單選題，四選一

1. What is the characteristic property being measured in stripping method?
   (A) electrical potential; (B) electrical current; (C) electrical charge; (D) electrical resistance.
2. What is the most appropriate quantitation method for analyzing complex samples,
   (A) calibration curves; (B) standard addition method; (C) internal standard method;
   (D) None of the above.
3. Which hardware method could recover the signals even when the signal-to-noise ratio is unity or less?
   (A) Lock-in amplifier; (B) Chopper Amplifier; (C) Analog filter; (D) Difference amplifier.
4. Which noise could be reduced by lowering the temperature of a measurement
   (A) Johnson noise; (B) Shot noise; (C) Flick Noise; (D) Power line noise.
5. Which spectrochemical method employ the 1014 to 1015 Hz frequency range ?
   (A) X-ray; (B) Ultraviolet; (C) Visible; (D) Infrared.
6. Which source is used to provide line source?
   (A) Xe lamp; (B) Nernst glower; (C) Hollow cathode lamp; (D) Nichrome wire.
7. Which detector is used for echelle monochromator?
   (A) photomultiplier tube; (B) Photodiode arrays; (C) charge-coupled device;
   (D) thermocouple.
8. Which X-ray method could used to determine trace elements in rock?
   (A) X-ray absorption; (B) X-ray diffraction; (C) X-ray fluorescence;
   (D) X-ray scattering.
9. Which gas chromatograph detector was used to detect organophosphate compounds?
   (A) flame ionization detector; (B) electron capture detector;
   (C) flame photometric detector; (D) thermal conductivity detector.
10. A molecular sieves column was used to separate the following compounds: CO, CO_2, H_2, and CH_4. The eluting order (from the first to last) is :
    (A) H_2, CO, CH_4, CO_2; (B) H_2, CH_4, CO, CO_2; (C) H_2, CO_2, CH_4, CO; (D) CO_2, H_2, CO, CH_4.
11. Which mass spectrometric ionization method generates multiple charged ions?
    (A) electron impact ionization; (B) chemical ionization,
    (C) electrospray ionization; (D) fast atom bombardment.
12. Which indicator is useful in the for the titration with low pH en point?
    (A) metho orange; (B) methyl red; (C) phenol red; (D) phenolphthalein.
13. Which of the following metal does not need to be detected using hydride generation technique?
    (A) As; (B) Pb; (C) Se; (D) Cd.

14. The Symmetry group of SO_2 is

(A) C_{2v} (B) $C_{\infty v}$ (C) D_{2h} (D) C_{2h}

15. According to the EAN rule, the number of electron count on the metal center of Wilkinson catalyst ($Rh(CO)(PPh_3)_2Cl$) is

(A) 15 (B) 16 (C) 17 (D) 18

16. How many groups of non-equivalent protons in bis(methylcyclopentadienyl) iron?

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

17. How many isomers (including optical isomers) in CoL_3 (HL = o-aminophenol)

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

18. Which of the following statement is not true.

(A) Hydroformylation is a reaction between olefin and carbon monoxide.

(B) In Monsanto acetic acid process, rhodium complex is one of the very efficient catalyst.

(C) In Fisher Tropsch reaction, the major product is hydrocarbon.

(D) $Co_2(CO)_8$ in an effective catalyst for hydroformylation reaction.

19. The major products of the following reactions are Pa and Pb respectively.

$Mn_2(CO)_{10} + Py \rightarrow Pa$ (Py = pyridine)

$Fe(CO)_5 + NaBH_4 \rightarrow Pb$

Which of the following combination of Pa and Pb is correct.

(A) $Mn_2(CO)_9Py$, $NaFe(CO)_4(BH_4)$

(B) $Mn_2(CO)_9Py$, $NaHFe(CO)_4$

(C) $[Mn(CO)_5][Mn(Py)_6]$, $NaFe(CO)_4(BH_4)$

(D) $[Mn(CO)_5][Mn(Py)_6]$, $NaHFe(CO)_4$

20. Which of the following is not currect.

(A) phosphoryl trichloride is $POCl_3$

(B) nitrite is NO_2^-

(C) hydrazide is NH_2NH_2

(D) hypochlorite is ClO^-

21. Which of the following statement about KK $\sigma_{2s}^2\sigma_{2s}^{*2}\sigma_{2p}^2\pi_{2p}^2\pi_{2px}^{*1}\pi_{2py}^{*1}$ is not correct.

