PHYSICS

1. Ans. D)

$\frac{1}{\sqrt{\mu_0\varepsilon_0}}$ = speed of light in vaccum (c)

$\therefore$ dimension of

$C = M^oL^{-1}T^{-1}$

2. Ans. D)

We have $P = VI$

$\frac{\Delta P}{P} = \frac{\Delta V}{V} + \frac{\Delta I}{I}$

$5\% = \frac{0.2}{10}\times 100 + \frac{\Delta I}{I}$

$\Rightarrow \frac{\Delta I}{I} = 3\%$

3. Ans. B)

Given $\theta = 90^{11} = 90\times\frac{\pi}{180\times 60\times 60} = \frac{\pi}{7200}$

$D = \pi\times 10^6 m \quad d = \frac{D}{\theta} = \frac{\pi\times 10^6\times 7200}{\pi}$

$= 7.2\times 10^9 M$

4. Ans. E)

Let $\vec{P} = 2\vec{A} + 3\vec{B}$ and $Q = 4\vec{A} - 3\vec{B}$

Resultant

$\vec{R} = \vec{P} + \vec{Q} = 6\vec{A}$

$\Rightarrow \vec{R} \,||\, \vec{A}$

5. Ans. C)

Knowledge based.

6. Ans. B)

$R = \frac{\left(\frac{V}{2}\right)^2 \sin 2\times 15}{g} = \frac{V^2.\sin 2\theta}{g}$

$\Rightarrow \frac{V^2}{8} = V^2 \sin 2\theta$

$\Rightarrow \sin 2\theta = \frac{1}{8}$ or $\theta = \frac{1}{2}\sin^{-1}\left(\frac{1}{8}\right)$

7. Ans. C)

knowledge based

8. Ans. A)

Knowledge based

9. Ans. B)

Reading of the weighing balance

$W_1 = m\left(1+\frac{a}{g}\right)$kgwt. when it is upwards

Given:

$a = \frac{g}{4}$; $\omega_1 = 50$kgwt.

$\Rightarrow m = \left(1+\frac{1}{4}\right) = 50$kgwt.

or $\frac{5}{4}M = 50$kgwt

Reading of the weighing balance when lift is accelerating downwards is

$\omega_2 = M\left(1-\frac{a}{g}\right) = \frac{3}{4}m$ kgwt $= 30$kgwt.

10. No answer

Given

$u = 0 \quad m = 2\times 10^7 kg; F = 5\times 10^5; S = 2m$

From work –energy theorem

$W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2 = FS$

$\frac{1}{2}\times 2\times 10^{-7}\times v^2 = 5\times 10^5\times 2$

$10^7 V^2 = 10^6$

$V^2 = 10^{-1}$

$V = \sqrt{10^{-1}}$

No answer

11. Ans. B)

$\vec{a} = \frac{\vec{F}}{m}$: Given $M = 1kg$

$\therefore \vec{a} = \vec{F}$

12. Ans. C)

Knowledge based

13. Ans. C)

Given :

$\frac{1}{2}mv^2 = \frac{1}{2}\times 2MV'^2$

$\Rightarrow V'^2 = \frac{V^2}{2}$ or $V' = \frac{V}{\sqrt{2}} = \frac{14.14}{1.414}$ m/s

14. Ans. C)

$KE = \frac{P^2}{2M}$

$\Rightarrow$ P momentum two times

$\Rightarrow \Delta P = P' - P = P = F\times t$

$10 = F\times 10$ or $F = 1N$

15. Ans. E)

$\vec{F} = \hat{i} - 2\hat{j} - 4\hat{k}$

$\vec{S} = (2-1)\hat{i} + (-1-1)\hat{j} + (0-1)\hat{i}$

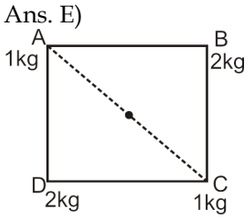
$= \hat{i} - 2\hat{j} - \hat{k}$

$\Rightarrow \omega = \vec{F}.\vec{S} = 1+4+4 = 9$

16. Ans. A)

$t = \frac{\omega}{\alpha} = \frac{27.5}{10} = 2.75$ s

17. Ans. E)



Since masses at A and C are same, masses at B and D must be same to get centre of mass exactly at geometric centre.

