CHEMISTRY (PG)
(FINAL)

1. For a reaction with an activation energy of 49.8 kJ mol^{-1}, the ratio of the rate constants at 600 K and 300 K, (k_{600}/k_{300}), is approximately (R = 8.3 J mol^{-1} K^{-1})

(A) ln(10)
(B) 10
(C) 10 + e
(D) e^{10}

2. The ionic mobilities of NH_4^+ and HCO_3^- are 6 × 10^{-4} $V^{-1}s^{-1}$ and 5 × 10^{-4} $V^{-1}s^{-1}$, respectively. The transport numbers of NH_4^+ and HCO_3^- are, respectively

(A) 0.545 and 0.455
(B) 0.455 and 0.545
(C) 0.090 and 0.910
(D) 0.910 and 0.090

3. The ionic strength of a solution containing 0.008 M $AlCl_3$ and 0.005 M KCl is

(A) 0.134 M
(B) 0.053 M
(C) 0.106 M
(D) 0.086 M

4. Mark-Houwink equation ($[\eta]=KM^a$) is used for the determination of

(A) number-average molar mass
(B) weight-average molar mass
(C) viscosity-average molar mass
(D) *z*-average molar mass

5. The absolute temperature of a perfectly black body is increased to twice its value. The rate of emission of energy per unit area will become

(A) 2 times
(B) 4 times
(C) 8 times
(D) 16 times

6. If the pre-exponential factor in the Arrhenius equation is $1.6 \times 10^{-12} s^{-1}$, the value of the rate constant at extremely high temperature will be close to

(A) $1.6 \times 10^{-12}\ s^{-1}$
(B) $4.2 \times 10^{-12}\ s^{-1}$
(C) $1.2 \times 10^{-9}\ s^{-1}$
(D) $2.4 \times 10^{-6}\ s^{-1}$

7. The degeneracy of an excited state of a particle in 3-dimensional cubic box with energy 2 times its ground state energy is

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

8. Which of the functions below is the common eigen function of $\frac{d}{dx}$ and $\frac{d^2}{dx^2}$ operators?

(A) $\cos x$
(B) kx
(C) $e - x^2$
(D) e^{ix}

9. Metallic silver crystallizes in an fcc structure with a unit cell of length 40 nm. The first-order diffraction angle of the X-ray beam from the (2, 1, 0) plane of silver is 30°. The wavelength of the X-ray used is close to

(A) 11 nm
(B) 18 nm
(C) 25 nm
(D) 32 nm

10. The emf of an electrochemical cell, $Cu|CuCl_2(a_1{=}0.01)||CuCl_2(a_2{=}0.1)|Cu$, is close to

(A) 0.059 volts
(B) –0.059 volts
(C) –0.0295 volts
(D) 0.0295 volts

11. For a reaction, $NO(g) + H_2(g) \rightarrow N_2(g) + H_2O(g)$, the experimentally observed rate is $k[NO]^2[H_2]$. If the concentration of NO ([NO]) is doubled, and the concentration of H_2($[H_2]$) is halved, what is the effect on the reaction rate?

(A) Rate will not change
(B) Rate will be doubled
(C) Rate will be halved
(D) Rate will be increased by four times

12. For a reaction $A \rightarrow B + C$, it is formed that the rate increases by a factor of 2.25 when the concentration of A is increased by a factor of 1.5 at the same temperature. What is the order of the reaction with respect to A?

(A) 1
(B) 1.5
(C) 2
(D) 2.25

13. For a sequence of consecutive reactions, $A \xrightarrow{k_1} I \xrightarrow{k_2} P$, the concentration of I obtained by steady-state approximation is

(A) $k_1[A]$
(B) $(k_1 + k_2)[A]$
(C) $k_1k_2[A]$
(D) $\frac{k_1}{k_2}[A]$

14. For a reaction $2A + B \rightarrow 3Z$, if the rate of consumption of A is 2×10^{-4} mol dm^{-3} s^{-1} then the rate of formation of Z (in mol dm^{-3} s^{-1}) will be

(A) 1×10^{-4} mol dm^{-3} s^{-1}
(B) 1.5×10^{-4} mol dm^{-3} s^{-1}
(C) 2×10^{-4} mol dm^{-3} s^{-1}
(D) 3×10^{-4} mol dm^{-3} s^{-1}

15. The Clausius-Clepyron equation is

(A) $\frac{dP}{dT} = \frac{\Delta S}{\Delta V}$

(B) $\frac{dP}{dT} = \frac{1}{\Delta S \Delta V}$

(C) $\frac{dP}{dT} = \frac{T\Delta S}{\Delta V}$

(D) $\frac{dP}{dT} = \frac{\Delta V}{T\Delta S}$

16. A Carnot engine with a low-temperature reservoir of 300K has an efficiency of 50%. It is desired to increase the efficiency to 70%. By how much should the temperature of the high-temperature reservoir be increased?

(A) 400K
(B) 600K
(C) 700K
(D) 1000K

17. Probability density of a wave function, $\psi(\phi) = \frac{1}{\sqrt{2\pi}} e^{-i\phi}$ within $0 \leq \phi \leq 2\pi$ is

(A) $\frac{1}{\sqrt{2\pi}}$

(B) $\frac{1}{2\pi}$

(C) 2π

(D) 1

18. The commutators of $\left[x, \frac{d}{dx}\right]$ and $\left[y, \frac{d}{dx}\right]$ are

(A) −1, 0
(B) 0, −1
(C) 0, 0
(D) −1, −1

19. The angular momentum operator of the z component (L_z) is

(A) $\frac{\hbar}{i}\left(y\frac{\partial}{\partial x}-x\frac{\partial}{\partial y}\right)$

(B) $\frac{\hbar}{i}\left(y\frac{\partial}{\partial y}-x\frac{\partial}{\partial x}\right)$

(C) $\frac{\hbar}{i}\left(x\frac{\partial}{\partial y}-y\frac{\partial}{\partial x}\right)$

(D) $\frac{\hbar}{i}\left(x\frac{\partial}{\partial x}-y\frac{\partial}{\partial y}\right)$

20. A system is represented by the wave function $=\frac{1}{\sqrt{3}}\Phi_1+\sqrt{\frac{2}{3}}\Phi_2$, where, Φ_1 and Φ_2 are orthonormal to each other. If E_1 and E_2 are the eigenvalues of Φ_1 and Φ_2 respectively, then the average energy expression of the system is

