1. Two particles of equal mass go round a circle of radius R under the action of their mutual gravitational attraction. The speed of each particle is

a) $v = \frac{1}{2R}\sqrt{\frac{1}{Gm}}$

b) $v = \sqrt{\frac{Gm}{2R}}$

c) $v = \frac{1}{2}\sqrt{\frac{Gm}{R}}$

d) $v = \sqrt{\frac{4Gm}{R}}$

2. Reason of weightlessness in a satellite is

a) Zero gravity

b) Centre of mass

c) Zero reaction force by satellite surface

d) None

3. The radii of two planets are respectively R_1 and R_2 and their densities are respectively ρ_1 and ρ_2. The ratio of the accelerations due to gravity at their surfaces is

a) $g_1 : g_2 = \frac{\rho_1}{R_1^2} : \frac{\rho_2}{R_2^2}$

b) $g_1 : g_2 = R_1 R_2 : \rho_1 \rho_2$

c) $g_1 : g_2 = R_1 \rho_2 : R_2 \rho_1$

d) $g_1 : g_2 = R_1 \rho_1 : R_2 \rho_2$

4. At what altitude in metre will the acceleration due to gravity be 25% of that at the earth's surface (Radius of earth = R *metre*)

a) $\frac{1}{4}R$

b) R

c) $\frac{3}{8}R$

d) $\frac{R}{2}$

5. If the Earth losses its gravity, then for a body

a) Weight becomes zero, but not the mass

b) Mass becomes zero, but not the weight

c) Both mass and weight become zero

d) Neither mass nor weight become zero

6. If radius of earth is R then the height 'h' at which value of 'g' becomes one-fourth is

a) $\frac{R}{4}$

b) $\frac{3R}{4}$

c) R

d) $\frac{R}{8}$

7. The acceleration due to gravity near the surface of a planet of radius R and density d is proportional to

a) $\frac{d}{R^2}$

b) dR^2

c) dR

d) $\frac{d}{R}$

8. The acceleration due to gravity is g at a point distant r from the centre of earth of radius R. If $r < R$, then

a) $g \propto r$

b) $g \propto r^2$

c) $g \propto r^{-1}$

d) $g \propto r^{-2}$

9. The gravitational potential energy of a body of mass 'm' at the earth's surface $-mgR_e$. Its gravitational potential energy at a height R_e from the earth's surface will be (Here R_e is the radius of the earth)

a) $-2mgR_e$

b) $2mgR_e$

c) $\frac{1}{2}mgR_e$

d) $-\frac{1}{2}mgR_e$

10. A body of mass m *kg*. starts falling from a point $2R$ above the Earth's surface. Its kinetic energy when it has fallen to a point 'R' above the Earth's surface [R-Radius of Earth, M-Mass of Earth, G-Gravitational Constant]

a) $\frac{1}{2}\frac{GMm}{R}$

b) $\frac{1}{6}\frac{GMm}{R}$

c) $\frac{2}{3}\frac{GMm}{R}$

d) $\frac{1}{3}\frac{GMm}{R}$

11. Two satellites of masses m_1 and $m_2 (m_1 > m_2)$ are revolving round the earth in circular orbits of radius r_1 and $r_2 (r_1 > r_2)$ respectively. Which of the following statements is true regarding their speeds v_1 and v_2 ?

a) $v_1 = v_2$

b) $v_1 < v_2$

c) $v_1 > v_2$

d) $\frac{v_1}{r_1} = \frac{v_2}{r_2}$

12. In a satellite if the time of revolution is T, then K.E. is proportional to

a) $\frac{1}{T}$

b) $\frac{1}{T^2}$

c) $\frac{1}{T^3}$

d) $T^{-2/3}$

13. According to Kepler, the period of revolution of a planet (T) and its mean distance from the sun (r) are related by the equation

a) $T^3r^3 =$ constant

b) $T^2r^{-3} =$ constant

c) $Tr^3 =$ constant

d) $T^2r =$ constant

14. The displacement of a charge Q in the electric field $E = e_1\hat{i} + e_2\hat{j} + e_3\hat{k}$ is $\hat{r} = a\hat{i} + b\hat{j}$. The work done is

