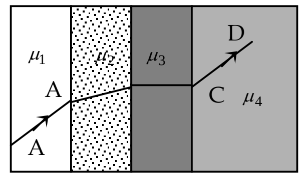
SOLUTIONS TO MOCK CET -3

Hints and explanations:



1. $\frac{\sin i}{\sin r_1} = \frac{\mu_2}{\mu_1}, \frac{\sin r_1}{\sin r_2} = \frac{\mu_3}{\mu_2}, \frac{\sin r_2}{\sin i} = \frac{\mu_4}{\mu_3}$

   Or $\frac{\sin i}{\sin r_1} \times \frac{\sin r_1}{\sin r_2} \times \frac{\sin r_2}{\sin ri} = \frac{\mu_2}{\mu_1} \times \frac{\mu_3}{\mu_2} \times \frac{\mu_4}{\mu_3}$

   Or $\frac{\sin i}{\sin i} = \frac{\mu_4}{\mu_1}$

   Or $\mu_4 = \mu_1$ or **option (4)**

2. (a) For the fish, the bird appears at a height of $\frac{6}{3/4} = \frac{6 \times 4}{3} = 8$ m from water surface

   (b) For the bird, the fish appears at a depth of $\frac{0.8}{4/3} = \frac{0.8 \times 3}{4} = 0.6$ m below water surface

Hence the bird sees the fish 6.60 m away while the fish sees the bird 8.8 m away or **option (2)**

3. As the lens can form both real and virtual images, it is a convex lens and $u = -ve$

   $\therefore$ we get $\frac{1}{v_1} + \frac{1}{16} = \frac{1}{f} \Rightarrow v_1 = \frac{16f}{16-f}$

   And $\frac{1}{v_2} + \frac{1}{6} = \frac{1}{f}$ and $v_2 = \frac{6f}{6-f}$

   As the images are of the same size

   $\frac{v_1}{u_1} = -\frac{v_2}{u_2}$

   Or $\frac{\frac{16f}{16-f}}{16} = -\frac{\frac{6f}{6-f}}{6}$

   Or $-(6-f) = 16 - f$

   Or $f = 11cm$ or **option (4)**

4. $r_2 + r_2 = A$ for emergent ray,

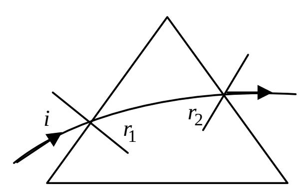
   For no emergent ray, $r_2 > C$,

   Max value of r_1 is when $i = 90$ or $\sin r_1 = \frac{1}{\mu} = \sin C$ or

   Or $r_1 = C$

   $\therefore r_1 + r_2 = A > (C + C)$

   OR $A > 2C$ is the condition for no emergent ray as per **option (3)**



5. Given $I_1 = 2I_2$; the required ratio is given by $\frac{I_{max}}{I_{min}} = \frac{\left(\sqrt{2I_2}+\sqrt{I_2}\right)^2}{\left(\sqrt{2I_2}-\sqrt{I_2}\right)^2} = \frac{\left(\sqrt{2}+1\right)^2}{\left(\sqrt{2}-1\right)^2} = \frac{3+2\sqrt{2}}{3-2\sqrt{2}}$

or by $\frac{I_{max}}{I_{min}} = \frac{3+2\times1.414}{3-2\times1.414} = \frac{5.828}{0.172} \approx 34$ 0r **option(2)**

6. Since the n^{th} red band coincides with the $(n+1)^{th}$ blue band, we get

$\frac{n\times7800\times D}{d} = (n+1)\frac{5200\times D}{d}$ or $78n = (n+1)52$ or n=2. Or **option (3)**

7. Polarisation means restriction of transverse vibrations to one plane perpendicular to the direction of propagation. This plane is called the plane of vibration. The plane perpendicular to both the plane of vibration and the direction of propagation is called the plane of polarization or **option (2)**

8. **Option (4)**

9. $dx = \frac{\lambda}{2n\sin\theta}$

$\Rightarrow dx \propto \lambda$

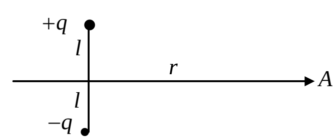
$\frac{dx_2}{dx_1} = \frac{\lambda_2}{\lambda_1}$

$dx_2 = \frac{4800}{6000}\times0.1\times10^{-3} = 0.08\,m$ or **option (4)**

10. In grating, the diffraction bands are coloured, while zero order principal maxima is white or **option (2)**

11. $\vec{F} = \vec{E}q = mg \Rightarrow \vec{F} = e\vec{E} = mg$ or $\vec{E} = \frac{mg}{e}$ or **option (2)**

