XYLEM SAT 2024
NEET SCHOLARSHIP EXAMINATION
SOLUTIONS

PHYSICS

1. (3)
The force will still remain $\frac{q_1 q_2}{4\pi\varepsilon_0 r^2}$ according to the superposition principle.

2. (2)
Electrostatic properties of a conductor are as follows :
   (i) Electrostatic field is zero inside a charged conductor or neutral conductor.
   (ii) Electrostatic field at the surface of a charged conductor must be normal to the surface at every point.
   (iii) There is no net charge at any point inside the conductor and any excess charge must reside at the surface.
   (iv) Electrostatic potential is constant throughout the volume of the conductor and has the same value (as inside) on its surface.
   (v) Electric field at the surface of a charged conductor is

$$\vec{E} = \frac{\sigma}{\varepsilon_0}\hat{n}$$

where σ is the surface charge density and n is a unit vector normal to the surface in the outward direction.

3. (2)
For uniformly charged spherical shell: When $r < R, E = 0$ When $r \geq R, E = \frac{Q}{4\pi\varepsilon_0 r^2}$

4. (2)
To make potential zero net charge on two capacitors must be made zero. Hence, capacitors must be connected such that

$$Q = Q_1 - Q_2 = 0$$
$$\therefore C_1 V_1 - C_2 V_2 = 0$$
$$\therefore C_1 V_1 = C_2 V_2$$
$$\therefore 120C_1 = 200C_2$$
$$\therefore 3C_1 = 5C_2$$

5. (4)
$\alpha = \frac{R_T - R_0}{R_0\ T}$ Comparing with the graph,

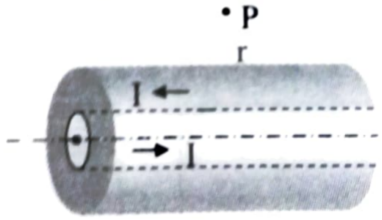
$$\frac{R_T - R_0}{T} = \text{slope} = m$$
$$\therefore \alpha = \frac{\text{slope}}{\text{Y - intercept}} = \frac{m}{R_0}$$

6. (3)
Balancing length is independent of crosssectional area of wire.

7. (3)
The force on a wire carrying current of any shape in a uniform magnetic field is indepen-

dent of its shape and depends on the vector length joining two end points of the wire. Hence the given portion of the curved wire may be treated as a straight wire of length 2 L which experiences a magnetic force $F_m = BI(2\,L)$

8. (2)
The respective figure is shown below. Magnetic fields at P due to inner and outer conductors are equal and opposite. Hence, net magnetic field at P will be zero.



9. (2)
$$I = \frac{e}{R_{eq}} = \frac{-n}{R_{eq}}\frac{(\phi_2 - \phi_1)}{t} \quad \ldots \left(\because e = -n\frac{d\phi}{dt}\right)$$
$$= \frac{-n(\phi_2 - \phi_1)}{(R + 4R)t}$$
$$= \frac{-n(\phi_2 - \phi_1)}{5Rt}$$

10. (3)
$E = 141\sin(628t)$,
$$\therefore\ E_{rms} = \frac{E_0}{\sqrt{2}} = \frac{141}{1.41} = 100\ \text{V}$$
Now, $2\pi v = 628$
$\therefore\ v = 100$ Hz

11. (2)
The voltage equation in going from point A to B is
$$V_{AB} = -IR + E - L\frac{di}{dt}$$
$$\therefore\ V_{AB} = -2\times 2 + 12 - \left(5\times 10^{-3}\times 10^{2}\right)$$
$$\left(\because \frac{di}{dt} \text{ is decreasing hence rate is negative}\right)$$
$$\therefore\ V_{AB} = -4 + 12 + 0.5 = 8.5\ \text{volt}$$

