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※請在答案卡內作答

參考用

單選題 100% (每題 2.5 分，共 40 題)

1. Which of the following statements is *not* correct?
   (A) The chemical formula of Prussian blue is $KFe[Fe(CN)_6]$.
   (B) $[SCN]^-$ ligand can act as an ambidentate ligand.
   (C) ^{10}B has been developed for use in the treatment of cancerous tumors.
   (D) Amine is commonly used as a disinfectant for wounds and to sterilize medical instruments.
   (E) Ethyl butanoate is partly responsible for the aroma of pineapples.

2. Consider the complex ions $[Co(NH_3)_6]^{3+}$, $[Co(CN)_6]^{3-}$ and $[CoF_6]^{3-}$. The wavelengths of absorbed electromagnetic radiation for these compounds (in no specific order) are 770 nm, 440 nm, and 290 nm. Match the complex ion (order: $[Co(NH_3)_6]^{3+}$, $[Co(CN)_6]^{3-}$ and $[CoF_6]^{3-}$) to the wavelength of absorbed electromagnetic radiation.
   (A) 770, 440, 290 nm
   (B) 440, 770, 290 nm
   (C) 290, 770, 440 nm
   (D) 770, 290, 440 nm
   (E) 440, 290, 770 nm

3. The largest of the alkali metal cations, Cs^+, is trapped most effectively by the
   (A) 18-crown-6-ether
   (B) cryptand ([3,2,2])
   (C) cryptand ([2,1,1])
   (D) metallacrown
   (E) ethylenediaminetetraacetate.

4. Which of the following compounds is a diamagnetic molecule
   (A) NO　(B) O_2　(C) NO^-　(D) NO^+　(E) O_2^+

5. Which of the following statements about the group of elements consisting of Li, Na, K, Rb, and Cs is correct?
   (A)They are all powerful oxidizing agents.
   (B)They are known as the alkaline earth metals since their hydroxides are strongly basic.
   (C)Each element differs from the one above it by the presence of one additional electron in the outer energy level of its atoms.
   (D)They are usually stored under water since they react readily with air.
   (E)Each has the largest atomic radius of any element in its period.

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6. Which of the following compounds may react with water to liberate organic molecules?
(A) SiO_4 (B) SiH_4 (C) CaC_2 (D) HN_3 (E) NO_3^-.

7. Compounds containing the sodide ion (Na^-) can be made by reaction of:
(A) Na_2O_2 and H_2O
(B) Na and 18-crown-6-ether
(C) Na and biphenyl
(D) Na and cryptand ($N[C_2H_4O]_2C_2H_4)_3N$)
(E) Na and $[BH_4]^-$

8. Ultraviolet radiation ozone absorption is (A) above 242 nm (B) below 242 nm (C) above 320 nm (D) below 320 nm (E) 450 nm, thus it forms an indispensable shield in the upper atmosphere, protecting the Earth's surface from most of the potentially hazardous effects of such electromagnetic radiation.

9. Solvation of the ions is certainly a factor in solubility. Which of the following ions is the most strongly solvated in aqueous solution?
(A) F^- (B) Cl^- (C) Br^- (D) I^- (E) Na^+

10. Which of the following bonds has the largest polarity?
(A) H–F (B) H–I (C) H–Cl (D) H–H (E) H–Br

11. Which of the following statements is *not* true?
(A) Nonpolar molecules still have intermolecular attractive forces acting on them. Small fluctuations in the electron density in such molecules create small temporary dipoles, with extremely short lifetimes. The result is an overall attraction among molecules. These attractive forces are called London or dispersion forces.
(B) All amino acids are chiral about that carbon.
(C) The common monosaccharides, in their ring form, include glucose and fructose.
(D) Beef fat and coconut oil are classified as saturated fatty acids.
(E) Triglycerides form when a glycerol molecule reacts with three fatty acids.

12. Which of the following molecules is Infrared (IR) inactive?
(A) CO (B) NO (C) HCl (D) N_2 (E) H_2O

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13. The metallic radii in the third row of the d block are very similar to those in the second row, and not significantly larger as might be expected. We name this phenomenon as
(A) penetration
(B) inert-pair effect
(C) lanthanide contraction
(D) catenation
(E) shielding effect

14. Which of the following compounds is responsible for short-term storage of energy in living organisms and make up the main structural components of plants?
(A) lipids (B) protein (C) carbohydrates (D) fats (E) nucleic acids.