(A) $\frac{1}{\sqrt{3}}E_1+\sqrt{\frac{2}{3}}E_2$

(B) $\frac{1}{3}E_1+\frac{2}{3}E_2$

(C) $\frac{E_1+E_2}{3}$

(D) $\frac{E_1+E_2}{2}$

21. For a particle in a 3-dimensional box with $L_x = L_y = \frac{L_z}{2} = L$, the energy expression for E_{211} and E_{112} are

(A) $\frac{21h^2}{32mL^2}$ and $\frac{3h^2}{8mL^2}$, respectively

(B) $\frac{6h^2}{8mL^2}$ and $\frac{6h^2}{8mL^2}$, respectively

(C) $\frac{9h^2}{32mL^2}$ and $\frac{9h^2}{16mL^2}$, respectively

(D) $\frac{9h^2}{32mL^2}$ and $\frac{3h^2}{8mL^2}$, respectively

22. ΔH of a reaction is equal to slope of the plot

(A) ΔG versus T
(B) ΔG versus (1/T)
(C) (ΔG/T) versus T
(D) (ΔG/T) versus (1/T)

23. Isothermal reversible expansion (change in volume from V_1 to V_2, where $V_2 > V_1$) of a gas, the change of system entropy (ΔS_{sys}) is

(A) $nR(V_2 - V_1)$

(B) $nR(P_2 - P_1)$

(C) $nR\ln\left(\frac{V_2}{V_1}\right)$

(D) $nR\ln\left(\frac{P_2}{P_1}\right)$

24. $\left(\frac{\partial U}{\partial V}\right)_T$ for one mole of Vander Waals gas is

(A) $\frac{1}{(V-b)}$

(B) $(V-b)$

(C) $\frac{a}{V^2}$

(D) $\frac{V^2}{a}$

25. The rotational spectrum is not observed for

(A) HCl
(B) CH_2Cl_2
(C) H_2O
(D) CH_4

26. The energy required for a transition between the rotational levels J=1 and J=2 of a molecule is (where B is the rotational constant of the molecule)

(A) B cm^{-1}
(B) 2B cm^{-1}
(C) 3B cm^{-1}
(D) 4B cm^{-1}

27. The transition energy expression for the hot band is (ω_e and x_e are the oscillation frequency and anharmonicity constant, respectively)

(A) $\Delta\epsilon = \omega_e(1-2x_e)$ cm^{-1}
(B) $\Delta\epsilon = \omega_e(1-4x_e)$ cm^{-1}
(C) $\Delta\epsilon = 2\omega_e(1-3x_e)$ cm^{-1}
(D) $\Delta\epsilon = 3\omega_e(1-4x_e)$ cm^{-1}

28. Which of the following statement is **CORRECT**?

(A) Symmetric stretching mode of vibration of CO_2 is IR active and Raman inactive
(B) Symmetric stretching mode of vibration of CO_2 is IR inactive and Raman active
(C) Bending mode of vibration of CO_2 is IR inactive and Raman active
(D) Asymmetric stretching mode of vibration of CO_2 is IR inactive and Raman active

29. Among the following, which electronic transition is **NOT** allowed?

(A) $^1S_0 \rightarrow {}^1P_1$
(B) $^3S_1 \rightarrow {}^3P_2$
(C) $^3S_1 \rightarrow {}^3P_1$
(D) $^3S_1 \rightarrow {}^1P_1$

30. On passing monochromatic light through a 0.04 molar solution in a cell of 2 cm thickness, the intensity of the transmitted light was reduced to 50%. Calculate the molar extinction coefficient.

(A) 3.76 lit mol^{-1} cm^{-1}
(B) 4.0 lit mol^{-1} cm^{-1}
(C) 1.88 lit mol^{-1} cm^{-1}
(D) 2.0 lit mol^{-1} cm^{-1}

31. Among the following photophysical processes, which one is the nonradiative process?

(A) Prompt Fluorescence
(B) Intersystem Crossing
(C) Delayed Fluorescence
(D) Phosphorescence

32. Given the equivalent conductances of sodium butyrate, sodium chloride and hydrochloric acid as 83, 127, and 426 $ohm^{-1}cm^2$ at 25°C, respectively, at infinite dilution. The equivalent conductance of butyric acid at infinite dilution is

(A) 382 $ohm^{-1}cm^2$
(B) 343 $ohm^{-1}cm^2$
(C) 299 $ohm^{-1}cm^2$
(D) 216 $ohm^{-1}cm^2$

33. In an enzymatic process, obeying the Michaelis-Menten kinetics, at the substrate concentration extremely low and extremely high conditions, the reaction rate with respect to substrate concentration will be

(A) zeroth order and first order respectively
(B) zeroth order for both cases
(C) first order and zeroth order respectively
(D) first order for both cases

34. In a random distribution of 10 particles between two boxes with equal probability, the number of microstates in the macrostate (3,7) (3 particles are in one box and 7 particles are in another box) is

(A) 120
(B) 5
(C) 10/21
(D) 120×2^{-10}

35. Elementary steps of a reaction are as follows

$$(i)\ A + B \overset{k_1}{\rightarrow} 2C, \quad (ii) A + B \overset{k_2}{\leftarrow} 2C, \quad (iii) 2C \overset{k_3}{\rightarrow} P,$$

if steady state approximation is applicable to C, the rate of the product formation is ([A] and [B] are the concentration of A and B, respectively)

(A) proportional to $([A][B])^{\frac{1}{2}}$
(B) proportional to [A][B]
(C) proportional to $([A][B])^2$
(D) independent of [A] and [B]

36. At what temperature, with pressure remaining unchanged, the root mean square velocity of hydrogen will be double of its value at NTP?

