Max Marks: 300 | **JR_WEEK-4 (06-07-2026)** | **Time: 180 mins**

Chemistry

1. Match List - I (compound) with list - II (Oxidation state of N) and select the correct answer using the codes given below the list: List - I:

List - I	List-II
(A) KNO_3	(a) – 1/3
(B) HNO_2	(b) – 3
(C) NH_4Cl	(c) 0
(D) NaN_3	(d) + 3
	(e) + 5

A) A-e, B-d, C-b, D-a **B)** A-e, B-b, C-d, D-a
C) A-d, B-e, C-a, D-c **D)** A- b, B-c, C-d, D-e

2. Which one of the following is a redox reaction?

A) $H_2 + Br_2 \rightarrow 2HBr$ **B)** $2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$
C) $HCl + AgNO_3 \rightarrow AgCl + HNO_3$ **D)** $NaOH + HCl \rightarrow NaCl + H_2O$

3. Which of the following is not a redox change?

A) $2H_2S + SO_2 \rightarrow 2H_2O + 3S$ **B)** $2BaO + O_2 \rightarrow 2BaO_2$
C) $BaO_2 + H_2SO_4 \rightarrow BaSO_4 + H_2O_2$ **D)** $2KClO_3 \rightarrow 2KCl + 3O_2$

4. In the reaction, $Cl_2 + OH^- \rightarrow Cl^- + ClO_4^- + H_2O$, chlorine is:

A) Oxidised **B)** Reduced
C) Oxidised as well as reduced **D)** Neither oxidised nor reduced

5. Which is a redox reaction:

A) $2CuI_2 \rightarrow 2CuI + I_2$ **B)** $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$
C) $NH_4Cl + NaOH \rightarrow NH_3 + NaCl + H_2O$ **D)** $Cr_2(SO_4)_3 + 6KOH \rightarrow 2Cr(OH)_3 + 3K_2SO_4$

6. Which of the following example does not represent disproportionation -

A) $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$ **B)** $2H_2O_2 \rightarrow 2H_2O + O_2$
C) $4KClO_3 \rightarrow 3KClO_4 + KCl$ **D)** $3Cl_2 + 6NaOH \rightarrow 5NaCl + NaClO_3 + 3H_2O$

7. Which of the following change represents a disproportionation reaction (s):

A) $Cl_2 + 2OH^- \rightarrow ClO^- + Cl^- + H_2O$ **B)** $Cu_2O + 2H^+ \rightarrow Cu + Cu^{2+} + H_2O$
C) $2HCuCl_2 \xrightarrow[Water]{dilution\ with} Cu + Cu^{2+} + 4Cl^- + 2H^+$ **D)** All of the above

8. In the reaction:
$MnO_4^- + SO_3^{2-} + H^+ \rightarrow SO_4^{2-} + Mn^{2+} + H_2O$

A) MnO_4^- and H^+ both are reduced **B)** MnO_4^- is reduced and H^+ is oxidised
C) MnO_4^- is reduced and SO_3^{2-} is oxidised **D)** MnO_4^- is oxidised and SO_3^{2-} is reduced

9. Which of the following reaction represents the oxidising behaviour of H_2SO_4 :-

A) $2PCl_5 + H_2SO_4 \rightarrow 2POCl_3 + 2HCl + SO_2Cl_2$ **B)** $2HCl + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2$
C) NaCl + $H_2SO_4 \rightarrow NaHSO_4 + HCl$ **D)** $2HI + H_2SO_4 \rightarrow I_2 + SO_2 + 2H_2O$

10. Which of the following reaction involves neither oxidation nor reduction :–

A) $CrO_4^{2-} \rightarrow Cr_2O_7^{2-}$ **B)** $Cr \rightarrow CrCl_3$
C) $Na \rightarrow Na^+$ **D)** $2S_2O_3^{2-} \rightarrow S_4O_6^{2-}$

11. Choose the set of coefficients that correctly balances the following equation :
$xCr_2O_7^{2-} + yH^+ + ze^- \rightarrow aCr^{3+} + bH_2O$

A) x-2, y-14, z-6, a-2, b-7 **B)** x-1, y-14, z-6, a-2, b-7
C) x-2, y-7, z-6, a-2, b-7 **D)** x-2, y-7, z-6, a-1, b-7

12. For the redox reaction $Zn + NO_3^- \rightarrow Zn^{2+} + NH_4^+$ in basic medium, coefficients of Zn, NO_3^- and OH^- in the balanced equation respectively are :

A) 4, 1, 7 **B)** 7, 4, 1
C) 4, 1, 10 **D)** 1, 4, 10

13. In the balanced equation-
$[Zn + H^+ + NO_3^- \rightarrow NH_4^+ + Zn^{+2} + H_2O]$ **coefficient of NH_4^+ is:-**

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

14. The reaction of aqueous $KMnO_4$ with H_2O_2 in acidic conditions gives:

A) Mn^{4+} and O_2 **B)** Mn^{2+} and O_2
C) Mn^{2+} and O_3 **D)** Mn^{4+} and MnO_2

15. Which is the best description of the behaviour of bromine in the reaction given below: $H_2O + Br_2 \rightarrow HOBr + HBr$

A) Both oxidized and reduced **B)** Oxidized only
C) Reduced only **D)** Proton acceptor only

16. Consider the following reaction:
$xMnO_4^- + yC_2O_4^{2-} + zH^+ \rightarrow xMn^{2+} + 2yCO_2 + \frac{z}{2}H_2O$
The values of x, y and z in the reaction are respectively:

A) $5, 2$ and 16 **B)** $2, 5$ and 8
C) $2, 5$ and 16 **D)** $5, 2$ and 8

17. In which of the following reaction H_2O_2 acts as a reducing agent? (a) $H_2O_2 + 2H^+ + 2e^- \to 2H_2O$ (b) $H_2O_2 - 2e^- \to O_2 + 2H^+$ (c) $H_2O_2 + 2e^- \to 2OH^-$ (d) $H_2O_2 + 2OH^- - 2e^- \to O_2 + 2H_2O$