15. One of the most remarkable redox reactions is the conversion of water and carbon dioxide into carbohydrates and oxygen using solar radiation as an energy source. There are two photochemical reaction centers, photosystem I and photosystem II; the photosystem I is based on chlorophyll a_1. Chlorophyll a_1 is a
(A) manganese (B) copper (C) iron (D) magnesium (E) cobalt dihydroporphyrin complex

16. Which of the following species is *not* classified as amphoteric?
(A)H_2O (B) HPO_4^{2-} (C) NO_3^- (D) HSO_4^- (E) $H_2PO_4^-$

17. Charge-transfer transitions are generally intense compared with ligand-field transitions. So, the color of the pigment "cadmium yellow, CdS" is due to the transition
(A) $Cd^{2+}(4d) \rightarrow S^{2-}(\pi)$
(B) $Cd^{2+}(4d) \leftarrow S^{2-}(\pi)$
(C) $Cd^{2+}(5s) \rightarrow S^{2-}(\pi)$
(D) $Cd^{2+}(5p) \leftarrow S^{2-}(\pi)$
(E) $Cd^{2+}(5s) \leftarrow S^{2-}(\pi)$.

18. Most animal cells have a higher concentration of K^+ ions inside the cell membrane than outside, and a higher concentration of Na^+ ions outside the cell than inside. The immediate source of the energy to sustain this disequilibrium is
(A) ATP (B) ADP (C) DNA (D) RNA (E) protein.

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19. Which of the following statements is correct (en = ethylenediamine)?
(A) *trans*-$[Co(en)_2Cl_2]^+$ is optically active.
(B) the *cis* isomer of $[Co(en)_2Cl_2]^+$ and its mirror image are not superimposable.
(C) *cis*-$[Co(en)_2Cl_2]^+$ and its mirror image are not optical isomers.
(D) *trans*-$[Co(en)_2Cl_2]^+$ and its mirror image are not identical.
(E) *cis*-$[Co(en)_2Cl_2]^+$ is optically inactive.

20. Which of the following statements is *not* true?
(A) Polyvinyl chloride is a polymer, the formula is $(\text{-}CH_2\text{-}CHCl\text{-})_n$.
(B) The catalyst of Haber process for manufacturing ammonia is iron oxide.
(C) B_2H_6 possesses a "three-center bond".
(D) The n-type semiconductor is a silicon crystal doped with boron.
(E) angular momentum quantum number (l) of 3d orbital is $l = 2$.

21. How many protons, neutrons, and electrons does ^{56}Fe have?
(A) 26 protons, 26 neutrons, 30 electrons
(B) 26 protons, 26 neutrons, 56 electrons
(C) 30 protons, 30 neutrons, 26 electrons
(D) 26 protons, 30 neutrons, 26 electrons
(E) 56 protons, 26 neutrons, 56 electrons

22. What is the molar mass of ethanol (C_2H_5OH)?
(A) 45.07　(B) 38.90　(D) 46.07　(D) 34.17　(E) 62.07

23. An aqueous solution of silver nitrate is added to an aqueous solution of potassium chromate and this reaction produces a solid. What is the formula for the solid?
(A) AgK　(B) $AgCrO_4$　(C) KNO_3　(D) K_2NO_3　(E) Ag_2CrO_4

24-25 Consider three 1-L flasks at STP. Flask A contains NH_3 gas, flask B contains NO_2 gas, and flask C contains N_2 gas.

24. Which contains the largest number of molecules?
(A) flask A　(B) flask B　(C) flask C　(D) all are the same　(E) none

25. In which flask do the molecules have the highest average velocity?
(A) flask A　(B) flask B　(C) flask C　(D) all are the same　(E) none

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26. For the hypothetical reactions 1 and 2, $K_1 = 10^2$ and $K_2 = 10^{-4}$.

1. $A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$
2. $2A_2(g) + C_2(g) \rightleftharpoons 2A_2C(g)$
3. $A_2C(g) + B_2(g) \rightleftharpoons 2AB(g) + (1/2)C_2(g)$

What is the value for K for reaction 3?

