Shift 1

Tribhuvan University

2080

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

1. **Dimensional Formula of Stefan's constant is: [IOE 2078]**

　a. $[ML^0T]$ 　　　　　b. $[M^1L^2T^{-2}K^{-4}]$

　c. $[M^1L^0T^{-2}K^{-4}]$ 　　　d. $[M^1L^0T^{-3}K^{-4}]$

2. **A particle is projected along a line of greatest slope up a rough inclined plane of slope angle $45°$ with the horizontal. If the coefficient of friction is 0.5, then retardation is:**

　a. $\dfrac{g}{2\sqrt{2}}$ 　　　　　b. $(1+0.5)\dfrac{g}{\sqrt{2}}$

　c. $\dfrac{g}{\sqrt{2}}$ 　　　　　d. $(1-0.5)\dfrac{g}{\sqrt{2}}$

3. **An astronaut feels weightlessness when:**

　a. it is leaving earth. 　　　b. it is provided with escape velocity.

　c. in any orbit. 　　　　　d. in certain orbit.

4. **A wire of length L and radius 'r' is pulled by the weight of mass M. If Young's Modulus is Y then elongation of wire is:**

　a. $\dfrac{MgLY}{\pi r^2}$ 　　　　　b. $\dfrac{MgL}{\pi r^2 Y}$

　c. $\dfrac{\pi r^2 Y}{Mg^2}$ 　　　　　d. $\dfrac{\pi r^2 Y}{ML}$

5. **A capillary tube when immersed vertically in a liquid record a rise of 2cm. If the tube is held immersed in a liquid at an angle of $60°$ with the vertical, the length of the liquid column along the tube will be**

　a. 1cm 　　　　　b. 2cm

　c. $\dfrac{4}{\sqrt{2}}$cm 　　　　　d. 4cm

6. **The amount of heat required to convert $1gm$ of ice at $-100°c$ to steam at $100°c$ is**

　a. 766 cal 　　　　　b. 696 cal

　c. 716 cal 　　　　　d. 736 call

7. **If dW = 0 , dQ < 0 then which of the following is true ? [IOE 2076]**

a. temperature increases

b. temperature decreases

c. volume decreases

d. volume increases

8. A diver inside a pond looks at an object whose natural color is green . He sees the object as

a. green

b. blue

c. yellow

d. red

9. A, B and C are three optical media of respective critical angles C1 , C2 and C3 . Total internal reflection can occur from A to B and also from B to C but not from C to A . The correct relation for the critical angles will be

a. $C_1 > C_2 > C_3$

b. $C_1 = C_2 = C_3$

c. $C_3 > C_1 > C_2$

d. $C_1 < C_2 < C_3$

10. A parallel plate capacitor with air as medium between the plates has a capacitor of 10 μ F . Now area of the capacitor is divided into the two equal halves and then filled with two media having dielectric constants K_1 = 2 and K_2 = 4 . The capacitance of the system will now be :

a. 15 μ F

b. 28 μ F

c. 28 μ F

d. 30 μ F

11. The thermoelectric power of a thermocouple when the cold junction is kept at $0°C$ is (if thermo emf is $E = AT + \frac{1}{2}BT^2$)

a. $A + BT$

b. $A + \frac{1}{2}BT$

c. $\frac{A}{2B}$

d. $\frac{AT^2}{2} + \frac{BT^2}{6}$

12. Which of the following is used in the core of an electromagnet

a. soft iron

b. soft steel

c. soft aluminium

d. soft zinc

13. A straight conducting rod of length 0.4 m is moving perpendicular to the magnetic flux density of $0.9 W/m^2$ with a speed of 7 m/s. the emf developed in the rod is:

a. 25.4 V

b. 2.52 V

c. 5.62 V

d. 1.36 V

14. In Young's double slit experiment , if the width of 2nd fringe is 2×10^{-3} cm , then the width of 4th fringe will be

a. 2×10^{-3}cm

b. 4×10^{-2}cm

c. 1.5×10^{-5}

d. 10^{-2}cm

15. If the phase difference between the two waves is 2π during superposition, then the resultant amplitude is

a. Maximum

b. Minimum

c. Both

d. None
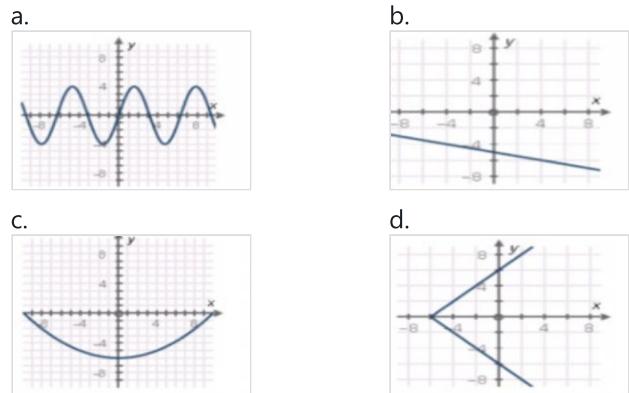
16. Millikan's oil drop experiment is based on principle of [IOE 2076]

a. Newton's law of gravitation

b. Hooke's law

c. Poisecuille's law

d. Stoke's law

17. Majority charge carries in n- type semiconductor are [IOE 2076]

a. free electrons
b. holes
c. bound electrons
d. both a and c

18. Which of the following does not represent a function ?

a.

b.

c.

d.