A) (a), (c) **B)** (b), (d)
C) (a), (b) **D)** (c), (d)

18. In the following reaction:
$2FeCl_3 + H_2S \to 2FeCl_2 + 2HCl + S$

A) $FeCl_3$ is oxidant **B)** $FeCl_3$& H_2S are oxidised
C) $FeCl_3$ is oxidised & H_2S is reduced **D)** H_2S is oxidant

19. In oxidation reduction reaction $Cr_2O_7^{2-} + SO_3^{2-} + H^+ \to Cr^{+3} + SO_4^{2-} + H_2O$ the balance equation coefficient for $Cr_2O_7^{2-}, SO_3^{2-}, H^+$ are:

A) 1, 3, 8 **B)** 16, 5, 2
C) 2, 16, 5 **D)** 5, 2, 16

20. $KMnO_4$ is titrated with ferrous ammonium sulphate hexahydrate in presence of dilute H_2SO_4. Number of water molecules produced for 2 molecules of $KMnO_4$ is ____.

A) 68 **B)** 34
C) 36 **D)** 72

21. In the reaction: $MnO_4^- + xH^+ + ne^- \to Mn^{2+} + yH_2O$. What is the value of n :

22. The number of electrons required to balance charge in the following equation – $MnO_4^- + 2H_2O \to MnO_2 + 4OH^-$ is

23. The value of n in : $4MnO^- + 8H^+ + ne^- \to Mn^{2+} + 4H_2O$ is

24. In the reaction $8Al + 3Fe_3O_4 \to 4Al_2O_3 + 9Fe$, the number of electrons transferred from reductant to oxidant is:

25. How many electrons should X_2H_4 liberate so that in the new compound X shows oxidation number of $-1/2$ (E.N. $X > H$)

Maths

26. $\frac{\sin\theta - \sin 2\theta}{1 - \cos\theta + \cos 2\theta} =$

A) $\tan 2\theta$ **B)** $\cot 2\theta$
C) $\tan\theta$ **D)** $-\tan\theta$

27. Which of the following is a rational number?

A) $\sin 15^\circ$ **B)** $\cos 15^\circ$
C) $\sin 15^\circ \cos 15^\circ$ **D)** $\sin 15^\circ \cos 75^\circ$

28. The value of $\cos^2 76^\circ + \cos^2 16^\circ - \cos 76^\circ \cos 16^\circ =$

A) $1/4$ **B)** $3/4$
C) $5/4$ **D)** $1/2$

29. $\sqrt{2 + \sqrt{2 + \sqrt{2 + \sqrt{2 + \sqrt{2}}}}} =$ **(with 5 square roots)**

A) $\cos\frac{\pi}{32}$ **B)** $2\cos\frac{\pi}{32}$
C) $2\cos\frac{\pi}{64}$ **D)** $\cos\frac{\pi}{64}$

30. $\tan 9^\circ - \tan 27^\circ - \tan 63^\circ + \tan 81^\circ =$

A) 0 **B)** 2
C) 1 **D)** 4

31. The value of the expression $\tan^6 20^\circ - 33\tan^4 20^\circ + 27\tan^2 20^\circ$ is

A) 0 **B)** 1
C) 2 **D)** 3

32. $\cos\frac{\pi}{11}\cos\frac{2\pi}{11}\cos\frac{3\pi}{11}\cos\frac{4\pi}{11}\cos\frac{5\pi}{11} =$

A) $1/4$ **B)** $1/8$
C) $1/16$ **D)** $1/32$

33. $\sqrt{3}\csc 20^\circ - \sec 20^\circ =$

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

34. $\cos\frac{2\pi}{15}\cos\frac{4\pi}{15}\cos\frac{8\pi}{15}\cos\frac{14\pi}{15} =$

A) $1/16$ **B)** $1/8$
C) $3/4$ **D)** $1/4$

35. $\cos\left\{\frac{2\pi}{2^{64}-1}\right\}\cos\left\{\frac{2^2\pi}{2^{64}-1}\right\}\cos\left\{\frac{2^3\pi}{2^{64}-1}\right\}\ldots\cos\left\{\frac{2^{64}\pi}{2^{64}-1}\right\} =$

A) $\frac{1}{2^{64}}$ **B)** $\frac{1}{2^{32}}$
C) $\frac{1}{2^{16}}$ **D)** $\frac{1}{2^8}$

36. If $f_n(x) = \frac{\sin x}{\cos 3x} + \frac{\sin 3x}{\cos 9x} + \frac{\sin 9x}{\cos 27x} + \cdots + n$ terms, then $f_2\left(\frac{\pi}{4}\right) + f_3\left(\frac{\pi}{4}\right) =$

A) 0 **B)** 1
C) -1 **D)** 2

37. Let $f_n(\theta) = \tan\frac{\theta}{2}(1+\sec\theta)(1+\sec 2\theta)(1+\sec 4\theta)\ldots(1+\sec 2^n\theta)$, then $f_2\left(\frac{\pi}{16}\right) + f_3\left(\frac{\pi}{32}\right) + f_4\left(\frac{\pi}{64}\right) + f_5\left(\frac{\pi}{128}\right) =$

A) 0 **B)** 2
C) 4 **D)** 8

38. If $2\cos\frac{A}{2} = \sqrt{1+\sin A} + \sqrt{1-\sin A}$, then $\frac{A}{2}$ lies between

A) $2n\pi + \frac{\pi}{4}$ and $2n\pi + \frac{3\pi}{4}$ **B)** $2n\pi - \frac{\pi}{4}$ and $2n\pi + \frac{\pi}{4}$
C) $2n\pi - \frac{3\pi}{4}$ and $2n\pi - \frac{\pi}{4}$ **D)** $2n\pi - \frac{5\pi}{4}$ and $2n\pi - \frac{3\pi}{4}$