(A) 273˚C
(B) 546˚C
(C) 819˚C
(D) 1092˚C

37. The equilibrium constant (K_p) for a reaction, $PCl_5 \rightleftarrows PCl_3 + Cl_2$, is 1.8. The pressure necessary to obtain a 50% dissociation of PCl_5 at 250˚C is

(A) 1.5 atm
(B) 1.8 atm
(C) 3.6 atm
(D) 5.4 atm

38. Which of the following equations is correct for the linear operator $\left(\hat{O}\right)$?

(A) $\hat{O}\Psi = \Psi *$

(B) $\hat{O}\Psi = \dfrac{d\Psi}{dx}$

(C) $\hat{O}\Psi = \Phi^2$

(D) $\hat{O}\Psi = \dfrac{1}{\Psi}$

39. If the reduced mass of a diatomic molecule is doubled without changing its force constant, the vibrational frequency of the molecule will be

(A) $\dfrac{1}{\sqrt{2}}$ times the original frequency

(B) $\sqrt{2}$ times the original frequency

(C) $\dfrac{1}{2}$ times the original frequency

(D) 2 times the original frequency

40. Considering the moment of inertia about the x, y and z axes, the CH_4, NH_3 and H_2O molecules are

(A) symmetric top, spherical top, and asymmetric top, respectively
(B) spherical top, symmetric top, and asymmetric top, respectively
(C) symmetric top, asymmetric top, and spherical top, respectively
(D) spherical top, asymmetric top, and symmetric top, respectively

41. The lowest possible energy of the simple Harmonic Oscillator is

(A) $E_0 = \hbar\omega$

(B) $E_0 = \dfrac{1}{2}\hbar\omega$

(C) $E_0 = 0$

(D) $E_0 = \dfrac{3}{2}\hbar\omega$

42. The probability of finding a particle at ground state within the vicinity of the center (0.5-0.01 nm to 0.5+0.01 nm) in a one-dimensional box of length 1nm is close to

(A) 0.01
(B) 0.02
(C) 0.04
(D) 0.1

43. The average speed of ideal gas molecules at 27°C is 0.3 ms^{-1}. The average speed at 927°C will be

(A) 0.3 ms^{-1}
(B) 0.6 ms^{-1}
(C) 0.9 ms^{-1}
(D) 3.0 ms^{-1}

44. The edge length of the unit cell of NaCl is 564 pm. If the size of the Cl^{-1} ion is 181 pm, the size of the Na^+ ion would be

(A) 101 pm
(B) 167 pm
(C) 202 pm
(D) 282 pm

45. Given that $E^0_{Fe^{2+}/Fe} = -0.441$ volts, and $E^0_{Fe^{3+}/Fe^{2+}} = 0.771$ volts. The value of $E^0_{Fe^{3+}/Fe}$ is

(A) -0.037 volts
(B) -0.111 volts
(C) -0.33 volts
(D) $+0.33$ volts

46. The chemical potential is expressed as

(A) $\mu = -\left(\frac{\partial G}{\partial N_i}\right)_{T,P,N_j}$

(B) $\mu = \left(\frac{\partial G}{\partial N_i}\right)_{T,P,N_j}$

(C) $\mu = \left(\frac{\partial G}{\partial T}\right)_{P,N}$

(D) $\mu = \left(\frac{\partial G}{\partial P}\right)_{T,N}$

47. If a polymer sample consists of 30% molecules of molar mass 20,000 g/mol, 40% molecules of molar mass 30,000 g/mol, and 30% of molecules of molar mass 60,000 g/mol, then weight average molar mass ($\bar{M}_w$) is

(A) 1100 g/mol
(B) 36,000 g/mol
(C) 36,666 g/mol
(D) 43,333 g/mol

48. If a unimolecular surface reaction obeys the Langmuir adsorption isotherm at very high pressure, the rate of the reaction (v) is

(A) independent of the pressure
(B) proportional to the pressure
(C) proportional to the square of the pressure
(D) inversely proportional to the pressure

49. The van't Hoff equation is

(A) $\frac{d \ln K_p}{dT} = \frac{\Delta H^0}{RT^2}$

(B) $\frac{d \ln K_p}{dT} = \frac{\Delta G^0}{RT^2}$

(C) $\frac{d \ln K_p}{dT} = \frac{\Delta H^0}{RT}$

(D) $\frac{d \ln K_p}{dT} = \frac{\Delta G^0}{RT}$

50. Which of the following is **NOT** an intensive property of a system?

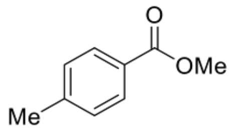
(A) Density
(B) Viscosity
(C) Entropy
(D) Temperature

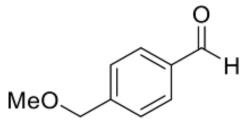
51. Among the following, the compound that forms the strongest hydrogen bonding is

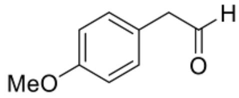
(A) HF
(B) HCl
(C) HBr
(D) HI

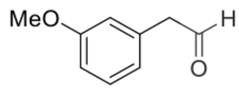
52. An organic compound having molecular formula $C_9H_{10}O_2$ exhibits the following spectral characteristics:

^{1}H NMR: δ 9.72 (t, 1H), 7.1 (d, 2H), 6.7 (d, 2H), 3.8 (s, 3H), 3.6 (d, 2H)
IR: ~1720 cm^{-1}
The most probable structure of the compound is

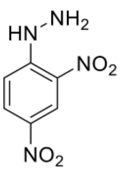
(A) 

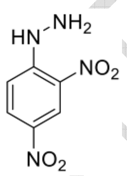
(B) 

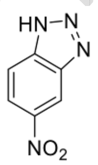
(C) 

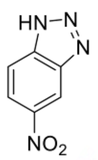
(D) 

53. The reaction of 2,4-dinitrofluorobenzene with hydrazine produces a yellow orange solid **X** used for the identification of an organic functional group **G.** Then **X** and **G**, respectively, are

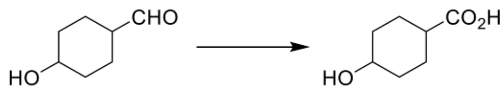
(A)  and carboxylic acid

(B)  and aldehyde

(C)  and aldehyde

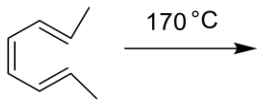
(D)  and carboxylic acid

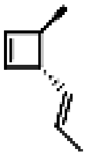
54. Which one of the following options is best suited for effecting the transformation?

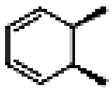


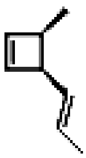
(A) MnO_2
(B) DMSO, $(COCl)_2$, Et_3N
(C) Al(O*i*-Pr)$_3$
(D) Ag_2O/NH_4OH (Tollens Reagent)

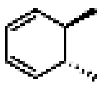
55. The major product formed in the following reaction is



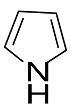
(A) 

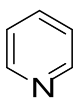
(B) 

(C) 

(D) 

56. Nitration is an important example for aromatic electrophilic substitution reaction. Major mononitration products of pyrrole and pyridine are, respectively

(Pyrrole) 



(Pyridine)

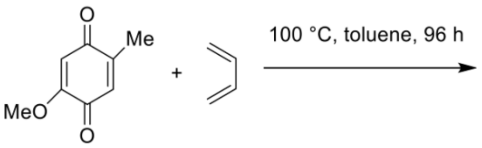
(A) 2-nitropyrrole and 4-nitropyridine
(B) 3-nitropyrrole and 3-nitropyridine
(C) 2-nitropyrrole and 2-nitropyridine
(D) 2-nitropyrrole and 3-nitropyridine

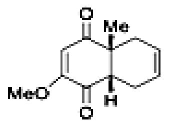
57. Which among the following exhibit aromatic character?