12. (1)
Here, $B_y = 8\times 10^{-6}\sin\left[2\times 10^{11}t + 300\pi x\right]$
The Y-component of the magnetic field is given by,
$$B_y = B_0\sin 2\pi\left(\frac{x}{\lambda} + \frac{t}{T}\right)$$
Comparing the given equation with the above equation,
$$\frac{2\pi}{\lambda} = 300\pi$$
$$\therefore\ \lambda = \frac{2}{300} = 6.67\times 10^{-3}\ \text{m}$$

13. (4)

14. (2)
$$\mu = \frac{h}{h'} \Rightarrow h' = \frac{8}{\left(\frac{4}{3}\right)} = 6\ \text{m}$$

15. (1)
$$\frac{1}{f_a} = ({}_a\mu_g - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$
$$\frac{1}{f_w} = ({}_w\mu_g - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$
$$\because\ {}_w\mu_g = \frac{{}_a\mu_g}{{}_a\mu_w} = \frac{3/2}{4/3} = \frac{9}{8}$$
$$\therefore\ \frac{f_w}{f_a} = \left(\frac{{}_a\mu_g - 1}{{}_w\mu_g - 1}\right) = \frac{1.5 - 1}{(9/8) - 1} = 4$$
$$\therefore\ f_w = 20\times 4 = 80\ \text{cm}$$

16. (4)
For two coherent sources of light,

$$I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$$
$$= (\sqrt{4I} + \sqrt{9I})^2$$

$\therefore \quad I_{max} = 25I$

$\therefore \quad I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$
$$= (\sqrt{4I} - \sqrt{9I})^2$$

$\therefore \quad I_{min} = I$

17. (2)
$\mu = \dfrac{1}{\sin i_c}$
Given: $i_c = \sin^{-1}\left(\dfrac{3}{5}\right) \Rightarrow \sin i_c = \dfrac{3}{5}$
$\therefore \quad \mu = \dfrac{1}{\sin i_c} = \dfrac{1}{\frac{3}{5}} = \dfrac{5}{3}$
and $\mu = \tan i_p$
$\therefore \quad i_p = \tan^{-1}(\mu) = \tan^{-1}\left(\dfrac{5}{3}\right)$

18. (3)
Let m_0 and e_0 be the mass and charge of a proton and m_1 and e_1 those of α-particle. Then
$\lambda_0 = \dfrac{h}{\sqrt{2\ m_0 e_0\ V}}$ and $\lambda_1 = \dfrac{h}{\sqrt{2\ m_1 e_1\ V}}$
Dividing, we get
$$\frac{\lambda_1}{\lambda_0} = \sqrt{\frac{m_0}{m_1} \times \frac{e_0}{e_1}} \quad \text{....(i)}$$
α-particle has twice the charge and 4 times the mass of proton, i.e., $m_1 = 4\ m_0$ and $e_1 = 2e_0$ Substituting these values in equation (i),
$$\lambda_1 = \frac{\lambda_0}{2\sqrt{2}}$$
$$\therefore \quad \frac{\lambda_0}{\lambda_1} = \frac{2\sqrt{2}}{1}$$

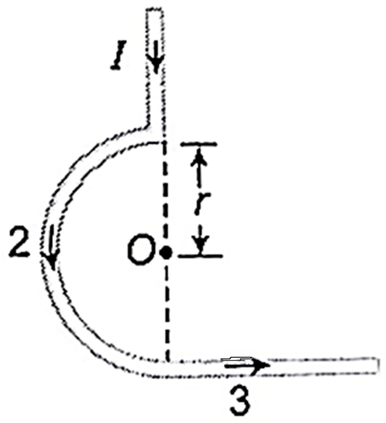
19. (2)
Kinetic energy $= -$T.E $= +3.4$eV

20. (1)
For Lyman series,
$$\frac{1}{(\lambda_L)_{max}} = R(1)^2\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \frac{3R}{4}$$
$$\therefore \quad (\lambda_L)_{max} = \frac{4}{3R}$$

For Balmer series,
$$\frac{1}{(\lambda_B)_{max}} = R(1)^2\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{5R}{36}$$
$$\therefore \quad (\lambda_B)_{max} = \frac{36}{5R}$$
$$\therefore \quad \frac{(\lambda_L)_{max}}{(\lambda_B)_{max}} = \frac{4}{3R} \times \frac{5R}{36} = \frac{5}{3 \times 9} = \frac{5}{27}$$

21. (2)
Because P-side is more negative as compared to N-side.

