1. (12500)

Power $= V_{rms} I_{rms} \left(\frac{R}{Z}\right)$

Z = R (at resonance)

Power $= 250 \times \frac{250}{5} \times \frac{5}{5}$

$= 12500 \text{ W}$

2. (c) $\Delta\lambda = 2886 - 2880 = 6\text{Å}$

Using doppler shift,

$$-\frac{\Delta\lambda}{\lambda} = -\frac{V_{\text{radial}}}{C}$$

$$\Rightarrow V_{\text{radial}} = C\left(\frac{\Delta\lambda}{\lambda}\right) = 3 \times 10^8 \times \left(\frac{6 \times 10^{-10}}{2880 \times 10^{-10}}\right)$$

$= 6.25 \times 10^5 \text{ ms}^{-1}$

Hence, speed of galaxy $= 6.25 \times 10^5 \text{ ms}^{-1}$.

3. (b) Power = P

Fv = P

$$m\left(\frac{dv}{dt}\right) \cdot v = P$$

$$\Rightarrow \int_0^v v dv = \int_0^t \frac{P}{m} \cdot dt$$

$$\Rightarrow v = \sqrt{\frac{2P}{m} t}$$

$\Rightarrow \frac{dx}{dt} = \sqrt{\frac{2P}{m}} t$ [assuming at $t = 0, x = 0 \& v = 0$]

$$\Rightarrow \int_0^x dx = \int_0^t \sqrt{\frac{2P}{m}} t \cdot dt$$

$$\Rightarrow t = x = \sqrt{\frac{2P}{m}} \frac{2}{3} t^{3/2}$$

$$\Rightarrow x \propto t^{3/2}$$

4. (b)

$: eV_0 = \frac{hc}{\lambda} - \phi \ldots (1)$

$$3eV_0 = \frac{hc}{2\lambda} - \phi \ldots$$

Multiply by 3 in equation (1)

$$3eV = \frac{3hc}{\lambda} - 3\phi \ldots$$

Equation (3) - (2)

$$\frac{3hc}{\lambda} - \frac{hc}{2\lambda} - 2\phi = 0$$
$$\frac{5hc}{2\lambda} = 2\phi = \frac{2hc}{\lambda_0}$$

$$\frac{5}{4}\frac{hc}{\lambda} = \frac{hc}{\lambda_0}$$

$$\lambda_0 = \frac{4\lambda}{5}$$

5. (c) Work $= PV\ln\frac{v_2}{v_1}$

$= 400 \times 2\ln\frac{4}{2}$

$= 800\ln 2$

$= 800 \times 0.7$=560 j

6. (c) $\frac{Gm_1m_2}{(r_1+r_2)^2} = \frac{m_1v_1^2}{r_1}$

$$v_1^2 = \frac{Gm_2r_1}{(r_1+r_2)^2} \Rightarrow v_1 = \frac{\sqrt{Gm_2r_1}}{(r_1+r_2)}$$

$$T = \frac{2\pi r_1}{v_1} = \frac{2\pi\sqrt{r_1}(r_1+r_2)}{\sqrt{Gm_2}}$$

By using COM concept.

$$r_1 = \frac{m_2(r_1+r_2)}{m_1+m_2}$$

Put this value of r_1 in eq^n (1)

We get

$$T = \frac{2\pi(r_1+r_2)^{3/2}}{\sqrt{G(m_1+m_2)}}$$

7. (d) Let the natural length of wire be l_0.

Using Hooke's law, $Y = \frac{Tl_0}{A\Delta l}$

Where, $\Delta l = l - l_0$

We get $l - l_0 = \frac{Tl_0}{AY}$

Case 1: Tension is T_1 and length of wire $l = l_1$

$$\therefore l_1 - l_0 = \frac{T_1 l_0}{AY}$$

Case 2: Tension is T_2 and length of wire $l = l_2$

$$\therefore l_2 - l_0 = \frac{T_2 l_0}{AY}$$

Dividing both equations

$$\frac{l_1 - l_0}{l_2 - l_0} = \frac{T_1}{T_2}$$

$$l_0 = \frac{l_1 T_2 - l_2 T_2}{T_2 - T_1}$$

8. (c) Work done by gas in isothermal process is $\Rightarrow W = nRT\ln\left(\frac{V_2}{V_1}\right)$

