clamphook

Shift 1

Clamphook CBT

2080

Full Marks: 140 **Time:** 2 hours **Pass Marks:** 56

1. Which of the following has same dimensions? [IOE 2074]

a. Heat and Temperature
b. Energy and Work done
c. Pressure and Surface Tension
d. Charge and Current

2. No force is required for a body moving with:

a. Constant velocity
b. Constant speed on circular path
c. Constant acceleration
d. Variable acceleration

3. What is the difference in potential energy when a body of mass 'm' is raised from Earth surface (Radius = R) to the height which is half of earth's radius? [IOE 2078]

a. $\frac{1}{3}mgR$
b. $\frac{5}{3}mgR$
c. mgR
d. $\frac{2}{5}mgR$

4. The time period of second pendulum is 2 sec. The spherical bob is empty from inside has a mass 50 g. If it is replaced by another solid bob of same radius but mass 100 g then its time period will be

a. 4 sec
b. 1 sec
c. 2 sec
d. 8 sec

5. If the excess pressure inside a soap bubble of radius 5 mm is equal to the pressure of a water column of height 0.8 cm, then the surface tension of the soap solution will be

a. $98N/m$
b. $980N/m$
c. $98 \times 10^{-2}N/m$
d. $98 \times 10^{-3}N/m$

6. A student proposed a new temperature scale with temperature given in $^\circ P$. He defined the normal melting point and boiling point of mercury are $0.0^\circ P$ and $100.0^\circ P$ respectively. If the melting point and boiling point of mercury in centigrade scale are $-38^\circ C$ and $358^\circ C$ respectively, then calculate the boiling of water in $^\circ P$.

a. 34.8
b. 35.6
c. 36.6
d. 37.6

7. A metal vessel having an area $1m^2$ and 2.5 mm thick is filled with ice and is surrounded by steam. How much ice will melt in minutes if the thermal conductivity of the vessel is 300 W/mK and latent heat of ice is 80 Cal/g?

a. 90 kg
b. 550 kg
c. 1150 kg
d. 2160 kg

8. Time taken by sun light to travel through a block 9.5 cm thick having refractive index 1.5 is [IOE 2076]

a. 0.21 ns
b. 0.21 μs
c. 0.47 ns
d. 0.47 μs

9. In the sun's spectrum there are several visible and invisible spectrum . If blue and green lights are passed through a transparent prism , then deviation of green light will be:

a. equal so that they will from achromatic condition
b. greater than that of blue light
c. smaller than that of blue light
d. can't be predicted.

10. A hollow metal sphere of radius 5 cm is charged such that potential on its surface is 10 V. The potential at center of the sphere is

a. 0 V
b. 10 V
c. 5 V
d. 20 V

11. The commercial aluminum ($At.Wt. = 27$) is generally obtained by electrolysis. What is the total charge required to deposit 9 grams of aluminium?

a. 65900 coulombs
b. 96500 coulombs
c. 32666 coulombs
d. 289500 coulombs

12. Magnetic field do not interact with

a. Stationary electric charge
b. Moving electric charge
c. Stationary permanent magnet
d. Moving permanent magnet

13. Admittance of an alternating circuit is defined as reciprocal of

a. Resistance
b. Capacitance
c. Inductance
d. Impedence

14. A ray of light strikes a glass plate at an angle of 60°. If the reflected and refracted rays are perpendicular to each other , the index of refraction of glass is

a. $\frac{1}{2}$
b. $\frac{\sqrt{3}}{2}$
c. $\frac{3}{2}$
d. 1.732

15. The equation off wave pulse is given by $y = \frac{6}{[2+(x+2t)^2]}$ where x and y are in cm and t in second, then velocity of wave is

a. $2cm/s$
b. $3cm/s$
c. $3cm/s$
d. $5cm/s$

16. Ionizing power of γ - rays as compared to α - particle

a. more
b. less
c. equal
d. None

17. The energy of a photon of sodium light $(\lambda = 589nm)$ equals, the band gap of semiconductor material. The minimum energy E required to create a hole–electron pair is :

a. $0.21eV$
b. $2.1eV$
c. $21eV$
d. 2.1×10^{-19} eV

18. Find the range of the given function : $f(x) = \sqrt{x - x^2}$ [IOE 2078]

a. $(-\infty, \infty)$ b. $(0, 1)$

c. $[0, 1/2]$ d. $[0, \infty)$

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19. If A is a 3×3 matrix then $|2A|$ is: [IOE 2078]

a. $-8|A|$ b. $2|A|$

c. $-2|A|$ d. $8|A|$

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20. If $|z| = 1$ then $\dfrac{1+z}{1+\bar{z}}$ is equal to

a. z b. $\bar{z}$

c. $z + \bar{z}$ d. $z - \bar{z}$

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21. If $C(35, n+7) = C(35, 4n-2)$, then n is:

a. 6 b. 5

c. 4 d. 3

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22. Principal value of $\cos^{-1}\left(-\dfrac{\sqrt{3}}{2}\right)$ is:

a. $\dfrac{7\pi}{6}$ b. $\dfrac{5\pi}{6}$

c. $\dfrac{\pi}{6}$ d. $-\dfrac{\pi}{6}$

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23. If $2\tan^{-1}(\cos\theta) = \tan^{-1}(2\operatorname{cosec}\theta)$ then θ is :

a. $n\pi - \dfrac{\pi}{4}$ b. $n\pi + \dfrac{\pi}{4}$

c. $n\pi + \dfrac{\pi}{3}$ d. $n\pi - \dfrac{\pi}{3}$

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24. In any triangle ABC, $\angle C$ is right angled triangle . Then the value of $\tan A + \tan B$ is :

a. $\dfrac{b^2}{ac}$ b. $a + bc$

c. $\dfrac{a^2}{bc}$ d. $\dfrac{c^2}{ab}$

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25. If $|\vec{a}| = 3, |\vec{b}| = 4$ and $|\vec{a} \times \vec{b}| = 10$ then $(\vec{a}.\vec{b})^2$ [IOE 2077]