19. Choose the correct answer:

a. Every identity matrix is a scalar matrix
b. Every scalar matrix is an identity matrix
c. Every diagonal matrix is an identity matrix
d. A square matrix who's each element is 1 is an identity matrix

20. The roots of the equation $x^2 - (p+1)x + p = 0$ are

a. Real, rational and distinct
b. Real and equal
c. Real and irrational
d. Imaginary

21. Sum of all coefficient in $(2x - 3y^2 + 2z + 5w^3 - 3)^4$:

a. 3
b. 9
c. 27
d. 81

22. If $\dfrac{1}{6}\sin\theta, \cos\theta, \tan\theta$ are in G.P. then, θ is

a. $2n\pi \pm \dfrac{\pi}{3}$
b. $2n\pi \pm \dfrac{\pi}{6}$
c. $n\pi + (-1)^n \dfrac{\pi}{3}$
d. $n\pi + \dfrac{\pi}{3}$

23. $\sin(\tan^{-1} x) =, |x| < 1$ [IOE 2074]

a. $\dfrac{x}{1 + x^2}$
b. $\dfrac{x}{\sqrt{1 + x^2}}$
c. $\dfrac{x}{\sqrt{1 - x^2}}$
d. $\dfrac{x}{1 - x^2}$

24. In an equilateral triangle, the in–radius and the circumradius are connected by the relation :

a. $r = 4R$
b. $2r = R$
c. $3r = R$
d. $4r = R$

25. The vector product $\vec{a} \times \vec{b} = 0$ iff

a. $\vec{a} = 0$
b. $\vec{b} = 0$
c. $\vec{a} = 0$ or $\vec{b} = 0$ or $\vec{a}, \vec{b}$ are parallel
d. vectors $\vec{b}$ and $\vec{a}$ are parallel

26. The value of k for which the points $(2, 1)$, $(4, 5)$ and ($k, -1$) are collinear is

a. 3
b. 4
c. 5
d. 1

27. The angle between the tangents to the circle $x^2 + y^2 = 100$ at points $(6, 8)$ and $(8, -6)$ is :

a. $0°$

b. $45°$

c. $90°$

d. $135°$

28. The equation of parabola whose vertex and focus are (0, 4) and (0, 2) is given by :

a. $y^2 - 8x - 32 = 0$

b. $y^2 + 8x - 32 = 0$

c. $x^2 + 8y - 32 = 0$

d. $y^2 + 8x - 32 = 0$

29. If P is a point on the ellipse $9x^2 + 36y^2 = 324$ whose foci are
S and S' then $PS + PS'$ equals

a. 6

b. 8

c. 10

d. 12

30. The foot of the perpendicular from $(7, 5, 2)$ on the plane $2x + y - 3z + 1 = 0$ is

a. $(-7, -5, -2)$

b. $(2, 5, 7)$

c. $(5, 4, 5)$

d. $(-5, 4, 5)$

31. The value of $\lim\limits_{n\to\infty} \dfrac{1}{2} + \dfrac{1}{2^2} + \dfrac{1}{2^3} + \dots\dots + \dfrac{1}{2^n}$ is equal to

a. 1

b. 0

c. $\dfrac{1}{2}$

d. None of these

32. Derivative of $\tan^{-1}(e^x)$ is [IOE 2075]

a. $\dfrac{1}{e^x + e^{-x}}$

b. $e^x + e^{-x}$

c. $e^x - e^{-x}$

d. $\dfrac{1}{e^x - e^{-x}}$

33. If $y = \dfrac{x}{1} + \dfrac{x^2}{2} + \dfrac{x^3}{3} + \dots + \infty$, then $\dfrac{dy}{dx}$

a. $\dfrac{1}{1-x}$

b. $\dfrac{1}{1+x}$

c. $\dfrac{x}{1+x}$

d. $\dfrac{x}{1-x}$

34. The tangents to the curve $y = x^3$ at $x = -1$ and $x = 1$ are

a. parallel

b. none of these

c. perpendicular to each other

d. intersecting obliquely

35. The curves $y = x^2$ and $6y = 7 - x^2$ intersect at the point $(1, 1)$ at an angle

a. $\tan^{-1} 7$

b. $\dfrac{\pi}{4}$

c. $\dfrac{\pi}{3}$

d. $\dfrac{\pi}{2}$

36. $\displaystyle\int_1^2 \dfrac{dx}{x+2}$ [IOE 2076]

a. 1

b. $\log_e 2$

c. $\log_e(3/4)$

d. $\log_e(4/3)$

37. If $f(x+y) = f(x)f(y)x, y \in R$ and $f(1) = 2$ then area enclosed by $3|x| + 2|y| \le 8$ is:

a. $\dfrac{f(6)}{2}$

b. $\dfrac{f(6)}{3}$

c. $\dfrac{f(6)}{4}$

d. $f(6)$

38. Which of the following alkyl halides is used as a methylating agent.

a. CH_3I

b. C_2H_5Cl

c. C_2H_5Br

d. C_6H_6Cl

39. Isomers of C_3H_6O are [IOE 2078]

a. Propanoic acid and Methane ethanoate

b. Propanal and Propanone

c. Ethanal and Propanone

d. Propanol and methyl ethyl ether

40. What happens when SO_2 treated with $KMnO_4$? [IOE 2074]

a. sulphur is oxidized from oxidation state of + 4 to + 6

b. manganese is reduced from oxidation state of +7 to + 6

c. the purple solution of $KMnO_4$ decolourizes

d. all of these

41. Temporary hardness may be removed by adding

a. $CaCO_3$

b. $CaSO_4$

c. $Ca(OH)_2$

d. HCl

42. Sodium metal cannot be kept in

a. Benzene

b. Alcohol

c. Kerosene

d. Toluene

43. Bordeaux used as fungicide is a mixture of

a. $CuSO_4 + Ca(OH)_2$

b. $CaSO_4 + Cu(OH)_2$

c. $CuCO_3 + Cu(OH)_2$

d. $CuO + CaO$

44. The iron salt used in blue print is

a. FeC_2O_4

b. $Fe_2(C_2O_4)_3$

c. $K_4[Fe(CN)_6]$

d. $FeSO_4$

45. Lowest oxidation state of manganese is found in [IOE 2076]

a. $KMnO_4$

b. Mn_2O_4

c. Mn_2O_3

d. MnO_2

46. Conjugate acid of HPO_3^{--} is [IOE 2076]

a. PO_3^{---}

b. H_2PO_3

c. $H_2PO_3^{-}$

d. $H_2PO_3^{--}$

47. The shape of short lived CH_2^{2+} ion is;

a. angular

b. linear

c. planar

d. none

48. In the periodic table, going down in fluorine group

a. Reactivity will increases

b. Electronegativity will increases

c. Ionic radius will increases

d. Ionization potential will increases

49. Please give me one of _____.

a. those

b. this

c. such

d. that

50. The _____ has caught the thief.

a. police

b. public

c. committee

d. gentry

51. He has an abundance _____ wealth.

a. to

b. of

c. for

d. about

52. The sentence structure of ‚Äú She presented him a warm welcome . ‚Äò is [IOE 2076]

a. S + V + O + C

b. S + V + IO + DO

c. S + V + O + Adverbial

d. S + V + O

53. Our classes _____ by next Friday.

a. will be completing

b. will complete

c. was completing

d. will have been completed

54. Active form of 'The dog was run over by a car.' Is [IOE 2075]

a. A car run over the dog.

b. A car runs over the dog.

c. A car ran over the dog.

d. A car had run over the dog.