12. Potential at $A = \frac{+kq}{\sqrt{r^2+l^2}} - \frac{kq}{\sqrt{r^2+l^2}} = 0$



Or **option (1)**

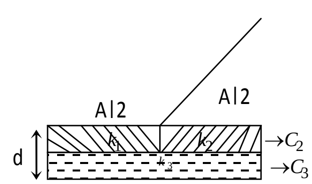
13. Total volume of droplets = volume of coalesced drop

or $n\times\frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$ or $R = 3\sqrt{nr}$

Capacity of drop $4\pi\varepsilon_0\sqrt[3]{n}r = \sqrt[3]{n}\times4\pi\varepsilon_0 r = \sqrt[3]{n}\times$ capacity of one droplet or **option (3)**.

14. $\frac{1}{Ceff} = \frac{1}{C_3} + \frac{1}{C_1+C_2}$

$= \frac{1}{\frac{k_3\varepsilon_0 A}{d/2}} + \frac{1}{\frac{k_1\varepsilon_0 A/2}{d/2} + \frac{k_2\varepsilon_0 A/2}{d/2}}$



or $\frac{d}{k_{eff}\varepsilon_0 A} = \frac{d}{\varepsilon_0 A}\left[\frac{1}{2k_3} + \frac{1}{k_1+k_2}\right]$

$\therefore \frac{1}{k_{eff}} = \frac{1}{2k_3} + \frac{1}{k_1+k_2}$ or **option (2)**

15. $R_A = \rho\frac{l_A}{A_A} = \frac{\rho\, l/2}{2A} = \frac{\rho l}{4A} = \frac{1}{4}R....(1)$

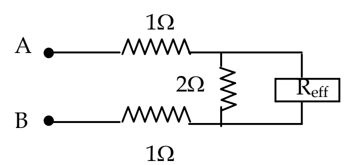
$R_B = \rho\frac{l_B}{A_B} = \rho\frac{2l}{A/2} = \frac{4\rho l}{A} = 4R.......(2)$

$R_C = \rho\frac{l_C}{A_C} = \rho\frac{2l}{2A} = \frac{\rho l}{A} = R......(3)$

$R_O = \rho\frac{l_o}{A_o} = \rho\frac{l/2}{A/2} = \rho\frac{l}{A} = R......(4)$

Hence max resistance $= R_B$ or **option (2)**

16. Since the sequence is infinite; it can be replaced by



$R_{eff} = 1\Omega + \frac{1}{\frac{1}{2}+\frac{1}{R_{eff}}} + 1$

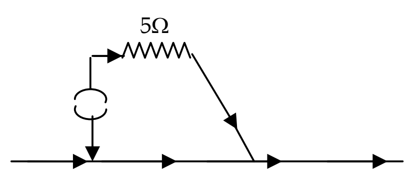
$R_{eff} = 2 + \frac{2R_{eff}}{R_{eff}+2} = \frac{4+4R_{eff}}{R_{eff}+2}$

Or $R_{eff}^2 + 2R_{eff} = 4 + 4R_{eff}$

$R_{eff}^2 - 2R_{eff} - 4 = 0$ Or $R_{eff} = \frac{+2 \pm \sqrt{4+16}}{2} = \frac{2 \pm 2\sqrt{5}}{2}$

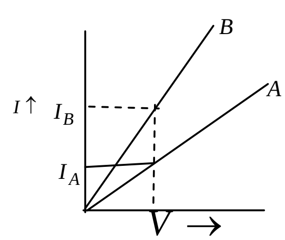
taking positive value $R_{eff} = 1+\sqrt{5} = (1+2.236) = 3.23\Omega$ or **option (1)**

17. In the absence of any resistance in the left gap, there will always be a current flow in the bridge wire. Hence no balance point will be found. Answer **option (4)**



18. $I_A R_A = I_B R_B$ Or $\frac{R_A}{R_B} = \frac{I_B}{I_A} > 1$

Or $R_A > R_B$ or **option (2)**



19. Initially the particle will move along the y-axis due to the force exerted by the electric field; then it gets bent in the y-z plane as the magnetic field imparts a radial force. However the effect of the magnetic field is to only change the direction –not the magnitude of the particle's velocity-which is affected only by the y-component of the electrical force. This component increases the value of the y co-ordinate of the particle. The longer the electric field operates, the higher the value of its velocity i.e. velocity depends only on y or **option (2)**

