111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。

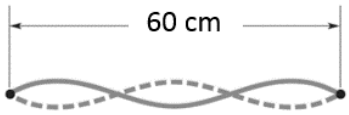
1. $1.25 \times 0.25 + 1.222 =$ _____.
   (A) 1.5345 (B) 1.535 (C) 1.53 (D) 1.5 (E) 2

2. Over a short interval near time $t = 0$ the coordinate of a bicycle in meters is given by $x(t) = 12t - 4t^3$, where t is in seconds. At the end of 1 s, what is the acceleration of the bicycle?
   (A) 23 m/s^2 (B) 15 m/s^2 (C) -4 m/s^2 (D) -12 m/s^2 (E) -24 m/s^2

3. A 8000-N trunk is pushed along a level road by two men who apply a total forward force of 1000 N. Neglecting friction, what is the acceleration of the trunk?
   (Gravitational acceleration g = 10 m/s^2)
   (A) 0.0125 m/s^2 (B) 0.125 m/s^2 (C) 0.8 m/s^2
   (D) 1.25 m/s^2 (E) 8 m/s^2

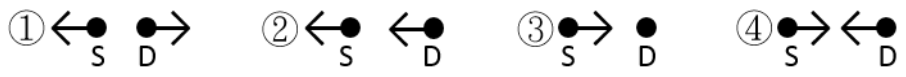
4. An incompressible fluid of density ρ is in a bucket on the elevator floor accelerating upward with acceleration a. What is the pressure difference between two points in the fluid separated by a vertical distance Δh? (Gravitational acceleration is g)
   (A) $\rho a \Delta h$ (B) $\rho g \Delta h$ (C) $\rho g a \Delta h$ (D) $\rho(g - a)\Delta h$ (E) $\rho(g + a)\Delta h$

5. The figure shows a standing wave pattern in a string. What is the wavelength of one of the component traveling waves?



   (A) 10 cm (B) 20 cm (C) 40 cm (D) 60 cm (E) 120 cm

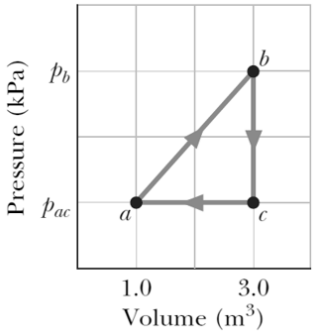
6. The figure shows four situations in which a source of sound S and a detector D are either moving or stationary. The arrows indicate the directions of motion. The speeds (when not zero) are all the same. (Note that the detector in situation ③ is stationary). Rank the situations according to the apparent frequency of the source, lowest to highest.



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

7. What is the deterministic factor of a sound wave for the sound pitch?
   (A) amplitude (B) frequency (C) phase (D) speed (E) intensity

8. A sample of an ideal gas is taken through the cyclic process *abca* shown in the figure. The scale of the vertical axis is set by p_b = 15 kPa and p_{ac} = 5 kPa. At point *a*, *T* = 200 K. What is the temperature of the gas at point *c*?

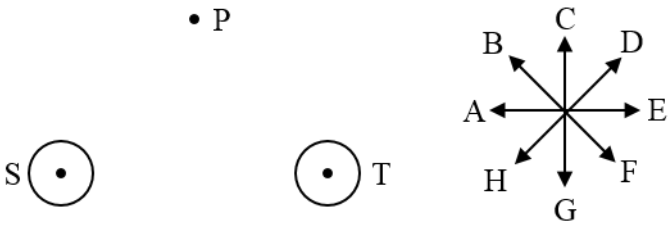


(A) 400 K (B) 600 K (C) 1419 K (D) 1800 K (E) 4258 K

9. An engine does 15 kJ of work while exhausting 37 kJ to a cold reservoir. What is the efficiency of the engine?

(A) 28.8 % (B) 38.8 % (C) 68.8 % (D) 88.8 % (E) 98.8 %

10. The point P lies along the perpendicular bisector of the line connecting two long straight wires S and T that are perpendicular to the page. A set of directions A through H is shown next to the figure. When the two equal currents in the wires are directed up out of the page, the direction of the magnetic field at P is closest to the direction of _____.



(A) A (B) E (C) F (D) G (E) H

11. Consider radio waves (r), visible light (v), infrared (i), X-rays (x), and ultraviolet (u). In order of increasing frequency, they are _____.