$$W = P_1 V_1 \ln\left(\frac{V_2}{V_1}\right)$$

$$W = 2 \times 100 \ln\left(\frac{200}{100}\right)$$

$$W_{\text{gas}} = 200 \ln 2$$

9. (a) $\omega = 300\text{rpm} = 300 \times \frac{2\pi}{60} = 10\pi\text{rad/sec}$

$$\alpha = \frac{\pi}{20}\text{rad/s}^2$$

$$\theta = \omega T + \frac{1}{2}\alpha T^2$$

$$\theta = 10\pi \times 10 + \frac{1}{2} \times \frac{\pi}{20} \times (10)^2 = 102.5\pi\text{rad}$$

$$\theta = \frac{102.5\pi}{2\pi}\text{rev} = \frac{205}{4}\text{rev}$$

10. (d) Let distance to be traversed = x

Speed of escalator $= \frac{x}{t_1}$

Speed of boy walking $= \frac{x}{t_2}$

When the boy is walking on a moving escalator, speed is $= x\left(\frac{1}{t_2} + \frac{1}{t_1}\right) = x\left(\frac{t_1 + t_2}{t_1 t_2}\right)$

Time taken is distance by speed $= \frac{x}{v} = \frac{t_1 t_2}{t_1+t_2}$

$$T = \frac{t_1 t_2}{t_1 + t_2}$$

11. (c)

$$v = \omega\sqrt{A^2 - x^2}$$
$$v_1 = \omega\sqrt{A^2 - x_1^2}$$
$$\Rightarrow v_1^2 = \omega^2(A^2 - x_1^2)$$
$$v_2 = \omega\sqrt{A^2 - x_2^2}$$
$$v_2^2 = \omega^2(A^2 - x_2^2)$$
$$\Rightarrow \left(\frac{v_1^2}{\omega^2} + x_2^2\right) = A^2$$

From (i) and (ii)

$$v_1^2 = \omega^2\left(\frac{v_2^2}{\omega^2} + x_2^2 - x_1^2\right)$$

$$v_1^2 = v_2^2 + \omega^2(x_2^2 - x_1^2)$$

$$\Rightarrow \omega^2 = \frac{v_1^2 - v_2^2}{x_2^2 - x_1^2}$$

$$\Rightarrow \omega = \sqrt{\frac{v_1^2 - v_2^2}{x_2^2 - x_1^2}}$$

We know that

$$T = \frac{2\pi}{\omega}$$

$$\Rightarrow T = 2\pi\sqrt{\frac{x_2^2 - x_1^2}{v_1^2 - v_2^2}}$$

12. (6.15×10^{-12})

$$\lambda = \frac{h}{\sqrt{2M_e eV}}$$

$$\lambda = \frac{6.6 \times 10^{-34}}{\sqrt{2 \times 9 \times 10^{-31} \times 1.6 \times 10^{-19} \times 40 \times 10^3}}$$

$$\lambda = \frac{6.6 \times 10^{-34}}{\sqrt{1152 \times 10^{-47}}}$$

$$\lambda = 0.615 \times 10^{-34+23}$$

$\lambda = 6.15 \times 10^{-12}$ m

13. **(a)** $\chi_M = \mu_r - 1$

$\mu_r = 499 + 1 = 500$

We know that

$\mu = \mu_r \mu_0$

$\mu = 500 \times 4\pi \times 10^{-7}$

$\mu = 2\pi \times 10^{-4}$ SI units

14. **(a)** Initial K.E. = k

Final K.E. = 4k

$$k = \frac{P^2}{2m}$$

$$\Rightarrow P = \sqrt{2mk}$$

$$\Delta P = \sqrt{2m(4k)} - \sqrt{2mk}$$

$$= 2\sqrt{2mk} - \sqrt{2mk}$$

$$= \sqrt{2mk}$$

% change $= \frac{\Delta P}{P} \times 100 = \frac{\sqrt{2mk}}{\sqrt{2mk}} \times 100 = 100\%$