20. The field due to segment NO is opposite to the field due to the segment MP as the current flows in opposite directions through them. The portions MN and OP do not create any field at C, which is in line with them. Hence nett field at C $= B_{NO} - B_{mp} = \frac{\mu_0 I}{4r_1} - \frac{\mu_0 I}{4r_2} = \frac{\mu_0 I}{4}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$ or **option (4)**

21. The shape of the Hysteresis loop depends on the retentivity and coercivity of the material. These depend on the composition, temperature and the degree of saturation of the material. The size of the loop depends on the dimensions of the material in addition to the above factors or **option (2)**

22. $B = \frac{\mu_0}{4\pi}\frac{2I_A}{r}$ (due to wire 'A')
$= \frac{10^{-7} \times 2 \times 10}{10 \times 10^{-2}} = 2 \times 10^{-5} T$
$F = B\, I_B\, l \sin\theta$ (force experienced by wire 'B')
$= 2 \times 10^{-5} \times 2 \times 2 \times \sin 90° = 8 \times 10^{-5} N$ or **option (1)**

23. Required $R' = (n-1)R$ ------------ (1)
$n = \frac{10}{V} = \frac{10}{20 \times 2 \times 10^{-3}} = 25$
sub in (1)
$R' = (25-1)20 \quad = 480\Omega$ or **option (1)**

24. $\phi = BA \qquad \therefore \frac{d\phi}{dt} = \frac{d}{dt}(BA) = B\frac{dA}{dt}$ as B is given constant.

$\therefore |\varepsilon| = \frac{d\phi}{dt} = 20 \times 10^{-3} \times 0.4V$

$= +8 \times 10^{-3} V$

$= 8\ mV$ or **option (3)**

25. Blue scatters more compared to any other colour or option (b)

26. Required ratio $=\dfrac{\left(\dfrac{q_p}{m_p}\right)}{\left(\dfrac{q_\alpha}{m_\alpha}\right)}=\dfrac{q_p}{q_\alpha}\times\dfrac{m_\alpha}{m_p}=\dfrac{q_p}{2q_p}\times\dfrac{4m_p}{m_p}$

$=2=2:1$

$=1:\dfrac{1}{2}$ or **option** (4)

27. $\dfrac{hc}{\lambda e}=\dfrac{W}{e}+V_S$ (Einstein's equations)

$\dfrac{hc}{100\times 10^{-3}e}=4.7+7.7=12.4$ ---------- (1)

$\dfrac{hc}{200\times 10^{-3}e}=4.7+V_S'$ -------------- (2)

from (1) and (2)

$\Rightarrow\dfrac{12.4\times 100\times 10^{-3}}{200\times 10^{-3}}=4.7+V_S'$

$V_S'=6.2-4.7$

$V_S'=1.5eV$

$\therefore V_S'=1.5V$ or **option (1)**

28. $\dfrac{1}{\lambda}=R_H\left[\dfrac{1}{n_1^2}-\dfrac{1}{n_2^2}\right]$

$=R_H\left[\dfrac{1}{2^2}-\dfrac{1}{3^2}\right](n_1=2,\ n_2=3)=\dfrac{5R_H}{36}\Rightarrow\lambda=\dfrac{36}{5R_H}$ or **option (1)**

29. $Q=(7\times 4)-(2\times 2\times 1.1)=23.6\ MeV$ or **option (4)**

30. Using $N=\dfrac{N_0}{2^n}$

$\Rightarrow\dfrac{N_A}{N_B}=\dfrac{2^{n_B}}{2^{n_A}}=2^{n_B-n_A}$ ………….. (1)

From $t=nT$

$\Rightarrow 4T=n_AT,\ \Rightarrow\ n_A=4$

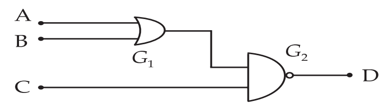
$4T=n_B(2T)\Rightarrow n_B=2$

sub in (1)

$\dfrac{N_A}{N_B}=2^{2-4}=2^{-2}=\dfrac{1}{4}=1:4$ or **option (1)**

31. Emitter base junction must forward biased (i.e. base should be at positive potential compared to emitter) and collector base junction must be reverse biased (i.e. collector should be at greater positive potential compared to base) or **option (1)**

32. For A=B=C=0, output of G_1 is 0 and that of G_2 is 1



For A=B=1 & C=0, output of G_1 is 1 and that of G_2 is 1 or

option (4)

