration than ball A.
   (E) Ball A has a greater acceleration than ball B.
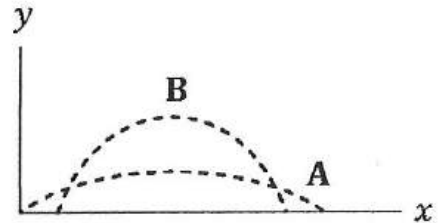
2. A shell explodes into two fragments, one fragment 25 times heavier than the other. If any gas from the explosion has negligible mass, then
   (A) the momentum change of the lighter fragment is 25 times as great as the momentum change of the heavier fragment.
   (B) the momentum change of the lighter fragment is exactly the same as the momentum change of the heavier fragment.
   (C) the momentum change of the heavier fragment is 25 times as great as the momentum change of the lighter fragment.
   (D) the kinetic energy change of the heavier fragment is 25 times as great as the kinetic energy change of the lighter fragment.
   (E) the kinetic energy change of the lighter fragment is 25 times as great as the kinetic energy change of the heavier fragment.

3. Two pure tones are sounded together and a particular beat frequency is heard. What happens to the beat frequency if the frequency of one of the tones is increased?
   (A) It increases.
   (B) It decreases.
   (C) It does not change.
   (D) It becomes zero.
   (E) We cannot tell from the information given.

4. When a fixed amount of ideal gas goes through an adiabatic expansion,
   (A) no heat enters or leaves the gas.
   (B) its internal (thermal) energy does not change.
   (C) the gas does no work.
   (D) its pressure must increase.
   (E) its temperature cannot change.

5. A bar magnet is dropped from above and falls through the loop of wire shown below. The north pole of the bar magnet points downward towards the page as it falls. Which statement is correct?
   (A) The current in the loop always flows in a counterclockwise direction.
   (B) The current in the loop always flows in a clockwise direction.
   (C) The current in the loop flows first in a clockwise, then in a counterclockwise direction.
   (D) No current flows in the loop because both ends of the magnet move through the loop.
   (E) The current in the loop flows first in a counterclockwise, then in a clockwise direction.
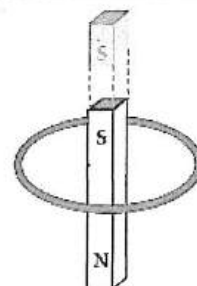
6. A 3.0-kg mass is projected down a rough, circular track (radius = 2.0 m) as shown. The speed of the mass at point A is 4.0 m/s, and at point B, it is 7.0 m/s. What is the change in mechanical energy done on the system between A and B by the force of friction?
   (A) −24 J
   (B) −9.3 J
   (C) −8.1 J
   (D) −7.2 J
   (E) −6.6 J
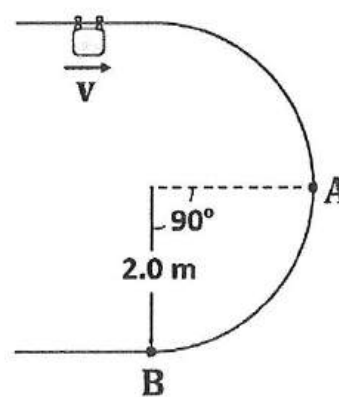
7. A straight wire is bent into the shape shown. Determine the net magnetic force on the wire when the current I travels in the direction shown in the magnetic field **B**:
   (A) $2IBL$ in the $+z$ direction
   (B) $2IBL$ in the $-z$ direction
   (C) $4IBL$ in the $+x$ direction
   (D) $4IBL$ in the $-y$ direction
   (E) zero
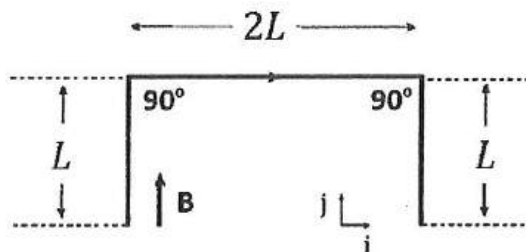
8. Three particles travel through a region of space where the magnetic field is out of the page, as shown in the figure. The electric charge of each of the three particles is, respectively,
   (A) 1 is positive, 2 is neutral, and 3 is negative
   (B) 1 is positive, 2 is negative, and 3 is neutral
   (C) 1 is neutral, 2 is negative, and 3 is positive
   (D) 1 is neutral, 2 is positive, and 3 is negative
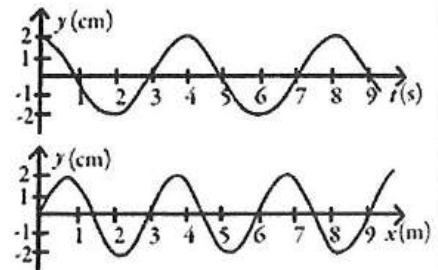   (E) 1 is negative, 2 is neutral, and 3 is positive
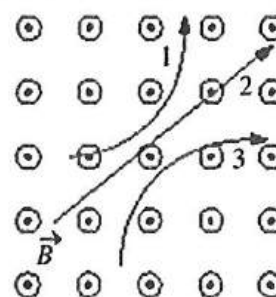
9. The figure shows the displacement y of a wave at a given position as a function of time and the displacement of the same wave at a given time as a function of position. Determine the frequency of the wave.
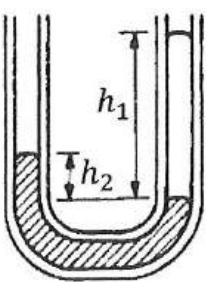   (A) 4.0 Hz
   (B) 3.0 Hz
   (C) 0.50 Hz
   (D) 0.33 Hz
   (E) 0.25 Hz

10. An ice cube at 0°C is placed in a very large bathtub filled with water at 30°C and allowed to melt, causing no appreciable change in the temperature of the bath water. Which one of the following statements is true?
    (A) The entropy gained by the ice cube is equal to the entropy lost by the water.
    (B) The entropy lost by the ice cube is equal to the entropy gained by the water.
    (C) The net entropy change of the system (ice plus water) is zero because no heat was added to the system.
    (D) The entropy of the system (ice plus water) increases because the process is irreversible.
    (E) The entropy of the water does not change because its temperature did not change.

