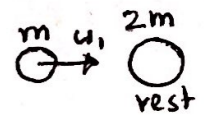
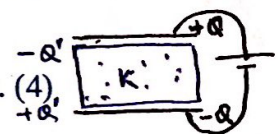
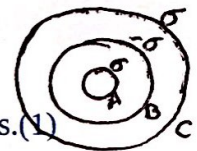


SOLUTIONS Of J.E.E.(Main)2018

(These 26 Questions out of 30 were taught directly in the Classroom by

Prof. MUKUL JHA)

61. **Diffraction & YDSE** 1st Diffraction minima --- $d \sin 30 = \lambda$ Hence $\lambda = d/2$
(YDSE) Fringe Width $\beta = \lambda D/d' = 0.01$ -- On calculation $d' = 25 \mu\text{m}$ Ans.(4)
63. **Electronics & Circuit** Potential barrier in Silicon is 0.7V, while in Germanium it is 0.3V
Current, $I = (3-0.7)/200 \text{ A} = 11.5 \text{ mA}$ Ans.(2)
64. **Errors in Measurements** Density $d = \text{Mass}/\text{Volume} = M/L^3$
Hence $\Delta d/d = 1. \Delta M/M + 3. \Delta L/L = 1.5+3.(1) = 4.5\%$ Ans.(2)
65. **Cyclotron** Radius $r = \sqrt{(2mK)/qB}$ $r_e = \sqrt{(2m_e K)/eB}$ $r_p = \sqrt{(2m_p K)/eB}$
 $r_\alpha = \sqrt{(2 \times 4m_p K)/2eB} = \sqrt{(2m_p K)/eB} = r_p$ Hence, $r_e < r_p = r_\alpha$ Ans.(1)
66. **Electrostatics** $V = Kq_A/r_B + Kq_B/r_B + Kq_C/r_C$
 $= 1/4\pi\epsilon_0 (\sigma \cdot 4\pi a^2/b - \sigma \cdot 4\pi b^2/b + \sigma \cdot 4\pi c^2/c)$
 $= \sigma/\epsilon_0 [(a^2 - b^2)/b + c]$... Ans.(1)
67. **Friction** For equilibrium .. $\mu(m+10)g = 5g$ $0.15(m+10) = 5$ $m+10 = 500/15$
 $m = 23.3 \text{ kg}$... no option correct... nearest Ans. 27.3 kgAns. (1)
68. **IRODOV CLASS** Attractive Force $F = -dU/dr = -(-K/2)(-2)/r^3 = -K/r^3$
For Circular Motion- by Newton's Law $K/r^3 = mv^2/r$ Hence $mv^2 = K/r^2$
Kinetic Energy, $K' = 1/2mv^2 = K/2a^2$
Total Energy $E = KE + PE = K/2a^2 + (-K/2a^2) = 0$ Ans.(2)
69. **Capacitors** $Q = KC/V = (5/3) \cdot 90 \cdot 20 = 3000 \text{ pC} = 3 \text{ nC}$
Induced charge on dielectric $Q' = Q[1 - (1/K)] = 3[1 - 3/5] = 1.2 \text{ nC}$ Ans. (4)
70. **S.H.Motion** Frequency $= 1/2\pi\sqrt{(k/m)} = 10^{12}$
 $m = \text{mass of one atom} = 108/(6.02 \cdot 10^{23}) \cdot 10^{-3} \text{ kg}$
On solving we can get $k = 7.1 \text{ N/m}$ Ans. (1)
71. **Collisions** For elastic collision apply formula... $v_1 = (m-2m)/(m+2m) \cdot u = -u_1/3$
Fractional loss $= [1/2mu_1^2 - 1/2m(u_1/3)^2] / (1/2mu_1^2) = 8/9 = 0.89$
Similarly for 2nd collision between m and $12m$ Fractional loss $= 48/169 = 0.28$...Ans (4)
72. **Magnetic Field by Current** Dipole moment of circular loop $= \mu = NIA = 1 \cdot I \cdot \pi R^2$
Magnetic field at centre $B_1 = \mu_0 I/2R$
Moment becomes double if new radius $= R\sqrt{2}$, as current I has to be kept constant
New magnetic field at centre $B_2 = \mu_0 I/(2R\sqrt{2}) = B_1/\sqrt{2}$
Hence, $B_1/B_2 = \sqrt{2}$ Ans.(2)
73. **Potentiometer (IRODOV CLASS)** $r = R(L/L' - 1) = 5.(52/40 - 1) = 3/2 = 1.5\Omega$
.....Ans. (1)