(A) KK indicate core electrons

(B) The bond order correspond to this electronic configuration is 2.

(C) The spin state of this configuration can not be triplet.

(D) F_2^{2+} has this configuration

22. Which of the following is not correct

(A) Si is a semiconductor

(B) SiO_2 is an insulator

(C) Cu_2O is a semiconductor

(D) $Yba_2Cu_3O_{7-\delta}$ ($\delta<1$) is a superconductor

23. Which of the following boiling point is correct.

(A) $LiF > LiI > SiCl_4 > SiO_2$

(B) $SiO_2 > LiF > SiCl_4 > LiI$

(C) $LiI > SiO_2 > LiF > SiCl_4$

(D) $SiO_2 > LiF > LiI > SiCl_4$

24. Which of the following is not correct

(A) $Ag(NH_3)_2^+$ has a linear structure

(B) $Cu(NH_3)_4^{2+}$ has a square structure

(C) $Zn(NH_3)_4^{2+}$ has a square structure

(D) $Pt(NH_3)_4^{2+}$ has a square structure

25. Which of the following is a correct description of the reaction

$$Cr(H_2O)_6^{3+} + F^- \leftrightarrow Cr(H_2O)_5F^{2+} + H_2O$$

(A) Solvate Isomerization

(B) Racemerization

(C) Nucleophilic Substitution

(D) Ligand Isomerization

26. Which one has the lowest first ionization potential?

(A) N (B) O (C) S (D) Cl

27. The radial function $\psi = A(Z/a_0)^{3/2}(2-\frac{1}{2}\rho)e^{-\rho/4}$, in which $\rho=2Zr/a_0$ and a_0 is the Bohr radius, describes the atomic orbital

(A) 1s (B) 2s (C) 2p (D) 3s

28. What is the term symbol of F atom in its ground electronic state?

(A) $^2S_{1/2}$ (B) $^2P_{1/2}$ (C) $^2P_{3/2}$ (D) $^2D_{1/2}$

29. What is the point group of C_2H_6 in its staggered form?

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

30. Which parameter determines the temperature dependence of the Gibb's free energy at constant pressure?

(A) U (B) A (C) V (D) S

31. The Helmholtz free energy A is sometimes called "work function" because dA represents the maximum available work accompanying a process

(A) under all condition. (B) at constant volume.

(C) under constant temperature and pressure.

(D) at constant temperature.

32. Which one is incorrect?

(A) $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$ (B) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(C) $\left(\frac{\partial P}{\partial T}\right)_V = \left(\frac{\partial S}{\partial V}\right)_T$ (D) $\left(\frac{\partial V}{\partial T}\right)_P = \left(\frac{\partial S}{\partial P}\right)_T$

33. Which one is not the property of an ideal solution?

(A) $\Delta V_{mix} = 0$ (B) $\Delta H_{mix} = 0$ (C) $\Delta S_{mix} > 0$ (D) $\Delta G_{mix} = 0$

34. Which is the potential of the cell $Zn\,|\,ZnCl_2(aq,b)\,|\,AgCl(s)\,|\,Ag$ at T°K? b is the molality of the solution.

(A) $E = E^0 - \frac{RT}{2F} \ell n\ 4\gamma_{\pm}^3 b^3$ (B) $E = E^0 - \frac{RT}{2F} \ell n\ 4\gamma_{\pm}^2 b^2$

(C) $E = E^0 - \frac{RT}{F} \ell n\ \gamma_{\pm} b$ (D) $E = E^0 - \frac{RT}{2F} \ell n\ \gamma_{\pm} b$

35. For a reversible first-order reaction

which one is incorrect?