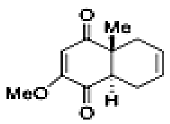
I II III IV

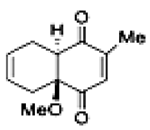
(A) II and IV
(B) III and IV
(C) III only
(D) None of the above

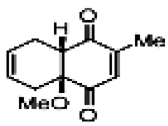
58. The major product formed in the following reaction is



(A) 

(B) 

(C) 

(D) 

59. For the radical chain reaction below, the correct classification for step 2 and step 3 is, respectively,

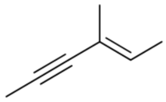
Step 1: $Br_2 + M \longrightarrow 2Br\bullet + M$

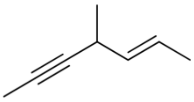
Step 2: $Br\bullet + H_2 \rightleftharpoons HBr + H\bullet$

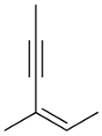
Step 3: $H\bullet + Br_2 \longrightarrow HBr + Br\bullet$

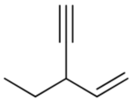
(A) chain propagating, chain terminating
(B) chain branching, chain terminating
(C) chain propagating, chain propagating
(D) chain propagating, chain branching

60. The ene-yne that produces a chiral compound upon treatment with Lindlar catalyst is

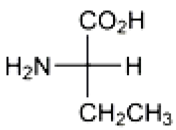
(A) 

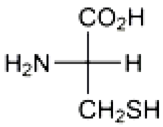
(B) 

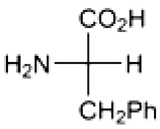
(C) 

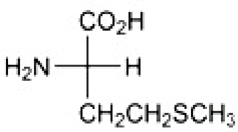
(D) 

61. The amino acid with *R* configuration is

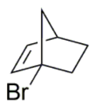
(A) 

(B) 

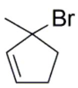
(C) 

(D) 

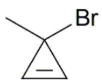
62. The rate of S_N1 solvolysis of I - IV follows



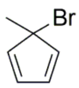
I



II



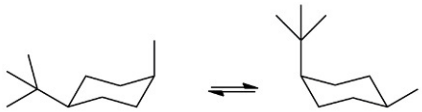
III



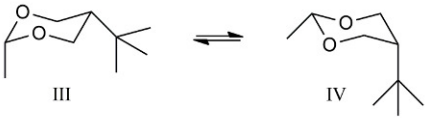
IV

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

63. The more stable species in each pair of conformers are



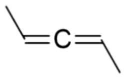
I II

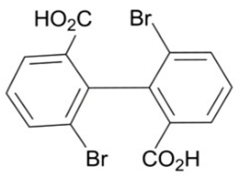


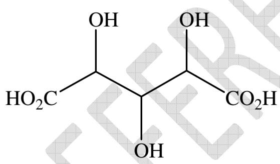
III IV

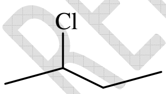
(A) I and IV
(B) I and III
(C) II and IV
(D) II and III

64. Achiral stereoisomer(s) is (are) possible for

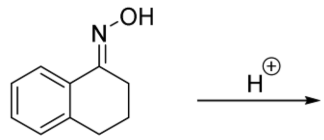
(A) 

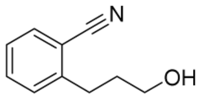
(B) 

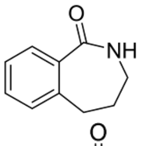
(C) 

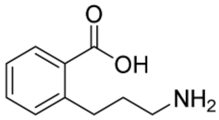
(D) 

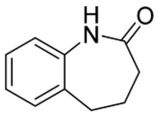
65. The major product formed in the following reaction is



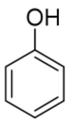
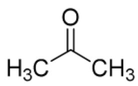
(A) 

(B) 

(C) 

(D) 

66. The order of acidity of the given molecules in aqueous media is

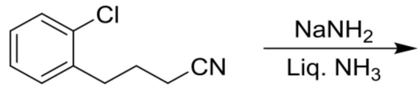
		FCH_2COOH	CH_3OH
I	**II**	**III**	**IV**

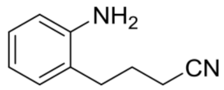
(A) IV < I < II < III
(B) II < I < IV < III
(C) II < IV < I < III
(D) IV < II < I < III

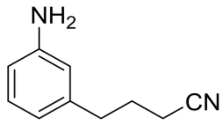
67. The compound formed upon fusing an aliphatic amine with sodium metal in Lassaigne's test is

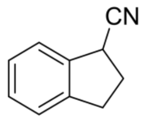
(A) $NaNH_2$
(B) $NaNO_2$
(C) NaCN
(D) NaN_3

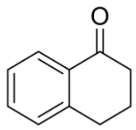
68. The major product formed in the following reaction is



(A) 

(B) 

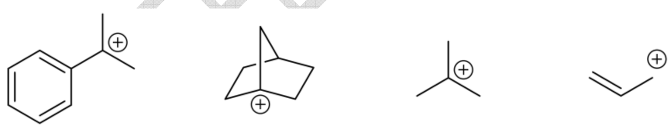
(C) 

(D) 

69. "All Altruists Gladly Make Gum in Gallon Tanks". The C-2 epimer of D-glucose is

(A) D-Mannose
(B) D-Altrose
(C) D-Galactose
(D) L-Glucose

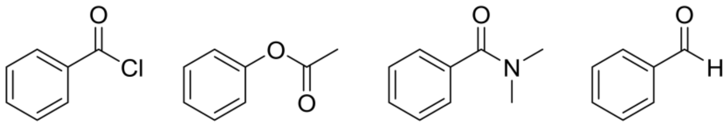
70. The **CORRECT** order of stability for the following carbocations is



