SOLUTIONS TO CET MOCK TEST

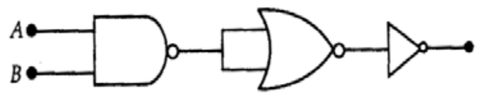
PHYSICS PAPER – V

1. **a)** Since, $r \propto n^2, \quad v \propto \frac{1}{n} \quad and \quad E \propto \frac{1}{n^2}$

   $\therefore vr \propto n$

2. **a)** P n junction being reverse biased, current through the diode is zero

3. **d)**



$\overline{A.B}$ $\quad\quad$ $\overline{\overline{A.B}}$ $\quad\quad$ $y = \overline{A.B}$

Hence, the given logic circuit is equivalent to NAND GATE

4. **b)** Magnetic field at the centre of semicircular current carrying current is given by $\mu = \frac{\mu_0 I}{4a}$

$$B = \frac{\mu_0 I}{4a}\left(1 - \frac{1}{2} + \frac{1}{4} - \frac{1}{8} + \frac{1}{16} - \frac{1}{32} + \dots\dots.\right)$$

$$= \frac{\mu_0 I}{4a}\left(1 - \frac{1}{2} + \frac{1}{2^2} - \frac{1}{2^3} + \frac{1}{2^4} - \frac{1}{2^5} + \dots\dots\right)$$

$$= \frac{\mu_0 I}{4a}\left(\left(1 + \frac{1}{2^2} + \frac{1}{2^4} + \cdots\right) - \left(\frac{1}{2} + \frac{1}{2^3} + \frac{1}{2^5} + \cdots\right)\right)$$

the series being Geometric progression

$$= \frac{\mu_0 I}{4a}\left(\left(\frac{1}{1-\frac{1}{4}}\right) - \left(\frac{\frac{1}{2}}{1-\frac{1}{4}}\right)\right) = \frac{\mu_0}{4a}\left(\frac{4}{3} - \frac{2}{3}\right)$$

$$B = \frac{\mu_0 I}{6a}$$

5. **a)** P and Q attract and Q and R repel each other. P Q R

   As $F \propto I_1 I_2$, repulsion being stronger, Q moves to left.

6. **c)** Magnetic force, $F = qvB, \quad \therefore \; F \propto B$

   Magnetic field at a point distant ‘x’ due to a straight conductor carrying current is

   $F = \frac{\mu_0}{4\pi}\frac{2I}{x} \quad \therefore F \propto \frac{1}{x}$

   $\therefore \; B \propto \frac{1}{x}$ F

7. **c)** For tension to be zero, $mg = BIl$

   $B = \frac{mg}{Il} = 0.2\,T$ W

8. **c)** Radius of circular path described by a charged particle, when it moves perpendicular to magnetic field is

   $r = \frac{mv}{Bq} \quad \therefore \; r \propto \frac{m}{q}$

$$r_p : r_d : r_\alpha = \frac{1}{1} : \frac{2}{1} : \frac{4}{2} = 1 : 2 : 2$$

9. **c)** $s = \frac{I_g G}{I - I_g} = 15\,\Omega\ in\ parallel$

10. **a)** At resonance, $I_{max} = 600\,mA = \frac{V}{Z}$

    $z = \frac{V}{I} = \frac{6}{0.6} = 10\,\Omega = R$

    In DC circuit the current through the coil is $I = \frac{E}{R + r} = \frac{6}{10 + 2} = 0.5\,A$

11. **c)** At resonance power factor is maximum

12. **b)** At every instant the ratio of the magnitude of the electric field to that of magnetic field in an electromagnetic wave equal to the speed of light.

13. **a)** Since $x_L = x_C, \quad z = R$

$\therefore \quad I = \frac{V}{Z} = \frac{100}{50} = 2A$

14. **b)** The velocity of electric field is the velocity of light. It is the field that causes current to flow and not the electrons that travel from one end to the other.

15. **d)** Total linear momentum, total angular momentum and total energy will be conserved

16. **c)** $_{Z}X^{A} \xrightarrow{\alpha} {}_{Z-2}Y^{A-4} \xrightarrow{2\beta^-} {}_{Z-2+2}Z^{A-4}$

$\therefore$ the resultant daughter is an isotope of parent nucleus.