11. A perfect Carnot engine operates between the temperatures of 300K and 700 K, drawing 60 kJ of heat from the 700 K reservoir in each cycle. How much heat is dumped into the 300 K reservoir in each cycle?
    (A) 26 kJ
    (B) 30 kJ
    (C) 34 kJ
    (D) 38 kJ
    (E) 42 kJ

12. A car of mass 1500 kg collides head-on with a parked truck of mass 3000 kg. Spring mounted bumpers ensure that the collision is essentially elastic. If the velocity of the truck is 18 km/h (in the same direction as the car's initial velocity) after the collision, what was the initial speed of the car?
    (A) 18 km/h
    (B) 38 km/h
    (C) 27 km/h
    (D) 10 km/h
    (E) 54 km/h

13. In which process will the internal energy of the system *not* change?
    (A) An adiabatic expansion of an ideal gas.
    (B) An isothermal compression of an ideal gas.
    (C) An isobaric expansion of an ideal gas.
    (D) The freezing of a quantity of a liquid at its melting point.
    (E) The evaporation of a quantify of a liquid at its boiling point.

14. A solid sphere, spherical shell, solid cylinder and a cylindrical shell all have the same mass m and radius R. If they are all released from rest at the same elevation and roll without slipping, which reaches the bottom of an inclined plane first? ($I_{\text{solid sphere}} = \frac{2}{5}MR^2$; $I_{\text{spherical shell}} = \frac{2}{3}MR^2$; $I_{\text{solid cylinder}} = \frac{1}{2}MR^2$; $I_{\text{hoop}} = MR^2$)
   (A) Solid sphere
   (B) Spherical shell
   (C) Solid cylinder
   (D) Hoop
   (E) All take the same time

15. Assume that the two liquids in the U-shaped tube as shown are water and oil. Compute the density of the oil if the water stands 19 cm above the interface and the oil stands 24 cm above the interface.
   (A) 455 kg/m^3
   (B) 532 kg/m^3
   (C) 664 kg/m^3
   (D) 792 kg/m^3
   (E) 825 kg/m^3

16. Acetylsalicylic acid is commonly used as
   (A) a pain killer　(B) a sedative　(C) anti-cancer drug　(D) tear gas　(E) a fertilizer

17. Which of the following classes of organic compounds gives effervescence with a NaHCO$_3$ solution?
   (A) Aldehydes　(B) Alkanes　(C) Esters　(D) Carboxylic acids　(E) None of above

18. According to the Crystal Field Theory, when the valence d orbitals of the central metal ion of a coordination compound are split in energy in an octahedral ligand field, which orbitals are raised least in energy?
   (A) d_{xy} and d_{x2-y2}　(B) d_{xy}, d_{xz} and d_{yz}　(C) d_{xz} and d_{yz}　(D) d_{xz}, d_{yz} and d_{z2}　(E) d_{x2-y2} and d_{z2}

19. According to the equations below, please calculate ΔH for the reaction: IF$_5$ (g) $\rightarrow$ IF$_3$ (g) + F$_2$ (g).
   IF (g) + F$_2$ (g) $\rightarrow$ IF$_3$ (g)　　ΔH = -390 kJ
   IF (g) + 2F$_2$ (g) $\rightarrow$ IF$_5$ (g)　　ΔH = -745 kJ
   (A) +1135 J　(B) -1135 J　(C) +355 kJ　(D) +35 kJ　(E) -35 kJ

20. Which of the following reactions would have a positive ΔS?
   (A) Pb(NO$_3$)$_2$ (aq) + 2KI (aq) $\rightarrow$ PbI$_2$ (s) + 2KNO$_3$ (aq)
   (B) 2H$_2$O (g) $\rightarrow$ 2H$_2$ (g) + O$_2$ (g)
   (C) H$_2$O (g) $\rightarrow$ H$_2$O (s)
   (D) NO (g) + O$_2$ (g) $\rightarrow$ NO$_2$ (g)
   (E) Ag$^+$ (aq) + Cl$^-$ (aq) $\rightarrow$ AgCl (s)

21. The balanced half-reaction in which a dichromate ion is reduced to chromium metal is a _____ process.
   (A) two-electron　(B) six-electron　(C) three-electron　(D) four-electron　(E) twelve-electron
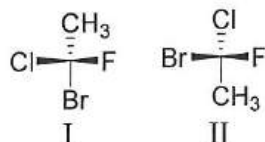
22. The molecules below are:

  I   II

(A) constitutional isomers　(B) enantiomers　(C) diastereomers　(D) identical　(E) none of above

23. Which of the following is a *correct* description of "catalyst?"
   (A) It stabilizes the product.
   (B) It lowers the reaction enthalpy.
   (C) There is no reaction between the catalyst and the reactants.
   (D) It decreases the activation energy.
   (E) It diminishes the energy gap between the starting materials and the products.

24. What is the point group of sulfuric acid (with the highest possible symmetry)?
   (A) T_d　(B) C_4　(C) D_{2d}　(D) C_{2v}　(E) C_s

25. Rank the following compounds from the most soluble to the least soluble in water.
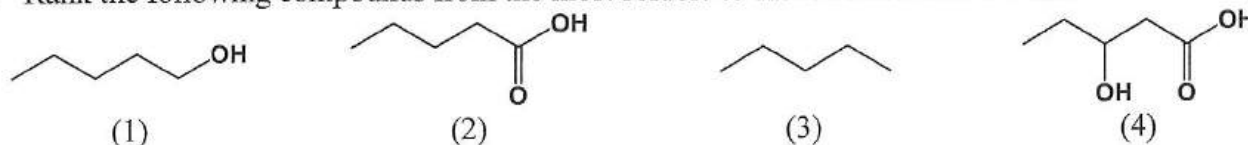
  (1)   (2)   (3)   (4)

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

26. There are three types of cubic unit cells, including simple cubic (SC), face-centered cubic (FCC), and body-centered cubic (BCC). Which of the following statements is *correct*?
   (A) BCC has 4 atoms per unit cell.
   (B) FCC has the largest unit cell.
   (C) The coordination number of SC is 8.
   (D) FCC is alternatively called hexagonal close-packed structure.
   (E) In BCC, the atomic packing factor is 0.68.