I II III IV

(A) I < III < IV < II
(B) III < II < IV < I
(C) II < IV < III < I
(D) IV < III < I < II

71. The **CORRECT** order of carbonyl stretching frequencies for the following compounds is



I II III IV

(A) II < I < III < IV
(B) I < III < II < IV
(C) IV < II < III < I
(D) III < IV < II < I

72. The **CORRECT** statement about carbene is

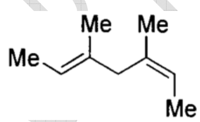
(A) Singlet carbenes are negatively charged while triplet carbenes are positively charged
(B) Carbene is an intermediate in Curtius rearrangement
(C) Carbene can insert into both σ and π-bonds
(D) Carbene is generated from amines on reaction with chloroform and acid

73. In the following sequence of reactions, the overall (%) yield of **O** is

$$\mathrm{L} \xrightarrow{92\%\ \text{yield}} \mathrm{M} \xrightarrow{78\%\ \text{yield}} \mathrm{N} \xrightarrow{85\%\ \text{yield}} \mathrm{O}$$

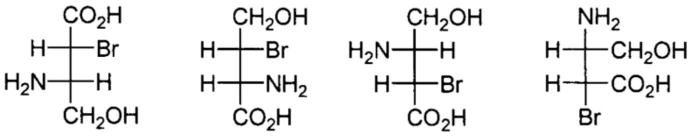
(A) 61
(B) 85
(C) 74
(D) 68

74. Catalytic hydrogenation of the following compound produces saturated hydrocarbons(s). The number of stereoisomer(s) formed is/are



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

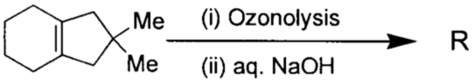
75. Among the following compounds, the pair of enantiomers is

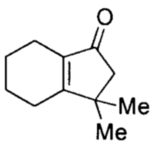


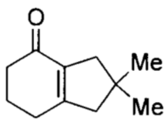
I II III IV

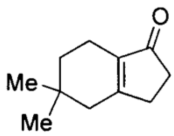
(A) I and IV
(B) I and III
(C) II and III
(D) III and IV

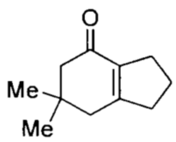
76. The product **R** in the following reaction is



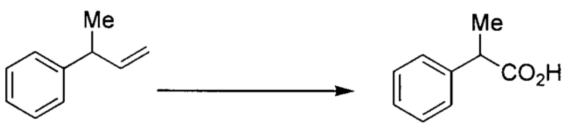
(A) 

(B) 

(C) 

(D) 

77. The following conversion is carried out using

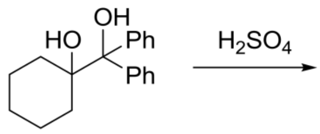


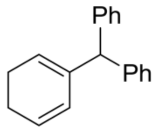
(A) hydroboration-oxidation followed by Jones oxidation
(B) Wacker oxidation followed by haloform reaction
(C) oxymercuration-demercuration followed by Jones oxidation
(D) ozonolysis followed by haloform reaction

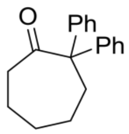
78. The most basic amino acid among the following is

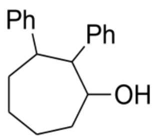
(A) tyrosine
(B) methionine
(C) arginine
(D) glutamine

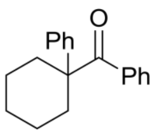
79. The major product formed in the following reaction is



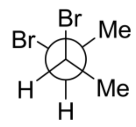
(A) 

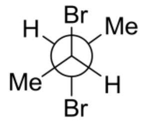
(B) 

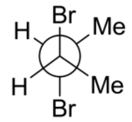
(C) 

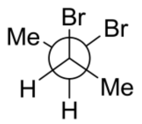
(D) 

80. Among the following, the most stable conformation of *meso*-2,3-dibromobutane is

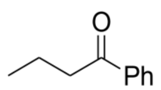
(A) 

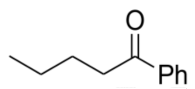
(B) 

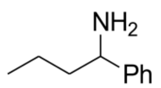
(C) 

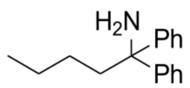
(D) 

81. The major product formed in the reaction of butyronitrile ($CH_3CH_2CH_2CN$) with phenylmagnesium bromide followed by acidification is

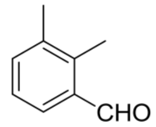
(A) 

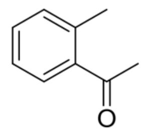
(B) 

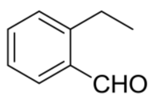
(C) 

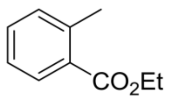
(D) 

82. An organic compound on reaction with 2,4-dinitrophenylhydrazine (2,4-DNP) gives a yellow precipitate. It also gives silver mirror on reaction with ammoniacal $AgNO_3$. It gives an alcohol and sodium salt of a carboxylic acid on reaction with concentrated NaOH. It yields benzene-1,2-dicarboxylic acid on heating with alkaline $KMnO_4$. The structure of the compound among the following is

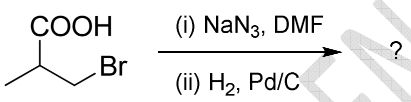
(A) 

(B) 

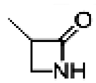
(C) 

(D) 

83. The major product formed in the following reaction is



(A) 

(B) 

(C) 

(D) 

84. An organic compound **P** (C_4H_8O) is positive to Bayer's test, but inert to sodium metal. On treatment with conc. HCl, **P** gives CH_3CH_2Cl and CH_3CHO. The structure of **P** is

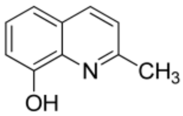
(A) 

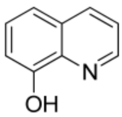
(B) 

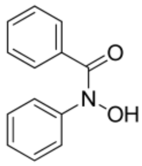
(C) 

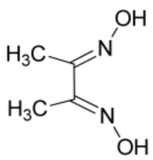
(D) 

85. Aluminium complex of oxine is a common component in Organic Light Emitting Diodes (OLEDs). Structure of oxine is

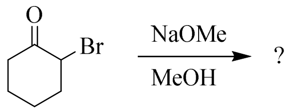
(A) 

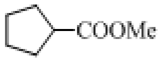
(B) 

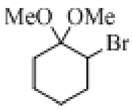
(C) 