a. 44 b. 64

c. 100 d. 144

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26. The circumcenter of the triangle formed by the points $(3, 0)$, $(0, 4)$ and $(0, 0)$ is

a. $(3, 0)$ b. $(0, 4)$

c. $(3, 4)$ d. $\left(\dfrac{3}{2}, 2\right)$

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27. Length of intercept made by circle $x^2 + y^2 + 2gx + 2fy + c = 0$ on x-axis [IOE 2078]

a. $2\sqrt{g^2 - c}$ b. $2\sqrt{f^2 - c}$

c. $\sqrt{g^2 - c}$ d. $\sqrt{f^2 - c}$

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28. The curve $y = kx^2 - 3x + 2$ will be normal to $y = x$ at $(1, 1)$, if value of k is [IOE 2076]

a. 1 b. -1

c. 2 d. -2

29. The locus of the point of the intersection of lines $x = \sec t + \tan t$ and $y = \sec t - \tan t$ is

a. Circle
b. Ellipse
c. Parabola
d. Hyperbola

30. If the two planes $2x + 3y + z + 6 = 0$ and $-4x - 6y + az + 9 = 0$ are parallel then $a =$: [IOE 2078]

a. 2
b. -2
c. 1
d. 0

31. A function $f(x) = \frac{1}{x-2}$ is [IOE 2078]

a. differentiable at x=2
b. continuous at x=2
c. continuous everywhere except at x=2
d. None

32. If $y = 1 + \frac{1}{x} + \frac{1}{x^2} + \frac{1}{x^3} + \ldots\ldots\ldots$ to ∞ with $|x| > 1$, then $\frac{dy}{dx} =$

a. $\frac{y}{x}$
b. $-\frac{y^2}{x^2}$
c. $\frac{y^2}{x^2}$
d. $-\frac{y}{x}$

33. If $y = |\cos x| + |\sin x|$ then $\frac{dy}{dx}$ at $x = \frac{2\pi}{3}$ is:

a. $\frac{\sqrt{3}-1}{4}$
b. $\frac{\sqrt{3}+1}{2}$
c. $\frac{\sqrt{3}-1}{2}$
d. $\frac{\sqrt{3}+1}{4}$

34. The tangent to a given curve is perpendicular to x-axis if

a. $\frac{dy}{dx} = 1$
b. $\frac{dy}{dx} = 0$
c. $\frac{dx}{dy} = 0$
d. $\frac{dx}{dy} = 1$

35. The abscissa of the points of curve $y = x(x-2)(x-4)$ where tangents are parallel to x-axis is

a. $x = 1 \pm \sqrt{3}$
b. $x = 2 \pm 2\sqrt{3}$
c. $x = \pm 1$
d. $x = 2 \pm \sqrt{3}$

36. $\int \frac{1-x^2}{1+x^2} dx =$ [IOE 2077]

a. $-x + 2\tan^{-1} x + c$
b. $x - 2\tan^{-1} x + c$
c. $-x + 2\log(1+x^2)x + c$
d. $x - 2\log(1+x^2)x + c$

37. The area of ellipse $\frac{x^2}{4} + \frac{y^2}{9} = 1$ is

a. 9π
b. 36π
c. 18π
d. 6π

38. The element least likely to be found in an organic compound is

a. oxygen
b. sulphur
c. nitrogen
d. silicon

39. In Friedel-Crafts reaction, the electrophilic reagent is: [IOE 2078]

a. $AlCl_3$ b. RCO^+

c. $RCOCl$ d. Cl^-

40. When NH_3 is heater with CuO, it gives [IOE 2075]

a. NO_2 b. NH_3

c. N_2 d. HNO_3

41. During preparation of Cl_2 from HCl, MnO_2 acts as

a. Oxidizing agent b. Reducing agent

c. Dehydrating agent d. Catalyst

42. Which of the following impart violet coloration to the Bunsen burner non-luminous flame

a. $NaCl$ b. $BaCl_2$

c. $CaCl_2$ d. KCl

43. Which element is alloyed with copper to form brass:

a. Pb b. Bi

c. Zn d. Sn

44. Lucas reagent is

a. $ZnCl_2 + conc \cdot HCl$ b. $MnO_2 + H_2O$

c. $H_2SO_4 + HCl$ d. $NO + H_2O$

45. When steam (H_2O) is passed over red hot coke (C) water gas $(CO + H_2)$ is produced according to the equation $C + H_2O \longrightarrow CO + H_2$ because

a. carbon is the oxidizing agent b. Steam is an oxidizing agent

c. steam is the reducing agent d. neither oxidation nor reduction occurs

46. Which of the following acids: possesses oxidizing and complex forming properties?

a. HNO_3 b. H_2SO_4

c. HCl d. HNO_2

47. Aluminium is diagonally related to

a. Li b. Be

c. C d. B

48. Which of the outermost electronic configurations given below would you expect for a noble gas?

a. ns^2np^6 b. ns^2np^5

c. ns^2np^4 d. ns^2np^3

49. .... of you is responsible for yourself.

a. no one b. neither

c. each d. any

50. Either he or us..... responsible.

a. has b. was

c. are d. is

51. A daughter takes _____her mother.

a. after b. for

c. by
d. with

52. When she was driving, she _____ with an accident.

a. meets
b. had meeting
c. will meet
d. met

53. when did you request him? Its passive voice is:

a. When he was requested by you?
b. When was he requested by you?
c. When had you requested by you?
d. When were you requested to you?

54. Which of the following options has the same initial sound as the middle consonant sound of 'machine"?

a. nation
b. harsh
c. sugar
d. masculine

55. After he gave it some thought, the mouse decided to wait until later for his trek.

a. Simple Sentence
b. Compound Sentence
c. Complex Sentence
d. Compound-Complex Sentence

56. The fire was $\underline{\text{extinguished}}$ by the rain. The underlined word means

a. put out
b. put on
c. put with
d. put by

57. The synonym of the word 'convene' is [IOE 2074]

a. summon
b. adjourn
c. dissemble
d. disperse

58. The agenda would have been accepted ..... in looking into the topics of the meeting.

a. if more care
b. more care had been taken
c. had taken more care
d. had more care been taken

59. Kiara said that she had been planning for that for a while. Its direct speech is

a. Kiara said, "I had a plan for this for a while."
b. Kiara said, "I have planned for this for a while."
c. Kiara said, "I have been planning for this for a while."
d. Kiara said, "I planned this for a while."