27. How many aromatic hydrocarbons have the molecular formula of C_8H_{10}?
   (A) 2　(B) 3　(C) 4　(D) 5　(E) 6

28. Which of the following statements about mass spectrometry is *correct*?
   I.　The ions are separated based on their charge-to-mass ratio.
   II.　Chemical ionization produces more fragmentation than electron ionization.
   III.　Mass spectrometry can be used to accurately measure small differences in isotopic abundance.
   (A) I and II only　(B) I and III only　(C) II and III only　(D) III only　(E) I only

29. Which of the following statements associated with collision theory is *incorrect*?
   (A) More collisions correspond to a faster reaction rate.
   (B) It is assumed that the reactant molecules are hard spheres.
   (C) The potential energy and orientation govern the occurrence of collisions between reacting particles.
   (D) Collisions can occur between atoms, ions, and molecules.
   (E) The Arrhenius equation gives the correlation between the rate constant k and temperature T.
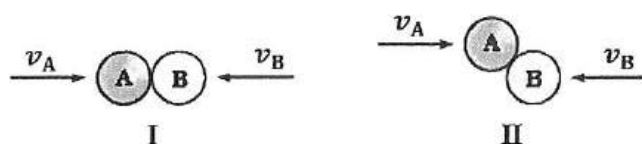
30. The ionization energy of H is 13.6 eV. The first and second ionization energies of He will be approximately
    (A) 5 eV and 14 eV   (B) 5 eV and 54 eV   (C) 14 eV and 24 eV
    (D) 14 eV and 34 eV   (E) 24 eV and 54 eV

貳、第 31~90 題每題 2 分，共 120 分，每題答錯倒扣四分之一。

31. Two bodies, A and B, collide as shown in Figures I and II below. Which statement is true?

    (A) They exert equal and opposite forces on each other in both I and II.
    (B) They exert equal and opposite forces on each other in II but not in I.
    (C) They exert equal and opposite forces on each other in I but not in II.
    (D) The forces are equal and opposite to each other in I, but only the components of the forces parallel to the velocities are equal in II.
    (E) The forces are equal and opposite in I, but only the components of the forces perpendicular to the velocities are equal in II.

32. Two identical balls strike normal to a wall with the same velocity respectively. Ball A bounces backwards at the same speed. Ball B stops. Which statement correctly describes the change in momentum of the two balls?
    (A) $|\Delta\mathbf{p_B}| > |\Delta\mathbf{p_A}|$
    (B) $|\Delta\mathbf{p_B}| = |\Delta\mathbf{p_A}|$
    (C) $|\Delta\mathbf{p_B}| < |\Delta\mathbf{p_A}|$
    (D) $\Delta\mathbf{p_B} = \Delta\mathbf{p_A}$
    (E) $\Delta\mathbf{p_B} > \Delta\mathbf{p_A}$

33. The circuit right contains three 100-W light bulbs. The emf $\varepsilon = 220$ V. Which light bulb(s) is(are) the brightest?
    (A) A
    (B) B
    (C) C
    (D) B and C
    (E) All three are equally bright
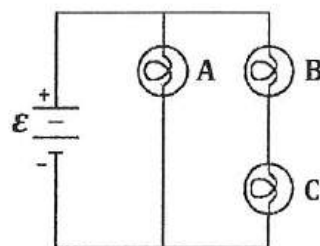
34. In an experiment, different wavelengths of light, all able to eject photoelectrons, shine on a freshly prepared (oxide-free) zinc surface. Which statement is true?
    (A) The number of photoelectrons emitted per second is independent of the intensity of the light for all the different wavelengths.
    (B) The number of photoelectrons emitted per second is directly proportional to the frequency for all the different wavelengths.
    (C) The maximum kinetic energy of the photoelectrons has a linear relationship with the frequency for each wavelength present.
    (D) The maximum kinetic energy of the photoelectrons emitted is directly proportional to the frequency for each wavelength present.
    (E) The maximum kinetic energy of the photoelectrons is proportional to the intensity of the light and independent of the frequency.
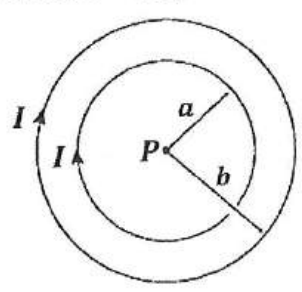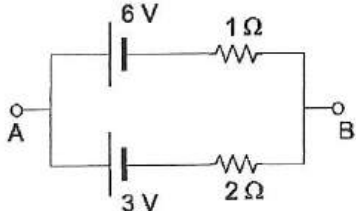
35. Equal volumes of hydrogen and helium gas are at the same pressure. The atomic mass of helium is four times that of atomic hydrogen (H). If the total mass of both gases is the same, the ratio of the temperature of helium (He) to that of hydrogen (H_2) is $T(He)/T(H_2) =$
    (A) 1/4
    (B) 1/2
    (C) 1
    (D) 2
    (E) 4

36. A block of material of mass m and specific heat c falls from height h and reaches speed v just before striking the ground. Its temperature is measured immediately after it strikes the ground. If we ignore any change in temperature owing to interaction with the air, the change in temperature of the block of material is
    (A) $\Delta T = \frac{v^2}{2c}$
    (B) $\Delta T = \frac{gh}{c}$
    (C) $\Delta T = \frac{vgh}{c}$
    (D) All of the answers above are correct
    (E) Only (A) and (B) above are correct

37. The work done in the expansion of a gas from an initial to a final state of a thermodynamic process
    (A) is the area under the curve of a PV diagram (P and V indicate the pressure and volume of the gas)
    (B) depends only on the end point
    (C) is independent of path
    (D) is the slope of a PV curve
    (E) equals $P(V_F - V_i)$

38. What is the magnitude of the magnetic field at point P if $a = R$ and $b = 2R$?
    (A) $\frac{3\mu_0 I}{4R}$
    (B) $\frac{\mu_0 I}{4R}$
    (C) $\frac{2\mu_0 I}{3R}$
    (D) $\frac{\mu_0 I}{3R}$
    (E) $\frac{3\pi\mu_0 I}{4R}$

39. The wave function $\psi(x)$ of a particle confined to $0 \leq x \leq L$ is given by $\psi(x) = Ax$. $\psi(x) = 0$ for $x < 0$ and $x > L$. When the wave function is normalized, the probability density at coordinate x has the value
    (A) $\frac{2}{L^2}x$
    (B) $\frac{2}{L^2}x^2$
    (C) $\frac{2}{L^3}x^2$
    (D) $\frac{3}{L^3}x^2$
    (E) $\frac{3}{L^3}x^3$

40. Two conducting spheres, of radii $R_1 = 0.2$ m and $R_2 = 0.1$ m, carry charges $q_1 = 6 \times 10^{-8}$ C, $q_2 = -2 \times 10^{-8}$ C and are placed at a distance $\gg R_1, R_2$ from each other. They are then connected by a conducting wire. What are their final charges (q_1', q_2')?
    (A) 1.85×10^{-8} C, 2.15×10^{-8} C
    (B) 2.67×10^{-8} C, 1.33×10^{-8} C
    (C) 2.33×10^{-8} C, 1.67×10^{-8} C
    (D) 2.15×10^{-8} C, 1.85×10^{-8} C
    (E) 1.33×10^{-8} C, 2.67×10^{-8} C