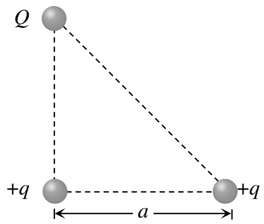
a) $Q(ae_1 + be_2)$

b) $Q\sqrt{(ae_1)^2 + (be_2)^2}$

c) $Q(e_1 + e_2)\sqrt{a^2 + b^2}$

d) $Q(\sqrt{e_1^2 + e_2^2})\,(a+b)$

15. Three charges $Q, +q$ and $+q$ are placed at the vertices of a right-angled isosceles triangle as shown. The net electrostatic energy of the configuration is zero if Q is equal to



a) $\frac{-q}{1+\sqrt{2}}$

b) $\frac{-2q}{2+\sqrt{2}}$

c) $-2q$

d) $+q$

16. Electric field intensity at a point in between two parallel sheets with like charges of same surface charge densities (σ) is

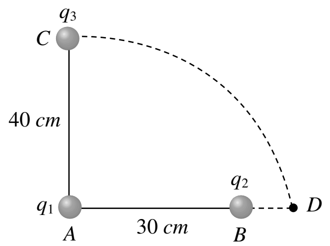
a) $\frac{\sigma}{2\varepsilon_0}$

b) $\frac{\sigma}{\varepsilon_0}$

c) Zero

d) $\frac{2\sigma}{\varepsilon_0}$

17. To charges q_1 and q_2 are placed $30\ cm$ apart, shown in the figure. A third charge q_3 is moved along the arc of a circle of radius $40\ cm$ from C to D. The change in the potential energy of the system is $\frac{q_3}{4\pi\varepsilon_0}k$, where k is



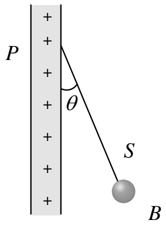
a) $8q_2$

b) $8q_1$

c) $6q_2$

d) $6q_1$

18. A charged ball B hangs from a silk thread S, which makes an angle θ with a large charged conducting sheet P, as shown in the figure. The surface charge density σ of the sheet is proportional to



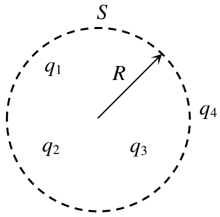
a) $\sin\theta$

b) $\tan\theta$

c) $\cos\theta$

d) $\cot\theta$

19. q_1, q_2, q_3 and q_4 are point charges located at points as shown in the figure and s is a spherical Gaussian surface of radius *R*. Which of the following is true according to the Gauss's law



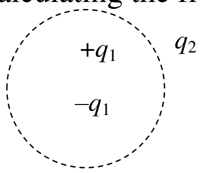
a) $\oint_s (\vec{E}_1 + \vec{E}_2 + \vec{E}_3).d\vec{A} = \frac{q_1 + q_2 + q_3}{2\varepsilon_0}$

b) $\oint_s (\vec{E}_1 + \vec{E}_2 + \vec{E}_3).d\vec{A} = \frac{(q_1 + q_2 + q_3)}{\varepsilon_0}$

c) $\oint_s (\vec{E}_1 + \vec{E}_2 + \vec{E}_3).d\vec{A} = \frac{(q_1 + q_2 + q_3 + q_4)}{\varepsilon_0}$

d) None of the above

20. Consider the charge configuration and spherical Gaussian surface as shown in the figure. When calculating the flux of the electric field over the spherical surface the electric field will be due to



a) q_2

b) Only the positive charges

c) All the charges

d) $+q_1$ and $-q_1$

21. Acceleration due to gravity is '*g*' on the surface of the earth. The value of acceleration due to gravity at a height of 32 *km* above earth's surface is (Radius of the earth = 6400 *km*)

22. An object weights 72 *N* on earth. Its weight at a height of *R*/2 from earth is

23. At what distance from the centre of the earth, the value of acceleration due to gravity *g* will be half that on the surface (*R* = radius of earth)

24. If the radius of the earth shrinks by 1.5% (mass remaining same), then the value of acceleration due to gravity changes by

25. A body weighs 700 *gm wt* on the surface of the earth. How much will it weigh on the surface of a planet whose mass is $\frac{1}{7}$ and radius is half that of the earth

Section : II Chemistry (Electrochemistry)

26. Which of the following will not conduct electricity in aqueous solution
a) Copper sulphate
b) Sugar
c) Common salt
d) None of these

27. Strong electrolytes are those which
a) Dissolve readily in water
b) Conduct electricity
c) Dissociate into ions at high dilution
d) Completely dissociate into ions at all dilutions

28. Electrolytes when dissolved in water dissociates into ions because
a) They are unstable
b) The water dissolves it
c) The force of repulsion increases
d) The forces of electrostatic attraction are broken down by water