60. The boys are playing foot ball now. The sentence pattern is

a. S+V+O+A
b. S+V+C
c. S+V+A
d. S+V+O+C

61. A particle experiences constant acceleration for 20 sec alter starting from rest. It travels a distance S_1 in first 10 sec and a distance S_2 in the next 10 sec then:

a. $S_1 = S_2$
b. $S_2 = 3S_1$
c. $S_2 = 2S_1$
d. $S_2 = 4S_2$

62. A particle moves under the effect of force $F = kx$, from $x = 0$ to $x = x_1$, the work done is [IOE 2078]

a. $\frac{kx_1^2}{2}$
b. $\frac{kx_1^2}{4}$
c. kx_1^2
d. 0

63. A particle is in SHM of amplitude 10 cm. The displacement, at which velocity of particle is half of maximum velocity is:

a. $10\ cm$
b. $5\ cm$
c. $5\sqrt{3}\ cm$
d. $2\sqrt{3}\ cm$

64. Two different liquids are mixed together in equal volume. If their densities are 0.6 g/ cc , 0.8 g/ cc then their density of mixture is:

a. 0.56 g/ cc
b. 0.68 g/ cc
c. 0.7 g/ cc
d. 0.83 g/ cc

65. A closed vessel conatins a gas at temperature of 250 K . If the gas is heated through 1K , then percentage increase in its pressure [ ]

a. 0.1%
b. 0.2%
c. 0.3%
d. 0.4%

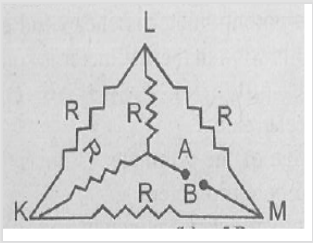
66. A mark at the bottom of the tank 1m deep appears to be raised to be 0.1 m . The value of refractive index of liquid tank is :

a. $\frac{10}{9}$
b. 10
c. $\frac{4}{3}$
d. $\frac{1}{10}$

67. 1000 identical drops of water each charged to the potential V at the surface combine to form a single drop. The potential on the surface will be:

a. 1000 V
b. 100 V
c. 10 V
d. V

68. Each of resistance in network shown in figure is equal to R . The resistance between the terminals A and B is:



a. R
b. $5R$
c. $3R$
d. $6R$

69. An electron enters in magnetic field with velocity 2×10^6 m/s. perpendicular to the field of 2×10^{-5} T. what is the radius of the path of electron?

a. 0.4 m
b. 0.57 m
c. 0.63 m
d. 0.67 m

70. A generator produces a voltage that is given by $V = 240 \sin 120t$, where t is in seconds. The frequency and r.m.s. voltage are:

a. 60 Hz and 240 V
b. 19 Hz and 120 V
c. 19 Hz and 170 V
d. 754 Hz and 70 V

71. A cord attached to a vibrating tuning fork is divided into six string segments under a tension of 36 N. it will be divided into 4 segments if the tension is

a. 16 N
b. 24 N
c. 48 N
d. 81 N

72. The frequency heard by a stationary observer is double than that blown by source coming towards it. The velocity of source is (velocity of sound $= 340 m/s$) [IOE 2077]

a. $680m/s$ b. $340m/s$

c. $170m/s$ d. $70m/s$

73. When 5 kV potential difference is applied in x- ray tube then current of 3.2 mA flows. The number of electrons striking the target per seconds are:

a. 2×10^{16} b. 5×10^{16}

c. 4×10^{16} d. 1.6×10^{16}

74. The ratio of energies of hydrogen atom in first to second excited states is

a. $1/4$ b. $4/9$

c. $9/4$ d. 4

75. Find the range of function $f(x) = x^2 - 4x - 5$ [IOE 2078]

a. $(-\infty, 9)$ b. $(-\infty, 9]$

c. $[-9, \infty)$ d. $(-9, \infty)$

76. If $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 1 & 2 \\ 2 & 3 & 1 \end{bmatrix}$ and $A^{-1} = \lambda adj(A)$, then λ is:

a. $\frac{1}{18}$ b. $-\frac{1}{18}$

c. $\frac{1}{36}$ d. $-\frac{1}{36}$

77. One real root of the equation $3x^2 + px + 3 = 0$ is square of the other, then $p =$

a. $\frac{1}{3}$ b. 1

c. -6 d. $\frac{2}{3}$

78. A man has 10 shirts and 8 ties. The number of different outfits he can wear are [IOE 2077]

a. ${}^{10}P_5$ b. ${}^{10}C_5$

c. $10! \times 8!$ d. 80

79. $\frac{1}{1!} + \frac{1+3}{2!} + \frac{1+3+5}{3!} + \ldots\cdots + \infty =$

a. e b. $2e$

c. $\frac{e}{2}$ d. $\frac{3e}{2}$

80. If $2\sin^2\theta - 3\sin\theta - 2 = 0$, then θ is equal to

a. $n\pi + (-1)^n \frac{7\pi}{6}$ b. $n\pi + (-1)^n \frac{\pi}{6}$

c. $n\pi + (-1)^n \frac{5\pi}{6}$ d. $n\pi - (-1)^n \frac{\pi}{2}$

81. If $\frac{\cos A}{a} = \frac{\cos B}{b} = \frac{\cos C}{c}$ and $a = 2$ then find the area of triangle [IOE 2078]

a. $\sqrt{3}$ b. $\frac{\sqrt{3}}{4}$

c. 4 d. 8

82. Find the area enclosed by curve $y^2 = 8x$, and and $y = 2x$ is [IOE 2078]

a. $\frac{4}{3}$ units

b. 16 units

c. 32 units

d. $\frac{16}{3}$ units

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83. The equation of the lines which are parallel to the lines represented by $2x^2 - 5xy + 3y^2 = 0$ and passing through the point (1, 2) is :