41. Given a sample of radium–226 having a half-life of 4 days, find the probability that a nucleus disintegrates after two half-lives.
    (A) 1/2
    (B) 1/4
    (C) 2/3
    (D) 3/4
    (E) 1/3

42. Two batteries of different emfs and different internal resistances are connected. The voltage across AB in volt is
    (A) 1
    (B) 2
    (C) 3
    (D) 4
    (E) 5

43. An ideal gas is allowed to undergo a free expansion. If its initial volume is V_1 and its final volume is V_2, the change in entropy is
    (A) 0
    (B) $nR \ln(V_2/V_1)$
    (C) $nRT \ln(V_2/V_1)$
    (D) $nk \ln(V_2/V_1)$
    (E) nRV_2/V_1

44. The magnetic field of a plane-polarized electromagnetic wave moving in the z-direction is given by $B = 1.2 \times 10^{-6} \sin\left[2\pi\left(\frac{z}{240} - \frac{t \times 10^7}{8}\right)\right]$ in SI units. What is the speed of the EM wave?
    (A) 3×10^8 m/s
    (B) 100 m/s
    (C) 10^6 m/s
    (D) 2×10^7 m/s
    (E) 2×10^8 m/s

45. A wave generated in a medium is a longitudinal wave when
    (A) there is a net transport of matter by the wave.
    (B) the molecules of the medium are unable to exert forces on each other.
    (C) molecular displacements are parallel to the wave velocity.
    (D) molecular displacements are perpendicular to the wave velocity.
    (E) the density of the medium is less than the density of matter.

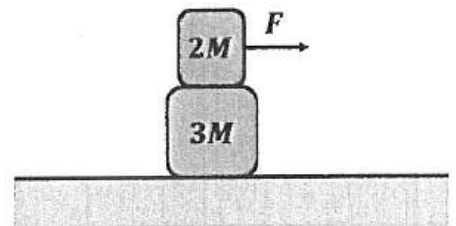46. The path difference between two waves is 5 m. If the wavelength of the waves emitted by the two sources is 4 m, what is the phase difference (in degrees)?
    (A) 90
    (B) 400
    (C) 1.57
    (D) 7.85
    (E) 15

47. Two blocks are accelerated across a horizontal frictionless surface as shown below. Frictional forces keep the two blocks from sliding relative to each other, and the two move with the same acceleration. If $F = 1.2$ N and $M = 1.0$ kg, what is the horizontal component (frictional force) of the force of the small block on the large block?
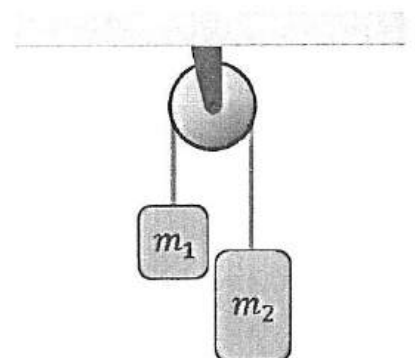   (A) 0.48 N to the right
    (B) 0.72 N to the right
    (C) 0.72 N to the left
    (D) 0.48 N to the left
    (E) 0.65 N to the left

48. Two particles ($m_1 = 0.20$ kg, $m_2 = 0.30$ kg) are positioned at the ends of a 2.0-m long rod of negligible mass. What is the moment of inertia of this rigid body about an axis perpendicular to the rod and through the center of mass?
    (A) $0.48 \text{ kg} \cdot \text{m}^2$
    (B) $0.50 \text{ kg} \cdot \text{m}^2$
    (C) $1.2 \text{ kg} \cdot \text{m}^2$
    (D) $0.8 \text{ kg} \cdot \text{m}^2$
    (E) $0.7 \text{ kg} \cdot \text{m}^2$

49. Two blocks, $m_1 = 1.0$ kg and $m_2 = 2.0$ kg, are connected by a light string as shown right. If the radius of the pulley is 1.0 m and its moment of inertia is $5.0 \text{ kg} \cdot \text{m}^2$, the acceleration of the system is
    (A) $g/6$
    (B) $3g/8$
    (C) $g/8$
    (D) $g/2$
    (E) $8g/5$

50. The moment of inertia of a collapsing spinning star drops to 1/3 of its initial value without changing the angular momentum. What is the ratio of the new rotational kinetic energy to the initial rotational kinetic energy?
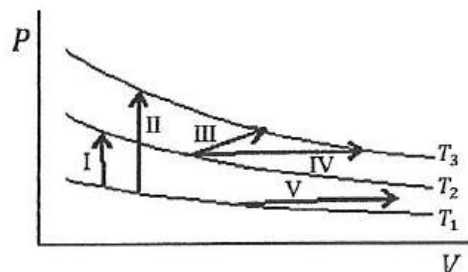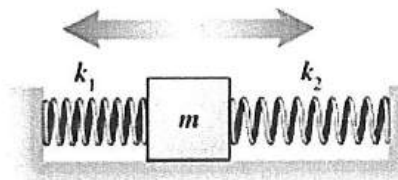   (A) 1/6
    (B) 1/3
    (C) 1
    (D) 3
    (E) 6

51. The diagram shows three isotherms for an ideal gas, with T_3-T_2 the same as T_2-T_1. It also shows five thermodynamic processes carried out on the gas. Rank the processes in order of the change in the internal energy of the gas, least to greatest.
    (A) I, II, III, IV, V
    (B) V; I; then III, and IV tied; then II
    (C) II; then I, III and IV tied; then V
    (D) II; I; then III, IV, and V tied
    (E) V; then I, III and IV tied; then II

52. A 2.0 kg block on a frictionless table is connected to two ideal massless springs with spring constants k_1 and k_2 whose opposite ends are fixed to walls, as shown in the figure. What is angular frequency of the oscillation if k_1 = 7.5 N/m and k_2 = 5.0 N/m?
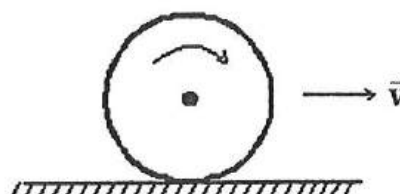   (A) 0.40 rad/s
    (B) 0.56 rad/s
    (C) 1.2 rad/s
    (D) 2.5 rad/s
    (E) 3.5 rad/s