(A) r, v, i, x, u (B) r, i, v, u, x (C) i, r, v, u, x (D) x, u, v, i, r (E) r, i, v, x, u

12. An erect object is in front of a convex mirror a distance greater than the focal length. The image is _____.

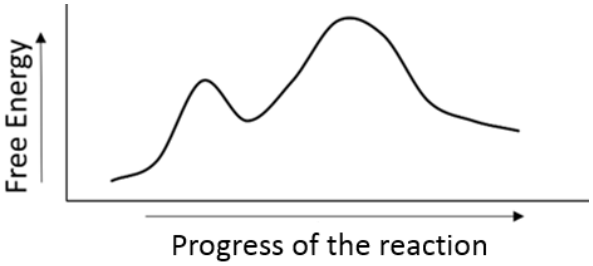
(A) real, inverted, and smaller than the object
(B) virtual, inverted, and larger than the object
(C) real, inverted, and larger than the object
(D) virtual, erect, and smaller than the object
(E) real, erect, and larger than the object

13. The major physics principle that supports endoscope is _____.
(A) refraction of light (B) diffraction of light
(C) interference of light (D) scattering of light
(E) total internal reflection of light

14. If we increase the wavelength of the light that falls on the metal in a photoelectric-effect experiment, which of the following will happen?
(A) The work function of the metal increases.
(B) The cutoff frequency decreases.
(C) The stopping potential decreases.
(D) The time delay of the emission of photoelectron increases.
(E) All of the above.

15. For the particles listed below with the same kinetic energy, which has the shortest wavelength?
(A) electron (B) positron (C) proton (D) α particle (E) neutron

16. In the given reaction coordinate diagram, how many intermediate(s) is/are presented?



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

17. How many nanometers is equal to 7.6 meters?
(A) 76×10^{7} (B) 76×10^{8} (C) 76×10^{9} (D) 76×10^{-8} (E) 76×10^{-9}

18. A specific type of nucleus has a half-life of 40 min. How long is required for 80% of the nuclides to decompose? (ln2 = 0.693; ln0.2 = -1.609)
(A) 80 min (B) 85 min (C) 95 min (D) 102 min (E) 120 min

19. Which of the following ionic compounds has the largest lattice energy (i.e., the lattice energy most favorable to a stable lattice)?
(A) MgO (B) CaO (C) Li_2O (D) Na_2O (E) K_2O

20. Determine the hybridization of Cl in ClF_2^-.
(A) *sp* (B) sp^2 (C) sp^3 (D) dsp^3 (E) d^2sp^3

21. Determine, respectively, the proper formulas for sodium tetrachloroaluminate(III) and sodium tetrachlorocobaltate(II).
(A) $Na(AlCl_4)$; $Na_2(CoCl_4)$ (B) $Na(AlCl_4)$; $Na(CoCl_4)$ (C) $Na_2(AlCl_4)$; $Na(CoCl_4)$
(D) $Na_2(AlCl_4)$; $Na_2(CoCl_4)$ (E) $Na_3(AlCl_4)$; $Na_2(CoCl_4)$

22. What is the sum of all coefficients when the following equation is balanced?
$NH_3(g) + O_2(g) \rightarrow NO_2(g) + H_2O(g)$
(A) 6 (B) 14 (C) 17 (D) 21 (E) 23

23. A compound is composed of element X and hydrogen. A mass analysis shows the compound contains 82.35% of X, with three times as many hydrogen atoms as X atoms per molecule. Which element is X? (atomic mass: B = 10.81, C = 12.01, N = 14.01, Al = 26.98, P = 30.97)
(A) B (B) C (C) N (D) Al (E) P

24. Which of the following statements is ***incorrect***?
(A) Heteronuclear linear molecules can have a net dipole moment.
(B) A molecular dipormenant is the dipole moment of the molecular taken as a whole.
(C) Ionic bonding results from the transfer of electrons from one atom to another.
(D) A molecule with polar bonds must be polar.
(E) The distribution of electrons in a polar bond is closer to the more electronegative element.

25. Regarding to the concept of reduction and oxidation, which of the following statements is ***true***?
(A) All chemical changes is accompanied by reduction and oxidation.
(B) When the atom is oxidized, the size becomes larger.
(C) The oxidizing agent is electron donor.
(D) Reduction and oxidation can occur independently of each other.
(E) Reduction and oxidation describe the gain and loss of electron(s), respectively.