39. $4\sin 27^\circ =$

A) $\sqrt{5+\sqrt{5}} + \sqrt{3-\sqrt{5}}$ **B)** $\sqrt{5-\sqrt{5}} + \sqrt{3+\sqrt{5}}$
C) $\sqrt{5+\sqrt{5}} - \sqrt{3-\sqrt{5}}$ **D)** $\sqrt{5+\sqrt{5}} + \sqrt{3+\sqrt{5}}$

40. If $\sin^2\theta = \frac{x^2+y^2+1}{2x}$, then x must be.....

A) -4 **B)** 1
C) 2 **D)** -1

41. $\frac{\sin 12A}{\sin 4A} - \frac{\cos 12A}{\cos 4A} =$

A) 6 **B)** 4
C) 2 **D)** 1

42. $\sin^2 160^\circ + \sin^2 140^\circ + \sin^2 100^\circ =$

A) $1/2$ **B)** $3/2$
C) $5/2$ **D)** $7/2$

43. The value of $\sin^2 46^\circ + \sin^2 14^\circ + \sin 46^\circ \sin 14^\circ =$

A) $1/4$ **B)** $3/4$
C) $5/4$ **D)** $1/2$

44. $\theta < \frac{\pi}{16}, \sqrt{2+\sqrt{2+\sqrt{2+2\cos 8\theta}}} = k\cos\theta \Rightarrow k =$

A) 2 **B)** 4
C) 8 **D)** 16

45. $\cos 36^\circ - \cos 72^\circ =$

A) 1 **B)** $1/2$
C) $1/4$ **D)** $1/8$

46. $\sec 72^\circ - \sec 36^\circ =$

47. The value of $(\sin 70^\circ)(\cot 10^\circ \cot 70^\circ - 1)$ **is**

48. $96\cos\frac{\pi}{33}\cos\frac{2\pi}{33}\cos\frac{4\pi}{33}\cos\frac{8\pi}{33}\cos\frac{16\pi}{33}$ **is equal to :**

49. $\sin^2\frac{\pi}{18}+\sin^2\frac{2\pi}{18}+\sin^2\frac{4\pi}{18}+\sin^2\frac{8\pi}{18}+\sin^2\frac{7\pi}{18}+\sin^2\frac{5\pi}{18}=$

50. **If** $\tan 15^\circ+\frac{1}{\tan 75^\circ}+\frac{1}{\tan 105^\circ}+\tan 195^\circ=2a$**, then the value of** $(a+\frac{1}{a})$ **is :**

Physics

51. **The velocity of a body is given by the equation** $v=\frac{b}{t}+ct^2+dt^3$**. The dimensional formula of** b **is**

A) $[M^0LT^0]$ **B)** $[ML^0T^0]$
C) $[M^0L^0T]$ **D)** $[MLT^{-1}]$

52. **The force** F **is given in terms of time** t **and displacement** x **by the equation** $F=A\cos Bx+C\sin Dt$**. The dimensional formula of** D/B **is**

A) $[M^0L^0T^0]$ **B)** $[M^0L^0T^{-1}]$
C) $[M^0L^{-1}T^0]$ **D)** $[M^0L^1T^{-1}]$

53. **If** P **represents radiation pressure,** c **represents speed of light and** Q **represents radiation striking unit area per second, then non-zero integers** $x, y,$ **and** z **such that** $P^xQ^yc^z$ **is dimensionless are**

A) $x=1, y=1, z=-1$ **B)** $x=1, y=-1, z=1$
C) $x=-1, y=1, z=1$ **D)** $x=1, y=1, z=1$

54. **A physical quantity is represented by** $X=M^aL^bT^{-c}$**. If percentage errors in the measurement of** M, L **and** T **are** α, β **and** γ**, respectively, then total percentage error is**

A) $(\alpha a+\beta b-\gamma c)$ **B)** $(\alpha a+\beta b+\gamma c)$
C) $(\alpha a-\beta b-\gamma c)$ **D)** zero

55. **If force, velocity and time are taken as fundamental quantities, find the dimensions of work.**

A) FVT **B)** FVT^2
C) F^0VT^{-1} **D)** FV^2T^{-1}

56. **Given that:** $y=A\sin\left[\left(\frac{2\pi}{\lambda}\right)(ct-x)\right]$**, where** y **and** x **are measured in the unit of length. Which of the following statements is true?**

A) The unit of λ is same as that of x and A. **B)** The unit of λ is same as that of x but not of A.
C) The unit of c is same as that of $2\pi/\lambda$. **D)** The unit of $(ct-x)$ is same as that of $2\pi/\lambda$.

57. **Suppose refractive index** μ **is given as** $\mu=A+\frac{B}{\lambda^2}$ **where** A **and** B **are constants and** λ **is wavelength, then dimensions of** B **are same as that of.**

A) wavelength **B)** volume
C) pressure **D)** area

58. **A physical quantity** x **depends on quantities** y **and** z **as follows:** $x=Ay+B\tan(Cz)$**, where** A, B **and** C **are constants. Which of the following do not have the same dimensions?**

A) x and B **B)** C and z^{-1}
C) y and B/A **D)** x and A

59. **Force** F **is given in terms of time** t **and distance** x **by** $F=A\sin Ct+B\cos Dx$**. Then, dimensions of** A/B **and** C/D **are.**

A) $[M^0L^0T^0], [M^0L^0T^{-1}]$ **B)** $[MLT^{-2}], [M^0L^{-1}T^0]$
C) $[M^0L^0T^0], [M^0LT^{-1}]$ **D)** $[M^0L^1T^{-1}], [M^0L^0T^0]$

60. **The frequency (**n**) of vibration of a string is given as** $n=\frac{1}{2l}\sqrt{\frac{T}{m}}$**, where** T **is tension and** l **is the length of vibrating string. Then, the dimensional formula for** m **is.**