a. $2x^2–5xy + 3y^2–6x–7y–4 = 0$

b. $2x^2–5xy + 3y^2 + 6x–7y + 4 = 0$

c. $2x^2–5xy + 3y^2 + 6x + 7y–4 = 0$

d. $2x^2–5xy + 3y^2 + 6x + 7y + 4 = 0$

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84. The centres of those circles which touch the circle, $x^2 + y^2–8x–8y–4 = 0$, externally and also touch the x-axis, lie on,

a. A parabola

b. An ellipse which is not a circle

c. A circle

d. A hyperbola

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85. The equations of normal at the ends of the latus rectum of the parabola $y^2 = 8x$ is :

a. $x^2 + y^2 - 12x - 36 = 0$

b. $x^2 - y^2 - 12x + 36 = 0$

c. $x^2 + y^2 - 12x + 36 = 0$

d. $x^2 - y^2 + 12x + 36 = 0$

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86. The equation of the plane through the points $(3, 4, 2)$ and $(7, 0, 6)$ and perpendicular to the plane $2x - 5y = 15$ is

a. $5x + 2y - 3z = 17$

b. $5x + 2y + 3z = 17$

c. $5x - 2y + 3z = 17$

d. $5x - 2y - 3z = 17$

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87. The value of $\lim_{x \to 0} \frac{1 - \cos 2x}{\sin 2x}$ is [IOE 2078]

a. 0

b. 1

c. 2

d. 4

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88. $f(x, y) = \sin(xy) + x^2 \ln(y)$ Find f_{yx} at $(0, \frac{\pi}{2})$ [IOE 2075]

a. 2

b. 3

c. 1

d. 0

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89. $y = \int_0^{\pi} xe^x dx$

Find the value of $\frac{dy}{dx}$ [IOE 2078]

a. $\pi e^{\pi} - 1$

b. $\pi e^{\pi} + \pi$

c. πe^{π}

d. 0

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90. IUPAC name of isopentane is

a. 3-methylbutane

b. 2-methylbutane

c. 2,2-dimethylpropane

d. 2,3-dimethylbutane

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91. The correct order of acid strength is

a. $HClO_4 < HClO_3 < HClO_2 < HClO$

b. $HClO < HClO_2 < HClO_3 < HClO_4$

c. $HClO_4 < HClO < HClO_2 < HClO_3$

d. $HClO_3 < HClO_2 < HClO_3 < HClO_4$

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92. The product obtained after reaction of copper sulphate and ammonium hydroxide is 'X'. When 'X' is heated, it gives black ppt of 'Y'. X and Y are [IOE 2077]

a. $Cu(OH)_2$, CuO

b. $Cu(OH)_2$, CuS

c. $Cu(OH)_2$, Cu_2O d. $Cu(OH)_2$, $CuSO_4$

93. The volume of CO_2 produced when 5g of $CaCO_3$ is reacted with 5g of HCl is.

a. 1.12 L b. 2.24 L

c. 3.36 L d. 4.48 L

94. 25ml of HCl librates 10ml of CO_2 at NTP. When reacting with excess of $CaCO_3$. The normality of HCl is

a. 0.03 b. 0.0357

c. 0.04 d. 0.057

95. The resultant pH when 500 ml of an aqueous solution of HCl with pH = 3.0 is mixed with 300 ml of an aqueous solution of NaOH with pH =11 is

a. 10.4 b. 9.3

c. 3.6 d. 1.6

96. The number of electrons required to deposit 1 g atom of aluminium from a solution of aluminium chloride will be

Where N_A is Avogadro number.

a. $1\,N_A$ b. $2\,N_A$

c. $3\,N_A$ d. $4\,N_A$

Read the following passages carefully and answer the questions given below them. *(Questions from 97 to 100)*

India is a country of villages. Rural population still dominates the urban population as far as the number is considered. This is despite the fact that there is rampant migration of rural families to urban centres. Generally, the gains of being a unit of the urban population are less than the disadvantages and risks that are in-built in the urban life. Crime, riots, etc are some of the examples of such risks of urban life. The forces that generate conditions conducive to crime and riots are stronger in urban communities than in rural areas. Urban living is more anonymous living. It often releases the individual from community restraints more common in tradition-oriented societies. But more freedom from constraints and controls also provides greater freedom to deviate. And living in the more impersonalized, formally controlled urban society means that regulatory orders of conduct are often directed by distant bureaucrats. The police are strangers executing these prescriptions on an anonymous set of subjects. Minor offences in small town or village are often handled without resort to official police action. As disputable as such action may seem to be, it results in fewer recorded violations of the law compared to those in the big cities. Although perhaps causing some decision difficulties for the

police in small town, formal and objective law enforcement is not always acceptable to the villagers. Urban area with mass population, greater wealth, more commercial establishments and more products of our technology also provide more frequent opportunities for theft. Victims are impersonalized, property is insured, consumer goods in more abundance are vividly displayed and are more portable. The crime rate increases despite formal moral education given in schools.

97. Which of the following would be the best title for the above passage?

a. Lure of Village Life
b. Rural-Urban Rift
c. Hazards of Urban Life
d. Crime and Punishment

98. The passage mainly emphasises the

a. need for formal moral education to be given in schools
b. reasons for growing crime rate in urban centres as compared to that in rural areas
c. increasing crime rate in rural areas
d. comparative account of wealth in rural and urban areas

99. The author thinks that risks and disadvantages are

a. outweigh the gains of rural life
b. surpassed by the gains of urban life
c. almost negligible in rural life
d. more than the gains in urban life

100. Which of the following is a characteristic of an urban setting?

a. Less forceful social control
b. Minimal opportunities of crime due to better law enforcement
c. Deviation from freedom
d. Unreported minor crimes

Answer Key

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

Solutions

1. b

Dimensional Formula of

Heat $[ML^2T^{-2}]$

Temperature $[K]$

Charge $[AT]$

Current $[A]$

Pressure $[ML^{-1}T^{-2}]$

Surface Tension $[MT^{-2}]$

Energy $[ML^2T^{-2}]$

Work done $[ML^2T^{-2}]$

2. a

For, $V = constant, a = zero$ so, $F = m.a = 0$

3. a

$$\Delta PE = \frac{mgRh}{R+h} = \frac{mgR\frac{R}{2}}{R+\frac{R}{2}} = \frac{1}{3}mgR$$

4. c

Time period of simple pendulum is independent of mass and shape of bob (T = 2 sec).