26. You have immersed electrodes of a light bulb in a solution of H_2SO_4 such that the light bulb is on. You add a dilute solution and the bulb grows dim. Which of the following molecule could be in the solution?
(A) $Cu(NO_3)_2$ (B) K_2SO_4 (C) $NaNO_3$ (D) $ZnCl_2$ (E) $Pb(NO_3)_2$

27. Which of the following anions is the most basic?
(A) ClO^- (B) ClO_2^- (C) ClO_3^- (D) ClO_4^- (E) Cl^-

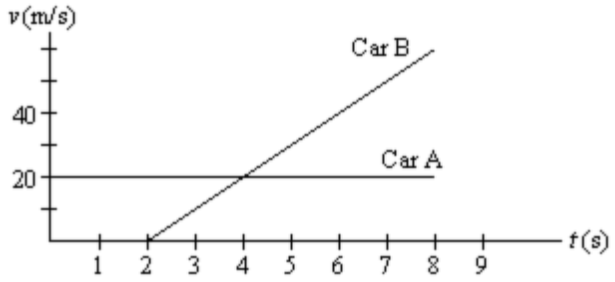
28. Which of the following element or ions is the largest in size?
(A) O^{2-} (B) F^- (C) Ne (D) Na^+ (E) Mg^{2+}

29. Which of the following molecules has the largest dipole moment?
(A) CO_2 (B) Cl_2 (C) XeF_4 (D) SF_4 (E) BF_3

30. I. The hybridization of boron in BF_3 is sp^3.
II. The molecule of I_3^- is polar.
III. The bond order of N_2 molecule is two.
IV. The molecule of HCN has one pi bond and two sigma bonds.
Which is ***true***?
(A) All four statements are correct. (B) II is incorrect.
(C) I and IV are incorrect. (D) II and III are incorrect.
(E) All four statements are incorrect.

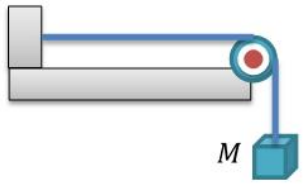
【單選題】每題 2 分，共計 120 分，答錯 1 題倒扣 0.5 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。31~60 題為物理，61~90 題為化學。

31. The velocities of drivers A and B are shown as functions of time in the figure below. Driver B starts her car at the instant driver A passes her. At which moment on the graph are drivers A and B side by side?



(A) 0 s, 2 s (B) 0 s, 4 s (C) 2 s, 4 s (D) 2 s, 6 s (E) 4 s, 6 s

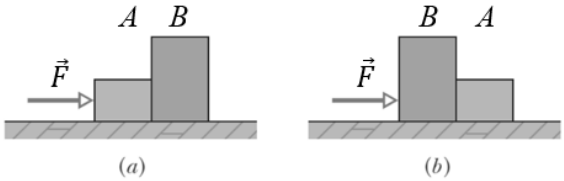
32. A uniform cord has the mass per unit length λ and it is arranged as that shown in the figure. Here the tension is maintained by suspending an object of mass M from one end. What is the speed of a pulse on the cord if the tension force is not affected by the mass of the cord? (Gravitational acceleration is g)



(A) $v = \sqrt{\frac{Mg}{2\lambda}}$ (B) $v = \sqrt{\frac{Mg}{\lambda}}$ (C) $v = 3\sqrt{\frac{Mg}{\lambda}}$

(D) $v = 2\sqrt{\frac{Mg}{\lambda}}$ (E) $v = \pi\sqrt{\frac{Mg}{\lambda}}$

33. As shown in figures (a) and (b), a constant force F is applied to the two contact blocks in both cases. In figure (a), block A pushes against block B with a 20 N force directed horizontally to the right. In figure (b), block A pushes against block B with a 10 N force directed horizontally to the left. The total mass of two blocks is 12 kg. Which of the following statement is ***correct***? (Gravitational acceleration g = 10 m/s^2)

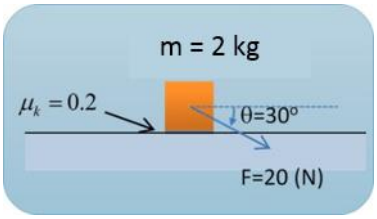


(A) The magnitude of F is 20 N.
(B) The mass ratio between block A and B is 2.
(C) The acceleration in (a) is 1.5 m/s^2.
(D) The acceleration in (b) is 2.5 m/s^2.
(E) The mass of block A is 8 kg.

34. A force of $\vec{F} = 3x^2\hat{\imath} + 4y\hat{\jmath}$ acts on a particle, changing only the kinetic energy of the particle. How much work is done on the particle as it moves from (2, 3) to (3, 0)?

(A) 6 (B) 5 (C) 3 (D) 2 (E) 1

35. A block of mass 2 kg on a table is pushed by a force of 20 N directed with an angle of 30^o downward from the horizontal as shown in the figure. The kinetic frictional coefficient is 0.2. What is the work done by the frictional force after traveling 10 m long? (Gravitational acceleration g = 10 m/s^2)

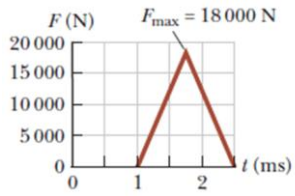


(A) 10 J (B) 30 J (C) 40 J (D) 50 J (E) 60 J

36. A bullet is hitting and getting stuck in a wood cube, which is sitting on a frictionless table. For this bullet-wood system, which item is not conserved before and after the collision event?