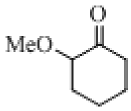
(D) 

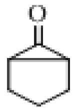
86. The major product isolated from the following reaction is



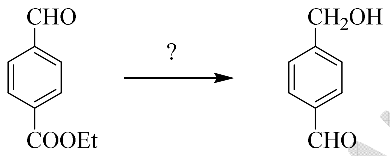
(A) 

(B) 

(C) 

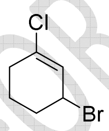
(D) 

87. Identify the correct reagents and reaction sequence required for the following transformation



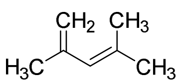
(A) (i) $NaBH_4$; (ii) H_3O^+
(B) (i) $LiAlH_4$; (ii) H_3O^+
(C) (i) $HOCH_2CH_2OH$, H^+; (ii) $LiAlH_4$; (iii) H_3O^+
(D) (i) $HSCH_2CH_2SH$, H^+; (ii) $LiAlH_4$; (iii) H_3O^+

88. What is the IUPAC name for the compound shown below?



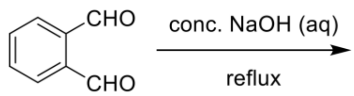
(A) 1-Bromo-3-chlorocyclohexene
(B) 2-Bromo-6-chlorocyclohex-1-ene
(C) 6-Bromo-2-chlorocyclohexene
(D) 3-Bromo-1-chlorocyclohex-1-ene

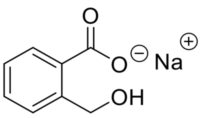
89. Calculate the λ_{max} for the following diene in hexane solution.

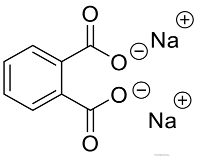


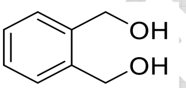
(A) 273
(B) 259
(C) 232
(D) 217

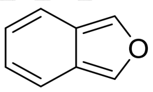
90. The major product formed in the following reaction is



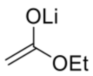
(A) 

(B) 

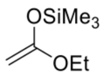
(C) 

(D) 

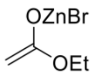
91. The reactivity of the enol derivatives towards benzaldehyde follows the order



I



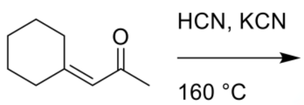
II

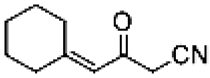


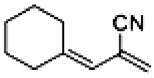
III

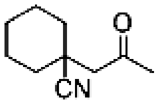
(A) I > II > III
(B) III > II > I
(C) II > I > III
(D) I > III > II

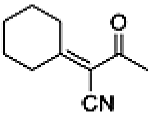
92. The major product formed in the following reaction is



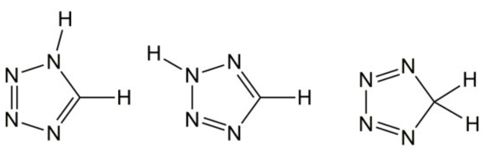
(A) 

(B) 

(C) 

(D) 

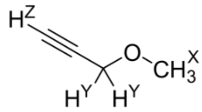
93. The correct statement for the following structures is



1 2 3

(A) **1**, **2** and **3** are resonance structures
(B) **1** and **2** are resonance structures, whereas **3** is an isomer of **1** and **2**
(C) **1** and **3** are resonance structures, whereas **2** is an isomer of **1** and **3**
(D) **1**, **2** and **3** are constitutional isomers

94. In ^{1}H NMR spectrum of the given molecule, the correct order of chemical shifts (δ) of the labelled protons (H^X, H^Y, H^Z) is

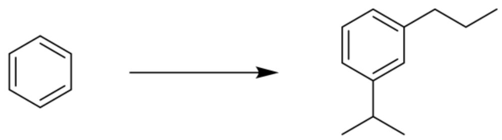


(A) $H^Z > H^X > H^Y$
(B) $H^Z > H^Y > H^X$
(C) $H^X > H^Z > H^Y$
(D) $H^Y > H^X > H^Z$

95. Copper phthalocyanine is prepared by

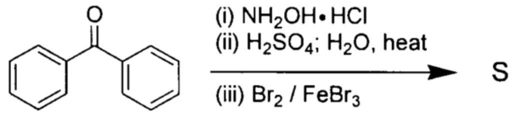
(A) heating phthalaldehyde with CuCN at 100°C
(B) heating phthalic anhydrade with acetonitrile in the presence of anhydrous $CuSO_4$
(C) heating benzonitrile with CuCl at 220-250°C
(D) reaction between a mixture of benzaldehyde and pyrrole in reflexing propionic acid in the presence of $Cu(CN)_2$

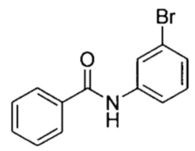
96. The sequence of three steps involved in the following conversion is (respectively)

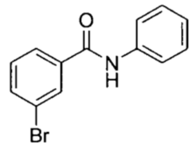


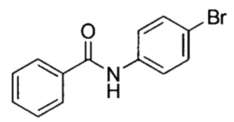
(A) (i) Friedel-Crafts alkylation; (ii) Reduction; (iii) Friedel-Crafts acylation
(B) (i) Friedel-Crafts acylation; (ii) Friedel-Crafts alkylation; (iii) Reduction
(C) (i) Friedel-Crafts acylation; (ii) Reduction; (iii) Friedel-Crafts alkylation
(D) (i) Friedel-Crafts alkylation; (ii) Friedel-Crafts acylation; (iii) Reduction

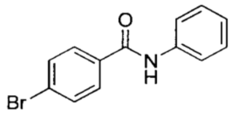
97. The major product **S** of the following reaction is



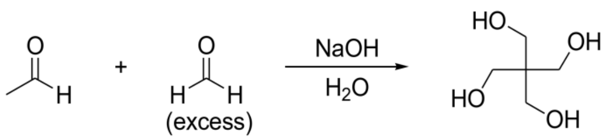
(A) 

(B) 

(C) 

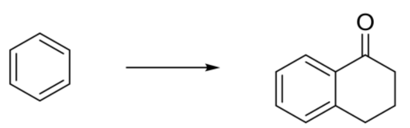
(D) 

98. The mechanism of the following transformation involves


+ Sodium formate

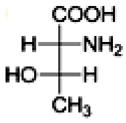
(A) Aldol reaction and Cannizzaro reaction
(B) Aldol reaction and Claisen-Schmidt reaction
(C) Knoevenagel condensation and Cannizzaro reaction
(D) Stobbe condensation and Cannizzaro reaction