A) $[M^0L^1T^1]$ **B)** $[M^0L^0T^0]$
C) $[M^1L^{-1}T^0]$ **D)** $[ML^0T^0]$

61. **The position** x **of a particle at time** t **is given by** $x=\frac{V_0}{a}(1-e^{-at})$**, where** V_0 **is constant and** $a>0$**. The dimensions of** V_0 **and** a **are.**

A) M^0LT^{-1} and T^{-1} **B)** M^0LT^0 and T^{-1}
C) M^0LT^{-1} and LT^{-2} **D)** M^0LT^{-1} and T

62. **Write the dimensions of** a/b **in the relation** $P=\frac{a-t^2}{bx}$**, where** P **is the pressure,** x **is the distance and** t **is the time.**

A) $M^{-1}L^0T^{-2}$ **B)** ML^0T^{-2}
C) ML^0T^2 **D)** MLT^{-2}

63. **Write the dimensions of** $a\times b$ **in the relation** $E=\frac{b-x^2}{at}$**, where** E **is the energy,** x **is the displacement and** t **is time.**

A) ML^2T **B)** $M^{-1}L^2T^1$
C) ML^2T^{-2} **D)** MLT^{-2}

64. **In the formula** $X=3YZ^2$**,** X **and** Z **have the dimensions of capacitance and magnetic induction, respectively. The dimensions of** Y **in M.K.S. system are.**

A) $M^{-3}L^{-2}T^{-2}A^{-4}$ **B)** $ML^{-2}A^o$
C) $M^{-3}L^{-2}T^8A^4$ **D)** $M^{-3}L^{-2}T^4A^4$

65. **In the relation** $P=\frac{\alpha}{\beta}e^{-\alpha z/K\theta}$**,** P **is pressure,** Z **is distance,** K **is Boltzmann constant and** θ **is the temperature. The dimensional formula of** β **will be.**

A) $[M^0L^2T^0]$ **B)** $[M^1L^2T^{-1}]$
C) $[M^1L^0T^{-1}]$ **D)** $[M^0L^2T^{-1}]$

66. **The speed of light** (c)**, gravitational constant** (G) **and Planck's constant** (h) **are taken as the fundamental units in a system. The dimension of time in this new system should be**

A) $G^{1/2}h^{1/2}c^{-5/2}$ **B)** $G^{-1/2}h^{1/2}c^{1/2}$
C) $G^{1/2}h^{1/2}c^{-3/2}$ **D)** $G^{1/2}h^{1/2}c^{1/2}$

67. **From the equation** $\tan\theta=\frac{rg}{v^2}$**, one can obtain the angle of banking** θ **for a cyclist taking a curve (the symbols have their usual meanings). Then say, it is**

A) Both dimensionally and numerically correct **B)** Neither numerically nor dimensionally correct
C) Dimensionally correct only **D)** Numerically correct only

68. **The frequency of vibration of string is given by** $\nu=\frac{p}{2l}\left[\frac{F}{m}\right]^{1/2}$**. Here p is number of segments in the string and l is the length. The dimensional formula for m will be**

A) $[M^0LT^{-1}]$ **B)** $[ML^0T^{-1}]$
C) $[ML^{-1}T^0]$ **D)** $[M^0L^0T^0]$

69. E**,** m**,** l **and** G **denote energy, mass, angular momentum and gravitational constant respectively, then the dimension of** $\frac{El^2}{m^5G^2}$ **are**

A) Angle **B)** Length
C) Mass **D)** Time

70. **In an electron gun, emission current from the cathode is given by the equation,** $I=AT^2\,e^{-(B/(KT))}$ **[K = Boltzmann constant, A = constant] The dimensional formula for** AB^2**is same as**

A) KT **B)** IT^2
C) IK^2 **D)** $\frac{IK^2}{T}$

71. **In a measurement, it is asked to find modulus of elasticity per unit torque applied on the system. The measured quantity has dimension of $[M^aL^bT^c]$. If $b = 3$, the value of c is _____.**

72. **A ball of radius r and density ρ dropped through a viscous liquid of density σ and viscosity η attains its terminal velocity at time t, given by $t = A\rho^a r^b \eta^c \sigma^d$, where A is a constant and a, b, c and d are integers. The value of $\frac{b+c}{a+d}$ is:**

73. **The velocity of a body which has fallen freely under gravity varies as $g^p h^q$, where g is the acceleration due to gravity and h is the height through which it has fallen. The value of $p + q$ is……..**

74. **The frequency f of vibrations of a mass m suspended from a spring of spring constant k is given by $f = Cm^x k^y$,where C is a dimensionless constant. The values of $y - x$ is…….**

75. **The wavelength associated with a moving particle depends upon p^{th} power of its mass m, q^{th} power of its velocity v and r^{th} power of Planck's constant h. Then, the sum of $p + q + 2r$ is…….**

ANSWER KEY

Chemistry

1.	**1**	8.	**3**	15.	**1**	22.	**3**
2.	**1**	9.	**4**	16.	**3**	23.	**5**
3.	**3**	10.	**1**	17.	**2**	24.	**24**
4.	**3**	11.	**2**	18.	**1**	25.	**3**
5.	**1**	12.	**3**	19.	**1**		
6.	**1**	13.	**4**	20.	**2**		
7.	**4**	14.	**2**	21.	**5**		

Maths

26.	**4**	33.	**4**	40.	**?**	47.	**1**
27.	**3**	34.	**1**	41.	**3**	48.	**3**
28.	**2**	35.	**1**	42.	**2**	49.	**3**
29.	**3**	36.	**3**	43.	**2**	50.	**4**
30.	**4**	37.	**3**	44.	**1**		
31.	**4**	38.	**2**	45.	**2**		
32.	**4**	39.	**3**	46.	**2**		

Physics

51.	**1**	58.	**4**	65.	**1**	72.	**1**
52.	**4**	59.	**3**	66.	**1**	73.	**1**
53.	**2**	60.	**3**	67.	**3**	74.	**1**
54.	**2**	61.	**1**	68.	**3**	75.	**0**
55.	**1**	62.	**2**	69.	**1**		
56.	**2**	63.	**2**	70.	**3**		
57.	**4**	64.	**3**	71.	**0**		

SOLUTIONS

Q1.