18. Ans. B)

$$L = \frac{2}{5}mr^2\omega = \text{const.}$$

$$\Rightarrow \omega r^2 = \omega'(nr)^2$$

$$\Rightarrow \omega' = \frac{\omega}{n^2}$$

19. Ans. D)
If t_R is the time taken by the body to roll down and t_s is the time taken by the body to slide down the same incline, then

$$\frac{t_R}{t_S} = \sqrt{1+\beta} \text{ whre } \beta = \frac{k^2}{R^2}$$

Here

$$t_R = t_1 \text{ and } t_S = t_2$$

$$\Rightarrow \frac{t_2^2}{t_1^2} = \frac{1}{1+\beta} = \frac{1}{2}$$

20. No answer
Angular momentum is conserve in planetary motion. Therefore

$$L \propto d^0$$

21. Ans. A)
Knowledge based

22. Ans. E)

$$\omega_h = \frac{mg}{\left(1+\frac{h}{R}\right)^2} \text{ Given } h = \frac{R}{10}$$

$$= \frac{100}{121}mg$$

$$\omega_d = mg\left(1-\frac{d}{R}\right) = mg\left(1-\frac{1}{10}\right) \quad \left(\therefore d = \frac{R}{10}\right)$$

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

$$\therefore \frac{\omega_h}{\omega_d} = \frac{100mg}{121} \times \frac{10}{9}mg = \frac{1000}{121\times 9} \approx \frac{8}{9}$$

23. Ans. A)

$$\Delta L = \frac{FL}{AY} = \frac{WL}{AY}$$

Here $\Delta L, L$ are same

$$\Rightarrow W \alpha Ay$$

$$W_1 : W_2 : W_3 = 1\times 4 : 2\times 2 : 4\times 1 = 1:1:1$$

24. Ans. B)
According to the equation of continuity, Av=constant
or

$$A_1U_1 = A_2V_2$$

$$\frac{\pi \times d_1^2}{4} \quad V_1 = \frac{\pi d_2^2 V_2}{4}$$

$$\text{or } V_2 = V_1.\left(\frac{d_1}{d_2}\right)^2 = 3\left(\frac{2}{0.5}\right)^2 = 48 \text{ cm/s}$$

25. Ans. D)

26. Ans. E)
Viscous force $F = 6\pi\eta rv$

$$\Rightarrow F \alpha r$$

But $r \times V^{1/3}$ (hence $V = \frac{4}{3}\pi r^3$)

$$\Rightarrow \frac{F'}{F} = \left(\frac{V'}{V}\right)^{1/3} = \left(\frac{27V}{V}\right)^{1/3} = 3$$

$$\therefore F' = 3F$$

27. Ans (D)
Mass of water collected from tap 1cm 10 minutes,

$$m_1 = 2\times 10 = 20\text{kg}$$

$$T_1 = 20°C$$

Mass of water collected from tap 2 cm 10 minutes

$$m_2 = 1\times 10 = 10\text{kg}$$

$$T_2 = 80°C$$

Final temperature $T = \frac{M_1T_1 + M_2T_2}{M_1 + M_2}$

$$= \frac{20\times 20 + 10\times 80}{30} = 40°C$$

28. Ans.C)
For adiabatic process $P \times V^{-r}$

$$\Rightarrow \frac{P'}{P} = \left(\frac{V}{V'}\right)^r ; \text{Given } ; V' = \frac{V}{27}; r = \frac{5}{3}$$

$$= (27)^{5/3} = 3^5 = 243$$

ie., $P' = 240P$

29. Ans.D)
Knowledge based

30. Ans D)
Pressured exerted by a gas $P = \frac{Nk_\beta T}{V}$

$$\Rightarrow P \times T$$

$$\frac{P'}{P} = \frac{T'}{T} = \frac{(273+27)}{(273+127)} = \frac{3}{4}$$

31. Ans.A)

$$\text{K.E} = \frac{3}{2}k_\beta.T = \frac{3}{2}\times 1.39\times 10^{-23}\times 300\text{J}$$