17. **a)** Linear width of central maximum

$$\beta_0 = \frac{2\lambda D}{d}$$

Given $\beta_0 = d, \quad \therefore d = \frac{2\lambda D}{d}$

$$d^2 = 2\lambda D$$

$$D = \frac{d^2}{2\lambda}$$

18. **c)** $N_s = t\left(1 - \frac{1}{n}\right)$

$n_R < n_v \quad \therefore N_{SR} > N_{SV}$

$\therefore$ Red colored letters appear to be raised more.

19. **b)** Let electron rises to E_n state by absorbing 12.1 eV

$$E_1 - E_n = 12.1\ eV$$

$$-13.6 - E_n = 12.1$$

$$E_n = -13.6 - 12.1 = -1.5$$

$$since\ \ E_n = -\frac{13.6}{n^2}, \quad -\frac{13.6}{n^2} = -1.5$$

$$n^2 = \frac{13.6}{1.5} = 9$$

$$\therefore n = 3$$

i.e., electron rises to $n = 3$ state.

The number of possible spectral lines emitted during its transmission to ground state is $\frac{n(n-1)}{2} = 3$

20. **b)** Fundamental frequency of vibration of a stretched string

$$f = \frac{1}{2l}\sqrt{\frac{T}{M}} = \frac{1}{2l}\sqrt{\frac{T}{\rho A}} = \frac{1}{2lr}\sqrt{\frac{T}{\pi\rho}}$$

$$f \propto \frac{1}{lr}\sqrt{\frac{T}{\rho}}$$

$$\frac{f_A}{f_B} = \frac{l_B r_B}{l_A r_A}\sqrt{\frac{T_A}{T_B}.\frac{\rho_B}{\rho_A}} = \frac{2l_A 2r_A}{l_A r_A}\sqrt{\frac{T_A}{2T_A}.\frac{2\rho_A}{\rho_A}} = 4$$

$$f_A = 4f_B$$

21. **d)** Two pipes of equal length one closed at one end and the other open at both ends can never resonate.

22. **c)** Wave velocity, $v = \frac{\omega}{k}$

$Particle\ velocity,\ u_{max} = A\omega$ since $A\omega = \frac{\omega}{k} = \frac{\lambda}{2\pi}$

$$\lambda = 2\pi A$$

23. **c)** $\frac{\lambda}{2} = 5\ cm \quad \therefore \lambda = 10\ cm$

$v = \lambda f$

$f = \frac{v}{\lambda} = \frac{2}{0.1} = 20Hz$

24. **a)** $p.d = \frac{work\ done}{charge} = \frac{2}{20} = 0.1\,V$

25. **a)** Equivalent circuit

is a balanced wheat stone's bridge.

Capacitance in upper branch

$$\frac{1}{C_1} = \frac{1}{4} + \frac{1}{4} = \frac{1}{2}$$

$$\therefore C_1 = 2\mu F$$

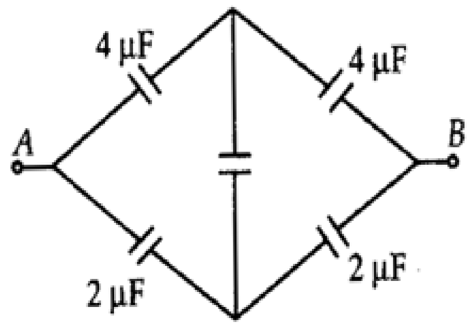
Capacitance in lower branch

$$\frac{1}{C_2}=\frac{1}{2}+\frac{1}{2}=\frac{1}{1}$$

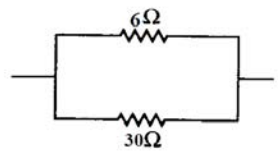
$\therefore\ c_2 = 1\mu F$

The efficient capacitance A and B is

$$C_1 + C_2 = 3\mu f$$



26. **c)** Current is independent of area of cross section of the conductor.
27. **a)** $\theta\ being\ 60^\circ, the$ resistance of the wire AB is



$=\frac{1}{6}\times 36\Omega = 6\Omega$

$\therefore\ 6\Omega\ and\ 30\Omega$ are in parallel between A and B

$$\therefore R=\frac{30\times 6}{36}=\frac{180}{36}=5\Omega$$

28. **d)** (i) Energy density = $\frac{E}{V}=\ \frac{ML^2T^{-2}}{L^3}=ML^{-1}T^{-2}$