Answer: A

Explanation:

The oxidation state of nitrogen is calculated by setting the sum of the oxidation numbers of all atoms in the neutral compound to zero. Hydrogen is typically $+1$, Oxygen is -2, and Alkali metals (like K and Na)are+1.

Q2.

Answer: A

Explanation:

A redox reaction involves a simultaneous increase and decrease in the oxidation numbers of different atoms. In option , the oxidation states of H_2 and Br_2 change from 0 to $+1$ and -1 respectively.

Q3.

Answer: C

Explanation:

A reaction is not redox if there is no change in the oxidation numbers of any of the participating atoms. In option , the oxidation states of Ba, O, H, and S remain identical on both sides.

Q4.

Answer: C

Explanation:

This is a disproportionation reaction where the same element (Cl) undergoes both oxidation and reduction.

Q5.

Answer: A

Explanation:

In a redox reaction, there must be a change in oxidation states. In option , Cu is reduced and I is oxidized.

Q6.

Answer: A

Explanation:

A disproportionation reaction involves one element in a single compound undergoing both oxidation and reduction. Option is an intermolecular redox reaction.

Q7.

Answer: D

Explanation:

A disproportionation reaction occurs when an element in an intermediate oxidation state is converted into both higher and lower oxidation states.

Q8.

Answer: C

Explanation:

Oxidation involves an increase in OS, while reduction involves a decrease in OS.

Q9.

Answer: D

Explanation:

H_2SO_4 acts as an oxidizing agent when its sulfur atom ($+6$) is reduced to a lower oxidation state (like $+4$ in SO_2).

Q10.

Answer: A

Explanation:

In the conversion of chromate to dichromate, the oxidation state of Chromium remains $+6$.

Q11.

Answer: B

Explanation:

Balancing atoms (except H, O)$first, then$O, then H, and then charge.

Q12.

Answer: C

Explanation:

Balancing involves equating the total increase in OS with the total decrease in OS.

Q13.

Answer: D

Explanation:

From the balanced redox equation $4Zn + NO_3^- + 10H^+ \rightarrow 4Zn^{2+} + NH_4^+ + 3H_2O$, the coefficient is determined.

Q14.

Answer: B

Explanation:

In acidic medium, $KMnO_4$ acts as a strong oxidizing agent and is reduced from Mn^{+7} to Mn^{2+}. Simultaneously, H_2O_2 acts as a reducing agent and is oxidized to O_2.

Q15.

Answer: A

Explanation:

A reaction where the same element undergoes both oxidation and reduction is called a disproportionation reaction.

Q16.

Answer: C

Explanation:

Balancing a redox reaction requires the total loss of electrons from the reductant to equal the total gain of electrons by the oxidant.

Q17.

Answer: B

Explanation:

A reducing agent is a substance that loses electrons (undergoes oxidation). In these half-reactions, loss of electrons is indicated by electrons on the product side or a minus sign on the reactant side.

Q18.

Answer: A

Explanation:

An oxidant is a substance that causes oxidation of another substance and is itself reduced.

Q19.

Answer: A

Explanation:

Balancing by the ion-electron method ensures that mass and charge are conserved by equalizing the electrons transferred.

Q20.

Answer: B

Explanation:

In acidic medium, potassium permanganate oxidizes ferrous ions present in ferrous ammonium sulphate (Mohr's salt) to ferric ions, while permanganate is reduced to manganese(II) ions. Balancing the complete molecular equation shows that for every 2 molecules of $KMnO_4$, a total of 68 molecules of water are produced.

Q21.

Answer: 5

Explanation:

The number of electrons n equals the change in the oxidation number of Manganese in an acidic medium.

Q22.

Answer: 3

Explanation:

In a neutral or weak alkaline medium, Manganese is reduced from $+7$ to $+4$, requiring 3 electrons.

Q23.

Answer: 5

Explanation:

In an acidic medium, the MnO_4^- ion is reduced to Mn^{2+} by gaining 5 electrons.

Q24.

Answer: 24

Explanation:

The number of electrons transferred is the total change in oxidation number for either the total amount of reductant or oxidant in the balanced equation.

Q25.

Answer: 3

Explanation:

The number of electrons liberated corresponds to the total increase in the oxidation number of the atoms.

Q26.

Answer: D

Explanation:

Use the standard trigonometric identities $\sin 2\theta = 2\sin\theta\cos\theta$ and $\cos 2\theta = 2\cos^2\theta - 1$.

Q27.

Answer: C

Explanation:

Use the standard result $\sin\theta\cos\theta = \frac{1}{2}\sin 2\theta$.

Q28.

Answer: B

Explanation:

Since $76^\circ - 16^\circ = 60^\circ$, use the standard result: If $A - B = 60^\circ$, then $\cos^2 A + \cos^2 B - \cos A\cos B = \frac{3}{4}$.

Q29.

Answer: C

Explanation:

Use the standard formula $\sqrt{2+\sqrt{2+\ldots+2}} = 2\cos\left(\frac{\pi}{2^{n+1}}\right)$, where n is the number of square roots.

Q30.

Answer: D

Explanation:

Group the terms using the identity $\tan\theta + \cot\theta = \frac{2}{\sin 2\theta}$ and use complementary angle properties like $\tan 81^\circ = \cot 9^\circ$ and $\tan 63^\circ = \cot 27^\circ$. Substitute the standard values for $\sin 18^\circ$ and $\sin 54^\circ$.

Q31.

Answer: D

Explanation:

Use the triple angle formula $\tan 3\theta = \frac{3\tan\theta - \tan^3\theta}{1 - 3\tan^2\theta}$. Set $\theta = 20^\circ$ so that $3\theta = 60^\circ$ and solve for the algebraic expression by squaring both sides.