32. Ans. B) Knowledge based

33. Ans.D)

$$y_1 = A\text{isn}\omega t$$

$$Y_2 = A\sin(\omega t + \phi) = A\sin\omega t\cos t\phi + A\cos\omega t\sin\phi$$

$$y = y_1 + y_2 = A(1+\cos\phi)\sin\omega t + A\sin\phi = \cos\omega t$$

$$= A'\sin(\omega t + \theta)$$

where $A' = 2A.\cos(\phi/2).$

Given $A' = A = 2A\cos\phi/2$

$$\Rightarrow \cos\phi/2 = \frac{1}{2} \text{ or } \frac{\phi}{2} = \frac{\pi}{3}$$

$$\Rightarrow \phi = 2\pi/3$$

34. Ans.A)
fundamental frequency= difference in adjacent frequencies

35. Ans. E)

$$f = \frac{1}{26}\sqrt{\frac{4T}{\pi d^2\rho}}$$

$$\Rightarrow f \times \frac{1}{d} \text{ or } d \times \frac{1}{f}$$

$$\text{ie.,} \frac{d'}{d'} = \frac{f'}{f} = \frac{700}{1600} = \frac{9}{16}$$

36. Ans.B)
Given $f = 400H_2$; $c = 300\text{m/s}, v = 100\text{m/c}$

Let f_1 and f_2 are the frequencies observed before and after train passes the observer. Then,

$$f_1 = f\frac{c}{c-v} = 400\times\frac{300}{200} = 600H_2$$

$$f_2 = f\frac{c}{c+v} = 400\times\frac{300}{400} = 300H_2$$

$$\therefore \Delta f = f_1 - f_2 = 300Hz$$

37. Ans.C) :flux linked with six faces of the cube

$$\phi = \frac{q}{\varepsilon_0}$$

Flux linked with one faces of the cube

$$= \frac{\phi}{6} = \frac{q}{6\varepsilon_0}$$

38. Ans. A)

$$\frac{C_m}{C_a} = K = \frac{20\mu F}{10\mu F} = 2$$

39. Ans.B)

Given : $v = 4z^2$

$$E = \frac{-dv}{dz} = -8z$$

E at (1,0,2) is $E = -16\,V/m$

40. Ans. E)

Electrostatic potential is zero along the equatorial line of the dipole

41. Ans E)

knowledge base

42. Ans. E)

$$\frac{4.5-4}{4.25-4} = \frac{T-O}{100}$$

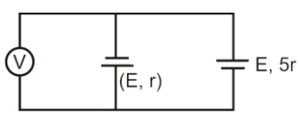
$T = 200°C$

43. Ans. A)

Knowledge based

44. No answer

Equivalent diagram can be given



$$E_{eff} = \frac{E_1r_2 - E_2r_1}{r_1 + r_2}$$

$$= \frac{E(5r) - E(r)}{6r}$$

$$= \frac{2}{3}E$$

As E = 5V $\quad E_{eff} = \frac{2}{3}\times 5 = \frac{10}{3}V$

Reading of voltmeter= Terminal potential of cell 6

$v = 5 - 0.1\,i$

But $i = \frac{E_{eff}}{R_{eff}} = \frac{10}{0.4} = \frac{100}{4} = 25A$

$\therefore$ V = 5-0.1 t = 5-2.5 = 2-1 N

No answer

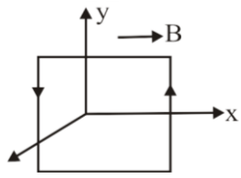
45. Ans. (B & D are correct)

Knowledge based

46. Ans. C)

$$\vec{\tau} = \vec{m}\times\vec{B}$$

$\vec{m}$=NiA $\hat{k}$ = 2 ×10 × 8 ×10-4 × 50



$$= 0.8\hat{k}$$

$$\vec{B} = 0.5\,\hat{i}$$

$$\therefore \vec{\tau} = \vec{m}\times\vec{B} = 0.4\,\hat{j}$$

47. Ans.C)

$$B = \frac{\mu_0 ni}{2} = \frac{4\pi\times10^{-7}\times500\times1.5}{2} = 47\times10^{-5}J$$

48. Ans.B)

In most of the northern hemisphere, North pole of the dip needle fills downwards.