53. Suppose you have a pendulum clock which keeps correct time on Earth (acceleration due to gravity = 9.8 m/s^2). Without changing the clock, you take it to the Moon (acceleration due to gravity = 1.6 m/s^2). For every hour interval (on Earth) the Moon clock will record:
    (A) $\sqrt{1.6/9.8}$ h
    (B) (1.6/9.8) h
    (C) 1 h
    (D) (9.8/1.6) h
    (E) $\sqrt{9.8/1.6}$ h

54. Under electrostatic conditions, the electric field just outside the surface of any charged conductor
    (A) is always parallel to the surface.
    (B) is always zero because the electric field is zero inside conductors.
    (C) is always perpendicular to the surface of the conductor.
    (D) is perpendicular to the surface of the conductor only if it is a sphere, a cylinder, or a flat sheet.
    (E) can have nonzero components perpendicular to and parallel to the surface of the conductor.

55. A wheel of radius 0.5 m rolls without sliding on a horizontal surface as shown. Starting from rest, the wheel moves with constant angular acceleration 6 rad/s^2. The distance in traveled by the center of the wheel from t = 0 to t = 4 s is:
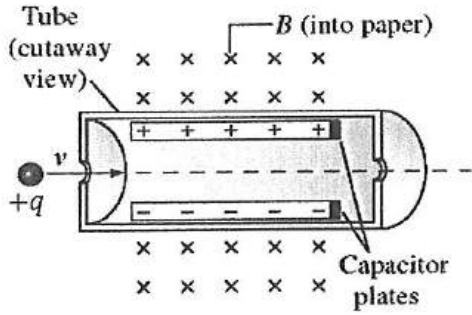   (A) 0 m
    (B) 12 m
    (C) 24 m
    (D) 48 m
    (E) None of these

56. A conducting sphere is charged up such that the potential on its surface is 100 V (relative to infinity). If the sphere's radius were twice as large, but the charge on the sphere were the same, what would be the potential on the surface relative to infinity?
   (A) 25 V
   (B) 50 V
   (C) 100 V
   (D) 200 V
   (E) 400 V

57. Electrons are in a two-dimensional square potential energy well with sides of length L. The potential energy is infinite at the sides and zero inside. The single-particle energies are given by $(h^2/8mL^2)(n_x^2 + n_y^2)$ where n_x and n_y are integers. At most the number of electrons that can have energy $5(h^2/8mL^2)$ is:
   (A) 1
   (B) 2
   (C) 3
   (D) 4
   (E) Any number

58. The figure shows a velocity selector that can be used to measure the speed of a charged particle. A beam of particles is directed along the axis of the instrument. A parallel plate capacitor sets up an electric field E, which is oriented perpendicular to a uniform magnetic field B. If the plates are separated by 2.0 mm and the value of the magnetic field is 0.90 T, what voltage between the plates will allow particles of speed $5.0×10^5$ m/s to pass straight through without deflection?
   (A) 900 V
   (B) 1900 V
   (C) 3800 V
   (D) 190 V
   (E) 94 V

59. In a certain electroplating process gold is deposited by using a current of 14.0 A for 19 minutes. A gold ion, Au$^+$, has a mass of approximately $3.3×10^{-22}$ g. How many grams of gold are deposited by this process? ($e = 1.60×10^{-19}$ C)
   (A) 22 g
   (B) 28 g
   (C) 31 g
   (D) 36 g
   (E) 97 g

60. One mole of an ideal gas has a temperature of 25 °C. If the volume is held constant and the pressure is doubled, the final temperature (in °C) will be
    (A) 174
    (B) 596
    (C) 50
    (D) 323
    (E) 25

61. Which of the following complexes only has σ-bonds between the organic ligand and the central metal?
    (A) Cp_2Fe (Cp = Cyclopentadienyl)　　　(B) $(\eta^6\text{-}C_6H_6)_2Cr$　　　(C) $W(CH_3)_6$
    (D) $K[PtCl_3(C_2H_4)]$　　　(E) None of above

62. The rate of a gaseous reaction is given by the expression $k[A][B]^2$. If the volume of vessel is reduced to one half of the initial volume, the reaction rate as compared to the original rate is
    (A) 1/4　(B) 1/8　(C) 4　(D) 8　(E) 16

63. The correct order of the bond angles in H_2S, NH_3, BF_3 and SiH_4 is
    (A) $H_2S < NH_3 < SiH_4 < BF_3$　　(B) $NH_3 < H_2S < SiH_4 < BF_3$　　(C) $H_2S < SiH_4 < NH_3 < BF_3$
    (D) $H_2S < NH_3 < BF_3 < SiH_4$　　(E) $BF_3 < SiH_4 < NH_3 < H_2S$

64. Which diene and dienophile would you choose to synthesize the following compounds?

(A)　　　　　(B)　　　　　(C)　　　　　(D)　　　　　(E)
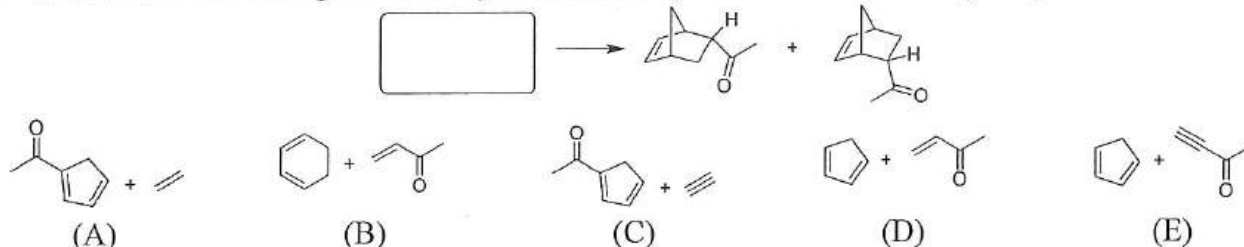
65. *trans*-3-Methylcyclopentanol is treated with CH_3SO_2Cl in the presence of base. The product of this reaction is then heated with 1 equivalent of KI in methanol. What is the final product?
    (A) *cis*-1-Iodo-3-methylcyclopentane　　(B) *trans*-1-Iodo-3-methylcyclopentane
    (C) 1-Methylcyclopentene　　(D) 2-Methylcyclopentene　　(E) 3-Methylcyclopentene

66. Given four oxygen species: O_2^+, O_2, O_2^-, O_2^{2-}. Which of the following is the correct order of their O-O bond length?
    (A) $O_2^+ > O_2 > O_2^- > O_2^{2-}$　　(B) $O_2^{2-} > O_2^- > O_2 > O_2^+$　　(C) $O_2^{2-} > O_2^- > O_2^+ > O_2$
    (D) $O_2^- > O_2^+ > O_2^{2-} > O_2$　　(E) $O_2 > O_2^+ > O_2^- > O_2^{2-}$

67. Which of the following monomers or pairs of monomers is used to make the addition polymer neoprene shown on the right?