15. **(a)** de-Broglie wavelength = λ

$$\Rightarrow mv = \frac{h}{\lambda}$$

$$\Rightarrow \frac{1}{2}mv^2 = \left(\frac{h}{\lambda}\right)^2 \times \frac{1}{2m}$$

Energy of corresponding to cut-off wavelength is equal to

$$\frac{hc}{\lambda_0} = \frac{1}{2}mv^2 = \frac{h^2}{\lambda^2} \times \frac{1}{2m}$$

$$\Rightarrow \lambda_0 = \frac{\lambda^2(2m)c}{w}$$

Hence, cut-off wavelength $= \frac{2mc\lambda^2}{h}$

16. **(a)** $N = N_0 e^{-\lambda t}$

$$\Rightarrow \frac{N_0}{16} = N_0 e^{-\lambda t}$$

$\Rightarrow 2^{-4} = e^{-\lambda t}$

$\Rightarrow -4\ln 2 = -\lambda t$

$\Rightarrow -4\frac{\ln 2}{\lambda} = -t$

$\Rightarrow t = 4\left(\frac{\ln 2}{\lambda}\right) = 4 \times t_{1/2}$

$\Rightarrow t_{1/2} = 5\text{sec.}$

17. **(d)** Loss in PE in gain in K.E

$\Rightarrow mgh = \frac{1}{2}mv^2 + \frac{1}{2}I\frac{v^2}{R^2}$

$\Rightarrow v = \sqrt{\frac{2mgh}{m + \frac{I}{R^2}}}$

$\Rightarrow v_{\text{cylinder}} = \sqrt{\frac{2mgh}{m + \frac{mR^2}{2R^2}}} = \sqrt{\frac{4gh}{3}}$ and $v_{\text{ring}} = \sqrt{\frac{2mgh}{m + \frac{mR^2}{R^2}}} = \sqrt{gh}$

$\Rightarrow \frac{v_{\text{cylinder}}}{v_{\text{ring}}} = \sqrt{\frac{4}{3}}$

18. **(a)** Angle of dip

$\tan\theta = \frac{V}{H}$

For 30 to meridian

$\tan 45^\circ = \frac{V}{H\cos 30^\circ} \Rightarrow \frac{V}{H} = \cos 30^\circ$

$\tan\theta = \cos 30^\circ$ (By comparing)

$\tan\theta = \frac{\sqrt{3}}{2}$

$\theta = \tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$

19. **(b)** Higher concentration of NO_2 damage the leaves of plants and retard the rate of photosynthesis
20. **(c)** Sodium will not react with But-2-yne
21. **(a)** Hybridisation of N in $NO_2^- = sp^2$

Hybridisation of N in $NO_2^+ = sp$

Hybridisation of N in $NH_4^+ = sp^3$

22. **(a)** In the Carius method, a known mass of the compound is heated with concentration nitric acid in the presence of silver nitrate in a hard glass tube. The hard glass is known as Carius tube.

23. **(d)** Ga has electronic configuration $4s^2 4p^1$

Sn is present diagonally to Ga in the next period in p-block.

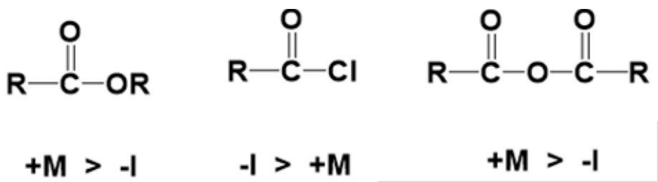
24. **(a)**

$$2Cu^{2+} + 4I^- \rightarrow \underset{\text{(white precipitate)}}{Cu_2I_2} + I_2 \uparrow$$

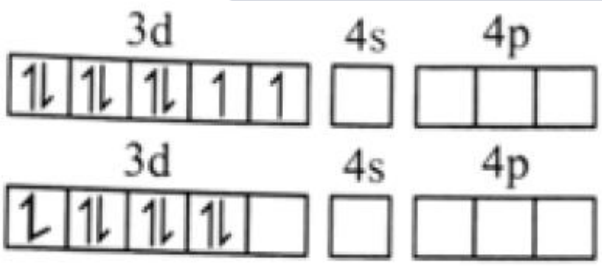
25. **(d)** Nitration is an electrophilic substitution reaction, in its first step HNO_3 takes a proton from sulphuric acid and then forms $-NO_2{}^+$. So, in the nitrating mixture HNO_3 acts as a base, and H_2SO_4 acts as an acid.