33. **Option (1)**

34. **Option (1)**

35. **Option (3)**

36. **Option (3)**

37. The gain in K.E. of a charged particle after moving through a potential difference of V is given by eV, that is also equal to $\frac{1}{2}mv^2$ where v is the velocity of the charged particle. Disregarding the relativistic effect,

$$\frac{1}{2}mv^2 = qV \quad \Rightarrow v = \sqrt{\frac{2qV}{m}} \quad \Rightarrow \quad mv = \sqrt{2mqV}$$

$\Rightarrow$ de Broglie wavelength $\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mqV}}$

$$\therefore \quad \frac{\lambda_p}{\lambda_\alpha} = \sqrt{\frac{m_\alpha q_\alpha V_\alpha}{m_p q_p V_p}}$$

Putting $V_\alpha = V_p, \frac{\lambda_p}{\lambda_\alpha} = \sqrt{\frac{(4)(2)}{(1)(1)}} = 2\sqrt{2}$ or **option (3)**

38. $[P] = \left[\frac{a}{V^2}\right] \Rightarrow [a] = [PV^2] = [ML^{-1}T^{-2}][L^3]^2$ or **option (2)**

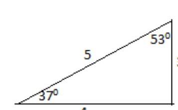
39. $v = \sqrt{2mqV} \Rightarrow v \, \alpha \, \sqrt{h}$ and as the ball is moving down, its velocity is negative and it is positive while ball is rising up. **Option (1)**

40. Average speed $= \frac{\text{total distance}}{\text{total time}} = \frac{\sum \text{segmentwise distances}}{\sum \text{segmentwise times}}$

average speed $= \frac{2 \times 20 + 3 \times 40}{5} = \frac{160}{5} = 32 km / hr$ or **option (3)**

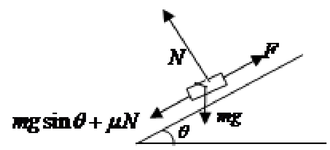
41. Since the ball just clears the wall horizontally, the wall's height is equal to the maximum elevation of the ball and the wall is situated at a distance equal to half the range of the ball.

given $\theta = 37^\circ$; $R = \frac{u^2 \sin 2\theta}{g}$ and $H = \frac{u^2 \sin^2\theta}{2g}$. $\therefore \frac{H}{R} = \frac{\sin^2\theta}{2\sin 2\theta} = \frac{1}{4}\tan\theta$



required ratio $= \frac{H}{R/2} = \frac{2H}{R} = 2 \times \left(\frac{1}{4}\tan\theta\right) = \tan\theta = \frac{1}{2}\tan 37^\circ = \frac{1}{2} \times 0.75 = \frac{3}{8}$ or **option (3)**

42. As the body has the tendency to move up the plane, friction acts down the plane.



$\therefore F = mg\sin\theta + \mu N$

$= mg\sin\theta + \mu mg\cos\theta$ or **option (4)**

43. Let 4 be initial velocity of mass $'m'$ be the collision v_1, v_2 find velocities of after collision

Then $\frac{1}{2}mu^2 = \frac{1}{2}mv_1^2 + \frac{1}{2}(3m)^{1/2^2}$ and $mn = mv_1 + (3m)v_2$

Or $mu = mv_1 + (3m)v_2$ or $u^2 = v_1^2 + 3v_2^2$ and $u = v_1 + 3v_2$ solying we get $v_1 = -v_2$

$\Delta u = -v_2 + 3v_2 = 2v_2$ or $v_2 = \frac{4}{2}, v_1 = -\frac{4}{2}$ initial of mass $m = \frac{1}{2}mu^2$

Final KE of mass $m = \frac{1}{2}m\left(-\frac{4}{2}\right)^2 = \frac{1}{2}\frac{mu^2}{u} = \frac{1}{4}$

$\therefore 75$ of its K.E leas been transferred to mass or **option (2)**

44.

- Both L and E are conserved.
- $I_1\omega_1 = I_2\omega_2$

  $\Rightarrow v_1R_1^2 = v_2R_2^2$

  As R (distance of P from S) decreases, its speed increases.

  $\therefore K$ is a maximum at P_1
- $U = -\frac{GMm}{a} = -2K_{max}$

  U is the least a P_1
- $E = \frac{GMm}{2a}$

  So, E is – ve at any position. **Option (3)**

45. Option (1)

46. Force due to surface tension along the circumference of the is

(i) capillary is $F_2 = 2\pi r_2 T$ and

(ii) the wire is $F_1 = 2\pi r_1 T$

Both are upward. The resultant must support the weight of the liquid columns.