5. d

$$P = \frac{4T}{R}, P_{hyd} = \rho gh$$

$$T = \frac{\rho ghR}{4} = 98 \times 10^{-3} N/m$$

6. a

$$\frac{C-(-38)}{358-(-38)} = \frac{x-0}{100-0}$$

$$\frac{100-(-38)}{358-(-38)} = \frac{x-0}{100-0}$$

$$x = 34.8^\circ P$$

7. d

$$\frac{mL}{t} = H = \frac{kA\theta}{x}$$

$$\frac{m}{t} = \frac{300 \times 1 \times 100}{2.5 \times 10^{-3} \times 334944} = 36 kg/s$$

8. c

$$t = \frac{d}{v} = \frac{d}{c/\mu} == 1.5 \times \frac{(9.5 \times 10^{-2})}{3 \times 10^8} = 4.75 \times 10^{-10} = 0.475 ns$$

9. c

For a prism,

Deviation $(\delta) = (\mu - 1)$A

$'\mu'$is the refractive index , A is the angle of prism . 'μ' for blue light is greater than green light . So , deviation of green light is smaller than that of blue light .

10. b

In the case of a hollow metal sphere (spherical shell), the electric field inside the shell is zero. This means that the potential inside the shell is constant. Therefore the potential at the centre of the sphere is the same as that on its surface, i.e. 10 V.

11. b

Chemical equivalent of Al,

$$E = \frac{M}{\text{valency}} = \frac{27}{3} = 9$$

Charge required to be passed to deposit a mass of aluminium equal to chemical equivalent is equal to one Faraday $= 96500C$.

12. a

Magnetic force (f_B) = Bev

When $v = 0$ [v = velocity of charged particle]

$f_B = 0$

energy in capacitor is stored in electric field and in inductor it is stored in magnetic field.

13. d

Admittance $(Y) = 1/Z$

14. d

When the reflected and refracted rays are perpendicular to each other , i = polarizing angle

$\mu = \tan i_p = \tan 60^\circ = \sqrt{3} = 1.732$

15. a

The equation of wave pulse is

$$Y = \frac{a}{[b + (x \pm vt)^2]}$$

Comparing above equation with general equation v = 2 cm/s

16. b

Order of ionizing power = $\alpha > \beta > \gamma$

17. b

The energy of the photon is

$$E = \frac{hc}{\lambda} = 2.1eV$$

Thus the band gap is 2.1eV.This is also the minimum energy E requried to push an electron from the valence band into the conduction band. Hence ,the minimum energy required to created a hole-electron pair is 2.1 eV.

18. c

minimum value of $f(x) = \sqrt{x - x^2} = 0$

For extreme value:

$$f'(x) = 0$$

$$1 - 2x = 0$$

$$x = \frac{1}{2}$$

At $x = \frac{1}{2}, f(x) = \frac{1}{2}$

$f''(x) = -2 < 0$, hence $f(1/2)$ is maximum value.

19. d

$|2A| = 2^3|A| = 8|A|$

20. a

$|z| = 1$

Hence,

$z\bar{z} = |z|^2 = 1 \implies \bar{z} = \frac{1}{z}$

$$\frac{1+z}{1+\frac{1}{z}}$$

$$z \times \left(\frac{1+z}{1+z}\right) = z$$

21. d

$C(35, n+7) = C(35, 4n-2)$

$n + 7 = 4n - 2$

$n = 3$

22. b

$$\cos^{-1}\left(-\frac{\sqrt{3}}{2}\right)$$

$$= \cos^{-1}\left(\cos(\pi - \frac{\pi}{6})\right)$$

$$= \cos^{-1}\cos(\frac{5\pi}{6})$$

$$= \frac{5\pi}{6}$$

23. b

$2\tan^{-1}(\cos\theta) = \tan^{-1}(2\operatorname{cosec}\theta)$

$$\tan^{-1}\left(\frac{2\cos\theta}{1-\cos^2\theta}\right) = \tan^{-1}(2\operatorname{cosec}\theta)$$

$$\frac{2\cos\theta}{\sin^2\theta} = \frac{2}{\sin\theta}$$

$\cos\theta = \sin\theta$

$\tan\theta = 1 = \tan\frac{\pi}{4}$

$\theta = n\pi + \frac{\pi}{4}$

24. d

$\tan A = \frac{a}{b}$

$\tan B = \frac{b}{a}$

$\tan A + \tan B = \frac{a}{b} + \frac{b}{a} = \frac{a^2 + b^2}{ab} = \frac{c^2}{ab}$

25. a

$(\vec{a}.\vec{b})^2 = a^2b^2\cos^2\theta = a^2b^2(1 - \sin^2\theta) = a^2b^2 - a^2b^2\sin^2\theta = a^2b^2 - |\vec{a} \times \vec{b}|^2 = 3^2 \times 4^2 - 10^2 = 144 - 100 = 44$

26. d

Circumcenter lies at the midpoint of the hypotenuse side of a right-angled triangle.

$(x, y) = \left(\frac{3+0}{2}, \frac{0+4}{2}\right) = \left(\frac{3}{2}, 2\right)$

27. a

Length of intercept made by circle $x^2 + y^2 + 2gx + 2fy + c = 0$ on x-axis is $2\sqrt{g^2 - c}$.