(A) total kinetic energy
(B) total linear momentum
(C) total angular momentum
(D) total mass
(E) None of the above.

37. An estimated force-time curve for a baseball struck by a bat is shown in the figure. From this curve, determine the average force exerted on the ball.

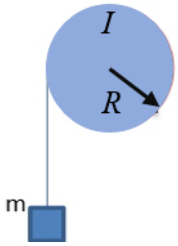


(A) 3 kN (B) 5 kN (C) 6 kN (D) 7 kN (E) 9 kN

38. A ball of mass m is released from a height of H. What is its speed when it is at a height of y? (Gravitational acceleration is g)

(A) $\sqrt{gH}$ (B) $2\sqrt{gy}$ (C) $\sqrt{2g(H-y)}$ (D) $\sqrt{g(H-y)}$ (E) $\sqrt{2gy}$

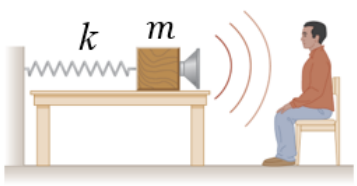
39. A wheel of radius R and moment of inertia I is mounted on a frictionless horizontal axle as shown in the figure. A light cord wrapped around the wheel supports an object of mass m. What is the linear acceleration of the object? (Gravitational acceleration is g)



(A) $a = \dfrac{mg}{m + I/R^2}$ (B) $a = \dfrac{mg}{m + I/2R^2}$ (C) $a = \dfrac{mg}{m + 2I/R^2}$

(D) $a = \dfrac{mg}{2m + I/R^2}$ (E) $a = \dfrac{2mg}{3(m + I/R^2)}$

40. A block with a speaker bolted to it is connected to a spring having spring constant $k = 20$ N/m as shown in figure. The total mass of the block and speaker is 5 kg, and the amplitude of this unit's motion is 0.5 m. The speaker emits sound waves of frequency 440 Hz. Determine the highest frequency heard by the person to the right of the speaker. (Assume that the speed of sound is 343 m/s)



(A) 481 Hz (B) 471 Hz (C) 461 Hz (D) 451 Hz (E) 441 Hz

41. A wire of length L, Young's modulus Y, and cross-sectional area A is stretched elastically by an amount ΔL. It behaves as a spring by using the Hooke's law. What is the work done in stretching the wire by an amount ΔL?

(A) $\frac{YA}{L^2}(\Delta L)^2$ (B) $\frac{1}{2}\frac{YA}{L^2}(\Delta L)^2$ (C) $\frac{1}{2}\frac{Y}{L^2}(\Delta L)^2$ (D) $\frac{1}{2}\frac{YA}{L}(\Delta L)^2$ (E) $\frac{YA}{L}\Delta L$

42. A balloon filled with air is pulled into a tank of water at room temperature. As the balloon sinks, the air pressure inside the balloon _____.

(A) increases (B) remains the same (C) decreases
(D) increases then decreases (E) decreases then increases

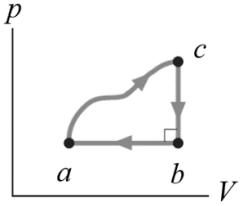
43. Ethanol of density ρ_E flows smoothly through a horizontal pipe that tapers in cross-sectional area from A_1 to A_2 ($A_1 = 2A_2$) as shown in the figure. The pressure difference between the wide and narrow sections of pipe is ΔP. What is the volume flow rate of the ethanol?

(A) $A_1\sqrt{\frac{2\Delta P}{3\rho_E}}$ (B) $A_1\sqrt{\frac{\Delta P}{\rho_E}}$ (C) $A_1\sqrt{\frac{\Delta P}{3\rho_E}}$ (D) $A_1\frac{\Delta P}{\rho_E}$ (E) $A_1\frac{\Delta P}{3\rho_E}$

44. An ideal monoatomic gas of one mole is at pressure P, volume V, and temperature T. The gas is heated at constant volume to $2T$. Then the gas is allowed to expand at constant temperature to $2V$. Finally, the gas cools at constant pressure to T. What is the net entropy change for this ideal gas? (The ideal gas constant is R)

(A) $R\ln 2$ (B) $-R\ln 2$ (C) 0 (D) $R\ln 4$
(E) not calculatable by the above information

45. The figure shows a closed cycle for a gas. From *c* to *b*, 60 J is transferred from the gas as heat. From *b* to *a*, 100 J is transferred from the gas as heat, and the magnitude of the work done by the gas is 80 J. From *a* to *c*, 400 J is transferred to the gas as heat. What is the work done by the gas from *a* to *c*?