55. The word 'obligation' gets its primary stress on its _____ syllable . [IOE 2075]

a. 1st

b. 2nd

c. 3rd

d. 4th

56. Though he was very rich, he is still unhappy. This sentence is a _____.

a. Simple Sentence

b. Compound Sentence

c. Complex Sentence

d. Compound-Complex Sentence

57. There is no point in shading crocodile tears. ' crocodile tears' means

a. heavy tears

b. tears in pain

c. being serious

d. showy tears

58. The antonym of the word 'cupidity' is [IOE 2076]

a. greed

b. voracity

c. avarice

d. generosity

59. If the book interesting, _____ it. [IOE 2077]

a. will buy

b. would have bought

c. would buy

d. buy

60. synonym of "corpulent" is:

a. Lean

b. Gaunt

c. Emaciated

d. Obese

61. By which velocity a ball be projected vertically upward so that the distance covered by it in fifth second is twice the

distance it covers in its sixth second ? [IOE 2076]

a. 19.6 m/s

b. 49 m/s

c. 58.8 m/s

d. 65 m/s

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62. **If a planet had mass and radius half of the earth, the acceleration due to gravity of that planet is**

a. $4.9\ m/s^2$

b. $9.8\ m/s^2$

c. $19.6\ m/s^2$

d. $10\ m/s^2$

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63. **Two springs A and B have force constant K_A and K_B such that $K_A = 2K_B$ are stretched by applying same force. Energy stored in spring A is E and energy stored in B will be**

a. E

b. 2E

c. 4E

d. 8E

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64. **A drop of water of $10^{-3}m^3$ is pressed between two glass plates so that it spread to an area $10^{-2}m^2$. The surface tension of liquid 4 N/m, then value of force required to separate the glass plate is [IOE 2073]**

a. 0.1 N

b. 0.2 N

c. 0.4 N

d. 0.8 N

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65. **A working substance takes 2000J of energy. If the temperature of source and sink is 800K and 300K respectively. The amount of work done by substance is: [IOE 2072]**

a. 500 J

b. 750 J

c. 1250 J

d. 1500 J

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66. **The velocity of light in a glass vessel is 2×10^8 m/s and 3×10^8 m/s in air . If a glass slab of thickness 9 cm is kept covering ink dot at its bottom , the height through which the ink dot will be appeared to be raised by in slab is [IOE 2076]**

a. 1.5 cm

b. 3 cm

c. 4.5 cm

d. 6 cm

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67. **A parallel plate capacitor has capacitance 5 μF in air and 15 μF in oil. The dielectric constant of oil is:**

a. $\dfrac{1}{3}$

b. 3

c. $\dfrac{3}{2}$

d. $\dfrac{2}{3}$

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68. **In a meter bridge experiment null point is obtained at 20 cm from one end of the wire when resistance x is balanced against another resistance Y. If $X < Y$ then where will be new position of null point from the same end. If one decides to balance a resistance of 4X against Y?**

a. 50 cm

b. 80 cm

c. 40 cm

d. 70 cm

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69. **The magnetic field at the center of a circular coil of radius 10 cm having 500 turns of the coil and carrying current 18 A is ($\mu_0 = 4\pi \times 10^{-7} Hm^{-1}$) [IOE 2076]**

a. 5.65×10^{-5} T

b. 5.65×10^{-4} T

c. 5.65×10^{-3} T

d. 5.65×10^{-2} T

70. A coil of mean area 500 cm^3 and having 1000 turns is held perpendicular to a uniform field if 0.4 gauss. The coil is turned $180°$ in $\frac{1}{10}$ second,, the induced emf is:

a. 4 V

b. 0.4 V

c. 0.04 V

d. 0.0004 V

71. If mercury is used in place of water in resonance tube the frequency gets [IOE 2078]

a. increases

b. decreases

c. remains same

d. cannot say

72. A vehicle sounding a whistle of frequency 300Hz is moving on a straight road towards a complex with velocity of $15ms^{-1}$. The number of beats per second observed by passenger is vehicle is (velocity of sound = 332 m/s) [IOE 2074]

a. 22

b. 26

c. 28

d. 27

73. The photo-electric threshold wavelength of tungsten is 2730 $\overset{\circ}{A}$. The work function

a. 15 eV

b. 25 eV

c. 3.5 V

d. 4.5 eV

74. Find the de Broglie wavelength of an electron in He^+ ion of level $n = 4$ [IOE 2078]

a. $66.6\overset{\circ}{A}$

b. $33.3\overset{\circ}{A}$

c. $6.67\overset{\circ}{A}$

d. $1.67\overset{\circ}{A}$

75. If $f^{-1}(x) = 3x + 5$, then $f^{-1}(-17)$ and $f(1) =$? [IOE 2078]

a. -45, -4/3

b. 46, -4/3

c. -46, 8

d. -46, -4/3

76. If $A = 2I_3$,then $A^5 =$

a. $8A$

b. $16A$

c. $24A$

d. $32A$

77. If roots of equation $x^2 - px + q = 0$ are in the ratio $2 : 3$ then [IOE 2076, IOE 2078]

a. $25q = 6p^2$

b. $25p = 6q^2$

c. $6q = 25p^2$

d. $6p = 25q^2$

78. In an A.P., the sum of the p terms is equal to the sum of the first q terms. Then, the sum of its first $(p + q)^{\text{th}}$ terms is