(A)　　　　　(B)　　　　　(C)　　　　　(D)　　　　　(E)
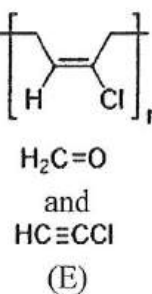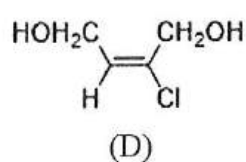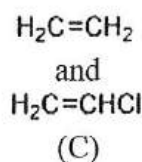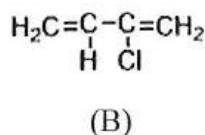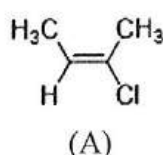
68. For the titration reaction A+B→C, where A=analyte, B=titrant, and C=product, the end point is to be detected spectrophotometrically at 550 nm, based on the absorbance information shown on the right. The shape of the titration curve at 550 nm would most closely resemble which of the following?

Substance	Wavelengths Absorbed (nm)
A	400-600, 700-800
B	< 400, 500-700
C	< 400

(A)　　　(B)　　　(C)　　　(D)　　　(E)

69. At sufficiently low temperatures, gaseous ammonia has a molar volume that is less than that predicted by the ideal gas law at certain low pressures, but has a molar volume that is greater than that predicted at certain high pressures. Which of the following is a reasonable explanation for this behavior?
    (A) Attractive forces predominate at these low pressures, and repulsive forces predominate at these high pressures.
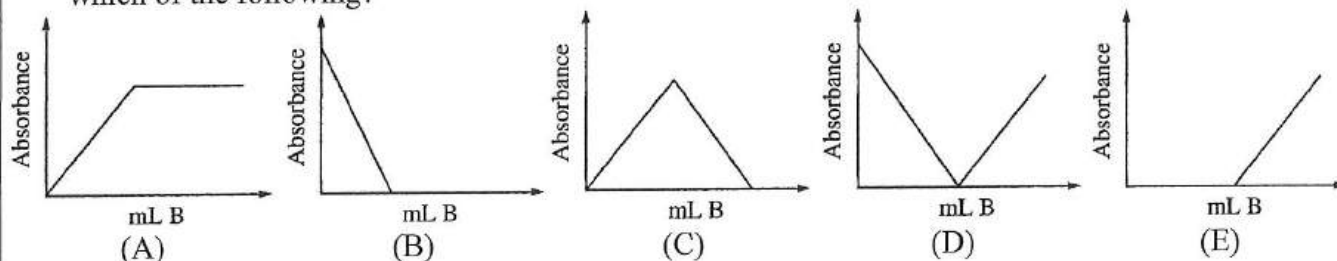   (B) Repulsive forces predominate at these low pressures, and attractive forces predominate at these high pressures.
    (C) Repulsive forces operate over greater distances than attractive forces.
    (D) As the pressure of a gas increases, its temperature increases.
    (E) Hydrogen bonding is not a factor at the critical pressure.

70. Analysis of a bottle of 100 mg vitamin C tablets yields an average vitamin C content of 99.8 mg, with a standard deviation of ±0.3 mg. Assuming Gaussian statistics, which of the following is true?
    (A) None of the tablets contains less than 99.5 mg of vitamin C.
    (B) 68% of the tablets contain between 99.5 and 100.1 mg of vitamin C.
    (C) 97% of the tablets contain between 99.5 and 100.1 mg of vitamin C.
    (D) All of the tablets contain less than 100 mg of vitamin C.
    (E) The average value is incorrect.

71. In emission spectroscopy, which of the following relaxation processes occurs at around 10^{-12} s?
    (A) Fluorescence resonance energy transfer　(B) Internal crossing　(C) Fluorescence emission
    (D) Phosphorescence emission　　　　(E) Vibration relaxation

72. Chelation therapy is known as the administration of chelating agents to eliminate toxic heavy metals from the body and has been practiced for many years in clinical toxicology. EDTA is used for intravenous injection as a detoxification treatment for heavy metal ions. Which of the following statement associated with EDTA is *incorrect*?
    (A) EDTA is a hexadentate ligand.
    (B) The full name of EDTA is ethylenediaminetetraacetate.
    (C) A direct titration method is suitable for analytes that are precipitated in the absence of EDTA.
    (D) EDTA is commonly used as an additive for collecting whole blood and plasma specimens.
    (E) After complexation with Fe^{3+}, the EDTA can be detected by UV-vis absorption spectroscopy.

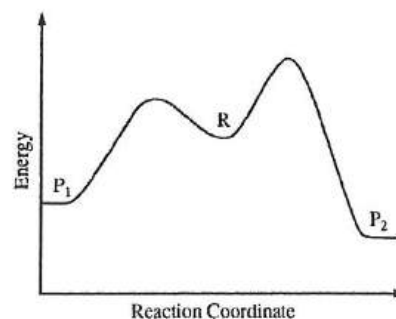73. Which of the following methods could be used to determine the molecular weight of bovine serum albumin?
    (A) Matrix-assisted laser desorption/ionization-time of flight mass spectrometry
    (B) Size-exclusion chromatography
    (C) Sodium dodecyl sulfate-polyacrylamide gel electrophoresis
    (D) Electrospray ionization mass spectrometry
    (E) All of above

74. Titanium dioxide nanoparticles absorb light at wavelengths below 400 nm. After absorbing light, water molecules adsorbed on the surface of titanium dioxide nanoparticles can be directly oxidized to hydroxide radicals. The produced hydroxyl radicals can decompose the adsorbed pollutants. Which of the following instruments is the most suitable to verify the generation of hydroxide radicals from the reaction of water molecules and titanium dioxide nanoparticles?
    (A) High-performance liquid chromatography
    (B) Fluorescence spectroscopy
    (C) Electron paramagnetic resonance spectroscopy
    (D) Nuclear magnetic resonance spectroscopy
    (E) X-ray photoelectron spectroscopy

75. Which of the following statements associated with the pH meter is *incorrect*?
    (A) The pH meter should include a working electrode, a reference electrode, and a counter electrode.
    (B) The pH meter is unable to determine the pH of 0.1 M NaOH.
    (C) Silver chloride-coated silver wire is commonly used as a reference electrode in the pH meter.
    (D) The glass membrane must be hydrated.
    (E) The difference in potential between the inner and outer layers is the boundary potential.

