NET/GATE Exam's Previous Year Questions

1. For an aqueous solution at 25°C, the Debye-Huckel limiting law is given by: **[NET June 2011]**

   (a) $\log \gamma_{\pm} = 0.509\ |Z_+Z_-|\sqrt{\mu}$ (b) $\log \gamma_{\pm} = 0.509\ |Z_+Z_-|\mu$

   (c) $\log \gamma_{\pm} = -0.509\ |Z_+Z_-|\sqrt{\mu}$ (d) $\log \gamma_{\pm} = 0.509\ |Z_+Z_-|\mu^2$

2. Given, $Ag^+ + e \rightarrow Ag$, $E_0 = 0.50V$; $Cu^{2+} + 2e \rightarrow Cu$, $E_0 = 0.34$ V **[NET June 2011]**
   A 100 ml solution is 1080 mg with respect to Ag^+ and 635 mg with respect to Cu^{2+}. If 0.1 mg Ag^+ left in the solution is considered to be the complete deposition of Ag^+, the cathode potential, ss that no copper is deposited during the process, is:

   (a) 0.16 V (b) 0.84 V (c) 0.31 V (d) –0.16 V

3. Debey-Huckel screening length is $\left(\kappa^{-1}\right)$ is a measure of size of diffuse ion could around an ion, provided at $\sqrt{\frac{2e^2 N_A}{\in_0 k_B T}} \approx 30\left(nm\sqrt{mol\ K_{g^{-1}}}\right)^{-1}$ at 298K, which of the following values of κ^{-1} is true for a 0.03 molal solution for Na_2SO_4 in water $(\in_r \approx 100)$? **[NET June 2011]**

   (a) $\frac{10}{9}nm$ (b) $\frac{9}{10}nm$ (c) $\frac{10\sqrt{2}}{9}$ nm (d) $\frac{9}{10\sqrt{2}}$ nm

4. If the ratio of composition of oxidized and reduced species in electrochemical cell, is given as $\frac{[O]}{[R]} = e^2$, the correct potential difference will be **[NET June 2011]**

   (a) $E - E^0 = +\frac{2RT}{nF}$ (b) $E - E^0 = -\frac{2RT}{nF}$

   (c) $E - E^0 = \frac{RT}{nF}$ (d) $E - E^0 = -\frac{RT}{nF}$

5. For a potentiometric, in the curve of emf (E) vs volume (V) of the titrant added the equivalence point is indicated by **[NET Dec. 2011]**

   (a) $|dE/dV| = 0, |d^2E/dV^2| = 0$ (b) $|dE/dV| = 0, |d^2E/dV^2| > 0$

   (c) $|dE/dV| > 0, |d^2E/dV^2| = 0$ (d) $|dE/dV| > 0, |d^2E/dV^2| > 0$

6. The overall reaction for the passage of 1.0 faraday of charge in the following cell Ag(s)–AgCl(s) | $KCl(a_1)$ | $KCl(a_2)$ | AgCl(s) – Ag(s) is given by (t denotes transport numbers) **[NET Dec. 2011]**

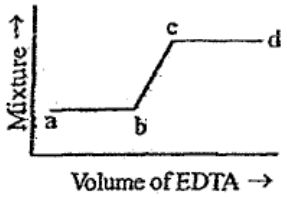
   (a) t_+ $KCl(a_1) \rightarrow t_+$ KCl (a_2) (b) t_+ $KCl(a_2) \rightarrow t_+$ KCl (a_1)

   (c) t_- $KCl(a_1) \rightarrow t_-$ KCl (a_2) (d) t_- $KCl(a_2) \rightarrow t_-$ KCl (a_1)

7. The molar conductivities at infinite dilution $\wedge_m^0$ for Na_2SO_4, K_2SO_4, KCl, HCl and HCOONa at 300K are 260, 308, 150, 426 and 105 Scm^2mol^{-1} respectively. Hence $\wedge_m^0$ for formic acid in the same unit and at the same temperature is **[NET Dec. 2011]**

   (a) 381 (b) 405 (c) 429 (d) 531

8. The spectrophotometric response for the titration of a mixture of Fe^{3+} and Cu^{2+} ions against EDTA is given below : **[NET June 2012]**