29. Which one of the following metals could not be obtained on electrolysis of aqueous solution of its salts
a) Ag
b) Mg
c) Cu
d) Cr

30. The atomic weight of Al is 27. When a current of 5 Faradays is passed through a solution of Al^{+++} ions, the weight of Al deposited is
a) 27 *gm*
b) 36 *gm*
c) 45 *gm*
d) 39 *gm*

31. The unit of electrochemical equivalent is
a) *Gram*
b) *Gram/ampere*
c) *Gram/coulomb*
d) *Coulomb/gram*

32. Specific conductance of 0.1 *m* nitric acid is $6.3 \times 10^{-2}\ ohm^{-1}cm^{-1}$. The molar conductance of solution is
a) 630 $ohm^{-1}cm^{2}mole^{-1}$
b) 315 $ohm^{-1}cm^{2}mole^{-1}$
c) 100 $ohm^{-1}cm^{2}mole^{-1}$
d) 6300 $ohm^{-1}cm^{2}mole^{-1}$

33. If X is the specific resistance of the solution and M is the molarity of the solution, the molar conductivity of the solution is given by
a) $\frac{1000\,X}{M}$

b) $\frac{1000}{MX}$

c) $\frac{1000\,M}{X}$

d) $\frac{MX}{1000}$

34. Conductivity (unit Siemen's) is directly proportional to area of the vessel and the concentration of the solution in it and is inversely proportional to the length of the vessel then the unit of the constant of proportionality is

a) $Sm\ mol^{-1}$

b) $Sm^2\ mol^{-1}$

c) $S^{-2}m^2\ mol$

d) $S^2m^2\ mol^{-2}$

35. If the half cell reaction $A + e^- \rightarrow A^-$ has a large negative reduction potential, it follows that

a) A is readily reduced

b) A is readily oxidised

c) A^- is readily reduced

d) A^- is readily oxidised

36. The specific conductance of a 0.1 N KCl solution at 23^oC is $0.012\,ohm^{-1}\,cm^{-1}$. The resistance of cell containing the solution at the same temperature was found to be 55 *ohm*. The cell constant will be

a) $0.142\,cm^{-1}$

b) $0.66\,cm^{-1}$

c) $0.918\,cm^{-1}$

d) $1.12\,cm^{-1}$

37. In $Cu-Zn$ cell

a) Reduction occurs at the copper cathode

b) Oxidation occurs at the copper cathode

c) Reduction occurs at the anode

d) Chemical energy is converted to light energy

38. The hydrogen electrode is dipped in a solution of $pH = 3$ at 25^oC. The potential of the cell would be (the value of $2.303\,RT/F$ is 0.059 V)

a) 0.177 V

b) – 0.177 V

c) 0.087 V

d) 0.059 V

39. When Zn piece is kept in $CuSO_4$ solution, the copper get precipitated due to standard potential of zinc is

a) > copper

b) < copper

c) > sulphate

d) < sulphate

40. The standard reduction electrode potentials of four elements are

$A = -0.250\ V$ $\quad$ $B = -0.136\ V$

$C = -0.126\ V$ $\quad$ $D = -0.402\ V$

The element that displaces A from its compounds is

a) B
b) C
c) D
d) None of these

41. Rusting of iron is catalysed by which of the following
a) Fe
b) O_2
c) Zn
d) H^+

42. Corrosion of iron is essentially an electrochemical phenomenon where the cell reactions are
a) Fe is oxidised to Fe^{2+} and dissolved oxygen in water is reduced to $\overset{\ominus}{O}H$
b) Fe is oxidised to Fe^{3+} and H_2O is reduced to O_2^{2-}
c) Fe is oxidised to Fe^{2+} and H_2O is reduced to O_2^-
d) Fe is oxidised to Fe^{2+} and H_2O is reduced to O_2

43. The reaction $\frac{1}{2}H_2(g)+AgCl(s)\rightarrow H^+(aq)+Cl^-(aq)+Ag(s)$ occurs in the galvanic cell
a) $Ag/AgCl(s)KCl(\text{soln})\|\ AgNO_3(\text{soln})/Ag$
b) $Pt/H_2(g)HCl(\text{soln})\|\ AgNO_3(\text{soln})/Ag$
c) $Pt/H_2(g)HCl(\text{soln})\|\ AgCl(s)/Ag$
d) $Pt/H_2(g)KCl(\text{soln})\|\ AgCl(s)/Ag$