a. $\sqrt{pq}$

b. p^2q

c. $2pq$

d. 0

79. The number of terms in the expansion of $(2x + y + 8z)^4$ are [IOE 2076]

a. 12

b. 13

c. 14

d. 15

80. The general solution of $2 \cos A \cos 3A + 1 = 0$ is [IOE 2076]

a. $n\pi \pm \dfrac{\pi}{3}$

b. $2n\pi \pm \dfrac{\pi}{3}$

c. $2n\pi \pm \dfrac{\pi}{4}$

d. $n\pi \pm \dfrac{\pi}{6}$

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81. In $\triangle ABC$, $\dfrac{r_2 - r}{b\tan\left(\dfrac{B}{2}\right)} =$ **[IOE 2076]**

a. $\dfrac{r}{R}$

b. $\dfrac{R}{r}$

c. $\dfrac{r_1}{R}$

d. 1

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82. If $\vec{a} + \vec{b} + \vec{c} = 0$, $\vec{a}, \vec{b}, \vec{c}$ are unit vectors . The value of $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}$ **[IOE 2076]**

a. 1/2

b. -1/2

c. 3/2

d. -3/2

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83. If the equation $x^2 + kxy + y^2 - 5x - 7y + 6 = 0$ represents a pair of st. lines then k is **[IOE 2078]**

a. 3/10

b. 10/3

c. 5/3

d. 3/5

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84. Find the equation of tangent of circle $x^2 + y^2 = 4$ and parallel to the line x+2y+3=0. **[IOE 2077]**

a. $x - 2y = \pm 2\sqrt{5}$

b. $x + 2y = \pm 2\sqrt{5}$

c. $y + 2x = \pm 2\sqrt{5}$

d. $y - 2x = \pm 2\sqrt{5}$

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85. The equation of parabola having vertex at (2,3) and focus at (2,5) is **[IOE 2076]**

a. $x^2 - 4x - 8y + 28 = 0$

b. $x^2 - 4x - 8y + 20 = 0$

c. $x^2 - 4x - 8y - 28 = 0$

d. $x^2 - 4x - 8y - 20 = 0$

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86. 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

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87. $\lim\limits_{x\to 0} \dfrac{\sin x^\circ}{x}$ **[IOE 2078]**

a. 0

b. $\dfrac{\pi}{180}$

c. $\dfrac{180}{\pi}$

d. 1

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88. Find $\dfrac{d}{dx}\left[\operatorname{cosec}^{-1}\left(\dfrac{x}{x^2 + 5}\right) + \cos^{-1}\left(\dfrac{x^2 + 5}{x}\right) \right] =$ **[IOE 2078]**

a. 0

b. 2

c. x

d. 1

---

89. $\displaystyle\int_1^4 e^{2x^2 - 1} dx^2$ **[IOE 2076]**

a. $\dfrac{(e^6 - 1)}{2}$

b. $\dfrac{e(e^6 - 1)}{2}$

c. $\dfrac{e(e^6 + 1)}{2}$

d. $\dfrac{(e^6 + 1)}{2}$

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90. Alkane is also called as

a. Olefin

b. Paraffin

c. Acetylene   d. Oxime

c. 8×10^{16} d. 6×10^{23}

91. H_2S is prepared in lab by

a. $FeS + dil \cdot HNO_3$ b. $FeS + dil \cdot H_2SO_4$

c. $FeS + conc \cdot H_2SO_4$ d. $Fe + dil \cdot H_2SO_4$

92. The important oxide ore of iron is

a. Sidirite   b. Haematite

c. Pyrites   d. Bauxite

93. Eq wt of a metal is 20. The wt of the metal that will produce 111 g of its chloride is

a. 40 g   b. 20 g

c. 60 g   d. 80 g

94. Which of these solutions has the highest normality?

a. 8 gm of KOH per 100 ml   b. 0.5 M H_2SO_4

c. 1 N phosphoric acid   d. 6 gm of NaOH per 100ml

95. How many gram of CaC_2O_4 will dissolve in distilled water to make one litre of saturated solution? $(K_{sp} = 2.5 \times 10^{-9})$

a. 0.0064 gm   b. 0.064 gm

c. 0.64 gm   d. 6.4 gm

96. The number of electron involved in the reaction when a faradays of electricity is passed through an electrolyte in solution is

a. 1.2×10^{46} b. 96540

Read the following passage and answer the questions below: *(Questions from 97 to 100)*

Critics of new media sometimes use science itself to press their case, citing research that shows how "experience can change the brain." But cognitive neuroscientists roll their eyes at such talk. Yes, every time we learn a fact or skill the wiring of the brain changes; it's not as if the information is stored in the pancreas. But the existence of neural plasticity does not mean the brain is a blob of clay pounded into shape by experience. Experience does not revamp the basic information-processing capacities of the brain. Speed-reading programs have long claimed to do just that, but the verdict was rendered by Woody Allen after he read Leo Tolstoy's famously long novel War and Peace in one sitting: "It was about Russia." Genuine multitasking, too, has been exposed as a myth, not just by laboratory studies but by the familiar sight of an SUV undulating between lanes as the driver cuts deals on his cell phone. Moreover, the effects of experience are highly specific to the experiences themselves. If you train people to do one thing (recognize shapes, solve math puzzles, find

hidden words), they get better at doing that thing, but almost nothing else. Music doesn't make you better at math, conjugating Latin doesn't make you more logical, brain-training games don't make you smarter. Accomplished people don't bulk up their brains with intellectual calisthenics; they immerse themselves in their fields. Novelists read lots of novels, scientists read lots of science. The effects of consuming electronic media are likely to be far more limited than the panic implies. Media critics write as if the brain takes on the qualities of whatever it consumes, the informational equivalent of "you are what you eat." As with ancient peoples who believed that eating fierce animals made them fierce, they assume that watching quick cuts in rock videos turns your mental life into quick cuts or that reading bullet points and online postings turns your thoughts into bullet points and online postings.