74. **Communication System** 10% of 10 GHz = n. 5 kHz where n is the total no of channels
 $0.10 \times 10^4 \times 10^9 = n \cdot 5 \times 10^3$ $n = 2 \times 10^5$ Channels Ans.(2)

75. **Polarization** As $I' = I/2$, Transmission axis of A and B are parallel
 Now, $(1/2 I \cos^2 \theta) \cdot \cos^2 \theta = 1/8$, from B $\therefore \cos^4 \theta = 1/4$
 $\cos \theta = 1/\sqrt{2}$ Hence $\theta = 45^\circ$ Ans.(2)

77. **Rotational Dynamics** M.I. of removed part about axis through C of bigger disc
 $= I + Md^2 = M(R/3)^2 + M(2R/3)^2 = MR^2/2$
 On superposition, $MI = 9MR^2/2 - MR^2/2 = 4MR^2$ Ans(4)

79. **Electromagnetic Waves** Speed of e.m.waves = $1/\sqrt{\epsilon\mu}$
 Speed in air = $\omega/k = c$ and speed in medium = $\omega/k = c/2$
 Hence ratio $c/(c/2) = 2 = \sqrt{\epsilon_2/\epsilon_1}$ Hence $\epsilon_1/\epsilon_2 = 1/4$... Ans.(2)

80. **Alternating Current** Quality Factor for sharpness of resonance, $Q = \omega_0 L/R$ in LCR Circuit
 Ans.(4)

81. **1-d Motion Graphs** Distance time graph indicates that velocity increases from 0, then decreases (slope $ds/dt = v$)
 But all other graphs indicate that velocity decreases first, then increases.
 Hence, incorrect graph is (1). Ans.(1)

82. **Electrical Circuits(IRODOV CLASS)** – Equivalent EMF = $[12 \times 2 + 13 \times 1]/[2+1] = 37/3V$
 Eqv internal resistance of cells = $(2 \times 1)/(2+1) = 2/3\Omega$
 Main current $i = (37/3) / [10 + (2/3)] = 37/32 A$
 Potential diff. Across 10Ω , $V = iR = 37 \times 10/32 = 11.56 V$... Ans.(1)

83. **Satellite Motion** $m\omega^2 R = k/R^n$ Hence $\omega^2 \propto (1/R^{n+1})$ Hence $\omega \propto (1/R^{(n+1)/2})$
 Now $T = 2\pi/\omega$ $T \propto R^{(n+1)/2}$... Ans.(2)

84. **Bohr Model of H- Atom** Series Limit implies last line of Lyman and Pfund Series ($n=5$)
 For Lyman Series $h\nu_L = 13.6e$ For Pfund Series $h\nu_P = 13.6e/5^2$
 Hence $\nu_P = \nu_L/25$... Ans.(2)

86. **Thermodynamics** Adiabatic process $T \cdot V^{\gamma-1} = \text{Constant}$ $T_1 \cdot V_1^{\gamma-1} = T_2 \cdot V_2^{\gamma-1}$
 For monoatomic gas $\gamma = 5/3$ $T_2 = T_1 [V_2/V_1]^{\gamma-1} = 300 [V/2V]^{\gamma-1} = 189 K$
 Change in Internal Energy $\Delta U = n \cdot D/2 \cdot R \cdot \Delta T = 2 \cdot (3/2) \cdot (8.3) \cdot (189-300) = -2.7 kJ$... Ans(2)

87. **Elasticity** Bulk Modulus, $K = dp/(dV/V) = mg/a(dV/V)$ $dV/V = mg/Ka$ ---- (1)
 Volume of sphere, $V = 4/3\pi R^3$ Hence $dV/V = 3 \cdot dr/r$ ---- (2)
 By eqn (1) and (2), $3 \cdot dr/r = mg/Ka$ $dr/r = mg/3Ka$.. Ans(2)

88. **Sound** Speed of wave $v = \sqrt{Y/\rho} = 5.85 \times 10^3 m/s$ As rod is clamped at mid $\lambda/4 = L/2$,
 $\lambda = 2L = 1.2m$
 Frequency $\nu = v/\lambda = 5.85 \times 10^3 / 1.2 = 4.88 \times 10^3 Hz = 5 kHz$.. Ans(4)

89. **Collisions** $F = dp/dt = N \cdot 2m\nu \cos 45^\circ / t$
 Pressure = $F/A = (N/t) \cdot 2m\nu \cos 45^\circ / A = 2.35 \times 10^3 N/m^2$
 .. Ans(4)

Nice Conceptual Numericals

ALL DIRECT FROM CLASSROOM LECTURES