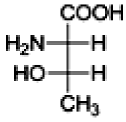
99. The appropriate reagents required for carrying out the following transformation are

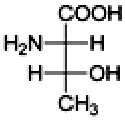


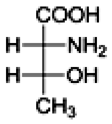
(A) (i) succinic anhydride, $AlCl_3$; (ii) Zn/Hg, HCl; (iii) polyphosphoric acid
(B) (i) maleic anhydride, $AlCl_3$; (ii) $H_2N\text{-}NH_2$, KOH; (iii) H_2SO_4
(C) (i) succinic anhydride, $FeCl_3$; (ii) $LiAlH_4$; (iii) H_2SO_4
(D) (i) phthalic anhydride, $F_3B{\cdot}OEt_2$; (ii) $HS(CH_2)_2SH$, H^+; (iii) Raney Ni; (iv) polyphosphoric acid

100. The structure of (2*S*,3*R*)-2-amino-3-hydroxybutanoic acid is

(A) 

(B) 

(C) 

(D) 

101. The CFSE of tetrahedral $[CoCl_4]^{2-}$ is 8000 cm^{-1}. The CFSE (in cm^{-1}) for octahedral $[CoCl_6]^{4-}$ will be

(A) 16000
(B) 18000
(C) 20000
(D) 12000

102. The complexes of $[Co(NH_3)_6]$ $[Cr(CN)_6]$ and $[Co(NH_3)_6]$ $[Cr(CN)_6]$ are an example of

(A) linkage isomerism
(B) optical isomerism
(C) polymerisation isomerism
(D) coordination isomerism

103. In a square planar complex with ligands on *x* and *y* axes, the highest energy metal d-orbital is

(A) d_{yz}
(B) $d_{x^2-y^2}$
(C) d_{xy}
(D) d_{z^2}

104. What is the shape of XeF_6 as per the VSEPR theory?

(A) Square pyramid
(B) Pentagonal planar
(C) Pentagonal bipyramid
(D) Square planar

105. Which of the following reagent is used in the extraction of aluminum from bauxite (Bayer's process)?

(A) NaCl
(B) Na_2CO_3
(C) Na_2SO_4
(D) NaOH

106. Producer gas is a mixture of

(A) $CO_2 + H_2$
(B) $CO_2 + N_2$
(C) $CO + H_2 + N_2$
(D) $CO + N_2$

107. The bond angle of NO_2^+, NO_2 and NO_2^- are respectively

(A) 115°, 180°, 134°
(B) 180°, 134°, 115°
(C) 134°, 115°, 180°
(D) 115°, 134°, 180°

108. Which of the following metal carbonyl will not obey the effective atomic number (EAN) rule?

(A) $Re_2(CO)_{10}$
(B) $W(CO)_6$
(C) $V(CO)_6$
(D) $Cr(CO)_6$

109. CN^- is

(A) Soft acid
(B) Hard acid
(C) Hard base
(D) Soft base

110. Vitamin B_{12} is the coordination compound of

(A) Mg
(B) Co
(C) Fe
(D) Zn

111. The noble gas having ionization potential close to that of oxygen is

(A) Neon
(B) Argon
(C) Xenon
(D) Krypton

112. In the species O_2, O_2^+, O_2^-, O_2^{2-} the correct decreasing order of bond strength is

(A) $O_2 > O_2^+ > O_2^- > O_2^{2-}$
(B) $O_2^+ > O_2 > O_2^- > O_2^{2-}$
(C) $O_2^{2-} > O_2^- > O_2^+ > O_2$
(D) $O_2^- > O_2^{2-} > O_2 > O_2^+$

113. Zn, Cd, Hg have lower melting points than other d-block elements because of

(A) absence of metallic bonds
(B) presence of strong metallic bonds
(C) presence of completely filled shell
(D) they are not transition elements

114. The IUPAC name of Wilkinson's catalyst is

(A) Bromotris(triphenylphosphine)rhodium(I)
(B) Chlorotris(triphenylphosphine)rhodium(I)
(C) Chlorotris(triphenylphosphine)palladium(I)
(D) Bromotris(triphenylphosphine)palladium(I)

115. Which among the following is Ziegler-Natta catalyst?

(A) RMgX
(B) RLi
(C) $AlR_3 + TiCl_4$
(D) R_2Zn

116. Due to lanthanide contraction following pair(s) may have approximately equal in size

(A) Zr and Hf
(B) Nb and Ta
(C) Mo and W
(D) All of the above

117. A brown coloured ring is formed, when ferrous sulphate is added to a solution containing nitrate. The colour is due to the formation of

(A) $[Fe(H_2O)_5(NO)_2]^{2+}$
(B) $[Fe(H_2O)_4(NO)_2]^{2+}$
(C) $[Fe(H_2O)_5NO]^{2+}$
(D) $[Fe(H_2O)_4NO]^{2+}$

118. Spin-only magnetic moment of Cu^+ ion is

(A) 3.88 BM
(B) 2.83 BM
(C) 1.41 BM
(D) 0 BM

119. Ferric alum gives red color with NH_4SCN due to formation of

(A) $Al(SCN)_3$
(B) $[Fe(SCN)]^{2+}$
(C) $Fe(SCN)_3$
(D) $[Fe(SCN)_3]^-$

120. Tetraethyllead in petrol act as

(A) Knocking agent
(B) Reducing agent
(C) Anti knocking agent
(D) Oxidising agent

121. Number of atoms in 20 g Ca is equal to number of atoms in

(A) 20 g Mg
(B) 1.7 g NH_3
(C) 1.8 g H_2O
(D) 1.6 g CH_4

122. Which of the following is an insulator?

(A) Magnesium
(B) Silicon
(C) Diamond
(D) Aluminium

123. What among the following are intracellular and extracellular ions respectively?

(A) Na^+, Cl^-
(B) Na^+, Ca^{2+}
(C) Cl^-, K^+
(D) K^+, Na^+

124. Hypophosphorous acid contains

(A) one hydrogen attached to P
(B) two hydrogens attached to P
(C) three hydrogens attached to P
(D) no hydrogen attached to P

125. Which of the following statements are correct?

(A) The hybridization in diamond and graphite is sp^3
(B) The hybridization in diamond is sp^2, graphite is sp^3
(C) The hybridization in diamond is sp^3, graphite is sp
(D) The hybridization in diamond is sp^3, graphite is sp^2