(A) -240 J (B) 240 J (C) 320 J (D) -320J (E) -160 J

46. A quantity of an ideal gas is compressed to half its initial volume. The process may be adiabatic, isothermal or occurring at isobaric. Rank those three processes in order of the work required of an external agent, least to greatest.

(A) adiabatic, isothermal, isobaric (B) adiabatic, isobaric, isothermal
(C) isothermal, adiabatic, isobaric (D) isobaric, adiabatic, isothermal
(E) isobaric, isothermal, adiabatic

47. An ideal parallel-plate capacitor connected to a battery of voltage V_0, it has charge of magnitude Q_0 on its plates. The plates are pulled apart to a separation from d to $2d$ while the capacitor remains connected to the battery. After the plates are $2d$ apart, what are the magnitude of the charge on the plates and the potential difference between them?

(A) $0.5Q_0$, $0.5V_0$ (B) $0.5Q_0$, V_0 (C) Q_0, V_0
(D) $2Q_0$, V_0 (E) $2Q_0$, $2V_0$

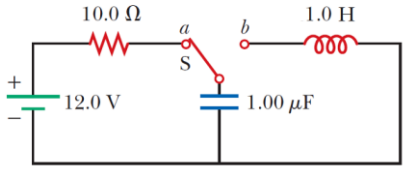
48. A group of identical capacitors is connected first in series and then in parallel. The combined capacitance in parallel is 100 times larger than for the series connection. How many capacitors are in the group?

(A) 5 (B) 10 (C) 50 (D) 100 (E) 200

49. A cylinder contains n mol of helium gas (ideal monatomic gas) at a temperature of 300 K. The universal gas constant is R ($R = N_A k_B$), where N_A is Avogadro' number and k_B is Boltzmann's constant. If the gas is heated at constant pressure, how much energy must be transferred by heat to the gas after it is heated to 500 K?

(A) $200nR$ (B) $300nR$ (C) $500nR$ (D) $800nR$ (E) $1000nR$

50. The switch is connected to position a for a long time interval as shown in the figure. At $t = 0$, the switch is thrown to position b. After this time, what are the frequency of oscillation of the LC circuit?

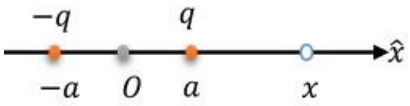


(A) 159 Hz (B) 359 Hz (C) 559 Hz (D) 759 Hz (E) 959 Hz

51. An infinite long wire is charged uniformly with line charge density λ. What is the electric field at a point with a distance y from the stick? (Electric constant is ε_0)

(A) $\frac{\lambda}{\varepsilon_0 y}$ (B) $\frac{\lambda}{\pi\varepsilon_0 y}$ (C) $\frac{\lambda}{2\pi\varepsilon_0 y}$ (D) $\frac{\lambda}{\varepsilon_0}$ (E) $\frac{2\lambda}{\varepsilon_0}$

52. A charge $+q$ is at the position a and a second charge $-q$ is placed at $-a$ as shown in the figure. What is the limiting form of the electric field for $x \gg a$? (Coulomb's constant is k_e)



(A) $\frac{k_e qa}{x^2}$ (B) $\frac{4k_e qa}{x^2}$ (C) $\frac{k_e qa}{x^3}$ (D) $\frac{4k_e qa}{x^3}$ (E) $\frac{2k_e qa}{x^3}$

53. A 30-turn circular coil of radius 1 m and resistance 1 Ω is placed in a magnetic field directed perpendicular to the plane of the coil. The magnitude of the magnetic field varies in time according to the expression $B = 0.1\ t + 0.04\ t^2$, where B is in tesla and t is in second. Calculate the induced emf in the coil at $t = 5$ s.

(A) 27 V (B) 37 V (C) 47 V (D) 57 V (E) 67 V

54. Electric currents I_1 and I_2 are flowing through two parallel electric wires which are separated apart by a distance R. What is the force per unit length between the two parallel wires? (Magnetic constant is μ_0)

(A) $\frac{\mu_0 I_1}{2\pi R}$ (B) $\frac{\mu_0 I_2}{\pi R}$ (C) $\frac{\mu_0 I_1 I_2}{2\pi R}$ (D) $\frac{\mu_0 I_1 I_2}{\pi R}$ (E) $\frac{2\mu_0 I_1 I_2}{\pi R}$

55. While you are under water in a pool, you look up and see objects above water in a circle of light with a radius R. The rest of your vision is the color of the sides of the pool. Assume that the index of refraction of air is 1 and that of water is n. How deep are you in the pool?