22. (3)
Magnetic field due to different parts are



$B_1 = 0$
$$B_2 = \frac{\mu_0}{4\pi} \cdot \frac{\pi I}{r} \odot$$
$$B_3 = \frac{\mu_0}{4\pi} \cdot \frac{I}{r} \odot$$
$$\therefore B_{net} = B_2 + B_3 = \frac{\mu_0 I}{4r} + \frac{\mu_0 I}{4\pi r}$$

23. (4)
Einstein's photoelectric equation can be written as

$\frac{1}{2}mv^2 = hv - \phi$

$\Rightarrow \frac{1}{2}m \times \left(4 \times 10^6\right)^2 = 2hv_0 - hv_0$ ......(i)

and $\frac{1}{2}m \times v^2 = 5hv_0 - hv_0$ ......(ii)

Dividing Eq. (ii) by (i), we get

$$\frac{v^2}{\left(4 \times 10^6\right)^2} = \frac{4hv_0}{hv_0}$$

$\Rightarrow v^2 = 4 \times 16 \times 10^{12} \Rightarrow v^2 = 64 \times 10^{12}$

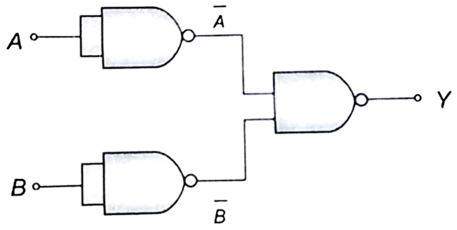
$\Rightarrow v = 8 \times 10^6$ m/s

24. (1)

B.E. $= \Delta mc^2 = [2(1.0087 + 1.0073) - 4.0015]$

$= 28.4\text{MeV}$

25. (2)



$Y = \overline{\overline{A}.\overline{B}} = \overline{\overline{A}} + \overline{\overline{B}} = A + B$

This output equation is equivalent to OR gate.

CHEMISTRY

26. **Ans(3)**
In Daniel cell, copper rod acts as cathode so there cations move towards copper electrode and reduction take place on copper rod.

27. **Ans(1)**
Vitamin C is ascorbic acid.

28. **Ans(2)**
$CH_3NH_2 + CHCl_3 + 3KOH \rightarrow$
$3KCl + CH_3NC + 3H_2O$

29. **Ans(1)**

30. **Ans(1)**
All the given statements about crystal field theory are correct.

31. **Ans(3)**
Clemmensen reduction is suitable for reduction of carbonyls containing additional acidic functional group.

32. **Ans(2)**
According to Raoult's law
$P_T = (0.08 \times 300 + 0.92 \times 800)$ torr
$= (24 + 736)$ torr
$= 760$ torr $= 1$ atm
$P_{\text{exp.}} = 0.95$ atm < 1 atm
Hence solution shows -ve deviation so $\Delta H_{\text{mix}} < 0$, and $\Delta V_{\text{mix}} < 0$.