97. The passage primarily focuses on

a. Facebook's hearing in the parliament

b. Facebook's impact in American Election

c. Facebook's defense against misinformation accuses

d. Facebook's role and action in election misinformation

98. Company research documents indicated that

a. election was not fraudulent

b. extremist groups were using Facebook

c. Facebook knew its platform was misused for polarization

d. Facebook knew votes were manipulated against Trump

99. What does the word "piecemeal" means in the context of the passage?

a. nothing

b. easy

c. slowly

d. abrupt

100. Why did Facebook struggled to control the situation?

a. Algorithms cannot be controlled

b. The number of people using Facebook are too large

c. It was concerned about image

d. People did not listen

Answer Key							
1.d	2.b	3.c	4.b	5.d	6.a	7.b	8.a
9.d	10.d	11.a	12.a	13.b	14.a	15.a	16.d
17.a	18.d	19.a	20.a	21.d	22.a	23.b	24.b
25.c	26.d	27.c	28.c	29.d	30.c	31.a	32.a
33.a	34.a	35.a	36.d	37.b	38.a	39.b	40.d
41.c	42.b	43.b	44.b	45.c	46.c	47.b	48.c
49.a	50.c	51.b	52.b	53.d	54.c	55.c	56.c
57.d	58.d	59.d	60.d	61.d	62.c	63.b	64.d

65.c	66.b	67.b	68.a	69.d	70.c	71.c	72.c
73.d	74.c	75.d	76.b	77.a	78.d	79.d	80.a
81.d	82.d	83.b	84.b	85.a	86.b	87.b	88.a
89.b	90.b	91.b	92.b	93.a	94.d	95.a	96.d
97.d	98.c	99.b	100.c				

Solutions

1. d

$P = \sigma e A T^4$

$[ML^2T^{-3}] = [\sigma][L^2][K^{-4}]$

$[\sigma] = [M^1 L^0 T^{-3} K^{-4}]$

2. b

$a = g \sin\theta + \mu g \cos\theta$

$a = g \sin 45° + 0.5g \cos 45°$

$= \dfrac{g}{\sqrt{2}} + 0.5 \times \dfrac{g}{\sqrt{2}}$

$= (1 + 0.5)\dfrac{g}{\sqrt{2}}$

3. c

When an astronaut leaves earth or is provided with escape velocity, there is change in velocity (gain in acceleration) so g' = g+a, and thus weight increases. But in orbit, total weight provides centripetal force that provides constant circular motion. Thus, astronaut feels weightlessness.

4. b

$e = \dfrac{FL}{YA} = \dfrac{MgL}{Y\pi r^2}$

5. d

$h =$ height of height of verticals liquid that remains always same

$l =$ length of liquid column

We have,

$\dfrac{h}{l} = \cos\alpha \quad [l = \dfrac{h}{\cos\alpha}]$

$\dfrac{l_1}{l_2} = \dfrac{h}{\cos\alpha_1} \times \dfrac{\cos\alpha_2}{h}$

$\dfrac{l_1}{l_2} = \dfrac{1}{2}$

$l_2 = 2 \times l_1 = 2 \times 2 = 4\text{cm}$

6. a

Total amount of heat required

$=$ ice $at - 100°C$ to ice at $0°C+$ ice $0°C$ to water $0°C+$

water $0°C$ to water $100°c$

+water $100°C$ to steam $100°C$

$= ms_1[0 - (-100)] + mL_1 + ms_w \times 100 + mL_v$

$= (1 \times 0.5 \times 100 + 1 \times 80 + 1 \times 1 \times 100 + 1 \times 536)Cal$

$= 50 + 80 + 100 + 536$

$= 766$ cal

- Steam at $100°c$ produces more severer burn than water at $100°c$ due to latent heat of vaporisation.

7. b

We have, dQ = dU + dW

For dW =0

• dU = dQ

$dQ < 0 \rightarrow dU < 0$ decrease in internal energy means decrease in temperature

8. a

9. d

For total internal reflection to occur, the light must pass from denser to rarer medium.

Since Total internal reflection occurs from A to B $(\mu_A > \mu_B)$, B to C $(\mu_B > \mu_C)$ and not from C to A $(\mu_c < \mu_A)$

i.e $\mu_A > \mu_B > \mu_c$

As, $\sin C \propto \dfrac{1}{\mu}$

$C_1 < C_2 < C_3$

10. d

$C = \dfrac{\epsilon_o A}{d}$

Capacitance of each half $= \dfrac{10}{2} = 5\mu F$

New value after dielectric insertion is ;

$C_1 = K_1 \times 5 = 2 \times 5 = 10\mu F$

$C_2 = K_2 \times 5 = 4 \times 5 = 20\mu F$

As area is divided , capacitors are is parallel .

$C_p = C_1 + C_2 = 10 + 20 = 30\mu F$

11. a

12. a

Soft iron: **core of electromagnet, laminated cores in transformer**

Steel : **making permanent magnet**

13. b

$E = Blv \sin\theta = 0.9 \times 7 \times \sin 90° = 2.52V$

14. a

Width of all fringe is same in interference.

15. a

Phase difference is 2π means constrictive interference so resultant amplitude will be maximum.

16. d

It is based on operation of terminal velocity oil drop i.e., stokes' law of viscosity.

17. a

N – type semiconductor contains electrons as majority charge carriers' holes as minority charge carriers.

18. d

Use vertical line test.

vertical line cuts at two points in option d. Hence it is not a function.

19. a

Scalar matrix which isnt identity matrix $A = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$

Diagonal matrix which isnt identity matrix $A = \begin{pmatrix} 0 & 5 \\ 4 & 0 \end{pmatrix}$

Square matrix with each element 1 $A = \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}$. It is not identity matrix.

But every identity matrix is a scalar matrix with 1 in the diagonal.

20. a
$x^2 - (p+1)x + p = 0$

Discriminant, $\Delta = b^2 - 4ac = -(p+1)^2 - 4.1.p = (p-1)^2 > 0$ and is a perfect square.

$\therefore$ Roots are real, unequal and rational.

21. d
Putting $x = y = z = w = 1$

$(2x - 3y^2 + 2z + 5w^3 - 3)^4 = 3^4 = 81$

22. a
$\frac{1}{6}\sin\theta, \cos\theta, \tan\theta$ are in G.P.