The correct statement is

(a) Volume ab ≡ $[Fe^{3+}]$ and volume cd ≡ $[Cu^{2+}]$

(b) Volume ab ≡ $[Cu^{2+}]$ and volume cd ≡ $[Fe^{3+}]$

(c) Volume ab ≡ $[Fe^{3+}]$ and volume cd ≡ excess EDTA

(d) Volume ab ≡ $[Cu^{2+}]$ and volume cd ≡ excess EDTA

9. Main assumption(s) involved in the derivation of Debye-Huckel equation is (are) the validity of **[NET June 2012]**

(a) Only poission equation

(b) Poission equation and Boltzmann distribution

(c) Poission equation, Boltzmann distribution and $|\pm Ze\phi >> k_BT$

(d) Poission equation Boltzmann distribution and $| |\pm Ze\phi| << k_BT$

10. For the deposition of Pb by electroplating, the best suited compound among the following is **[NET Dec. 2012]**

(a) $PbCl_2$ (b) $PbSO_4$

(c) $Pb(Et)_4$ (d) $Pb(BF_4)_2$

11. The Daniel cell is **[NET Dec. 2012]**

(a) Pt_I (s)|Zn(s)| Zn^{2+} (aq) || Cu^{2+}(aq)| Cu(s) | Pt_{II} (s)

(b) Pt_I (s)|Zn(s)| Zn^{2+} (aq) || Ag^{+} (aq) | Ag(s)| Pt_{II} (s)

(c) Pt_I (s)|Fe(s)| Fe^{2+} (aq) || Cu^{2+}(aq)| Cu(s) | |Pt_{II} (s)

(d) Pt_I (s)|H_2(s)| H_2SO_4 (aq) || Cu^{2+}(aq)| Cu(s) | Pt_{II} (s)

12. Kohlrausch's law is applicable to a dilute solution of **[NET Dec. 2012]**

(a) Potassium chloride in hexane (b) Acetic acid in water

(c) Hydrochloric acid in water (d) Benzoic acid in benzene

13. A solution of 2.0 g of brass was analysed for Cu electro gravimetrically using Pt gauze as electrode. The weight of Pt-gauze changed from 14.5g to 16.0g. The percentage weight of Cu in brass is

(a) 50 (b) 55 (c) 60 (d) 75 **[NET Dec. 2012]**

14. The potential in Debye-Huckel theory is proportional to **[NET Dec. 2012]**

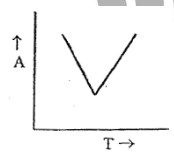
(a) $1/\kappa r$ (b) $\exp[-\kappa r]$

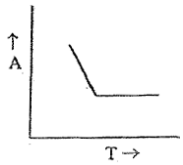
(c) $\exp[-\kappa r]/r$ (d) κr

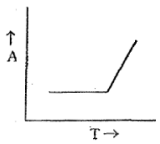
15. In complexometric titration

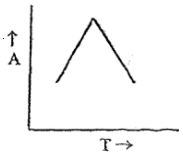
S(substrate) + T(titrant) → P (product) **[NET June 2013]**

The end point is estimated spectrophotometrically. If S and P have ε = 0, the shape of the titration curve would look like

(a) 

(b) 

(c) 

(d) 

16. Identify, from the following, the correct ionic strengths for (A) 0.01 molal solution of NaCl and (B) at 0.01 molal solution of Na_2SO_4. **[NET June 2013]**

(a) (A) 0.010 mol kg^{-1} (B) 0.010 mol kg^{-1} (b) (A) 0.010 mol kg^{-1} (B) 0.030 mol kg^{-1}

(c) (A) 0.010 mol kg^{-1} (B) 0.025 mol kg^{-1} (d) (A) 0.010 mol kg^{-1} (B) 0.015 mol kg^{-1}

17. Consider the cell:

Zn | Zn^{2+} (a = 0.01) || Fe^{2+} (a = 0.001), Fe^{3+} (a = 0.01) | Pt **[NET Dec. 2013]**

E_{cell} = 1.71 V at 25°C for the above cell. The equilibrium constant for the reaction:

$Zn + 2Fe^{3+} \rightleftharpoons Zn^{2+} + 2Fe^{2+}$ at 25°C is close to,

(a) 10^{27} (b) 10^{54} (c) 10^{81} (d) 10^{40}

18. The limiting molar conductivities of NaCl, NaI and RbI are 12.7, 10.8 and 9.1 mS m^2mol^{-1}, respectively. The limiting molar conductivity of RbCl would be: **[NET Dec. 2013]**