(ii) $\frac{Force}{area}=\frac{ML^1T^{-2}}{L^2}=ML^{-1}T^{-2}$

(iii) $\frac{Q}{V}\times voltage=\frac{Q}{V}\times\frac{W}{Q}=\frac{ML^2T^{-2}}{L^3}=ML^{-1}T^{-2}$

(iv) $\frac{angular\ momentum}{mass}=\frac{L}{m}=\frac{r_P}{m}=\frac{rmv}{m}=LLT^{-1}=L^2T^{-1}$

29. **b)** $E_k=\frac{1}{2}mv^2 = 98 \quad (\because\ v^2-u^2=2gh)$

$v^2=\frac{2\times 98}{m}=98 = 2gh \qquad \therefore\ h=\frac{v^2}{2g}=\frac{98}{2\times 9.8}=5\ m$

$E_k=\frac{1}{2}\ m\ (2gh)\ \ and\ \ E_k{}^{|}=\frac{1}{2}m\left(2gh^{|}\right)=\ \frac{E_k}{2}$

$$\therefore\ \ h^{|}=\frac{h}{2}=\frac{5}{2}=2.5m$$

30. **d)** For a given velocity of projection range is maximum when θ = 45˚
31. **c)** $T=mg+\frac{mv^2}{r} \qquad \because\ \ \frac{1}{2}mv^2=mgh$

$=mg+\frac{2mgh}{r} \qquad mv^2=2mgh$

$=mg\ \left(1+\frac{2h}{r}\right)=0.01\times 10\left(1+\frac{2}{1}\right)$

$=0.30N$

32. **b)** $v=\sqrt{\frac{Gm}{r}}$ since $v\propto\frac{1}{\sqrt{r}} \qquad v_A\propto\frac{1}{\sqrt{4R}}\ \ and\ \ v_B\propto\frac{1}{\sqrt{R}}$

$\frac{v_B}{v_A}=\sqrt{\frac{4R}{R}}=2, \quad v_B=2v_A=2\times 3v=6v.$

33. **b)** $surface\ Tension=\frac{surface\ energy}{area}$

$U=TA=T4\pi R^2$

$but, \quad volume\ of\ big\ drop=1000\ volume\ of\ small\ drop$

$$\frac{4}{3}\pi R^3=1000\frac{4}{3}\pi r^3=10^3r^3$$

$$R=10r$$

$\therefore\ \ radius\ of\ small\ drop,\ r=\frac{R}{10}$

$\therefore surface\ energy\ of\ each\ small\ drop,\ U^{|}=T.4\pi\ \left(\frac{R}{10}\right)^2=\frac{1}{100}U$

$$Surface\ energy\ of\ 1000\ small\ drops=\frac{1000}{100}U=10\ U$$

34. **a)** $Given \quad \alpha = 0.98 \ and\ \Delta I_E = 5.0\ mA$

$Current\ gain, \alpha = \frac{\Delta I_c}{\Delta I_E}$

$\therefore\ \Delta I_c = \alpha . \Delta I_E = 0.98 \times 05 = 4.9\ mA$

$Change\ in\ base\ current, \Delta I_B = \Delta I_E - \Delta I_c$ $\quad (\because\ \Delta I_E = \Delta I_B + \Delta I_c)$

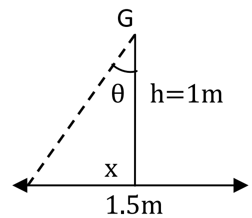
$= 50 - 4.9$

$= 0.1 mA$

35. **d)** $\tan\theta = \frac{v^2}{rg}$

$\frac{x}{h} = \frac{v^2}{rg}$

$v = \sqrt{\frac{rgx}{h}} = \sqrt{\frac{100 \times 9.8 \times 0.75}{1}} = 2.71\ m/\ s$



36. **d)** $Weight\ of\ train, w = 10^7 N = ma = m \times 10$

$mass\ of\ train, m = 10^6\ kg$

$friction = \frac{0.5\ kg}{100} = \frac{0.5}{100} \times 10^6 = 5000\ kg$

$F = 5000 \times 10$

$= 5 \times 10^4 N$

$Power, P = F \times v = 5 \times 10^4 \times 10$

$= 5 \times 10^5 W$

$= 500 kW$

37. **b)** Relative velocity, $v_R = v_A + v_B = 4\ m\ /s\ while\ getting\ loser$