44. The number of electrons to balance the following equation $NO_3^-+4H^++e^-\rightarrow 2H_2O+NO$ is
a) 5
b) 4
c) 3
d) 2

45. The standard EMF for the given cell reaction $Zn+Cu^{2+}=Cu+Zn^{2+}$ is $1.10V$ at 25^oC. The EMF for the cell reaction, when $0.1M\ Cu^{2+}$ and $0.1M\ Zn^{2+}$ solutions are used, at 25^oC is
a) $1.10\ V$
b) $0.110\ V$
c) $-1.10\ V$
d) $-0.110\ V$

46. When 9.65 coulombs of electricity is passed through a solution of silver nitrate (atomic weight of $Ag=107.87$ taking as 108) the amount of silver deposited is

47. Three faradays electricity was passed through an aqueous solution of iron (II) bromide. The weight of iron metal (at. wt. = 56) deposited at the cathode (in *gm*) is

48. A silver cup is plated with silver by passing 965 coulombs of electricity, the amount of silver deposited is

49. In infinite dilutions, the equivalent conductances of Ba^{2+} and Cl^- are 127 and 76 $ohm^{-1}cm^{-1}\ eqvt^{-1}$. The equivalent conductivity of $BaCl_2$ at indefinite dilution is

50. The standard electrode potentials of Zn^{2+}/Zn and Ag^+/Ag are $-0.763\ V$ and $+0.799\ V$ respectively. The standard potential of the cell is

51. $\sec^{-1}[\sec(-30^{o})] =$

a) -60^{o}

b) -30^{o}

c) 30^{o}

d) 150^{o}

52. $\sec^{2}(\tan^{-1}2) + \text{cosec}^{2}(\cot^{-1}3) =$

a) 5
b) 13
c) 15
d) 6

53. The solution set of the equation $\sin^{-1}x = 2\tan^{-1}x$ is
a) {1, 2}
b) {−1, 2}
c) {−1,1, 0}
d) {1, 1/2, 0}

54. If $\pi \le x \le 2\pi$, then $\cos^{-1}(\cos x)$ is equal to
a) x
b) $-x$
c) $2\pi + x$
d) $2\pi - x$

55. The value of $\cos(\tan^{-1}(\tan 2))$ is

a) $\frac{1}{\sqrt{5}}$

b) $-\frac{1}{\sqrt{5}}$

c) $\cos 2$

d) $-\cos 2$

56. If $\tan^{-1}\frac{a+x}{a} + \tan^{-1}\frac{a-x}{a} = \frac{\pi}{6}$,then $x^{2} =$

a) $2\sqrt{3}a$

b) $\sqrt{3}a$

c) $2\sqrt{3}a^{2}$

d) None of these

57. $\tan^{-1}\frac{3}{4} + \tan^{-1}\frac{3}{5} - \tan^{-1}\frac{8}{19} =$

a) $\frac{\pi}{4}$

b) $\frac{\pi}{3}$

c) $\frac{\pi}{6}$

d) None of these

58. The greatest and the least value of $(\sin^{-1}x)^{3} + (\cos^{-1}x)^{3}$ are

a) $-\frac{\pi}{2}, \frac{\pi}{2}$

b) $-\frac{\pi^{3}}{8}, \frac{\pi^{3}}{8}$

c) $\frac{7\pi^3}{8}, \frac{\pi^3}{32}$

d) None of these

59. If $\sin^{-1} a + \sin^{-1} b + \sin^{-1} c = \pi,$ then the value of $a\sqrt{(1-a^2)} + b\sqrt{(1-b^2)} + c\sqrt{(1-c^2)}$ will be

a) $2abc$

b) abc

c) $\frac{1}{2}abc$

d) $\frac{1}{3}abc$

60. $\tan\left[2\tan^{-1}\left(\frac{1}{5}\right) - \frac{\pi}{4}\right] =$

a) $\frac{17}{7}$

b) $-\frac{17}{7}$

c) $\frac{7}{17}$

d) $-\frac{7}{17}$

61. The value of $\cos^{-1}(\cos 12) - \sin^{-1}(\sin 14)$ is

a) -2

b) $8\pi - 26$

c) $4\pi + 2$

d) None of these

62. $2\tan^{-1}\left[\sqrt{\frac{a-b}{a+b}}\tan\frac{\theta}{2}\right] =$

a) $\cos^{-1}\left(\frac{a\cos\theta + b}{a + b\cos\theta}\right)$

b) $\cos^{-1}\left(\frac{a + b\cos\theta}{a\cos\theta + b}\right)$

c) $\cos^{-1}\left(\frac{a\cos\theta}{a + b\cos\theta}\right)$

d) $\cos^{-1}\left(\frac{b\cos\theta}{a\cos\theta + b}\right)$

63. $2\tan^{-1}(\cos x) = \tan^{-1}(\operatorname{cosec}^2 x),$ then $x =$

]