$\cos^2\theta = \frac{1}{6}\sin\theta\tan\theta$

$6\cos^2\theta = \frac{\sin^2\theta}{\cos\theta}$

$6\cos^3\theta = 1 - \cos^2\theta$

$6\cos^3\theta + \cos^2\theta - 1 = 0$

$(2\cos\theta - 1)(3\cos^2\theta + 2\cos\theta + 1) = 0$

$\cos\theta = \frac{1}{2}$

$\theta = 2n\pi \pm \frac{\pi}{3}$

23. b
$\tan^{-1} x = \theta$

$\tan\theta = x$

$\frac{\sin\theta}{\cos\theta} = x$

$\frac{\sin\theta}{\sqrt{1 - \sin^2\theta}} = x$

$\sin^2\theta = x^2(1 - \sin^2\theta)$

$$\sin\theta = \frac{x}{\sqrt{1+x^2}}$$

24. b

$$r = 4R\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$$

In equilateral triangle $A = B = C = 60°$

$$r = 4R(\sin 30°)^3$$

$$r = 4R(\frac{1}{2})^3$$

$$2r = R$$

25. c

$$\vec{a} \times \vec{b} = ab\sin\theta\hat{n} = 0 \iff a = 0, b = 0 \, or \, \theta = 0$$

26. d

$(2, 1)$, $(4, 5)$ and $(k, -1)$ are collinear

Slope from first two points = Slope from second two points

$$\frac{5-1}{4-2} = \frac{-1-5}{k-4}$$

$$2 = \frac{-6}{k-4}$$

$$2k - 8 = -6$$

$$2k = 2$$

$$k = 1$$

27. c

$$x^2 + y^2 = 100$$

$$2x + 2y\frac{dy}{dx} = 0$$

$$\frac{dy}{dx} = -\frac{x}{y}$$

Slope at (6,8) = $m_1 = -\frac{6}{8}$

Slope at (8,- 6) = $m_2 = -\frac{8}{-6} = \frac{8}{6}$

$m_1 m_2 = -1$ Hence the tangent lines at these two points are perpendicular.

28. c

The vertex and focus lie in y -axis and focus is below vertex. so, it opens downwards.

$(x - h)^2 = -4a(y - k)$ is the general equation of such parabola.

$$(x - 0)^2 = -4 \times 2(y - 4)$$

$x^2 = -8y + 32$

$x^2 + 8y - 32 = 0$

29. d

$2a = PS + PS'$

$9x^2 + 36y^2 = 324$

$\dfrac{x^2}{6^2} + \dfrac{y^2}{3^2} = 1$

$a = 6, b = 3$

$2a = 12$

30. c

Line through $(7, 5, 2)$ and perpendicular to $2x + y - 3z = -1$

is $\dfrac{x-7}{2} = \dfrac{y-5}{1} = \dfrac{z-2}{-3}$ ... (i)

A point on (i) is $(7 + 2r, 5 + r, 2 - 3r)$

To get the foot of the perpendicular

$2(7 + 2r) + (5 + r) - 3(2 - 3r) = -1$

$13 + 14r = -1$

$r = -1$

$\therefore$ Foot of perpendicular is $Q(5, 4, 5)$.

31. a

$\lim\limits_{n \to \infty} \dfrac{1}{2} + \dfrac{1}{2^2} + \dfrac{1}{2^3} + \ldots\ldots + \dfrac{1}{2^n}$

$\lim\limits_{n \to \infty} \dfrac{\frac{1}{2}\left(\left(\frac{1}{2}\right)^n - 1\right)}{\frac{1}{2} - 1}$

$\dfrac{\frac{1}{2}(0 - 1)}{\frac{1}{2} - 1}$

1

32. a

$\dfrac{d}{dx} \tan^{-1}(e^x) = \dfrac{1}{1 + (e^x)^2} \times e^x = \dfrac{1}{e^{-x} + e^x}$

33. a

$y = \dfrac{x}{1} + \dfrac{x^2}{2} + \dfrac{x^3}{3} + \ldots + \infty$

$y = -\left(-\dfrac{x}{1} - \dfrac{x^2}{2} - \dfrac{x^3}{3} \ldots \infty\right)$

$$y = -\log_e(1-x)$$

Differentiating,

$$\frac{dy}{dx} = -\frac{1}{(1-x)} \cdot (-1) = \frac{1}{1-x}$$

34. a

$$y = x^3$$

$$\frac{dy}{dx} = 3x^2$$

$$\frac{dy}{dx}\bigg|_{-1} = 3(-1)^2 = 3$$

$$\frac{dy}{dx}\bigg|_{1} = 3(1)^2 = 3$$

Equal slope so, parallel.

35. a

$$y = x^2, m_1 = \frac{dy}{dx} = 2x = 2$$

$$6y = 7 - x^2, m_2 = \frac{dy}{dx} = \frac{-2x}{6} = -\frac{1}{3}$$

$$\tan\theta = \frac{m_1 - m_2}{1 + m_1 m_2} = \frac{2 + \frac{1}{3}}{1 - \frac{2}{3}} = \frac{7}{1}$$

36. d

$$\int_1^2 \frac{dx}{x+2} = \log_e(x+2)\big|_1^2 = \log_e 4 - \log_e 3 = \log_e \frac{4}{3}$$

37. b

$$3|x| + 2|y| \le 8$$

Putting $x = 0$ and $y = 0$ we get the respective co-ordinates.

Required area:

$$(A) = 4 \cdot \frac{1}{2}\left(\frac{8}{3} \times 4\right)$$

$$A = \frac{64}{3} = \frac{2^6}{3} \dots\dots \text{(i)}$$

$$f(x+y) = f(x) \cdot f(y)$$

$$f(1+1) = f(2) = f(1)$$

$$[\because \cdot f(1) = 2]$$

$$f(3) = f(1) \cdot f(2) = 2^3$$

....
....
....

$$f(n) = 2^n$$

From (i). we get $A = \dfrac{2^6}{3} = \dfrac{f(6)}{3}$
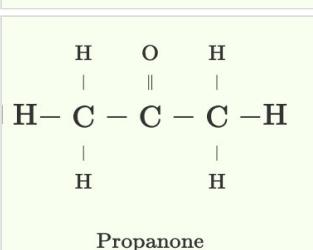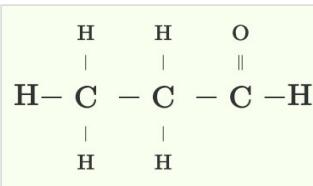
38. a

Methyl iodide (CH_3I) is used as a methylating agent, because methyl group (CH_3) is easily released by methyl iodide.
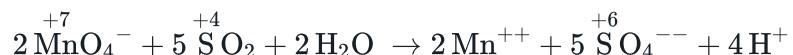
39. b

Isomers are compounds that have the same empirical formula but differ in the arrangement of atoms in the compound

Isomers of C_3H_6O.