(A) 10^{-2} (B) 10^4 (C) 10^6 (D) 10^2 (E) 10^{-4}

27. Which of the following does *not* represent a conjugate acid-base pair?

(A) HF and F^-

(B) $C_5H_5NH^+$ and C_5H_5N

(C) H_3O^+ and H_2O

(D) HCN and NH_3

(E) none of the above

28. Buffers in the human body

(A) help to maintain a constant blood pH.

(B) help to keep the body temperature constant.

(C) help change the blood plasma pH when foods are eaten.

(D) precipitate proteins so that enzymes are inactive.

(E) none of the above.

29. An indicator HIn has a $K_a = 1 \times 10^{-8}$. At pH = 6.0, what is the ratio of HIn/In^-?

(A) 1/1

(B) 100/1

(C) 1/100

(D) 1/10

(E) none of the above

30. Which one of the following statements is *false*?

(A) The change in internal energy, ΔE, for a process is equal to the amount of heat absorbed at constant volume, q_v.

(B) The change in enthalpy, ΔH, for a process is equal to the amount of heat absorbed at constant pressure, q_p.

(C) A bomb calorimeter measures ΔH directly.

(D) If q_p for a process is negative, the process is exothermic.

(E) The freezing of water is an example of an exothermic reaction.

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31. Which of the following statements is true?

(A) As long as the disorder of the surroundings is increasing, a process will be spontaneous.

(B) For any process, ΔS_{surr} and ΔS_{sys} have opposite signs.

(C) If $\Delta S_{surr} = -\Delta S_{sys}$, the process is at equilibrium.

(D) $\Delta H°$ is zero for a chemical reaction at constant temperature.

(E) none of the above.

32. How many electrons are transferred in the following reaction?

$$SO_3^{2-}(aq) + MnO_4^-(aq) \rightarrow SO_4^{2-}(aq) + Mn^{2+}(aq)$$

(A) 6　(B) 2　(C) 10　(D) 4　(E) 3

33. What is the oxidation state of Cr in $Cr_2O_7^{2-}$?

(A) +7　(B) +6　(C) +12　(D) –1　(E) –2

34. Which of the following statements about quantum theory is *incorrect*?

(A) The energy and position of an electron cannot be determined simultaneously.

(B) Lower energy orbitals are filled with electrons before higher energy orbitals.

(C) When filling orbitals of equal energy, two electrons will occupy the same orbital before filling a new orbital.

(D) No two electrons can have the same four quantum numbers.

(E) All of the above are correct.

35. Which of the following statement is correct?

(A) The shape of a H_2O molecule is linear.

(B) The molecule ClO_2 cannot be accurately described by a Lewis structure consistent with the octet rule.

(C) The diatomic molecule Cl_2 is an example of a polar molecule.

(D) The bonds in LiF have more covalent character than those in F_2.

(E) none of the above.

36. Which of the following statements is true?

(A) Electrons are never found in an antibonding MO.

(B) All antibonding MOs are higher in energy than the atomic orbitals of which they are composed.

(C) Antibonding MOs have electron density mainly outside the space between the two nuclei.

(D) None of the above is true.

(E) Two of the above statements are true.

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37. For which order reaction is the half life of the reaction proportional to 1/k (k is the rate constant)?
(A) zero order
(B) first order
(C) second order
(D) all of the above
(E) none of the above

38. Which statement regarding water is true?
(A) Energy must be given off in order to break down the crystal lattice of ice to a liquid.
(B) Hydrogen bonds are stronger than covalent bonds.
(C) Liquid water is less dense than solid water.
(D) Only covalent bonds are broken when ice melts.
(E) All of the statements (A–D) are false.

39. A solution of two liquids, A and B, shows negative deviation from Raoult's law. This means that
(A) molecules of A interact strongly with other A-type molecules.
(B) the two liquids have a positive heat of solution.
(C) molecules of A interact weakly, if at all, with B molecules.
(D) the molecules of A hinder the strong interaction between B molecules.
(E) molecular interaction A–B > (A–A, B–B).

40. Within the halogen family, as atomic number increases,
(A) ionic radius decreases.
(B) covalent atomic radius increases.
(C) melting point decreases.
(D) electronegativity increases.
(E) none of the above.