33. **Ans(3)**
We know that the value of colligative property is directly proportional to no. of particles of solute.
Since $K_4[Fe(CN)_6]$ and $Al_2(SO_4)_3$ both form 5 ions on dissociation. Hence osmotic pressure of $Al_2(SO_4)_3$ solution will be nearest to that of equimolar solution of $K_4[Fe(CN)_6]$

34. **Ans(4)**
As the value of standard reduction potential decreases, the reducing power increases i.e.
$\therefore$ Reducing power Z > X > Y

35. **Ans(4)**

$$k = 1.2 \times 10^{14} e^{-\frac{25000}{RT}}$$
$$\ln k = \ln 1.2 \times 10^{14} - \frac{25000}{RT}$$

36. **Ans(2)**
For zero order reaction:
$x = Kt$
$= 0.6 \times 10^{-3} \times 2.0 \times 60$
$x = 0.72\text{M}$

37. **Ans(1)**
$F_2 + 2Cl^- \rightarrow Cl_2 + 2\ F^-$
$F_2 + 2Br^- \rightarrow Br_2 + 2\ F^-$
$F_2 + 2I^- \rightarrow I_2 + 2\ F^-$

38. **Ans(2)**
Decreases from + 6 to + 3.
$K_2Cr_2O_7 + 4H_2SO_4 \rightarrow$
$K_2SO_4 + Cr_2(SO_4)_3 + 4H_2O + 3O$
$[H_2S + [O] \rightarrow S + H_2O] \times 3$
$K_2\overset{+6}{C}r_2O_7 + 4H_2SO_4 + 3H_2S \rightarrow$
$K_2SO_4 + \overset{+3}{Cr}(SO_4)_3 + 7H_2O + 3S$

39. **Ans(4)**
$_{22}Ti = 3d^2 4s^2, Ti^{2+} = 3d^2$
$_{23}V = 3d^3 4s^2,\ V^{3+} = 3d^2$
$_{24}Cr = 3d^5 4s^1, Cr^{4+} = 3d^2$
$_{25}Mn = 3d^5 4s^2, Mn^{5+} = 3d^2$

40. **Ans(2)**
pentaammine nitrito-o-cobalt (III) chloride

41. **Ans(3)**
$C_2H_5CHO + 2Cu^{+2} + 5OH^- \rightarrow$
$\underset{\text{Red ppt}}{Cu_2O} + 3H_2O + C_2H_5COO^-$
$CH_3COCH_3 + 2Cu^{+2} + 5OH^-$
$\rightarrow$ No reaction

42. **Ans(4)**
With ethoxide base, most substituted alkene (I) is formed as the major product. Also, since E_2 reaction is an elementary reaction in which halogen leaves in the rate determining step, iodide leaves most easily and fluoride with maximum difficulty. All the given statements are correct

43. **Ans(2)**
Halogen atom because of its $-I$ effect has some tendency to withdraw electrons from the benzene ring, as a result, the ring gets somewhat deactivated as compared to benzene.

44. **Ans(2)**

45. **Ans(2)**

	$(CH_3)_2NH >$	$CH_3NH_2 >$	$(CH_3)_3N$
$K_b =$	5.4×10^{-4}	4.5×10^{-4}	0.6×10^{-4}

46. **Ans(2)**
Glycine $H_2N - CH_2 - COOH$ is optically inactive.

47. **Ans(2)**
$$\text{Eq. of Al} = \frac{13.5}{27/3} = 1.5$$
Thus 1.5 F is needed.

48. **Ans(3)**
Consider 1000 mL of water
Mass of 1000 mL of water
$= 1000 \times 1 = 1000$ grams
$$\text{Number of moles of water} = \frac{1000}{18}$$
$= 55.5$
$$\text{Molarity} = \frac{\text{No. of moles of water}}{\text{Volume in litre}}$$
$$= \frac{55.5}{1} = 55.5\text{M}$$

49. **Ans(1)**
HCl has lowest boiling point and HF has highest boiling point on account of intermolecular hydrogen bonding.

50. **Ans(2)**

BOTANY

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

ZOOLOGY

76. (4)	81. (1)	86. (4)	91. (4)	96. (3)
77. (4)	82. (1)	87. (1)	92. (1)	97. (3)
78. (2)	83. (1)	88. (4)	93. (1)	98. (4)
79. (1)	84. (4)	89. (2)	94. (3)	99. (1)
80. (2)	85. (4)	90. (2)	95. (2)	100. (4)