(A) $R\sqrt{n-1}$ (B) $\frac{R}{n}$ (C) $\frac{R}{\sqrt{n^2-1}}$ (D) Rn (E) $R\sqrt{n^2-1}$

56. The pupil of a cat's eye narrows to a vertical slit of width 0.5 mm in daylight. Assume the average wavelength of the light is 500 nm. What is the angular resolution for horizontally separated mice?

(A) 1.0×10^{-3} rad (B) 2.0×10^{-3} rad (C) 2.5×10^{-3} rad
(D) 3.0×10^{-3} rad (E) 3.5×10^{-3} rad

57. The focal length of a spherical, concave mirror is 8 cm. An object is placed at a distance of 24 cm in front of the mirror. How fast does the image move if the object starts to move at speed v_p toward the concave mirror?

(A) v_p (B) $0.50\ v_p$ (C) $0.25\ v_p$ (D) $0.20\ v_p$ (E) $0.18\ v_p$

58. In a lecture demonstration of single-slit diffraction, a laser beam of wavelength λ passes through a vertical slit of a wide *a* and hits a screen at a distance of L away. What is the width of the central diffraction maximum on the screen?

(A) $L\frac{\lambda}{a}$ (B) $2L\frac{\lambda}{a}$ (C) $4L\frac{\lambda}{a}$ (D) $3L\frac{a}{\lambda}$ (E) $L\frac{a}{\lambda}$

59. An AC voltage source is connected to a capacitor. There is a phase difference between the voltage across the capacitor and the current passing it. Which of the following statement is ***correct***?

(A) The phase of the current leads the voltage by $\pi/2$.
(B) The phase of the current leads the voltage by $\pi/4$.
(C) The phase of the current lags the voltage by $\pi/2$.
(D) The phase of the current lags the voltage by $\pi/4$.
(E) None of the above.

60. MRI machine probes the concentration distribution of water molecules by detecting the magnetic resonance between the nucleus of hydrogen atoms, placed in a strong static magnetic field B, and a small alternating magnetic field of frequency f. If B is 2T and the z-component of the proton magnetic moment is 1.4×10^{-26} J/T. What is the frequency f of the alternating magnetic field? (Plank constant is 6.6×10^{-34} J/s)

(A) 43 MHz (B) 85 MHz (C) 170 MHz (D) 340 MHz (E) 680 MHz

61. When a certain atom emits a photon of light at 232 nm, what is the frequency of this light?

(A) 1.29×10^{15} s^{-1} (B) 1.15×10^{15} s^{-1} (C) 1.15×10^{-15} s^{-1}
(D) 76.7 s^{-1} (E) None of the above.

62. Given a cylinder of fixed volume filled with 1 mol of argon gas, which of the following is ***correct***? (Assume all gases obey the ideal gas law.)

(A) If the temperature of the cylinder is changed from 25°C to 50°C, the pressure inside the cylinder will remain the same.
(B) If a second mole of argon is added to the cylinder, the ratio of *T*/*P* would decrease.
(C) A cylinder of identical volume filled with the same pressure of helium must contain more atoms of gas, because helium has a smaller atomic radius than argon.
(D) Two of the above.
(E) None of the above.

63. Which of the following statements is ***true***?

(A) The energy of electromagnetic radiation increases as its frequency decreases.

(B) An electron in the n = 4 state in the hydrogen atom can go to the n = 2 state by absorbing electromagnetic radiation at the appropriate frequency.

(C) The frequency and wavelength of electromagnetic radiation are proportional to each other.

(D) The energy of an atom is increased when electromagnetic radiation is emitted from it.

(E) An excited atom can return to its ground state by emitting electromagnetic radiation.

64. What is the hybridization of the central carbon atom of allene ($H_2C=C=CH_2$)?

(A) *sp* (B) sp^2 (C) sp^3 (D) dsp^3 (E) d^2sp^3

65. How many of the following molecules have all of their atoms in the same plane?

$H_2C=CH_2$, $H_2C=C=CH_2$, CH_3COCH_3, NH_3, CO_2, $BeCl_2$

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

66. Which of these species, O_2^-, O_2, and O_2^+, should be paramagnetic?

(A) O_2^+ and O_2^- (B) O_2^+ and O_2 (C) O_2 and O_2^- (D) only O_2

(E) All three are paramagnetic.

67. Based on the molecular orbital theory, which of the following molecules has the strongest bond?

(A) NO^+ (B) NO (C) NO^- (D) NO^{2-}

(E) All the above molecules have the same bond strength.

68. Which of the following molecules has the smallest bond angle?

(A) CH_4 (B) SiH_4 (C) NH_3 (D) H_2O (E) H_2S

69. Which of the following statements is ***false***?

(A) The layering in a hexagonal closest-packed structure is *aba*.