Q32.

Answer: D

Explanation:

Apply the standard product result for cosines:
$\cos\frac{\pi}{2n+1}\cos\frac{2\pi}{2n+1}\ldots\cos\frac{n\pi}{2n+1} = \frac{1}{2^n}$.

Q33.

Answer: D

Explanation:

According to the hints and synopsis for trigonometric transformations, convert the expression into sine and cosine functions. Combine the terms into a single fraction and use the sine difference formula $\sin(A-B) = \sin A\cos B - \cos A\sin B$ and the double angle formula $\sin 2\theta = 2\sin\theta\cos\theta$ to simplify the expression.

Q34.

Answer: A

Explanation:

Apply the standard product result for cosines:
$\cos\theta\cos 2\theta\cos 4\theta\ldots\cos 2^{n-1}\theta = \frac{\sin 2^n\theta}{2^n\sin\theta}$. Utilize the property $\cos(\pi - \theta) = -\cos\theta$ to align the angles with the formula.

Q35.

Answer: A

Explanation:

Apply the standard product formula for cosines in geometric progression:
$\cos\theta\cos 2\theta\cos 2^2\theta\ldots\cos 2^{n-1}\theta = \frac{\sin 2^n\theta}{2^n\sin\theta}$.

Q36.

Answer: C

Explanation:
Use the trigonometric summation identity: $\sum\frac{\sin 3^{r-1}x}{\cos 3^r x} = \frac{1}{2}(\tan 3^n x - \tan x)$
.

Q37.

Answer: C

Explanation:
Use the identity $(1+\sec\theta) = \frac{1+\cos\theta}{\cos\theta} = \frac{2\cos^2(\theta/2)}{\cos\theta}$. Combined with $\tan(\theta/2)$
, this leads to the result $f_n(\theta) = \tan 2^n\theta$.

Q38.

Answer: B

Explanation:
According to the synopsis for square roots of trigonometric expressions, $\sqrt{1\pm\sin A} = |\cos\frac{A}{2} \pm \sin\frac{A}{2}|$. The given identity $2\cos\frac{A}{2} = \sqrt{1+\sin A} + \sqrt{1-\sin A}$ holds true when the values inside the modulus result in the cancellation of the sine terms, specifically when $\cos\frac{A}{2} + \sin\frac{A}{2} > 0$ and $\cos\frac{A}{2} - \sin\frac{A}{2} > 0$.

Q39.

Answer: C

Explanation:

According to the hints for C.U.Q, use the radical identity $2\sin\frac{A}{2} = \sqrt{1+\sin A} - \sqrt{1-\sin A}$ for the case where $\cos\frac{A}{2} > \sin\frac{A}{2}$. By setting $A = 54^\circ$, we can find the value of $4\sin 27^\circ$ using the standard value for $\sin 54^\circ$.

Q40.

Answer: ?

Explanation:

Since $0 \leq \sin^2\theta \leq 1$,

$0 \leq \frac{x^2+y^2+1}{2x} \leq 1.$

Also,

$x^2+y^2+1 = (x-1)^2+y^2+2x.$

Hence,

$x^2+y^2+1 \geq 2x,$

with equality only when

$x = 1, \qquad y = 0.$

Therefore,

$\frac{x^2+y^2+1}{2x} \geq 1.$

Since the value is also equal to $\sin^2\theta \leq 1$, it must be exactly 1.

Thus,

$x = 1.$

Hence, the required value is

$\boxed{1}$.

Q41.

Answer: C

Explanation:

According to the hints, express $\sin 12A$ as $\sin 3(4A)$ and $\cos 12A$ as $\cos 3(4A)$, then apply the triple angle formulas $\sin 3\theta = 3\sin\theta - 4\sin^3\theta$ and $\cos 3\theta = 4\cos^3\theta - 3\cos\theta$.

Q42.

Answer: B

Explanation:

Use the supplementary angle property $\sin(180^\circ - \theta) = \sin\theta$ to simplify the angles. Then, apply the standard result:
$\sin^2\theta + \sin^2(60^\circ - \theta) + \sin^2(60^\circ + \theta) = 3/2.$

Q43.

Answer: B

Explanation:

Since $46^\circ + 14^\circ = 60^\circ$, use the standard result: If $A + B = 60^\circ$, then $\sin^2 A + \sin^2 B + \sin A \sin B = 3/4.$

Q44.

Answer: A

Explanation:

Apply the nested radical formula $\sqrt{2+\sqrt{2+\ldots+2\cos\theta}} = 2\cos\left(\frac{\theta}{2^n}\right)$, where n is the number of square roots.

Q45.

Answer: B

Explanation:

Substitute the standard values for $\cos 36^\circ$ and $\cos 72^\circ$ (which is equal to $\sin 18^\circ$) into the expression.

Q46.

Answer: 2

Explanation:
According to the hints provided for LEVEL - I (H.W), substitute the standard trigonometric values for the angles presented in the expression.

Q47.

Answer: 1

Explanation:
The expression is simplified by converting cotangent terms into sine and cosine and applying the product-to-sum trigonometric identity
$\cos(A+B) = \cos A\cos B - \sin A\sin B.$

Q48.

Answer: 3

Explanation:

This problem uses the product formula for cosines: $\prod_{k=0}^{n-1}\cos(2^k\theta) = \frac{\sin(2^n\theta)}{2^n\sin\theta}$. Here, $n = 5$ and $\theta = \frac{\pi}{33}$.

Q49.

Answer: 3

Explanation:

Using the identity

$[\sin^2\theta + \sin^2\left(\frac{\pi}{2} - \theta\right) = \sin^2\theta + \cos^2\theta = 1,$

pair the terms as follows:

$\sin^2\frac{\pi}{18} + \sin^2\frac{8\pi}{18} = 1,$

$\sin^2\frac{2\pi}{18} + \sin^2\frac{7\pi}{18} = 1,$

$\sin^2\frac{4\pi}{18} + \sin^2\frac{5\pi}{18} = 1.$

Hence,

$1 + 1 + 1 = 3.$

Therefore, the required value is

$\boxed{3}$.