26. **(b)** Formaldehyde (Methanal) is the common monomer that is present in both novolac and bakelite.

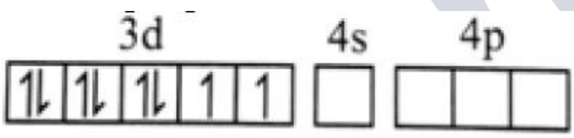
27. **(a)**



28. **(d)** $[Ni(CN)_4]^{2-} Ni(Z = 28) \Rightarrow 3\ d^8 4\ s^2 Ni^{2+} = 3\ d^8$



Unpaired electrons = 0
$[NiCN_4]^{2-}$
$Ni^{2+} = [Ar]3\ d^8$



Unpaired electrons = 2
Difference between unpaired electrons = 2

29. **(20)**

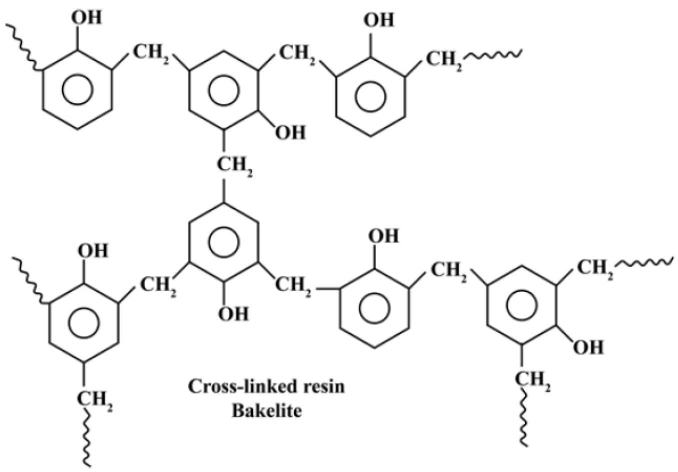
$$k = \frac{1}{t} \times 2.303 \log \frac{1}{1/16}$$

$$k = \frac{1}{80} \times 2.303 \log 16$$

$$k = \frac{1}{80} \times 2.303 \times 4 \log 2 = 0.035\ min^{-1}$$

$t_{1/2} = \dfrac{0.693}{0.035\ \text{min}^{-1}} = 20\ \text{min}$

30. (a)



(Formed by Novolac)

31. (d) Number of atoms in FCC unit cell = 4

Total number of tetrahedral voids $= 2 \times 4 = 8$

Given that 50% tetrahedral voids are occupied by atoms, i.e.,

Number of atoms present in tetrahedral voids = 50% of 8 = 4

Therefore, the effective number of atoms in the cell $= 4 + 4 = 8$

32. (d) $CuI: Cu^{+}: [Ar]3\ d^{10}$

No unpaired electrons

33. (b) Given equimolar mixture of NaOH and Na_2CO_3

Mass of mixture = 4 g

Let mass of NaOH = w

$\Rightarrow \dfrac{w}{40} = \dfrac{4-w}{106}$

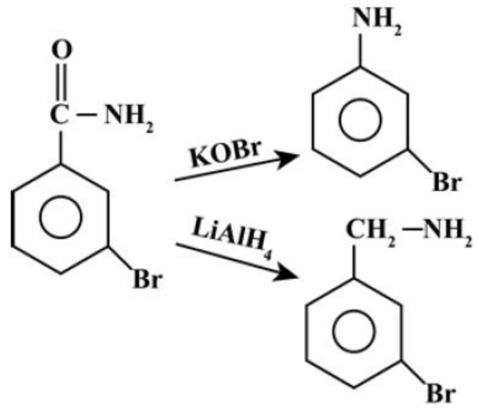
$\Rightarrow w = \dfrac{160}{146} = 1.0958\ \text{g}$