(B) A body-centered cubic unit cell has two atoms per unit cell.

(C) For unit cells having the same edge length, a simple cubic structure would have a smaller density than a body-centered cube.

(D) The size of tetrahedral hole is always larger than the size of octahedral hole.

(E) Atoms in a solid, consisting of only one element would have six nearest neighbors if the crystal structure was a simple cubic array.

70. Rank the following compounds in the order from the highest boiling point to the lowest boiling point.

(a) $C_2H_5OC_2H_5$ (b) CH_3OH (c) $HCONH_2$ (d) HCOOH

(A) (b) > (a) > (c) > (d) (B) (b) > (a) > (d) > (c)

(C) (c) > (d) > (b) > (a) (D) (d) > (c) > (b) > (a)

(E) (b) > (d) > (a) > (c)

71. The reaction "A + 2B → 2 C" exhibits the rate law as following: Rate = k [A][B]^2

Which of the following mechanisms could be consistent with this rate law?

(A) A + 2B → D (fast), D → 2 C (slow)

(B) 2B → D (fast), D + A → 2 C (slow)

(C) 2B → D (slow), A + D → E (fast), E → 2 C (fast)

(D) A + B ⇌ D (fast equilibrium), B + D → 2 C (slow)

(E) B ⇌ 2 D (fast equilibrium), D + A → C (slow)

72. Consider the following reaction:

$N_2(g)$ + 3 $H_2(g)$ ⇌ 2 $NH_3(g)$, equilibrium constant (K) = 6.0×10^{-2} M^{-2} at 500 °C.

Predict the reaction direction of the following cases:

a. $[N_2] = 1.00 \times 10^{-2}$ M; $[H_2] = 3.00 \times 10^{-2}$ M; $[NH_3] = 6.00 \times 10^{-4}$ M

b. $[N_2] = 1.00 \times 10^{-3}$ M; $[H_2] = 4.00 \times 10^{-2}$ M; $[NH_3] = 1.00 \times 10^{-5}$ M

c. $[N_2] = 1.00 \times 10^{-5}$ M; $[H_2] = 5.00 \times 10^{-1}$ M; $[NH_3] = 2.00 \times 10^{-4}$ M

(A) a. No shift; b. shift to left; c. shift to right

(B) a. No shift; b. shift to right; c. shift to left

(C) a. Shift to right; b. shift to left; c. no shift

(D) a. Shift to left; b. shift to right; c. shift to right

(E) a. Shift to left; b. shift to right; c. shift to left

73. Consider the following reaction at equilibrium. Which change will cause the equilibrium to shift to the left?

$2NOBr(g) \rightleftharpoons 2NO(g) + Br_2(g)$, $\Delta H^o_{rxn} = +30$ kJ/mol

(A) Increase the container volume (B) Remove some NO

(C) Decrease the temperature (D) Add more NOBr

(E) Increase the temperature

74. How many of the following will raise the pH of a weak acid HA in aqueous solution?

I. Addition of water.

II. Making a buffered solution by adding NaA(*s*).

III. Addition of NaCl(*s*).

IV. Addition of HNO_3.

V. Titrating with KOH.

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

75. What is the point group of triphenylphosphine?

(A) D_{3d} (B) D_3 (C) D_{3h} (D) C_3 (E) C_{3v}

76. Consider a galvanic cell based on the following reactions:

$2\ Au^{3+} + 3\ Mg \rightarrow 2\ Au + 3\ Mg^{2+}$

The reduction potentials for Au^{3+} and Mg^{2+}:

$Au^{3+} + 3\ e^- \rightarrow Au$, $\varepsilon^o = 1.5$ V

$Mg^{2+} + 2\ e^- \rightarrow Mg$, $\varepsilon^o = -2.37$ V

What is the value of ΔG^o?

(A) -84 kJ (B) -373 kJ (C) -746 kJ (D) -1120 kJ (E) -2240 kJ

77. What type of radioactive process would be expected in the following reaction?

$^{234}_{90}Th \rightarrow {}^{234}_{91}Pa$

(A) α particle production (B) β particle production (C) positron production

(D) γ ray production (E) electron capture

78. Which of the following complexes can exhibit optical isomerism?

(A) *cis*-$Co(NH_3)_4Cl_2$ (B) *trans*-$Co(en)_2Br_2$ (C) *cis*-$Co(en)_2Cl_2$

(D) $Co(NH_3)_3Cl_3$ (E) None of the above.