Propanal

Propanone

40. d

$$2\,\overset{+7}{Mn}O_4{}^- + 5\,\overset{+4}{S}O_2 + 2\,H_2O \ \rightarrow 2\,Mn^{++} + 5\,\overset{+6}{S}O_4{}^{--} + 4\,H^+$$

$KMnO_4$ becomes colourless.

41. c
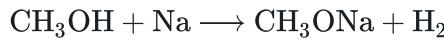
Temporary hardness of water can be removed using Clark's method by adding $Ca(OH)_2$.

In Clark's process, slaked lime $Ca(OH)_2$ is added to temporary hard water. Insoluble calcium carbonate precipitates out and thus, temporary hardness is removed.

42. b

Sodium metal cannot be stored under alcohol because alcohol being a protic solvent and sodium being highly reactive will react and form an alkoxide.
For example:

$$CH_3OH + Na \longrightarrow CH_3ONa + H_2$$

43. b

$$CuSO_4 + Ca(OH)_2 \longrightarrow Cu(OH)_2 + CaSO_4$$

44. b

The iron salt used in blue prints is $Fe_2(C_2O_4)_3$ (Ferric oxalate).

45. c

Oxidation state Mn in $KMnO_4 = \ +7$

Oxidation of Mn in $Mn_2O_4 = \ +4$
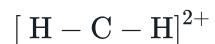
Oxidation state of Mn in $Mn_2O_3 = \ +3$

Oxidation state of Mn in $MnO_2 = \ +4$

46. c

$$HPO_3^{--} + H^+ \longrightarrow H_2PO_3^{-}$$

47. b

$$[H - C - H]^{2+}$$

Carbon is tetravalent atom.

Here; it is short of 2 electron pairs, therefore has a charge of 2.

CH_2^{2+} has 2 σ bond. hence sp hybridized; and resembles, the AX_2 type of molecule, hence Linear.

48. c

In the fluorine group of Periodic Table, as we move downwards ionic radius increases, while electronegativity, ionisation potential and reactivity decreases.

49. a

50. c

51. b

52. b

53. d

54. c

55. c

56. c

57. d

58. d

59. d

60. d

61. d

$$S_{5th} = 2 \times S_{6th}$$

$$u - \frac{g}{2}(2 \times 5 - 1) = 2(u - \frac{g}{2}(2 \times 6 - 1))$$

$$u - \frac{9g}{2} = 2u - 11g$$

$$u = \frac{13g}{2} = 65m/s$$

62. c

$$g = \frac{GM}{R^2}$$

$$\therefore \frac{g_e}{g_p} = \frac{M_e}{M_p} \times \frac{R_p{}^2}{R_e{}^2} = \frac{M_e \times 2}{M_e} \times \frac{R_e{}^2}{4R_e{}^2} = \frac{1}{2}$$

$$\therefore g_p = 2 \times g_e = 2 \times 9.8 = 19.6 \ m/s^2$$

63. b

We know , $E = \frac{1}{2} \cdot F \cdot x$

or, $E = \frac{1}{2} \cdot F \frac{F}{K}$ \qquad $[Since, F = Kx]$

or, $E = \dfrac{1}{2}\dfrac{F^2}{K}$

or, $E \propto \dfrac{1}{K}$ [F = Constant]

As, $K_A = 2K_B$

So, $E_B = 2F_A$

... Energy stored in B will be 2E

64. d

$F = P \times A$

$F = \dfrac{2TA}{t}$

$F = \dfrac{2TA^2}{V}$

$F = \dfrac{2 \times 4 \times (10^{-2})^2}{10^{-3}}$

$F = 0.8N$

65. c

$\eta = 1 - \dfrac{T_2}{T_1} = 1 - \dfrac{300}{800} = \dfrac{5}{8}$

Work done = $\eta \times E = \dfrac{5}{8} \times 2000 = 1250J$

66. b

Here,

R.I of glass$\mu = \dfrac{\text{velocity in air}}{\text{velocity in glass}} = \dfrac{3 \times 10^8}{2 \times 10^8} = 1.5$

Shift = $d\left(1 - \dfrac{1}{\mu}\right) = 9 \times \left(1 - \dfrac{1}{1.5}\right) = 3cm$

67. b

$C_{\text{oil}} = \dfrac{k\varepsilon_0 A}{d} \ldots (i)$

$C_{\text{air}} = \dfrac{\varepsilon_0 A}{d} \ldots (ii)$

Now, Dividing (i) by (ii)

$\dfrac{C_{\text{oil}}}{C_{\text{air}}} = \dfrac{\dfrac{K\varepsilon_0 A}{d}}{\dfrac{\varepsilon_0 A}{d}} = K$

K= $\dfrac{15}{5} = 3$

68. a

$\dfrac{x}{y} = \dfrac{l}{100 - l} = \dfrac{20}{80} = \dfrac{X}{Y} = \dfrac{1}{4}$

$\dfrac{4X}{Y} = \dfrac{l_1}{100 - l_1} = 4 \times \dfrac{1}{4} = \dfrac{l_1}{100 - l_1}$

$l_1 = 50cm$

69. d

$B = \dfrac{\mu_0 NI}{2r} = \dfrac{4\pi \times 10^{-7} \times 500 \times 18}{2 \times 10 \times 10^{-2}} = 0.0565T =$

5.65×10^{-2} T

70. c

$$E = \frac{d\phi}{dt}$$

$$= \frac{-NBA(\cos 180° - \cos 0°)}{t}$$

$$\frac{-NBA(-1-1)}{t}$$

$$= \frac{2NBA}{t}$$

$$= \frac{2 \times 1000 \times 0.4 \times 10^{-4} \times 500 \times 100^{-4}}{\frac{1}{10}}$$

$$= 4 \times 10^{-2} = 0.04V$$

71. c

72. c

Number of beats = frequency of reflected sound - initial frequency

$$= \frac{(v+u_o)}{(v-u_s)}f - f = \frac{(332+15)}{(332-15)} \times 300 - 300 = 28.39 = 28$$