$\therefore 2\pi(r_1 - r_2)T = \pi\left(r_2^2 - r_1^2\right)h\rho g$

$\Rightarrow h = \frac{2T}{(r_2 - r_1)\rho g}$

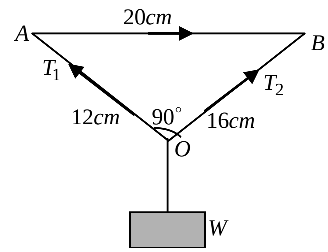
Option (1)

47. $W \perp AB,\ T_1 \perp OB\ \&\ T_2 \perp OA$

$\therefore \frac{W}{AB} = \frac{T_1}{OB} = \frac{T_2}{OA} \Rightarrow \frac{W}{20} = \frac{T_1}{16} = \frac{T_2}{12}$

$\Rightarrow T_1 = \frac{4W}{5}\ \ \&\ \ T_2 = \frac{3W}{5}$

$T_1^2 + T_2^2 = \frac{16W}{25} + \frac{9W}{25}$ or **option (2)**



48. $Q = \frac{KA(T_1 - T_2)t}{l} \Rightarrow \frac{Q_{semicircular\ rod}}{Q_{straight\ road}} = \frac{l}{\pi\frac{l}{2}} = \frac{2}{\pi}$ or **Option (2)**

49. $m_b s_b(30-0) + \frac{1}{2}mv^2 = m_{ice}L$

$\Rightarrow 50 \times 0.02 \times (30-0)(cal) + \frac{1}{2} \times 50 \times 10^{-3} \times 840 \times 840(J) = m_{ice}80(cal)$

$\Rightarrow 30(cal) + \frac{1}{2} \times \frac{50 \times 10^{-3} \times 840 \times 840(cal)}{4.2} = m_{ice}80(cal)$

$\Rightarrow m_{ice} = 52.875g$ or **option (4)**

50. **Option (3)**

51. Work done is positive if expansion curve lies above compression curvre (clockwise) and is represented by the area enclosed by the curve. As area of 2 is more than that of 1, net work done is positive or **option (1)**

52. $y = A\sin(\omega t)$ In the first case $\frac{A}{2} = A\sin(\omega t_1) \Rightarrow \omega t_1 = \frac{\pi}{6} \Rightarrow t_1 = \frac{T}{12}$

In the second case, $\frac{T}{4} - t_2 = \frac{T}{12} \Rightarrow t_2 = \frac{T}{6}\ \ \&\ \ \frac{t_1}{t_2} = \frac{6}{12} = \frac{1}{2}$ or **option (2)**

53. **Option (3)**

54. $f' = f\left(\frac{V + \frac{V}{10}}{V - \frac{V}{10}}\right) = \frac{11f}{9} = 1.22f$ or **option (2)**

55. **Option (4)**

56. **Option (3)**

57. $m\omega^2 x = k(2q)(q)\left[\frac{1}{(x-d)^2} - \frac{1}{(x+d)^2}\right] = 2kq^2\left[\frac{4xd}{d^4}\right] x << d$

$m\omega^2 x = \frac{8kq^2}{d^3}x \qquad \therefore \omega^2 = \frac{8kq^2}{md^3} \qquad \therefore T = 2\pi\sqrt{\frac{md^3}{8kq^2}}$

Shortcut , $T = 2\pi\sqrt{\frac{m}{K(restoring\ \ factor)}}$ hence mass must be in the numerator. **Option (1)**

58. Dielectric strength of air =3x10^6 V/m. Then pd required to conduct electricity through 0.1mm air is 300V.

If 300V is peak value, then rms value is $V_{rms} = \frac{V_0}{\sqrt{2}} = 0.707 \times 300 \approx 210V$ or **option (1)**

59. From the given kinetic energy of the neutrons, we first calculate their velocity. Thus

$$\frac{1}{2} m u^2 = 0.0327 \times 1.6 \times 10^{-19}$$

$$\therefore \quad u^2 = \frac{2 \times 0.0327 \times 1.6 \times 10^{-19}}{1.675 \times 10^{-27}} = 625 \times 10^4$$

or $u = 2500 \ m/s$

with this speed, the time taken by the neutrons to travel a distance of 10 m is,

$$\Delta t = \frac{10}{2500} = 4 \times 10^{-3} s$$

The fraction of neutrons decayed in time Δt second is, $\frac{\Delta N}{N} = \lambda \Delta t$ & also, $\lambda = \frac{0.693}{T_{1/2}}$

$$\therefore \quad \frac{\Delta N}{N} = \frac{0.693}{T_{1/2}} \Delta t = \frac{0.693}{700} \times (4 \times 10^{-3}) = 3.96 \times 10^{-6}$$. **Option (3)**

60. Measured value must be accurate upto the least count of the instrument. **Option (1)**