$v_R = v_A - v_B = 0.4\ m\ /s\ while\ travelling\ in\ same\ distance$

$\therefore\ v_A = 2.2 \frac{m}{s}\ and\ v_B = 1.8\ m\ /s$

38. **d)** $v = \frac{dx}{dt} = -4 + 12t$

The above equation is of the form $y = mx + c$

$\therefore v - t\ graph\ is\ a\ straight\ line\ with\ negative\ intercept$

39. **b)** $\eta = 1 - \frac{T_2}{T_1}, \quad T_2 < T_1$

$\therefore \quad T_2 + 100 < T_1 + 100$

$\frac{T_2}{T_1} < \frac{T_2 + 100}{T_1 + 100}$

$\therefore \eta' < \eta$

40. **b)** $Temperature\ gradient, \frac{dy}{dx} = \frac{80 - 0}{100} = 0.8^\circ c\ /cm$

$\therefore Decrease\ in\ temperature\ for\ 60\ cm\ is = 60 \times 0.8 = 48^\circ C$

$\therefore temperature$ at 60 $cm\ from\ end\ A = 80 - 48 = 32^\circ C$

41. **d)** Rate of cooling ∝ area of the body

$\propto r^2$

$since,\ radius\ of\ A\ is \frac{1}{2}\ that\ of\ B, rate\ of\ cooling\ A\ is\ \frac{1}{4} that\ of\ B.$

42. **d)** magnification, $m = \frac{f}{u - f}$

$\frac{f}{u_1 - f} = -\frac{f}{u_2 - f}$

$u_2 - f = -u_1 + f$

$\therefore\ f = \frac{u_1 + u_2}{2}$

43. **c)** For 1st minimum in diffraction, d $sin\theta = \lambda$

$sin\theta = \frac{\lambda}{d}$

$\therefore \quad \theta = sin^{-1}\left(\frac{\lambda}{d}\right)$

$Angular\ width\ of\ central\ max. = 2\theta = 2 sin^{-1}\left(\frac{\lambda}{d}\right)$

44. **a)** In interference, int. at a point $I = R^2 = a^2 + b^2 + 2ab\,cos\phi$

$Here\ a = b\ and\ \phi = 2\pi$, since a path difference is λ

$\therefore\ I = a^2 + a^2 + 2a^2\cos 2\pi = 4a^2 = k$

if path difference is $\lambda/3$, phase difference $= \frac{2\pi}{3} = 120^\circ$

$\therefore\ I^{|} = a^2 + a^2 + 2a^2\left(-\frac{1}{2}\right) = a^2 = \frac{k}{4}$

45. **b)** $n = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\frac{A}{2}} = \frac{sin\left(\frac{60+30}{2}\right)}{sin\left(\frac{60}{2}\right)} = \frac{\sin 45}{\sin 30} = \frac{\frac{1}{\sqrt{2}}}{\frac{1}{2}}$

$n = \sqrt{2}$

If $D = 30^\circ, n = \sqrt{2}$

If $D \geq 30^\circ,\ then\ n \geq \sqrt{2}$

46. **a)** $N_{X_1} = N_0 e^{-6\lambda t}\ \ and\ \ N_{X_2} = N_0 e^{-4\lambda t}$

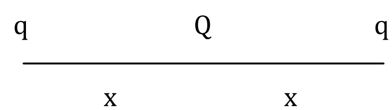
$\frac{N_{X_1}}{N_{X_2}} = \frac{1}{e} = e^{-2\lambda t}$

$\therefore\quad e^1 = e^{+2\lambda t}$

$t = \frac{1}{2\lambda}\ \ s$

47. **d)** For a system to be in equilibrium, net for on q = 0

$\therefore \frac{1}{4\pi\epsilon_o}\frac{qQ}{x^2} + \frac{1}{4\pi\epsilon_o}\frac{q^2}{4x^2} = 0$



$qQ = \frac{-q^2}{4}$

$\therefore\ \frac{Q}{q} = -\frac{1}{4}$

48. **c)** ${}_w n_g = \frac{1}{\sin c} = \frac{n_g}{n_w} = \frac{3/2}{4/3} = \frac{9}{8}$

$\sin c = \frac{8}{9}$

$C = sin^{-1}\left(\frac{8}{9}\right)$

49. **a)** When f < u < 2f, the image due to a convex lens is real magnified and inverted.