(a) 32.6 mS m^2 mol^{-1} (b) 7.2 mS m^2 mol^{-1}

(c) 14.4 mS $m^2 mol^{-1}$ (d) 11.0 mS $m^2 mol^{-1}$

19. In polarographic estimation, the limiting currents (μA) were 0.15, 4.65, 9.15 and 27.15 when concentration (mM) of Pb(II) were 0, 0.5, 1.0 and 3.0 respectively. An unknown solution of Pb(II) gives a limiting current of 13.65 μA. Concentration of Pb(II) in the unknown is, **[NET June 2014]**
(a) 1.355 mM (b) 1.408 mM
(c) 1.468 mM (d) 1.500 mM

20. Given; **[NET June 2014]**
A. $Fe(OH)_2(s) + 2e^- \rightarrow Fe(s) + 2OH^-(aq)$; $E° = -0.877V$
B. $Al^{3+}(aq) + 3e^- \rightarrow Al(s)$; $E^0 = -1.66V$
C. $AgBr(aq)\ e^- \rightarrow Ag(s) + Br^-(aq)$; $E^0 = 0.071V$
The overall reaction for the cells in the direction of spontaneous change would be
(a) Cell with A and B : Fe reduced
Cell with A and C : Fe reduced
(b) Cell with A and B : Fe reduced
Cell with A and C : Fe oxidized
(c) Cell with A and B : Fe oxidized
Cell with A and C : Fe oxidized
(d) Cell with A and B : Fe oxidized
Cell with A and C : Fe reduced

21. Solutions of three electrolytes have the same ionic strength and different dielectric constants as 4, 25 and 81. The corresponding elative magnitude of Debye Huckel screening, lengths of the three solutions are
(a) 4, 25 and 81 (b) 2,5 and 9 **[NET June 2014]**
(c) 1/2, 1/5 and 1/9 (d) 1,1 and 1

22. Dominant contribution to the escaping tendency of a charged particle with uniform concentration in a phase, depends on **[NET June 2015]**
(a) chemical potential of the phase (b) electric potential of the phase
(c) thermal energy of the phase (d) gravitational potential of that phase

23. The temperature dependence of an electrochemical cell potential is, **[NET June 2015]**
(a) $\frac{\Delta G}{nFT}$ (b) $\frac{\Delta H}{nF}$ (c) $\frac{\Delta S}{nF}$ (d) $\frac{\Delta S}{nFT}$

24. Conductometric titration of a strong acid with a strong alkali (MOH) shows linear fall of conductance up to neutralization point because of **[NET June 2015]**
(a) Formation of water
(b) increase in alkali concentration
(c) Faster moving H being replaced by slower moving M^+
(d) Neutralization of acid

25. Differential pulse polarography (DPP) is more sensitive than D.C. polarography (DCP). Consider following reasons for it, **[NET June 2015]**
(A) non-faradic current is less in DPP in comparison to DCP
(B) non-faradic current is more in DPP in comparison to DCP
(C) polarogram of DPP is of different shape than that of DCP
Correct reaction(s) is/are
(a) A and C (b) B and C (c) B only (d) A only

26. The concentration of a $MgSO_4$ solution having the same ionic strength as that of a 01 M Na_2SO_4 solution is **[NET Dec. 2015]**
(a) 0.05 M (b) 0.067 M (c) 0.075 M (d) 0.133 M

27. Given that E^0 (Cl_2/Cl^-) = 1.35 V and K_{sp} (AgCl) = 10^{-10} at 25°C, E^0 corresponding to the electrode reaction $\frac{1}{2}Cl_2(g) + Ag^+(\text{soln.}) + e^- \rightarrow AgCl(s)$ is **[NET Dec. 2015]**

$\left[\frac{2.303RT}{F} = 0.06V\right]$

(a) 0.75 V (b) 1.05 V (c) 1.65 V (d) 1.95 V

28. The standard EMF of the cell, Pt, $H_2(g)$ | HCl (soln). | AgCl(s), Ag(s) **[NET Dec. 2015]**

(a) Increases with T (b) decreases with T

(c) Remains unchanged with T (d) decreases with [HCl]

29. The standard electrode potential E^0 at a fixed temperature and in a given medium is dependent on

(a) Only the electrode composition **[NET June 2016]**

(b) The electrode composition and the extent of the reaction

(c) The extent of the electrode reaction only

(d) The electrode reaction and the electrode composition

30. Two aqueous 1:1 electrolyte systems A and B are at different temperature T_A and T_B and C_A and C_B concentrations, respectively. Their Debye lengths will be equal if, **[NET June 2016]**