79. Which one of the following is paramagnetic?

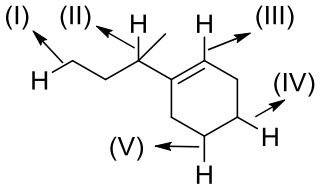
(A) $Zn(H_2O)_6^{2+}$ (B) $Co(NH_3)_6^{3+}$ (C) $Cu(CN)_3^{2-}$ (D) $Mn(CN)_6^{2-}$ (E) $Fe(SCN)_6^{2+}$

80. A formula of a certain compound is $[M(NH_3)_5Cl]Cl_2$, where the M is a type of metal. The metal ion has 24 electrons in this complex. Determine the identity of the metal.

(A) Mn (B) Fe (C) Co (D) Ni (E) Cu

81. Two well-known complex ions containing Ni are $[Ni(H_2O)_6]^{2+}$, which is green, and $[Ni(en)_3]^{2+}$, which is purple. Which one of the following statements is ***true***?
(A) The crystal field splitting energy (Δ) is greater for $[Ni(en)_3]^{2+}$ than for $[Ni(H_2O)_6]^{2+}$.
(B) $[Ni(en)_3]^{2+}$ absorbs energy in the red region of the spectrum.
(C) Both complex ions are diamagnetic.
(D) $[Ni(H_2O)_6]^{2+}$ transmits light with wavelengths of approximately 650–700 nm.
(E) The green complex absorbs green light.

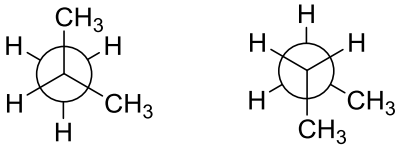
82. Which of the labeled C-H bond is the weakest?



(A) I (B) II (C) III (D) IV (E) V

83. Which of the following alkenes generates the greatest heat upon hydrogenation?
(A) 1,3-pentadine (B) 1,4-pentadiene (C) 1,3-butadiene
(D) *cis*-2-pentene (E) *trans*-2-pentene

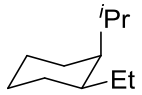
84. What is the structural relationship of the following two compounds?

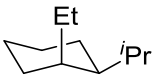


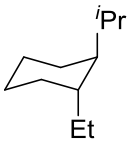
(A) not isomers (B) conformational isomers
(C) *cis-trans* isomers (D) structural isomers
(E) both conformational isomers and structural isomers

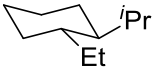
85. A tetracyclic compound, aldrin ($C_{12}H_8Cl_6$), was used as an insecticide. How many double bonds are presented in aldrin?
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

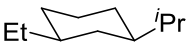
86. Which of following structures presents the most stable conformation of *cis*-1-ethyl-2-isopropylcyclohexane?

(A) 

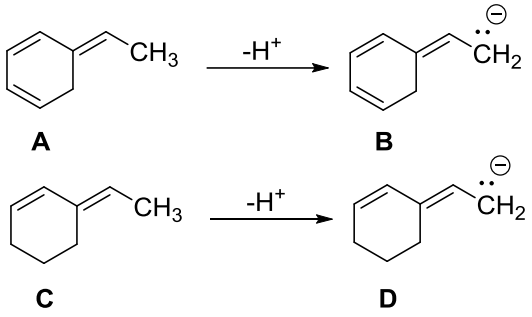
(B) 

(C) 

(D) 

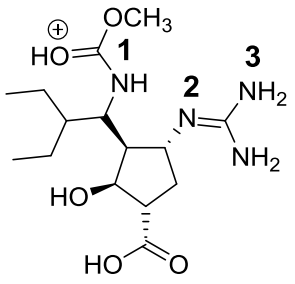
(E) 

87. Determine the most acidic compound shown below.



(A) A (B) B (C) C (D) D
(E) There is not enough information to determine the acidic order.

88. Peramivir has shown to be effective against the influenza B virus. Rank following nitrogen atoms in the order from the strongest base to the weakest base.



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

89. Arrange the following arenes in the decreasing reactivity toward HNO_3/H_2SO_4.
(a) PhH (b) PhCl (c) $PhCO_2H$ (d) $PhCH_3$
(A) (c) > (d) > (b) > (a) (B) (a) > (b) > (d) > (c) (C) (d) > (a) > (b) > (c)
(D) (d) > (b) > (a) > (c) (E) (a) > (b) > (c) > (d)

90. Which compound exhibits only two signals in its ^1H NMR spectrum, a triplet and a quintet?
(A) $BrCH_2CH_2CH_2Br$ (B) $BrCH_2CH_2CH_2Cl$ (C) $(CH_3)_2CHCH(CH_3)_2$
(D) $CH_3CH_2CH_2CH_3$ (E) $(CH_3)_2CHOCH(CH_3)_2$

後醫-英文

題號	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
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後醫-物理及化學

題號	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
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後醫-普通生物及生化概論

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後醫-計算機概論與程式設計

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