126. Which of the following has zero dipole moment?

(A) CO
(B) SO_2
(C) SO_3
(D) H_2O

127. Temporary hardness of water is due to the presence of

(A) HCO_3^- of Ca^{2+}, Mg^{2+} and Na^+
(B) SO_4^{2-} and Cl^- of Na^+ and K^+
(C) SO_4^{2-} and Cl^- of Ca^{2+} and Mg^{2+}
(D) HCO_3^- of Ca^{2+} and Mg^{2+}

128. The type of structure associated with $[C_2B_9H_{11}]^{2-}$ is

(A) Closo
(B) Arachno
(C) Nido
(D) None of the above

129. Arrange the following element according to electron affinity value.

O, S, Se, Te

(A) O > S > Se > Te
(B) O > Se > S > Te
(C) O > S > Se > Te
(D) S > Se > Te > O

130. Which one of the following molecules will form a linear polymeric structure due to hydrogen bonding?

(A) NH_3
(B) H_2O
(C) HCl
(D) HF

131. Which of the following is paramagnetic?

(A) NO^-
(B) NO^+
(C) CN^-
(D) O_2^-

132. In an octahedral structure, the pair of d orbitals involved in d^2sp^3 hybridization is

(A) $d_{x^2-y^2}, d_{z^2}$
(B) $d_{xz}, d_{x^2-y^2}$
(C) d_{z^2}, d_{xz}
(D) d_{xy}, d_{yz}

133. Crystal field stabilization energy for high spin d^4 octahedral complex is

(A) $-1.6\Delta_O+P$
(B) $-0.6\Delta_O$
(C) $-1.2\ \Delta_O$
(D) $-1.8\ \Delta_O$

134. Identify the function of hemocyanin and the metal responsible for the function

(A) O_2 transport and Fe
(B) O_2 transport and Cu
(C) Electron transport and Fe
(D) Electron transport and Cu

135. Which of the following carbonyls will have the strongest C−O bond?

(A) $[Mn(CO)_6]^+$
(B) $[Cr(CO)_6]$
(C) $[V(CO)_6]^-$
(D) $[Fe(CO)_5]$

136. Which of the following oxides will be the least acidic?

(A) As_4O_6
(B) As_4O_{10}
(C) P_4O_{10}
(D) P_4O_6

137. Glass reacts with HF to produce

(A) SiF_4
(B) H_2SiF_6
(C) H_2SiO_3
(D) Na_3AlF_6

138. The tendency of BF_3, BCl_3, and BBr_3 to behave as Lewis acid decreases in the following order:

(A) $BCl_3 > BF_3 > BBr_3$
(B) $BBr_3 > BCl_3 > BF_3$
(C) $BBr_3 > BF_3 > BCl_3$
(D) $BF_3 > BCl_3 > BBr_3$

139. On doping Ge metal with a little of In or Ga, it forms a/an

(A) p-type semiconductor
(B) n-type semi-conductor
(C) insulator
(D) rectifier

140. The number of geometrical isomers for $[Pt(NH_3)_2Cl_2]$ is

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

141. In neutron activation analysis the radiation commonly detected is

(A) α- rays
(B) β- rays
(C) γ- rays
(D) X-rays

142. Function of myoglobin is

(A) O_2 transport
(B) O_2 storage
(C) Electron carriers
(D) Iron storage

143. What is the denticity of acetylacetonato(acac) ligand ?

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

144. The mineral of iron is

(A) Malachite
(B) Cassiterite
(C) Magnetite
(D) Pyrolusite

145. Triclinic crystal system is defined by

(A) $a \neq b \neq c, \alpha = \beta = \gamma = 90°$

(B) $a = b = c$, $\alpha = \beta = \gamma = 90^\circ$
(C) $a = b = c$, $\alpha \neq \beta \neq \gamma \neq 90^o$
(D) $a \neq b \neq c$, $\alpha \neq \beta \neq \gamma \neq 90^o$

146. The metal ions involved in nitrogenase are

(A) Fe and Zn
(B) Mo and Fe
(C) Mn and Mg
(D) Mg and Fe

147. Number of radial nodes for 5d orbitals are

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

148. The angular nodal surfaces for a $3d_{xy}$ orbital are

(A) *YZ* and *XZ* planes
(B) *YZ* plane
(C) *XZ* and *XY* planes
(D) *XY* plane

149. Number of angular nodes for d and f orbitals are

(A) 2 and 3
(B) 1 and 2
(C) 0 and 1
(D) None of the above

150. The type of hybridization and shape of the molecule in ClF_3 are respectively

(A) sp^3, pyramidal
(B) sp^2,trigonal planer
(C) dsp^3, trigonal bipyramidal
(D) sp^3d, T- shaped

FINAL ANSWER KEY

Subject Name: CHEMISTRY

SI No.	Key	SI No.	Key	SI No.	Key	SI No.	Key	SI No.	Key
1	D	31	B	61	B	91	D	121	D
2	A	32	A	62	C	92	C	122	C
3	B	33	C	63	B	93	D	123	D
4	C	34	A	64	C	94	D	124	B
5	D	35	B	65	D	95	C	125	D
6	A	36	C	66	C	96	B	126	C
7	C	37	D	67	C	97	C	127	D
8	D	38	B	68	C	98	A	128	C
9	B	39	A	69	A	99	A	129	D
10	D	40	B	70	C	100	C	130	D
11	B	41	B	71	D	101	B	131	D
12	C	42	C	72	C	102	D	132	A
13	D	43	B	73	A	103	B	133	B
14	D	44	A	74	C	104	C	134	B
15	A	45	A	75	B	105	D	135	A
16	A	46	B	76	D	106	C	136	A
17	D	47	D	77	B	107	B	137	B
18	A	48	A	78	C	108	C	138	B
19	C	49	A	79	B	109	D	139	A
20	B	50	C	80	B	110	B	140	A
21	A	51	A	81	A	111	C	141	B
22	D	52	C	82	C	112	B	142	B
23	C	53	B	83	A	113	C	143	C
24	C	54	D	84	B	114	B	144	C
25	D	55	B	85	B	115	C	145	D
26	D	56	D	86	A	116	D	146	B
27	B	57	B	87	C	117	C	147	A
28	B	58	A	88	D	118	D	148	A
29	D	59	C	89	C	119	B	149	A
30	A	60	B	90	A	120	C	150	D