(a) $T_A = 2T_B$ and $C_A = 2C_B$ (b) $T_A = 2T_B$ and $C_A = C_B / 2$

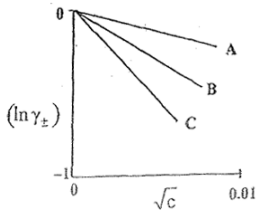
(c) $T_A = \sqrt{2}T_B$ and $C_A = 2C_B$ (d) $T_A = 2T_B$ and $C_A = \sqrt{2}C_B$

31. In a potentiometric titration, the end point is characterized by **[NET June 2016]**

(a) $\frac{dE}{dV} = 0, \frac{d^2E}{dV^2} = 0$ (b) $\frac{dE}{dV} \neq 0, \frac{d^2E}{dV^2} = 0$

(c) $\frac{dE}{dV} = 0, \frac{d^2E}{dV^2} \neq 0$ (d) $\frac{dE}{dV} \neq 0, \frac{d^2E}{dV^2} \neq 0$

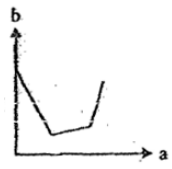
32. Aqueous solutions of NaCl, $CaCl_2$ and $LaCl_3$ show the following plots of logarithms of mean ionic activity coefficient ($\ln \gamma_\pm$) vs root of molar concentration (c) **[NET June 2016]**

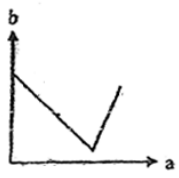


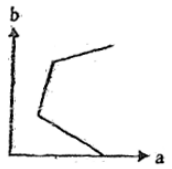
The correct option is then

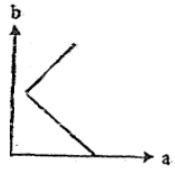
	NaCl	$CaCl_2$	$LaCl_3$
(a)	C	B	A
(b)	A	B	C
(c)	A	C	B
(d)	C	A	B

33. On titrating conductometrically a NaOH solution with a mixture of HCl and CH_3CO_2H solutions, plot of the volume of mixed acid added (b) in y-axis against the conductance (a) in x-axis is expected to look like **[NET June 2016]**

(a) 

(b) 

(c) 

(d) 

34. If the specific conductances of a sparingly soluble (1:1) salt (MW = 200 g mol^{-1}) in its saturated aqueous solution at 25°C and that of water are 1.5×10^{-3} ohm^{-1} dm^{-1}, respectively, and the ionic conductances for its cation and anion at infinite dilution are 0.485 and 1.0 ohm^{-1} dm^2 mol^{-1}, respectively, the solubility (in g L^{-1}) of the salt in water at 25°C is **[NET Dec. 2016]**

(a) 1×10^{-6} (b) 1×10^{-3} (c) 2×10^{-1} (d) 2×10^{-4}

35. Given, (i) $Zn + 4NH_3 \rightarrow Zn(NH_3)_4^{2+} + 2e$, $E^0 = 1.03$ V

(ii) $Zn \rightarrow Zn^{2+} + 2e$, $E^0 = 0.763$ V

The formation constant of the complex $Zn(NH_3)_4^{2+}$ is approximately, **[NET Dec. 2016]**

$\left(\frac{2.303RT}{F} = 0.0591\right)$

(a) 1×10^{5} (b) 1×10^{7} (c) 1×10^{9} (d) 1×10^{12}

36. The correct statement for d.c polarography is **[NET Dec. 2016]**

(a) $E_{1/2}$ is concentration dependent

(b) Dropping mercury electrode is macro electrode

(c) Limiting current is equal to diffusion current

(d) A large excess of supporting electrolyte eliminates migration current

37. For the reaction, $Hg_2Cl_2(s) + H_2(g) == 2Hg(\ell) + 2HCl(aq)$, the correct representation of the cell and the thermodynamic properties ΔG, ΔH and ΔS at 298 K respectively, are (given : E_{298} = 0.2684 V and temperature coefficient = -3×10^{-4} VK^{-1}) **[GATE 2003]**