Q50.

Answer: 4

Explanation:

All tangent and cotangent terms are reduced to $\tan 15^\circ$ using periodicity and quadrant rules to solve for a.

Q51.

Answer: A

Explanation:

In the equation, left hand side has the dimension of velocity. Thus, from the principle of homogeneity each term in the right hand side should have the dimensions of velocity. $[\frac{b}{t}] = [v]$ or $[b] = [vt] = [L]$.

Q52.

Answer: D

Explanation:

In the given equation Bx and Dt should be dimensionless. $[B] = [x^{-1}]$ and $[D] = [T^{-1}] \Rightarrow [\frac{D}{B}] = [\frac{x}{T}] = [\text{velocity}]$.

Q53.

Answer: B

Explanation:

Dimensions of $P^xQ^yc^z = [ML^{-1}T^{-2}]^x[MT^{-3}]^y[LT^{-1}]^z$. As it is dimensionless, so $[ML^{-1}T^{-2}]^x[MT^{-3}]^y[LT^{-1}]^z = [M^0L^0T^0]$ or $[M^{x+y}L^{-x+z}T^{-2x-3y-z}] = [M^0L^0T^0]$ Comparing powers of M, L and T, we get $x+y=0, -x+z=0, -2x-3y-z=0$. Solving,
$x=1, y=-1, z=1$.

Q54.

Answer: B

Explanation:

$\frac{\Delta x}{x} \times 100 = a\frac{\Delta M}{M} \times 100 + b\frac{\Delta L}{L} \times 100 + c\frac{\Delta T}{T} \times 100 = a\alpha + b\beta + c\gamma.$

Q55.

Answer: A

Explanation:

$W = ML^2T^{-2} = [F]^a[V]^b[T]^c \Rightarrow ML^2T^{-2} = [MLT^{-2}]^a[LT^{-1}]^b[T]^c \Rightarrow a = 1, a + b = 2 \Rightarrow b = 1$ and $c - 2a - b = -2 \Rightarrow c = 1$. So, $[W] = FVT$.

Q56.

Answer: B

Explanation:

Here, unit of $(y)$and A will be same and that of $(x)\ and\ \lambda$will be same. $(\frac{2\pi}{\lambda}(ct - x))$ is dimensionless. Here, $(\frac{ct}{\lambda})$ and $(\frac{x}{\lambda})$ are dimensionless. Unit of (ct) is same as that of (λ) or (x).

Q57.

Answer: D

Explanation:

As $(\mu = \text{ velocity of light in vacuumvelocity of light in medium})$, hence, (μ) is dimensionless. Thus, each term on the R.H.S. of given equation should be dimensionless, i.e., $(\frac{B}{\lambda^2})$ is dimensionless, i.e., (B) should have dimension of (λ^2), i.e., (cm^2), i.e., area.

Q58.

Answer: D

Explanation:

$[x] = [Ay] = [B] \Rightarrow [y] = [B/A]$Also, ([x]\ne[A]) and ([Cz]=) dimensionless $\Rightarrow [C] = [z^{-1}]$.

Q59.

Answer: C

Explanation:

$\frac{A}{B} = \frac{\text{Force}}{\text{Force}} = [M^0L^0T^0]\ Ct = \text{angle} \Rightarrow C = \frac{\text{angle}}{\text{time}} = \frac{1}{T} = T^{-1}$,
$Dx = \text{angle} \Rightarrow D = \frac{\text{angle}}{\text{distance}} = \frac{1}{L} = L^{-1} \therefore\ \frac{C}{D} = \frac{T^{-1}}{L^{-1}} = [M^0LT^{-1}]$

Q60.

Answer: C

Explanation:

$n = \frac{1}{2l}\sqrt{\frac{T}{m}}; \Rightarrow; n^2 = \frac{1}{4l^2} \cdot \frac{T}{m} m = \frac{T}{4l^2n^2} = \left[\frac{MLT^{-2}}{L^2 \times T^{-2}}\right] = [ML^{-1}]$

Q61.

Answer: A

Explanation:

Here, (at) is dimensionless$\Rightarrow; a = \frac{1}{t} = \left[\frac{1}{T}\right] = [T^{-1}]\ x = \frac{V_0}{a}$and $V_0 = xa = [LT^{-1}] = [M^0LT^{-1}]$.

Q62.

Answer: B

Explanation:

Here, (a) has the same dimensions as (t^2),a= $[T^2], b = \frac{T^2}{Px} = \frac{T^2}{ML^{-1}T^2L} = \frac{T^4}{M} = [M^{-1}T^4]$Now, $\frac{a}{b} = \frac{T^2}{M^{-1}T^4} = ML^0T^{-2}$

Q63.

Answer: B

Explanation:

Here, (b) and $(x^2 = L^2)$ have same dimensions. Also, $a = \frac{x^2}{E \times t} = \frac{L^2}{(ML^2T^{-2})T} = M^{-1}T^1 a \times b = [M^{-1}L^2T^1]$ Hence, correct answer is (b).

Q64.

Answer: C

Explanation:

Here, $X = \frac{Q}{V}$.But,$V = \frac{W}{Q}.\therefore; X = \frac{Q^2}{W}$. Now,$Z = B = \frac{F}{IL}$
$\therefore; Y = \frac{X}{3Z^2} = \frac{1}{3} \cdot \frac{Q^2}{W} \times \frac{I^2L^2}{F^2} = \frac{A^2T^2, A^2L^2}{[ML^2T^{-2}][M^2L^2T^{-4}]} = [M^{-3}L^{-2}T^8A^4]$.

Q65.