73. d

74. c

$$v = \frac{ze^2}{2\epsilon_0 nh} = 2.18 \times 10^6 \times \frac{2}{4} = 1.09 \times 10^6$$

$$m = 9.1 \times 10^{-31}$$

$$\lambda = \frac{h}{mv} = \frac{6.62 \times 10^{-34}}{1.09 \times 10^6 \times 9.1 \times 10^{-31}} = 6.67\mathring{A}$$

75. d

76. b

$$A^5 = (2I_3)^5 = 2^5 I_3^5 = 2^4 \times 2I_3 = 16A$$

77. a

$$(m+n)^2 ac = mnb^2$$

$$5^2 \times 1 \times q = 2 \times 3 \times p^2$$

$$25q = 6p^2$$

78. d

$$S_p = \frac{p}{2}(2a + (p-1)d]$$

$$S_q = \frac{q}{2}(2a + (q-1)d)$$

$$\frac{p}{2}(2a + (p-1)d) = \frac{q}{2}(2a + (q-1)d)$$

or, $2ap + pd(p-1) = 2aq + qd(q-1))$

or, $2a(p - q) + d\left(p^2 - p - q^2 + q\right] = 0$

or, $2a(p - q) + d\left(p^2 - q^2 - (p - q)\right] = 0$

or, $2a(p - q) + d[(p - q)(p + q) - (p - q)] = 0$

or, $(p - q)[2a + d[(p + q) - 1] = 0$

Either, $(p - q) = 0$

or, $2a + [(p + q) - 1]d = 0$

Sum of $(p + q)$ terms
$= \dfrac{p + q}{2}[2a + (p + q - 1)d] = \dfrac{p + q}{2} \times 0 = 0$

79. d
$m = 3, n = 4$

No. of terms = $^{m+n-1}C_{m-1} = {}^6 C_2 = \dfrac{6!}{(6 - 4)!2!} = 15$

80. a
Here, $2\cos A \cos 3A + 1 = 0$

Or, $2\cos A(4\cos^3 A - 3\cos A) + 1 = 0$

Or, $8\cos^4 A - 6cos^2 A + 1 = 0$

Or, $(4\cos^2 A - 1)(2\cos^2 A - 1) = 0$

Either, $4\cos^2 A - 1 = 0$ or, $\cos^2 A = (\dfrac{1}{2})^2 \to A = n\pi \pm \dfrac{\pi}{3}$

81. d

$\dfrac{r_2 - r}{b\tan(\dfrac{B}{2})} = \dfrac{\dfrac{\Delta}{s - b} - \dfrac{\Delta}{s}}{b\sqrt{\dfrac{(s - a)(s - c)}{(s - b)}}} = \dfrac{\dfrac{b\Delta}{s(s - b)}}{b\sqrt{\dfrac{(s - a)(s - c)}{(s - b)}}}$

$= \dfrac{\Delta}{\sqrt{s(s - a)(s - b)(s - c)}}$

$= 1$

82. d
$\vec{a} + \vec{b} + \vec{c} = 0$

Squaring both sides;

$a^2 + b^2 + c^2 + 2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = 0$

$3 + 2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = 0$

$\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a} = -\dfrac{3}{2}$

83. b

84. b

$$\int_1^4 e^{2y-1}dy$$

85. a

Observing the coordinates of vertex focus, Vertex = $(h, k) = (2, 3)$ Focus = $(h, k + a) = (2, 5)$ i.e., $h = 2, k = 3$ and $a = 2$

$$\frac{e^{2y-1}}{2}\Big|_0^4$$

$$\frac{e^7}{2} - \frac{e}{2}$$

the equation of parabola is: $(x - h)^2 = 4a(y - k)$

$$\frac{e(e^6 - 1)}{2}$$

or, $(x - 2)^2 = 4 \times 2 \times (y - 3)$

$x^2 - 4x - 8y + 28 = 0$

90. b

Alkanes are called paraffins because they have a little affinity towards a general reagent. Alkanes are inert substances. They undergo reactions under drastic conditions.

86. b

87. b

91. b

$$\mathrm{FeS + dil \cdot H_2SO_4 \longrightarrow FeSO_4 + H_2S} \uparrow$$

88. a

89. b

92. b

$$\int_1^4 e^{2x^2-1}dx^2$$

Haematite is the main ore of iron. Its chemical name is 'Iron (III) oxide' and the formula is $\mathrm{Fe_2O_3}$.

$y = x^2$

93. a

$$\frac{\text{wt of metal}}{\text{wt of metal chloride}} = \frac{\text{eq wt of metal}}{\text{eq wt of metal chloride}}$$

when $x^2 = 1, y = 1$

when $x = 4, y = 4$

$$\text{wt of chloride} = \frac{20}{20 + 35.5} \times 111 = 40$$

94. d

a. 8 gm of KOH per 100 ml

$$N = \frac{gm/L}{\text{Equivalent weight}} = \frac{\frac{8}{0.1}}{56} = 1.428\,N$$

b. $0.5\,M\,H_2SO_4 \equiv 1\,N\,H_2SO_4$

c. 1 N phosphoric acid

d. 6 gm of NaOH per 100ml

$$N = \frac{gm/L}{\text{Equivalent weight}} = \frac{\frac{6}{0.1}}{40} = 1.5\,N$$

95. a

$$CaC_2O_4 \rightleftharpoons Ca^{++} + C_2O_4^{--}$$

$$K_{sp} = S^2 = 2.5 \times 10^{-9}$$

$$S = 5 \times 10^{-5}$$

It means 5×10^{-5} moles of CaC_2O_4 will dissolve in distilled water to make one litre of saturated solution.

Mass=Moles×Molar mass $= 5 \times 10^{-5} \times 128 = 0.0064g$

96. d
1 Faraday= 96500 coulombs

1F is charge carried by 1 mole of electrons so 6×10^{23} electrons are involved.

97. d

98. c

99. b

100. c