28. a

Slope of $y = x$ at $(1, 1) = 1$

Slope of $y = kx^2 - 3x + 2$ at $(1, 1) = 2kx - 3 = 2k \times 1 \times (-3) = 2k - 3$

As these are perpendicular, Product of slopes $= -1$

Or, $1 \times (2k - 3) = -1$

$k = 1$

29. d

$x = \sec t + \tan t$ ... (i)

$y = \sec t - \tan t$... (ii)

$xy = (\sec t + \tan t)(\sec t - \tan t) = \sec^2 t - \tan^2 t = 1$

$xy = 1$

30. b

$\frac{2}{-4} = \frac{3}{-6} = \frac{1}{a}$

$a = -2$

31. c

the expression is in fraction, and a fraction is not defined only when its denominator equals zero,

⇒x−2=0

⇒x=2

32. b

$y = 1 + \frac{1}{x} + \frac{1}{x^2} + \frac{1}{x^3} + \ldots\ldots\ldots$ to ∞

$$y = \frac{1}{1 - \frac{1}{x}} = \frac{x}{(x-1)} \cdots (i)$$

$$\frac{\mathrm{d}y}{\mathrm{dx}} = \frac{(x-1)\cdot 1 - x(1-0)}{(x-1)^2}$$
$$= -\frac{1}{(x-1)^2}$$
$$= -\frac{1}{(x/y)^2} \quad [\text{ from (i)}]$$
$$= -\frac{y^2}{x^2}$$

33. c

Around $x = \frac{2\pi}{3}$

$|\cos x| = -\cos x$ and $|\sin x| = \sin x$

ie. $y = -\cos x + \sin x$

$$\frac{dy}{dx} = \sin x + \cos x$$

when $x = \frac{2\pi}{3} : \frac{dy}{dx} = \sin\frac{2\pi}{3} + \cos\frac{2\pi}{3}$

$$= \frac{\sqrt{3}}{2} - \frac{1}{2} = \frac{\sqrt{3}-1}{2}$$

34. c

The tangent to a given curve is perpendicular to x-axis is$\frac{dx}{dy} = 0$

35. b

$y = x(x-2)(x-4)$

$y = x^3 - 6x^2 + 8x$

$\frac{dy}{dx} = 3x^2 - 12x + 8$

$0 = 3x^2 - 12x + 8$

$0 = 3x^2 - 4x + 2$

$x = 2 \pm 2\sqrt{3}$

36. a

$$\int \frac{1-x^2}{1+x^2} dx$$

$$= \int \frac{2-(1+x^2)}{1+x^2} dx$$

$$= \int \frac{2}{1+x^2} dx - \int 1 dx$$

$$= 2\tan^{-1} x - x + c$$

37. d

Equation of the ellipse

$$\frac{x^2}{4}+\frac{y^2}{9}=1$$

$a^2=4, b^2=9$

area of ellipse $(A)=\pi ab$

$=\pi \cdot 2 \cdot 3=6\pi$ sq. units

38. d

silicon is least likely to be found in an organic compound.

39. b

The Friedel -Crafts acylation reaction involves the addition of an acyl group to an aromatic ring. The halogen belonging to the acyl halide forms a complex with the Lewis acid and generating a highly electrophilic acylium ion, which has a general formula of RCO^{+} and is stabilized by resonance.

40. c

When $\mathrm{NH_3}$ is passed over heated CuO, if oxidizes to nitrogen.
$3\,\mathrm{CuO}+2\,\mathrm{NH_3}\longrightarrow 3\,\mathrm{Cu}+3\,\mathrm{H_2O}+\mathrm{N_2}$

41. a

$\mathrm{MnO_2}+4\,\mathrm{HCl}\longrightarrow \mathrm{MnCl_2}+2\,\mathrm{H_2O}+\mathrm{Cl_2}$

In the above reaction $\mathrm{MnO_2}$ is reduced to $Mn+2$ and oxidation number decreases from $+4$ to $+2$, thus it acts as oxidising agent.

42. d

KCl is the one that imparts violet colouration to the Bunsen burner non-luminous flame.

43. c

For preventing corrosion of copper, alloying of copper is done with zinc forming brass.

$\mathrm{Cu}+\mathrm{Zn}=\mathrm{Brass}$

44. a

"Lucas' reagent" is a solution of anhydrous zinc chloride in concentrated hydrochloric acid.

45. b

$\mathrm{C\ oxidises\ from\ 0\ to}+2$

46. a

$\mathrm{HNO_3}$ (Nitrous acid) acid acts as an oxidising, reducing agent and has complex formation properties.

47. b

Aluminium is diagonally related to beryllium.

48. a

49. c

50. c

51. a

52. d

53. b

54. a

55. c

56. a

57. a

58. b

59. c

60. a

61. c

First case$s_1 = \frac{1}{2}a \times (10)^2 = 50 \times a = 50a$

$2^{nd} case$

$u = 10 \times a = 10a$

$s_2 = 10 \times a \times 10 + \frac{1}{2}a \times (10)^2$

$= 100 \times a + 50 \times a$

$= 100a + 50a$

$= 150a$

$= 3s_1$

$s_2 = s_1$

62. a

$$W = \int F dx = \int kx dx = k\frac{x^2}{2}\Big|_0^{x_1} = k\frac{x_1^2}{2}$$

63. c

$v = \frac{1}{2}y_{max}$

$or, \omega\sqrt{r^2 - y^2} = \frac{1}{2}r\omega$

$or, 4r^2 - 4y^2 = r^2$

$or, y^2 = \frac{3r^2}{4}$

$or, y = \frac{\sqrt{3}}{2}r$

64. c

$$\rho = \frac{\rho_1 + \rho_2}{2} = \frac{0.6 + 0.8}{2} = 0.7 g/cc$$

65. d

$$\frac{\Delta P}{P} \times 100\% = \frac{\Delta T}{T} \times 100\% = \frac{1}{250} \times 100\% = 0.4\%$$