76. The boiling points of halogens (see table right) increases from F_2 to I_2. This is the result of an increase in which quantity from F_2 to I_2?
    (A) Ionic bonding
    (B) Covalent bond strength
    (C) Electron affinity
    (D) Van der Waals forces
    (E) Nuclear quadrupole moment

Compound	Boiling point
F_2	–187.9 °C
Cl_2	–187.9 °C
Br_2	+58.8 °C
I_2	+184.5 °C

77. A reactant, R, can produce either of two products, P_1 or P_2, with competing pathways, as illustrated in the reaction profile shown right. If the reaction is carried out at low temperature, which of the following best indicates the preferred product and the type of control?
    (A) Preferred product P_1, kinetic control
    (B) Preferred product P_1, thermodynamic control
    (C) Preferred product P_2, kinetic control
    (D) Preferred product P_2, thermodynamic control
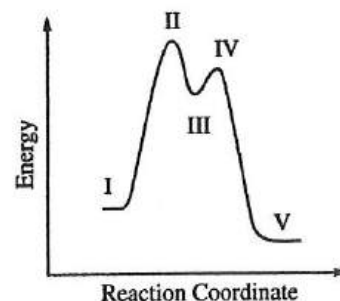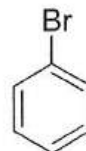   (E) Preferred product R, thermodynamic control

78. The reaction energy diagram for the electrophilic bromination of benzene with Br_2 and $FeBr_3$ is shown right. Which position on the energy diagram corresponds to Structure 1?
    (A) I
    (B) II
    (C) III
    (D) IV
    (E) V

    Structure 1
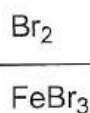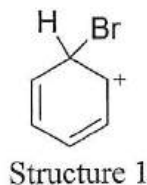
79. Carbon monoxide is extremely dangerous to living organisms because it
    (A) is an irreversible inhibitor of serine proteases such as acetylcholine esterase.
    (B) competes very effectively with oxygen for binding to the sixth coordination position of Fe^{2+} in heme.
    (C) causes oxidative DNA damage.
    (D) is a small nonpolar molecule and therefore acts like a detergent and rips open cell membranes.
    (E) carbamylates free amino groups in a variety of proteins and enzymes, thus disrupting normal hydrogen bonding.

80. Which reagent would convert 1,3-octadiene into 3-octen-2-ol?
    (A) $KMnO_4/^-OH$　　(B) OsO_4　　(C) $mCPBA$, then H_3O^+　　(D) Cl_2/H_2O　　(E) H_3O^+

81. At some temperatures, the relative reactivities of 3°, 2°, and 1° alkane hydrogens in free radical chlorination are in the ratio of 5:3:1. Thus, monochlorination of isopentane should produce these percentages of 2-chloro-2-methylbutane (a), combined 1-chloro-2-methylbutane and 1-chloro-3-methylbutane (b), and 2-chloro-3-methylbutane (c):
    (A) 8% a, 75% b, 17% c　　(B) 25% a, 45% b, 30% c　　(C) 29% a, 44% b, 18% c
    (D) 30% a, 35% b, 35% c　　(E) 36% a, 43% b, 21% c

82. Starting with benzene, the best method for preparing *p*-nitrobenzoic acid is:
    (A) HNO_3/H_2SO_4, then $CH_3Cl/AlCl_3$, then separation of isomers, then $KMnO_4/^-OH$/heat, followed by H_3O^+
    (B) $CH_3Cl/AlCl_3$, then HNO_3/H_2SO_4, then separation of isomers, then $KMnO_4/^-OH$/heat, followed by H_3O^+
    (C) $CH_3Cl/AlCl_3$, then $KMnO_4/^-OH$/heat, followed by H_3O^+, then HNO_3/H_2SO_4
    (D) HNO_3/H_2SO_4, then $KMnO_4/^-OH$/heat, followed by H_3O^+, then $CH_3Cl/AlCl_3$
    (E) HNO_3/H_2SO_4; then CO_2, followed by H_3O^+

83. Arrange the following isoelectronic species in order of increasing ionic radius.
    (A) $O^{2-} > F^- > Na^+ > Mg^{2+}$　　(B) $F^- > O^{2-} > Mg^{2+} > Na^+$　　(C) $Mg^{2+} > O^{2-} > Na^+ > F^-$
    (D) $Na^+ > F^- > Mg^{2+} > O^{2-}$　　(E) $Mg^{2+} > Na^+ > F^- > O^{2-}$

84. What is the formal charge of oxygen in carbon monoxide?
    (A) +2　　(B) +1　　(C) 0　　(D) -1　　(E) -2

85. Nylon is synthesized via the polycondensation reaction. For example, the Nylon 6,6 is from the condensation reaction of hexamethylenediamine and adipic acid. To obtain the polymeric product with good physical properties, the conversion of the condensation needs to be above 99% to achieve the high molecular weight. Accordingly, when we select the monomer for the production of Nylon, what is the lower limit of the equilibrium constant?
(A) 10　(B) 100　(C) 1000　(D) 10000　(E) 100000

86. How many signals does the unsaturated ketone $(CH_3)_2CHCH_2C(O)CH=CH_2$ have in ^1H NMR and ^{13}C NMR spectra?
(A) 5 ^1H signals, 6 ^{13}C signals　　(B) 6 ^1H signals, 6 ^{13}C signals　　(C) 6 ^1H signals, 7 ^{13}C signals
(D) 5 ^1H signals, 7 ^{13}C signals　　(E) 5 ^1H signals, 5 ^{13}C signals

87. X in limited amount is present in soil and is essential for plants nutrients but if present in high concentration can be harmful both for plants, animals and aquatic organisms. What is X?
(A) Hydrogen sulphide　(B) Carbon dioxide　(C) Ammonia　(D) Water　(E) All of above

88. Which of the following electrodes are commonly used as a reference electrode in voltammetry?
(A) Platinum wire　(B) Carbon paste　(C) Mercury thin film　(D) Gold disk
(E) Silver chloride-coated silver wire