49. Ans.A)

$$B = \frac{\mu_o ni}{2r} = \frac{2\pi\times10^{-7}\times50\times1}{10^{-1}}$$

$$= \pi\times10^{-4}\,J$$

50. Ans.E)

Current lags the voltage by $\pi/2$.

51. Ans.A)

$$\varepsilon = B_v\ell V = 4\times10^{-5}\times1.5\times20 = 1.2\,MV.$$

52. Ans.B): $P_0 = P_i$

$\Rightarrow$7.2 kW = 6 KV × I or I = 1.2 A

53. Ans.A

Theory based.

54. Ans.A)

Refractive index

$$n = \sqrt{\mu_r\varepsilon_r} = \frac{\lambda_{air}}{\lambda_{medium}}$$

or

$$\lambda_{med} = \frac{\lambda_{air}}{\sqrt{\mu_r\varepsilon_r}} = \frac{\lambda}{\sqrt{4}} = \frac{\lambda}{2}$$

55. Ans.E)

Theory based.

56. Ans.E)

Theory based.

57. Ans.C)

Theory based.

58. Ans.B)

In terms of angle of refraction, Brewster's law can be expressed as

Cot r = μ

$\Rightarrow \mu = \cot 30 = \sqrt{3}$

59. Ans.D)

$\delta = i + e - A \Rightarrow 45 = 43 + 62 - A$

Or A = 43 + 62 – 45 = 60^0

$D_{min} = 2i - A$ or $i = \frac{A + A}{2} = \frac{60 + 42}{2} = 51^0$

60. Ans.A):

$\frac{I_{max}}{I_{min}} = \left(\frac{\sqrt{I_1} + \sqrt{I_2}}{\sqrt{I_1} - \sqrt{I_2}}\right)^2 = \frac{9}{1}$

61. Ans.C)

Alkali metals have the least work function

62. Ans.B)

$\lambda = \frac{h}{mV} = \frac{h}{m\sqrt{2gn}}$

$\Rightarrow \lambda \alpha \frac{1}{\sqrt{x}}$

63. Ans.A)

ΔA=226–206=N×4

(N-No. of α-particles).

or N = 5

64. Ans.D)

Wave length of the spectral series of Paschen series is

$\lambda = \frac{9n^2}{(n^2 - 9)R}$ where $n = 4,5,6,....$

Shortest wavelength of Paschen series

$\lambda_s = \frac{9}{R}$

Longest wavelength of Paschen series

$\lambda_L = \frac{16}{7} \times \left(\frac{9}{R}\right) = \frac{16}{7}\lambda_s.$

$= \frac{16}{7} \times 8182 = 18700\ A^0$

65. Ans.C)

From the conservation of linear momentum;

$O = m_1\vec{V}_1 + m_1\vec{V}_2$

or $\frac{V_1}{V_2} = \frac{-m_2}{m_1} = -\left(\frac{r_2}{r_1}\right)^3 \left(-m = f \times \frac{4}{3}\pi r^3\right)$

$\Rightarrow \left|\frac{V_1}{V_2}\right| = \left(\frac{1}{2}\right)^3 = \frac{1}{8}$

(Negative sign represent the direction of motion after explosion)

66. Ans.C)

4 hydrogen nuclei are required per fusion in sun. There, energy released in the fusion of 4 kg of hydrogen is

$E_1 = \frac{4000}{4} \times 6.023 \times 10^{23} \times 26\ MeV$

$= 26 \times 6.023 \times 10^{26} MeV.$

Energy released in the nuclear fusion of Uranium is

$E_2 = \frac{23500}{235} \times 6.023 \times 10^{23} \times 200 MeV$

$\therefore \frac{E_1}{E_2} = \frac{26}{20} = \frac{13}{10}$

67. Ans. D)

$\frac{15 - 0.2}{2} = \frac{14.8}{2} = 7.4mn$

$\frac{15 - 0.7}{2} = 7.15mA$

$\therefore I_1 - I_2 = 0.25mA$

68. Ans.E)

Given:

$\frac{I_E}{I_A} = \frac{0.75}{0.25} = 3 = \frac{n_e\, eAV_e}{n_h eAV_h}$

$3 = \left(\frac{n_e}{n_h}\right) \times \frac{3}{2}$

$\Rightarrow \frac{n_e}{n_h} = \frac{2}{1}$

69. Ans.B)

Power gain $A_p = \beta^2 . \frac{R_0}{R_i}$

Voltage gain $A_V = \beta . \frac{R_o}{R_i}$

$\Rightarrow 50 = \beta \times \frac{500}{200} \Rightarrow \beta = 20$

$\therefore A_p = 20^2 \times \frac{500}{200} = 1000$

70. Ans.D)

Theory based

71. Ans.C)

Theory based

72. Ans.E)

Theory based

CHEMISTRY

73. Ans. C)

No. of atoms in 1g $Au = \frac{1}{197}N_A$

No. of atoms in 1g $Na = \frac{1}{23}N_A$

No. of atoms in lg $Li = \frac{1}{7}N_A$

No of atoms in 1g $Cl_2 = \frac{1}{35.5}N_A$

No. of atoms in 1g $O_2 = \frac{1}{16}NA$

74. Ans.B)

Percentage	No.of moles	Atomic ratio
$C = 24\%$	$\frac{24}{12} = 2$	$\frac{2}{2} = 1$
$H = 4\%$	$\frac{4}{1} = 4$	$\frac{4}{2} = 2$
Cl72%	$\frac{72}{35.5} = 2$	$\frac{2}{2} = 1$

$E.F. = CH_2Cl$

75. Ans.C)
Unbilnilium- 120

76. Ans.D)
$e = 10, p = 11, n = 12$
$^{23}_{11}Na^+$

77. Ans.B)
Eka-silicon- Germanium

78. Ans.C)
a) Lithium, sodium, potassium- Akali metals
b) Beryllium, mangnesium, calcium- Alkaline earth metals
c) Oxygen, sulphur, selenium- Chalcogens
d) silicon, Germanium, Argenic- Semi metals

79. Ans.B)
$PF_5 - sp^3d$ hybridization

80. Ans.B)
$N_2 > O_2 > C_2 > B_2$

81. Ans.A)

dipole dipole forces

82. Ans.B)

Schottky defect – ionic substance in which the cation and anion are almost similar sizes

83. Ans.D)

Entropy decreases-water crystallizes into ice

84. Ans.A)

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O, \Delta_f H^0 = -286$
$C + O_2 \rightarrow CO_2, \Delta_f H^0 = -394$
$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O, \Delta_C H^0 - 891$
$C + 2H_2 \rightarrow CH_4 \qquad \Delta_f H = ?$
$-394 + (-286 \times 2) + 891 = -75 kJmol^{-1}$

85. Ans.B)

$PCl_5 \rightleftarrows PCl_3 + Cl_2$
x 0 0 $Kc = 2 \times 10^{-2}$
Equi: x-0.2 0.2 0.2 $2 \times 10^{-2} = \frac{0.2 \times 0.2}{x - 0.2}$

On solving $x = 2.2$

86. Ans.D)

$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$
$n = 0.005 \times \frac{20}{1000}$ $0.01 \times \frac{20}{1000}$
1×10^{-4} 2×10^{-4}
1 mol $Ca(OH)_2 \rightarrow 2$mol HCl

1×10^{-4} mol $Ca(OH)_2 \rightarrow 2 \times 10^{-4}$ molHCl HCl

Solution is neutral in nature

pH = 7

87. Ans.C)

$\overset{-4}{C}H_4 + 4Cl_2 \rightarrow \overset{+4}{C}Cl_4 + 4HCl$
Change of oxidation number of carbon is

-4 to +4

88. Ans.E)

$\overset{4+}{P}t + 4e^- \rightarrow Pt$
$4F \rightarrow 1$mole
$0.4F \rightarrow 0.1$mole