(a) $Pt|H_2(g, 1atm)|HCl(aq)|Hg_2Cl_2(s)|Hg(\ell)|$
$\Delta G = -51.8$ kJ mol^{-1}, $\Delta H = -69$ kJ mol^{-1}, $\Delta S = -58 JK^{-1}$ mol^{-1}

(b) $Pt|H_2(g, 1atm)|HCl(aq)|Hg_2Cl_2(s)|Hg(\ell)|$
$\Delta G = -25.9 kJmol^{-1}$, $\Delta H = -34.5$kJ mol^{-1}, $\Delta S = -29JK^{-1}$ mol^{-1}

(c) $Hg(\ell)|Hg_2Cl_2(s)|HCl(aq)|H_2(g, 1 atm)Pt$
$\Delta G = -51.8$ kJ mol^{-1}, $\Delta H = -69$ kJ mol^{-1}, $\Delta S = 58$ JK^{-1} mol^{-1}

(d) $Hg(\ell)|Hg_2Cl_2(s)|HCl(aq)|H_2(g, 1 atm)Pt$
$\Delta G = +51.8 kJmol^{-1}$, $\Delta H = 69$kJ ,mol^{-1}, $\Delta S = 58$ JK^{-1} mol^{-1}

38. From the data of two half-cell reactions:

$AgCl(s) + e^- \rightarrow Ag(s) + Cl^-(aq)$ $E° = +0.22$ V

$Ag^+(aq) + e^- \rightarrow Ag(s)$ $E° = +0.80$ V

The solubility product of AgCl at 298 K, is calculated to be **[GATE 2003]**

(a) 1.5×10^{-10} (b) 2.1×10^{-7} (c) 3.0×10^{-3} (d) 1.2×10^{-5}

39. The solubility product of silver sulphate at 298 K is 1.0×10^{-5}. If the standard reduction potential of the half-cell $Ag^+ + e \rightarrow Ag$ is 0.80 V, the standard reduction potential of the half-cell $Ag_2SO_4 + 2e \rightarrow 2Ag + SO_4^{2-}$ is **[GATE 2004]**

(a) 0.15 V (b) 0.22 V (c) 0.65 V (d) 0.95 V

40. Match the following: **[GATE 2004]**

P. Coulometry	I. Dropping mercury electrode
Q. Ion selective electrode	II. Current efficiency
R. Polarography	III. Dead stop end point
S. Amperometry	IV. Membrane potential
	V. Conductometer
	VI. Actinometer

(a) P-II, Q-IV, R-I, S-III

(b) P-I, Q-II, R-III, S-V

(c) P-VI, Q-V, R-III, S-IV

(d) P-III, Q-IV, R-I, S-VI

41. A substance undergoes a two electron reversible reduction at dropping mercury electrode, and gives a diffusion current of 7.5μA. When the potential at the dropping mercury electrode is –0.615V, the current is 1.5 mA. The $E_{1/2}$ (in volt) will be: **[GATE 2005]**

(a) –0.683 (b) –0.674 (c) –0.652 (d) –0.633

42. In the reversible chemical reaction taking place under standard condition at 298K and 1 atm in a Daniel cell, $Zn\,|\,Zn^{2+}(aq)\,||\,Cu^{2+}(aq)\,|\,Cu$, The heat change is **[GATE 2005]**

(A) Equal to ΔH° (b) equal to TΔS°

(c) equal to zero (d) equal to ΔU°

43. According to the Deby-huckel limiting law, the mean activity coefficient of 5×10^{-4} mol kg^{-1} aqueous solution of $CaCl_2$ at 25°C is (the Debye-Huckel constant 'A' can be taken to be 0.509) **[GATE 2008]**

(a) 0.63 (b) 0.72

(c) 0.80 (d) 0.91

44. For a 1 molal aqueous NaCl solution, the mean ionic activity coefficient ($\gamma_{\pm}$) and the Debye–Hückel Limiting Law constant (A) are related as **[GATE 2011]**

(A) $\log\gamma_{\pm} = \sqrt{2}A$ (B) $\log\gamma_{\pm} = -\sqrt{2}A$

(C) $\gamma_{\pm} = 10^{A}$ (D) $\gamma_{\pm} = 10^{-A}$

45. At 298 K, the EMF of the cell **[GATE 2012]**

Pt $|H_2(1bar)|\ H^+$ (solution) $||\ Cl^-\ |Hg_2Cl_2|Hg$

is 0.7530V. The standard potential of the calomel electrode is 0.2802 V. If the liquid junction potential is zero, the pH of the solution is