(A) $\frac{[B]_{eq}}{[A]_{eq}} = \frac{k_f}{k_r}$ (B) $[A] = [A]_0 e^{-(k_f + k_r)t}$

(C) after a temperature jump, the relaxation rate coefficient is $k_f + k_r$

(D) none of the above

36. How many collisions in one second does a particular N_2 molecule experience in a sample at 1 atm and 25°C?

(A) ~10^{23} (B) ~10^{15} (C) ~10^{10} (D) ~10^{8}

37. What is the mean speed of N_2 in air at 25°C?

(A) ~1275 ms^{-1} (B) ~55 ms^{-1} (C) ~255 ms^{-1} (D) ~475 ms^{-1}

38. In the lowest energy chair conformation of *trans*-1,4-dimethylcyclohexane, how many *axial* positions are occupied by hydrogen atoms?
(A) 3 (B) 4 (C) 5 (D) 6

39. Choose the correct hybridization for the central carbon of 1,2-propadiene (allene).
(A) sp^3 (B) sp^2 (C) sp (D) none of the above

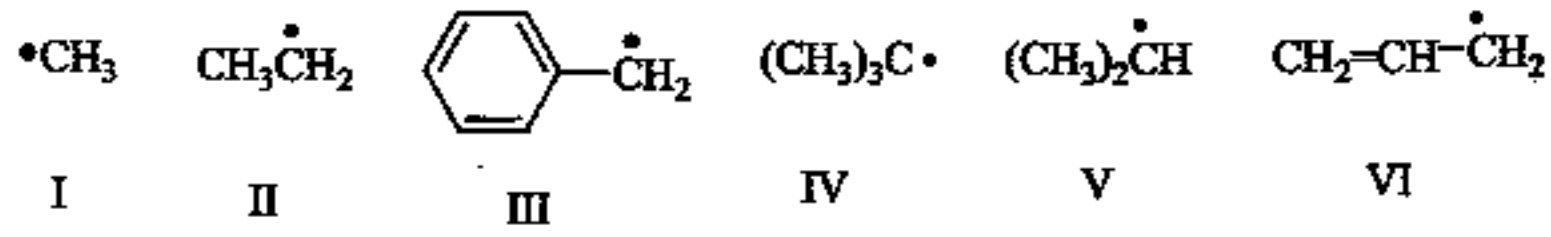
40. An alkene yields a mixture of 2-pentanone and 3-pentanone when treated with ozone followed by treatment with dimethyl sulfide. The alkene is possibly
(A) 3,4-dimethyl-3-octene (B) 3,4-diethyl-3-hexene
(C) 3-ethyl-4-methyl-3-heptene (D) 2,3,4,5-tetramethyl-3-hexene

41. When (*R*)-2-octanol is treated with $SOCl_2$ in dioxane, the product formed is
(A) a mixture of *cis* and *trans*-2-octene
(B) a racemic mixture of 2-chlorooctane
(C) (*R*)-2-chlorooctane (D) (*S*)-2-chlorooctane

42. An ether solution of salicyclic acid (I), aniline (II) and anisole (III) is extracted with aqueous NaOH. What compound(s) will be contained in the ether layer after the extraction?
(A) I + II (B) I + III (C) II + III (D) I + II + III

43. How many rings are there present in the structure of cholic acid, $C_{24}H_{40}O_5$, which has a carboxyl group and three hydroxyl groups?
(A) 2 (B) 3 (C) 4 (D) 5

44. Which of the following correctly ranks the radicals in decreasing order of stability. (*more stable > less stable)



I II III IV V VI

(A) I > II > V > IV > VI > III (B) III > VI > IV > V > II > I
(C) VI > III > IV > V > II > I (D) I > II > V > IV > III > VI

45. The reagents which convert a carbonyl group of a ketone into a methylene group are
(A) $LiAlH_4$, THF (B) Na, NH_3, EtOH (C) $NaBH_4$, EtOH
(D) H_2NNH_2, KOH, triethylene glycol

46. The Diels-Alder reaction is a concerted reaction because
(A) a mixture of endo and exo products is formed
(B) all bond making and bond breaking occurs simltaneously

(C) the products contain rings

(D) the reaction is highly endothermic

47. Which of the following elements is necessary to the vulcanization of rubber?

(A) titanium (B) silicon (C) sulfur (D) aluminum

48. Prostaglandins, a class of biochemical regulators, are derived from

(A) palmitic acid (B) phosphatidic acid (C) arachidonic acid

(D) stearic acid

49. Almost all the naturally occurring amino acids

(A) are stereochemically related to D-glyceraldehyde

(B) have the (*R*)-configuration at the α-carbon

(C) have the (*S*)-configuration at the α-carbon

(D) give the levorotatory (-) specific rotation

50. The relationship between ketones and their corresponding enols is one of

(A) allotropes (B) enantiomers (C) anomers (D) tautomers