66. a

$$\mu = \frac{\text{Real Depth}}{\text{Apparent Depth}} = \frac{1}{1 - 0.1} = \frac{1}{0.9}$$

or, Apparent shift = $t\left(1 - \frac{1}{\mu}\right)$

or, $0.1 = 1\left(1 - \frac{1}{\mu}\right)$

or, $1 - \frac{1}{\mu} = \frac{1}{10}$

or, $\frac{1}{\mu} = \frac{9}{10}$

$$\mu = \frac{10}{9}$$

67. b

$$\frac{\mathrm{V}_2}{\mathrm{V}_1} = (\mathrm{n})^{\frac{2}{3}}$$

or, $\mathrm{V}_2 = (1000)^{\frac{2}{3}}\ \mathrm{V}$ = 100V

68. a

The circuit can be redrawn as Wheatstone's bridge. The bridge is balanced circuit.

$$\frac{1}{R'} = \frac{1}{2R} + \frac{1}{2R}$$

$$\frac{1}{R'} = \frac{2 \times 1}{2R}$$

$$R' = R$$

69. b

Force experienced by a charge on moving in an electric field,

$F = Bqv \sin\theta$

If $\theta = 90^\circ, F = Bqv$

In this case,

Centripetal force = Bqv

Or, $\frac{mv^2}{r} = Bqv$

$$r = \frac{mv}{Bq}$$

$$r = \frac{9.1 \times 10^{-31} \times 2 \times 10^6}{2 \times 10^{-5} \times 1.6 \times 10^{-19}} = 0.57 \text{ m.}$$

70. c

$\omega = 2\pi f = 120;$

$$f = \frac{120}{2\pi} = 19 \text{ Hz}$$

$V_o = 240$ V;

$$V_{rms} = \frac{V_o}{\sqrt{2}} = 170 \text{ Volt}$$

71. d

According to Melde's law

$P\sqrt{T} =$ constant

Where P is the no. of loops

So, $\frac{6}{4} = \sqrt{\frac{T_2}{T_1}} = \sqrt{\frac{T_2}{36}}$

Or, $\frac{9}{4} = \frac{t_2}{36}$

So, $T_2 = 9 \times \frac{36}{4} = 81$ N

72. c

For source approaching the observer:

$$f' = \frac{v}{v - v_s} f$$

$$2f = \frac{340}{340 - v_s} f$$

$$680 - 2v_s = 340$$

$2v_s = 340$

$v_s = 170$ m/s

73. a

$I = \frac{ne}{t}$

or, $\frac{n}{t} = \frac{I}{e} = \frac{3.2 \times 10^{-3}}{1.6 \times 10^{-19}} = 2 \times 10^{16}$

74. c

$\frac{E_2}{E_3} = \frac{-\frac{13.6}{4}}{-\frac{13.6}{9}} = \frac{9}{4}$

Energy is – ve

75. c

f(x) = x^2-4x-5, quadratic function,

Domain (the values if x) is all real numbers.

To find range we should draw a graph or to write an equation in vertex
form.

f(x) = x^2-4x+4-4-5

f(x) = $(x-2)^2$-9

Point (-2,-9) is the vertex of the parabola, and it is a minimum because a parabola has positive sign in front of x^2, so it is looking up. Minimum value of y = -9

Range(the values of y) is [-9, ∞)

76. a

$A^{-1} = \lambda adj(A)$

$A^{-1} = \frac{1}{|A|} adj(A)$

$\lambda = \frac{1}{|A|}$

$A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 1 & 2 \\ 2 & 3 & 1 \end{bmatrix}$

$|A| = 1(1-6) - 2(3-4) + 3(9-2) = 18$

$\lambda = \frac{1}{|A|} = \frac{1}{18}$

77. c

Let α, α^2 are roots then,

$\alpha + \alpha^2 = -\frac{p}{3}$

$\alpha\alpha^2 = 1$

$\boxed{\alpha = 1}$

$1 + 1^2 = -\frac{p}{3} \implies p = -6$

78. d

He can choose any one shirt out of 10 shirts and other one tie out of 8 ties for a unique outfit.

∴ total number of outfits = 10 × 8 = 80

79. b

General term is $= \frac{n^2}{n!}$

$= \frac{n \cdot n}{n(n-1)}$

$= \frac{n-1+1}{(n-1)!}$

$= \frac{(n-1)}{(n-1)(n-2)!} + \frac{1}{(n-1)!}$

$= \frac{1}{(n-2)!} + \frac{1}{(n-1)!}$

Applying summation,

$= \sum \left[\frac{1}{(n-2)!} + \frac{1}{(n-1)!} \right] = e + e = 2e$

80. a

$2\sin^2\theta - 3\sin\theta - 2 = 0$

$2\sin^2\theta - 4\sin\theta + \sin\theta - 2 = 0$

$2\sin\theta(\sin\theta - 2) + 1(\sin\theta - 2) = 0$

$(2\sin\theta + 1)(\sin\theta - 2) = 0$

$(\sin\theta - 2) \neq 0 \rightarrow (2\sin\theta + 1) = 0$

$\sin\theta = -\frac{1}{2} = \sin\frac{7\pi}{6}$

$\theta = n\pi + (-1)^n \frac{7\pi}{6}$

81. a

$\frac{\cos A}{a} = \frac{\cos B}{b} = \frac{\cos C}{c}$

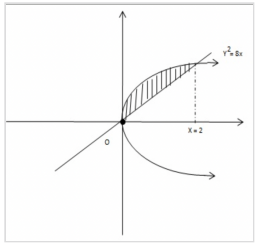
from sine law;

$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

so, $a = b = c = 2$

Hence, $\Delta = \frac{\sqrt{3}}{4}a^2 = \sqrt{3}$

82. a



83. b

$2x^2 - 5xy + 3y^2 = 0$

$2x^2 - 3xy - 2xy + 3y^2 = 0$

$x(2x - 3y) - y(2x - 3y) = 0$

$(x - y)(2x - 3y) = 0$

The lines are: $x - y = 0$ and $(2x - 3y) = 0$

Line parallel to $x - y = 0$ is $x - y + k = 0$ and passes through (1,2) $k = 1$ so, $x - y + 1 = 0$

Line parallel to $2x - 3y = 0$ is $2x - 3y + k = 0$ and passes through (1,2) $k = 4$ so, $2x - 3y + 4 = 0$

The pair of line is $(x - y + 1)(2x - 3y + 4) = 0 \rightarrow$
$2x^2 – 5xy + 3y^2 + 6x – 7y + 4 = 0$

84. a

The general equation of the circle with center (h, k) and radius r is, $(x - h)^2 + (y - k)^2 = r^2$ ...(1)

$r_1 = \sqrt{g^2 + f^2 - c} = \sqrt{16 + 16 + 4} = \sqrt{36} = 6$

Where r1 is the radius of given circle.