34. (a) $K = \frac{1}{t} \times 2.303 \log \frac{[A_o]}{[A_t]}$

$K = \dfrac{1}{20} \times 2.303 \log \dfrac{10}{2}$

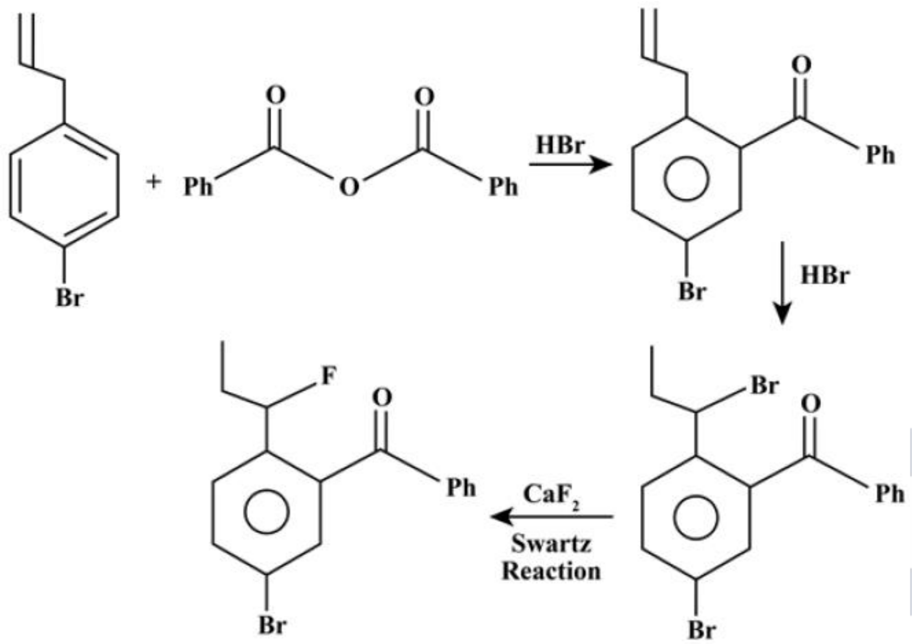
$K = \dfrac{1}{20} \times 2.303 \log 5 = 0.08\ \text{min}^{-1}$

35. (a)

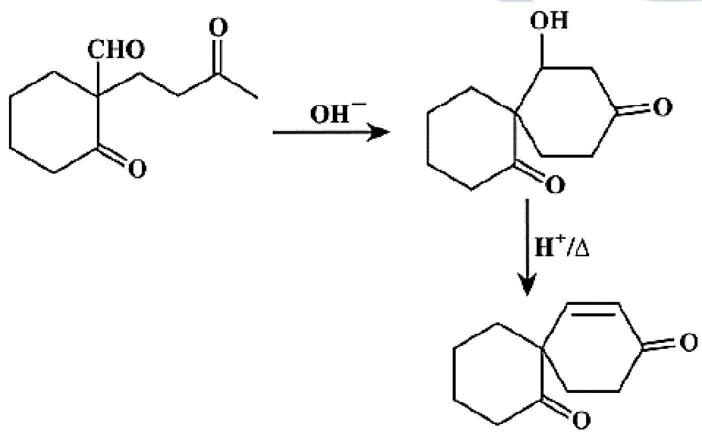


36. (a) Fe^{2+} (with weak field ligand) has 4 unpaired electrons $\left(t_{2g}{}^{4}eg^{2}\right)$, therefore spin only magnetic moment is 4.90BM

37. (d)



38. (b)



39. (d)

40. (b)

41. (c)

42. (b)

43. (a)
44. (a)
45. (a)
46. (b)
47. (d)
48. (b)
49. (c)
50. (b)
51. (a)
52. (d)
53. (d)
54. (b)
55. (b)
56. (b)
57. (d)
58. (c)
59. (108)
60. (1)
61. (2)
62. (6)
63. (9)
64. (9)
65. (1)
66. (9)
67. (7)
68. (c)