a) $\frac{\pi}{2}$

b) π

c) $\frac{\pi}{6}$

d) $\frac{\pi}{3}$

64. If $y = \frac{1}{a-z},$ then $\frac{dz}{dy} =$

a) $(z-a)^2$

b) $-(z-a)^2$

c) $(z+a)^2$

d) $-(z+a)^2$

65. If $y=\sin^{-1}(x\sqrt{1-x}+\sqrt{x}\sqrt{1-x^2})$, then $\frac{dy}{dx}=$

a) $\frac{-2x}{\sqrt{1-x^2}}+\frac{1}{2\sqrt{x-x^2}}$

b) $\frac{-1}{\sqrt{1-x^2}}-\frac{1}{2\sqrt{x-x^2}}$

c) $\frac{1}{\sqrt{1-x^2}}+\frac{1}{2\sqrt{x-x^2}}$

d) None of these

66. If $y=x\left[\left(\cos\frac{x}{2}+\sin\frac{x}{2}\right)\left(\cos\frac{x}{2}-\sin\frac{x}{2}\right)+\sin x\right]+\frac{1}{2\sqrt{x}}$, then $\frac{dy}{dx}=$

a) $(1+x)\cos x+(1-x)\sin x-\frac{1}{4x\sqrt{x}}$

b) $(1-x)\cos x+(1+x)\sin x+\frac{1}{4x\sqrt{x}}$

c) $(1+x)\cos x+(1+x)\sin x-\frac{1}{4x\sqrt{x}}$

d) None of these

67. If $y=\log\left(\frac{1+x}{1-x}\right)^{1/4}-\frac{1}{2}\tan^{-1}x$, then $\frac{dy}{dx}=$

a) $\frac{x^2}{1-x^4}$

b) $\frac{2x^2}{1-x^4}$

c) $\frac{x^2}{2\,(1-x^4)}$

d) None of these

68. $\frac{d}{dx}\log_7(\log_7 x)=$

a) $\frac{1}{x\log_e x}$

b) $\frac{\log_e 7}{x\log_e x}$

c) $\frac{\log_7 e}{x\log_e x}$

d) $\frac{\log_7 e}{x\log_7 x}$

69. If $y=\log x.e^{(\tan x+x^2)}$, then $\frac{dy}{dx}=$

a) $e^{(\tan x+x^2)}\left[\frac{1}{x}+(\sec^2 x+x)\log x\right]$

b) $e^{(\tan x+x^2)}\left[\frac{1}{x}+(\sec^2 x-x)\log x\right]$

c) $e^{(\tan x+x^2)}\left[\frac{1}{x}+(\sec^2 x+2x)\log x\right]$

d) $e^{(\tan x+x^2)}\left[\frac{1}{x}+(\sec^2 x-2x)\log x\right]$

70. If $y=\tan^{-1}\left(\frac{\sqrt{a}-\sqrt{x}}{1+\sqrt{ax}}\right)$, then $\frac{dy}{dx}=$

a) $\frac{1}{2(1+x)\sqrt{x}}$

b) $\frac{1}{(1+x)\sqrt{x}}$

c) $-\frac{1}{2(1+x)\sqrt{x}}$

d) None of these

71. $\tan\left[\cos^{-1}\frac{4}{5}+\tan^{-1}\frac{2}{3}\right]$ = A/B where A and B are relatively prime. Then A+B is

72. If $\cos^{-1}\frac{3}{5}-\sin^{-1}\frac{4}{5}=\cos^{-1}x$, then x =

73. A solution of the equation $\tan^{-1}(1+x)+\tan^{-1}(1-x)=\frac{\pi}{2}$ is

74. If $\sin^{-1}\frac{3}{5}+\cos^{-1}\left(\frac{12}{13}\right)=\sin^{-1}C$, then greatest integer of C is

75. $\sin\left(4\tan^{-1}\frac{1}{3}\right)=$ A/B, where A and B are relatively prime. Then A+B is