Answer: A

Explanation:

Argument of exponential term must be dimensionless, i.e., $\left[\frac{\alpha Z}{K\theta}\right] = [M^0L^0T^0]$ Now,$[K\theta] = [\text{Energy}] = [ML^2T^{-2}]$
$\Rightarrow; [\alpha] = \frac{[K\theta]}{[Z]} = \frac{[ML^2T^{-2}]}{[L]} = [MLT^{-2}]$Hence,
$[\beta] = \frac{[\alpha]}{[P]} = \frac{[MLT^{-2}]}{[ML^{-1}T^{-2}]} = [M^0L^2T^0]$.

Q66.

Answer: A

Explanation:

Time$\propto c^xG^yh^z \Rightarrow T = kc^xG^yh^z$ Putting the dimensions in the above relation $\Rightarrow [M^0L^0T^1] = [LT^{-1}]^x[M^{-1}L^3T^{-2}]^y[ML^2T^{-1}]^z \Rightarrow$ $[M^0L^0T^1] = [M^{-y+z}L^{x+3y+2z}T^{-x-2y-z}]$ Comparing the powers of $M,\ L$ and $T\ -y + z = 0 \ldots$(i) $x + 3y + 2z = 0 \ldots$(ii) $-x - 2y - z = 1 \ldots$(iii) On solving equations (i) and (ii) and (iii) $x = \frac{-5}{2},\ y = z = \frac{1}{2}$ Hence dimension of time are $[G^{1/2}h^{1/2}c^{-5/2}]$

Q67.

Answer: C

Explanation:

Given equation is dimensionally correct because both sides are dimensionless but numerically wrong because the correct equation is $\tan\theta = \frac{v^2}{rg}$.

Q68.

Answer: C

Explanation:

$\nu = \frac{P}{2l}\left[\frac{F}{m}\right]^{1/2} \Rightarrow \nu^2 = \frac{P^2}{4l^2}\left[\frac{F}{m}\right] \therefore m \propto \frac{F}{l^2\nu^2}$
$\Rightarrow [m] = \left[\frac{MLT^{-2}}{L^2T^{-2}}\right] = [ML^{-1}T^0]$

Q69.

Answer: A

Explanation:

$[E] = [ML^2T^{-2}],\ [m] = [M],\ [l] = [ML^2T^{-1}]$and $[G] = [M^{-1}L^3T^{-2}]$ Substituting the dimension of above quantities in the given formula : $\frac{El^2}{m^5G^2}$
$\frac{[ML^2T^{-2}]\,[ML^2T^{-1}]^2}{[M^5]\,[M^{-1}L^3T^{-2}]^2} = \frac{M^3L^6T^{-4}}{M^3L^6T^{-4}} = [M^0L^0T^0]$

Q70.

Answer: C

Explanation:

$\frac{B}{kT}$ is dimensionless $\begin{array}{l} [B] = [kT] \\ Also\,[I] = [AT2] \\ [A] = [IT2] \\ [AB2] = [IK2] \end{array}$

Q71.

Answer: 0

Explanation:

The dimension of the Modulus of Elasticity (E) is $[ML^{-1}T^{-2}]$. The dimension of Torque (τ) is $[ML^2T^{-2}]$. The ratio of Torque to the Modulus of Elasticity is $\frac{\tau}{E} = \frac{[ML^2T^{-2}]}{[ML^{-1}T^{-2}]} = [L^3]$. Comparing this with the dimension $[M^aL^bT^c]$, we get $a = 0$, $b = 3$, and $c = 0$. Thus, for $b = 3$, the value of c is 0.

Q72.

Answer: 1

Explanation:

The characteristic time t for a particle to reach terminal velocity is proportional to the mass m divided by the viscous drag coefficient k. Using Stokes' law for terminal velocity, the drag force is $F = 6\pi\eta r v_t$, which implies a damping coefficient proportional to ηr. The time constant τ is given by $\tau = \frac{m}{6\pi\eta r}$. Substituting mass $m = \frac{4}{3}\pi r^3 \rho$, we get $t \propto \frac{r^3\rho}{\eta r} \propto \frac{\rho r^2}{\eta}$. Comparing this with the given equation $t = A\rho^a r^b \eta^c \sigma^d$, we can identify the exponents $a = 1, b = 2, c = -1$, and $d = 0$ (since time does not depend on the density of the liquid σ in this simplified characteristic time model).

Q73.

Answer: 1

Explanation:

Here, we are given$v = kg^p h^q$. Dimensions of left hand side and right hand side terms should be same.$[M^0LT^{-1}][LT^{-2}]^p[L]^q[L^{p+q}T^{-2p}]$Comparing powers of (L) and (T),$p + q = 1$and$-2p = -1$.Solving them, we get$p = \frac{1}{2}$ and$q = \frac{1}{2}$. Putting these values, we get$v = k\sqrt{gh}$,which is the required relation.

Q74.

Answer: 1

Explanation:

Here, we are given$f = Cm^x k^y$. Dimensions of left hand side and right hand side terms should be same. $[M^0L^0T^{-1}][M]^x[MT^{-2}]^y[M^{x+y}T^{-2y}]$ Comparing powers of (M) and (T), $x + y = 0$and$-2y = -1$.Solving them, we get,$y = \frac{1}{2}$ And,$x = -\frac{1}{2}$.Putting these values, we get $f = C\sqrt{\frac{k}{m}}$,which is the required relation.

Q75.

Answer: 0

Explanation:

Given,$\lambda = km^p v^q h^r$ The dimensions of the right-hand side and left-hand side should be equal. So,$[M^0L^1T^0][M]^p[LT^{-1}]^q[ML^2T^{-1}]^r$or, $[M^0L^1T^0][M^{p+r}][L^{q+2r}][T^{-q-r}]$Now, comparing the powers of (M), (L), and (T), we get $p + r = 0 \qquad (i) q + 2r = 1 \qquad (ii) -q - r = 0 \qquad (iii)$ After solving,$p = -1, \qquad q = -1, \qquad r = 1.$