50. **b)** $\boldsymbol{V} = \frac{1}{4\pi\epsilon_o}\frac{Q}{r} = Q \times 10^{11}$

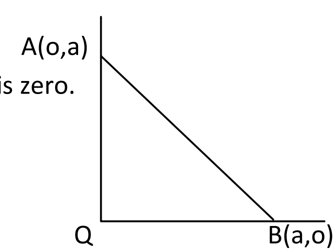
$\therefore\quad 4\pi\epsilon_o r = 10^{-11}$

Now $E = \frac{1}{4\pi\epsilon_o}\frac{Q}{r^2} = \frac{Q \times 4\pi\epsilon_o}{(4\pi\epsilon_o r)^2}$

$E = \frac{Q \times 4\pi\epsilon_o}{(10^{-11})^2} = 4\pi\epsilon_o Q\ \ X\ 10^{+22}$ V/m

51. **b)** $A\ and\ B$ being equipotential points, potential difference is zero.

$\therefore\quad w = Vq = 0$



52. **a)** After inserting the dielectric the resultant electric field decreases, but the electric field between plates of capacitor remains same.

53. **b)** Sp. BE is maximum for A=56

54. **b)** If I_0 is intensity of unpolarised light, then intensity through 1st Polaroid, $I_1 = \frac{I_0}{2}$

Intensity through 2nd Polaroid, $I_2 = \left(\frac{I_0}{2}\right) cos^2\theta = \frac{I_0}{2} cos^2 45^\circ = \frac{I_0}{4}$ = 25% I_0

55. **b)** Einstein's photoelectric equation, $E = w + KE$

$$\therefore \quad \frac{hC}{\lambda} = \frac{hC}{\lambda_0} + eV_s$$

Initially $\frac{1}{\lambda} - \frac{1}{\lambda_0} = \frac{3e}{hc}$ -------(1)

$\frac{1}{2\lambda} - \frac{1}{\lambda_0} = \frac{e}{hc}$ -- -- -- - (2)

(1) $\times \frac{1}{2}$ $\quad \frac{1}{2\lambda} - \frac{1}{2\lambda_0} = \frac{3e}{2hc}$

$\frac{1}{2\lambda} - \frac{1}{\lambda_0} = \frac{e}{hc}$

on subtracting $\frac{1}{\lambda_0}\left(1 - \frac{1}{2}\right) = \frac{e}{hc}\left(\frac{3}{2} - 1\right)$

$$\frac{1}{2\lambda_0} = \frac{e}{2hc}$$

$$\frac{1}{\lambda_0} = \frac{e}{hc}$$

From Equation (1)

$\frac{1}{\lambda} - \frac{1}{\lambda_0} = \frac{3}{\lambda_0}$; $\quad \frac{1}{\lambda} = \frac{4}{\lambda_0}$

$\therefore \lambda_0 = 4\lambda$

56. **b)** Sp.BE for deuteron = $\frac{BE}{A} = \frac{1.125}{2} = 0.5625$ MeV

for alpha particle $= \frac{7.2}{4} = 1.8\ MeV$

$\therefore$ alpha particle is more stable

57. **d)** Limit of resolution of microscope, $d = \frac{\lambda}{2\, n\, sin\theta}$

since $d\ \alpha\ \lambda$

$$\therefore \frac{\lambda_2}{\lambda_1} = \frac{d_2}{d_1}$$

$$\frac{4800}{6000} = \frac{d_2}{0.1} \qquad d_2 = 0.08\ mm$$

58. **b)** Nuclear density is independent of mass number

59. **c)** From Bohr's Ist postulate, angular momentum of an electron in a stationary orbit = $\frac{nh}{2\pi}$. For 2nd orbit, n = 2

$$= \frac{2h}{\pi} = \frac{h}{\pi}$$

60. **d)** De Broglie wavelength, $= \frac{h}{p}$. since wavelength is same for electron and photons

$$p = \frac{h}{\lambda}$$

$\therefore$ momentum is same for electron and photons.