89. Ans.C)

P	Q
$w_1 = 500g$	$w_1 = 500g$
$w_2 = xg$	$w_2 = xg$
$\Delta T_f = 0.15$	$\Delta T_f = 0.3$
$M_p 80$	$M_6 = 7$

$$\frac{\Delta T_{f_{(P)}}}{\Delta T_{f_{(Q)}}} = \frac{K_f \times \frac{w_{2(P)}}{M_{2(P)}} \times \frac{1000}{w_1}}{K_f \times \frac{w_{2(Q)}}{M_{2(Q)}} \times \frac{1000}{w_1}}$$

$$\frac{0.15}{0.3} = \frac{\frac{x}{80} \times \frac{1000}{500}}{\frac{x}{M_Q} \times \frac{1000}{500}}$$

$$\frac{1}{2} = \frac{M_{(Q)}}{80}$$

$M_Q = 40g / mole$

90. Ans.E)

d = 0.89 g/ml

V = 1250 ml

$W_t = 1250 \times 0.8 = 1000$ g.

$$m = \frac{w_2}{M_2} \times \frac{1000}{w_1} = \frac{20}{40} \times \frac{1000}{1000} = 0.5$$

91. Ans. B)

$$K = 231 \times 10^{-5}\ S^{-1}$$

$$t_{1/2} = \frac{0.693}{231 \times 10^{-5}} = 300S$$

92. Ans.B)

$$\Delta H = E_{a_{(f)}} - E_{a_b}$$

$$2 = 13 - E_{a(b)}$$

$$E_{a_{(b)'}} = 13 - 2 = 11$$

93. Ans.A)

Decrease in enthalpy and decrease in entropy

94. Ans.B)

$PO_4^{3-} > SO_4^{2-} > C\bar{l}$

95. Ans.E)

$2KNO_3 \rightarrow 2KNO_2 + O_2$

96. Ans.D)

Be does not exhibit Co ordination number six

97. Ans.A)

Phosphinic acid – H_3PO_2

98. Ans.B)

I, II, V statements are correct

99. Ans.E)

$$Pu\ [Rn] 5f^6 7S^2$$

No electron in 6d orbital

100. Ans.C)

$PdCl_2$ – Wacker's process

101. Ans.E)

$\left[NiCl_2(PPH_3)_2\right]$

102. Ans.D)

$S\bar{C}N$ is an ambidental ligand

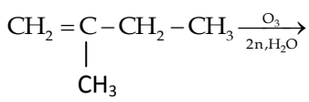
103. Ans.E)

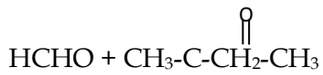
Cuprite - Cu_2O

104. Ans.D)

Toluene is Banzenoid aromatic

105. Ans.C)





106. Ans.A)

2, 3-dimethyl buta-1, 3-diene is not an isomer of 3-methyl but-1-yne

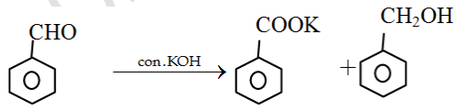
107. Ans.C)

C_6H_5Cl

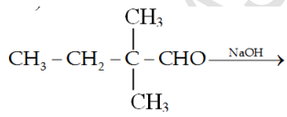
108. Ans.D)

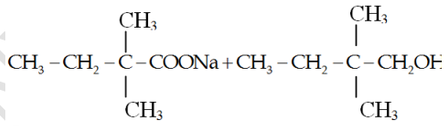
3- methyl butan-2-ol is a secondary alcohol

109. Ans.E)



110. Ans.C)





111. Ans.D)

Allyl amine

112. Ans.A)

P-toluene sulphonyl chloride similar to -Hinsberg reagent

113. Ans.E)

Water insoluble component of starch is amylopectin

114.Ans.C)

Sucrose is a non reducing sugar

115. Ans.D)

Melamine formaldehyde polymer

116.Ans.A)

3-hydroxy butanoic acid + 3-hydroxy pentanoic acid $\rightarrow$PHBV

117.B)

Salvarsan

118.E)

Glucose on oxidation with Br_2water gives gluconic acid

119. C) Norethindrone is an antifertility drug.

120. A) CH_4 is a green house gas $\Delta_f H^0$

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