(A) 4.7 (B) 7.4 (C) 8.0 (D) 12.7

Statement for Linked Answer Questions 46 and 47

46. For the determination of solubility product (K_{SP}) of $Fe(OH)_3$, the appropriate cell representation and its *emf* are, respectively. **[GATE 2013]**

(A) <Fe | Fe $(OH)_3$ (s) | OH^- (aq) Fe^{3+} (aq) | Fe>, –0.750 V

(B) <Fe | Fe^{3+} (aq) OH^- (aq) | $Fe(OH)_3$ (s) | Fe >, –0.750 V

(C) <Fe | Fe $(OH)_3$ (s) | OH^- (aq) Fe^{3+} (aq) | Fe >, +0.750 V

(D) <Fe | Fe^{3+} (aq) OH^- (aq) | $Fe(OH)_3$ (s) | Fe >, –0.822 V

47. The value of $\log_e$ (K_{SP}) for $Fe(OH)_3$ at 298K is **[GATE 2013]**

(A) –38.2 (B) +87.6 (C) –96.0 (D) –87.6

48. A platinum electrode is immersed in a solution containing 0.1 M Fe^{2+} and 0.1 M Fe^{3+}. Its potential is found to be 0.77V against SHE. Under standard conditions and considering activity coefficients to be equal to unity, the potential of the electrode, when the concentration of Fe^{3+} is increased to 1 M, is_____ **[GATE 2014]**

49. Given the E^0 values for the following reaction sequence **[GATE 2015]**

$$Mn^{6+} \xrightarrow{1.28V} Mn^{5+} \xrightarrow{2.9V} Mn^{4+}$$

$$\xrightarrow{0.96V} Mn^{3+} \xrightarrow{1.5V} Mn^{2+}$$

the compound value of E^0 for $Mn^{6+} \rightarrow Mn^{2+}$ (in volts) is _____

50. The mean ionic activity coefficient of 0.001 molal $ZnSO_4$ (aq) at 298 K according to the Debye-Huckel limiting law is (Debye Huckel constant is 0.509 $molal^{-1}$)_____ **[GATE 2015]**

51. The mobility of a univalent ion in aqueous solution is 6.00 (10^{-2} m^2 s^{-1}) V^{-1} at 300 K. Its diffusion coefficient at 300K is X× 10^{-9} m^2s^{-1}. The value of X is___.(up two decimal places) **[GATE 2017]**

52. The ionic activity coefficients of Ca^{2+} and F^- are 0.72 and 0.28, respectively. The mean activity coefficient of CaF_2 is_____ (up to two decimal places) **[GATE 2017]**

53. The diffusion limiting current (I_d) at a dropping mercury electrode for an aqueous Mg(II) solution of concentration'c'($molL^{-1}$) is_____(up to two decimal places). **[GATE 2017]**

54. The standard Gibbs free energy change of the reaction shown below is –2.7 kJ mol^{-1}
$Sn(s) + Pb^{2+} = Sn^{2+} + Pb(s)$, Given that $E°(Pb^{2+}/Pb)$ is –0.126 V, the value of E^0 (Sn^{2+}/Sn) in V is_____ (up to two decimal places) **[GATE 2017]**

1.		**21.**		**41.**		**61.**		**81.**	
2.		**22.**		**42.**		**62.**		**82.**	
3.		**23.**		**43.**		**63.**		**83.**	
4.		**24.**		**44.**		**64.**		**84.**	
5.		**25.**		**45.**		**65.**		**85.**	
6.		**26.**		**46.**		**66.**		**86.**	
7.		**27.**		**47.**		**67.**		**87.**	
8.		**28.**		**48.**		**68.**		**88.**	
9.		**29.**		**49.**		**69.**		**89.**	
10.		**30.**		**50.**		**70.**		**90.**	
11.		**31.**		**51.**		**71.**		**91.**	
12.		**32.**		**52.**		**72.**		**92.**	
13.		**33.**		**53.**		**73.**		**93.**	
14.		**34.**		**54.**		**74.**		**94.**	
15.		**35.**		**55.**		**75.**		**95.**	
16.		**36.**		**56.**		**76.**		**96.**	
17.		**37.**		**57.**		**77.**		**97.**	
18.		**38.**		**58.**		**78.**		**98.**	
19.		**39.**		**59.**		**79.**		**99.**	
20.		**40.**		**60.**		**80.**		**100.**	