Since circle (1) touch the given circle, $r_2 = r = k$.

$(h - 4)^2 + (k - 4)^2 = (6 + k)^2$

Solving above equation, we have

$(h - 4)^2 = 20k + 20$

Replace (h, k) by (x, y)

$(x - 4)^2 = 4(5y + 5)$

Which is locus of parabola.

85. b

The one end point of latus rectum is $(a, 2a) = (2, 4)$

Slope = $\frac{dy}{dx} = -\frac{y}{2a} = -\frac{4}{2 \times 2} = -1$

Equation is: $y - 4 = -1(x - 2) \rightarrow x + y - 6 = 0$

The other end point of latus rectum is $(a, -2a) = (2, -4)$

Slope = $\frac{dy}{dx} = -\frac{y}{2a} = -\frac{-4}{2 \times 2} = 1$

Equation is: $y + 4 = 1(x - 2) \rightarrow x - y - 6 = 0$

Combined equation is $(x + y - 6)(x - y - 6) = 0$

$x^2 - y^2 - 12x + 36 = 0$

86. a

A plane through $(3, 4, 2)$ is

$A(x - 3) + B(y - 4) + C(z - 2) = 0$

Since it passes through $(7, 0, 6)$

$4A - 4B + 4C = 0$

$i.e., A - B + C = 0$

Also, the plane is perpendicular to

$2x - 5y = 15$

$\therefore 2A - 5B = 0$

$A = \frac{5}{2}B$

$C = B - A = B - \frac{5}{2}B = -\frac{3}{2}B$

$\therefore A : B : C = \frac{5}{2} : 1 : -\frac{3}{2} = 5 : 2 : -3$

The plane is $5(x - 3) + 2(y - 4) - 3(z - 2) = 0$

i.e., $5x + 2y - 3z - 17 = 0$.

87. a

88. c

$f_y = x\cos(xy) + \frac{x^2}{y}$

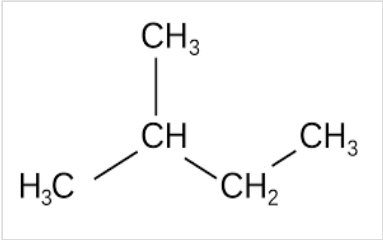
$f_{yx} = \cos(xy) – xy\sin(xy) + \frac{2x}{y}$

Put $(x, y) = (0, \frac{\pi}{2})$

$= 1$

89. d

90. b



91. d

Oxygen is more electronegative than chlorine. With an increase in the number of O atoms attached to Cl, more electrons are pulled away from O–H bond and more weaker becomes the O–H bond. This increases the acid strength.

The decreasing order of acidic strength is
$\mathrm{HClO_4} > \mathrm{HClO_3} > \mathrm{HClO_2} > \mathrm{HClO}$.

92. a

$$\mathrm{CuSO_4 + 2\,NH_4OH \longrightarrow Cu(OH)_2 + (NH_4)_2SO_4}$$

$$\mathrm{Cu(OH)_2 \xrightarrow[100\,^\circ C]{\Delta} CuO\,(s) + H_2O\,(l)}$$

$\mathrm{X} \Rightarrow \mathrm{Cu(OH)_2}$
$\mathrm{Y} \Rightarrow \mathrm{CuO}$

93. a

$$\mathrm{CaCO_3 + 2\,HCl \rightarrow CaCl_2 + H_2O + CO_2}$$

$\mathrm{1\,mole}$ $\mathrm{2\,mole}$ $\mathrm{1\,mole}$

$\mathrm{100\,g}$ $\mathrm{73g}$ $\mathrm{22.4\,liters\ at\ STP}$

100 g $CaCO_3$ reacts with 73 of HCl

5g $CaCO_3$ reacts with 3.65g of HCl

Hence, Limiting reactant is $CaCO_3$

Then, 100g of $CaCO_3$ gives 22.4 liter of CO_2 at STP.

5 g of $CaCO_3$ gives 22.4100×5 liter of CO_2 at STP = 1.12 liters

94. b

$$E_{CO_2} = \frac{22400}{2}\mathrm{ml\ at\ NTP}$$
$$= 11200\ \mathrm{ml\ at\ NTP}$$
$$\frac{V_{CO_2}}{E_{CO_2}} = \frac{V_{HCl} \times N_{HCl}}{1000}$$
$$\frac{10}{11200} = \frac{25 \times N_{HCl}}{1000}$$
$$N_{HCl} = \frac{100}{25 \times 112} = \frac{1}{28} = 0.0357N$$

95. c

500 ml of an aqueous solution of HCl with pH = 3.0

The number of moles of hydrogen ions present are $0.5 \times 10^{-3} = 0.0005$

300 ml of an aqueous solution of NaOH with pH = 11.0 i.e pOH = 3

The number of moles of hydroxide ions present are $0.3 \times 10^{-3} = 0.0003$

Out of 0.0005 moles of hydrogen ions, 0.0003 moles will be neutralized with 0.0002 moles of hydroxide ions.

Hydrogen ion concentration = $\frac{0.0002}{0.8} = 0.00025$

$$\mathrm{pH} = -\log\left[\mathrm{H^+}\right] = -\log 0.00025 = 3.6$$

96. c

$$\mathrm{Al^{+3} + 3\,e^- \longrightarrow Al}$$

3 mole of electron requied to deposite 1g equiv Al

97. c

98. b

99. d

100. a