89. In fall 2017, clouds of ruthenium-106 (^{106}Ru) radioactive contamination appeared over Eastern Europe. Scientists measured the airborne radio-ruthenium isotope ratio ($^{103}Ru/^{106}Ru$) and confirmed its concentration. Which of the following techniques is the most suitable for the detection of the $^{103}Ru/^{106}Ru$ ratio?
(A) Inductively coupled plasma mass spectrometry (ICP-MS)
(B) Matrix-assisted laser desorption/ionization-time of flight mass spectrometry
(C) Electrospray ionization mass spectrometry
(D) Fourier-transform ion cyclotron resonance mass spectrometry
(E) Elemental analyzers

90. Capillary electrophoresis is powerful in detecting various genetic diseases, such as Thalassemia and Spinal Muscular Atrophy. Which of the following modes in capillary electrophoresis is the most suitable for diagnosing genetic disease (i.e., separation of DNA molecules)?
(A) Capillary zone electrophoresis
(B) Capillary isoelectric focusing
(C) Micellar electrokinetic chromatography
(D) Capillary electrochromatography
(E) Capillary gel electrophoresis

111學年度學士後醫學系各科標準答案

學士後醫學系-普通生物及生化概論

試題	第1題	第2題	第3題	第4題	第5題	第6題	第7題	第8題	第9題	第10題	第11題	第12題	第13題	第14題	第15題	第16題	第17題	第18題	第19題	第20題
答案	A	A	E	E	A	E	D	C	A	B	C	D	E	E	D	D	B	A	C	C
試題	第21題	第22題	第23題	第24題	第25題	第26題	第27題	第28題	第29題	第30題	第31題	第32題	第33題	第34題	第35題	第36題	第37題	第38題	第39題	第40題
答案	E	C	A	B	B	C	D	A	D	C	B	A	C	A	A	C	D	E	B	A
試題	第41題	第42題	第43題	第44題	第45題	第46題	第47題	第48題	第49題	第50題	第51題	第52題	第53題	第54題	第55題	第56題	第57題	第58題	第59題	第60題
答案	D	A	D	D	E	D	B	A	B	B	C.E	C	A	D	B	E	C	B	B	E
試題	第61題	第62題	第63題	第64題	第65題	第66題	第67題	第68題	第69題	第70題	第71題	第72題	第73題	第74題	第75題	第76題	第77題	第78題	第79題	第80題
答案	A	D	A	B	E	D	C	A	D	D	D	A	C	C	C	E	E	D	B	C
試題	第81題	第82題	第83題	第84題	第85題	第86題	第87題	第88題	第89題	第90題										
答案	A	E	A	B	C	D	D	C	C	A										

學士後醫學系-物理與化學

試題	第1題	第2題	第3題	第4題	第5題	第6題	第7題	第8題	第9題	第10題	第11題	第12題	第13題	第14題	第15題	第16題	第17題	第18題	第19題	第20題
答案	C	B	E	A	E	B	A	E	E	D	A	C	B	A	D	A	D	B	C	B
試題	第21題	第22題	第23題	第24題	第25題	第26題	第27題	第28題	第29題	第30題	第31題	第32題	第33題	第34題	第35題	第36題	第37題	第38題	第39題	第40題
答案	E	D	D	D	E	E	C	D	C	E	A	C	A	C	D	E	A	A	D	B
試題	第41題	第42題	第43題	第44題	第45題	第46題	第47題	第48題	第49題	第50題	第51題	第52題	第53題	第54題	第55題	第56題	第57題	第58題	第59題	第60題
答案	D	E	B	A	C	A	B	A	C	D	E	D	A	C	C	B	D	A	C	D
試題	第61題	第62題	第63題	第64題	第65題	第66題	第67題	第68題	第69題	第70題	第71題	第72題	第73題	第74題	第75題	第76題	第77題	第78題	第79題	第80題
答案	C	D	A	D	A	B	B	D	A	B	E	C	E	C	A	D	A	C	B	E
試題	第81題	第82題	第83題	第84題	第85題	第86題	第87題	第88題	第89題	第90題										
答案	B	B	A	B	D	B	C	E	A	E										

學士後醫學系-計算機概論與程式設計

試題	第1題	第2題	第3題	第4題	第5題	第6題	第7題	第8題	第9題	第10題	第11題	第12題	第13題	第14題	第15題	第16題	第17題	第18題	第19題	第20題
答案	C	D	D	B	C	A	A	B	C	E	C	A	A	C	D	B	B	B	E	E
試題	第21題	第22題	第23題	第24題	第25題	第26題	第27題	第28題	第29題	第30題	第31題	第32題	第33題	第34題	第35題	第36題	第37題	第38題	第39題	第40題
答案	D	C	A	E	B	E	A	E	A	E	A	B	D	B	D	A	B	B	B	E
試題	第41題	第42題	第43題	第44題	第45題	第46題	第47題	第48題	第49題	第50題	第51題	第52題	第53題	第54題	第55題	第56題	第57題	第58題	第59題	第60題
答案	B	A	A	C	B	D	A	C	E	C	C	D	D	B	E	D	E	C	D	E

試題	第61題	第62題	第63題	第64題	第65題	第66題	第67題	第68題	第69題	第70題	第71題	第72題	第73題	第74題	第75題	第76題	第77題	第78題	第79題	第80題
答案	A	D	D	A	D	A	B	C	C	B	E	C	B	C	B	C	E	C	E	C
試題	第81題	第82題	第83題	第84題	第85題	第86題	第87題	第88題	第89題	第90題										
答案	A	C	B	E	B	A	A	A	A	A										

學士後醫學系- 英文

試題	第1題	第2題	第3題	第4題	第5題	第6題	第7題	第8題	第9題	第10題	第11題	第12題	第13題	第14題	第15題	第16題	第17題	第18題	第19題	第20題
答案	B	B	C	D	D	D	E	B	E	D	B	C	D	B	D	E	A	E	B	B
試題	第21題	第22題	第23題	第24題	第25題	第26題	第27題	第28題	第29題	第30題	第31題	第32題	第33題	第34題	第35題	第36題	第37題	第38題	第39題	第40題
答案	A	A	E	D	D	C	D	E	D	A	B	D	C	B	A	B	D	D	D	E
試題	第41題	第42題	第43題	第44題	第45題	第46題	第47題	第48題	第49題	第50題										
答案	A	B	D	A	A	E	D	C	C	B										