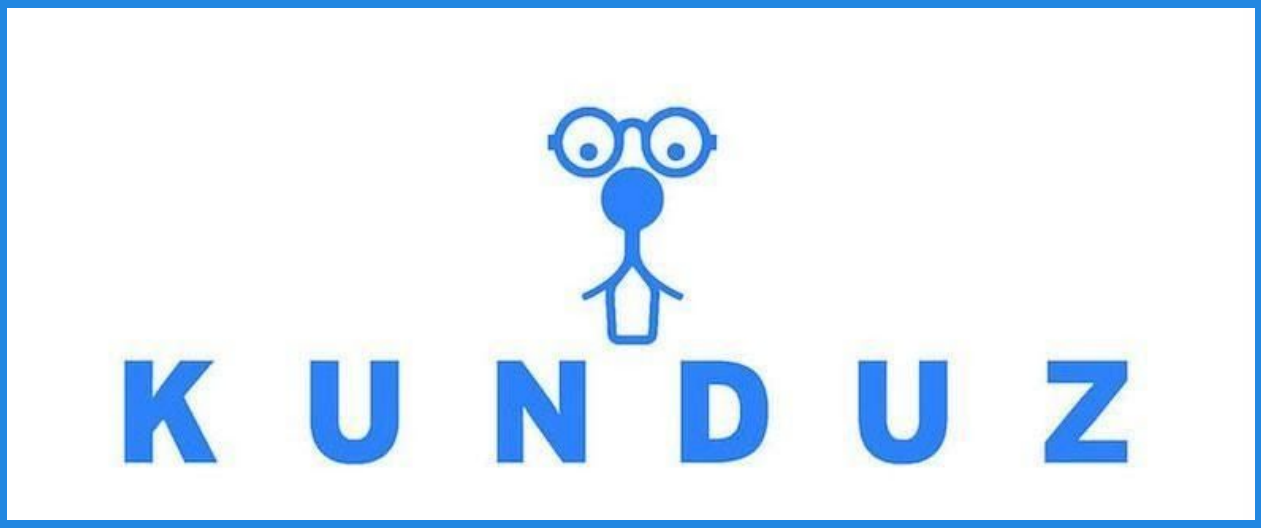
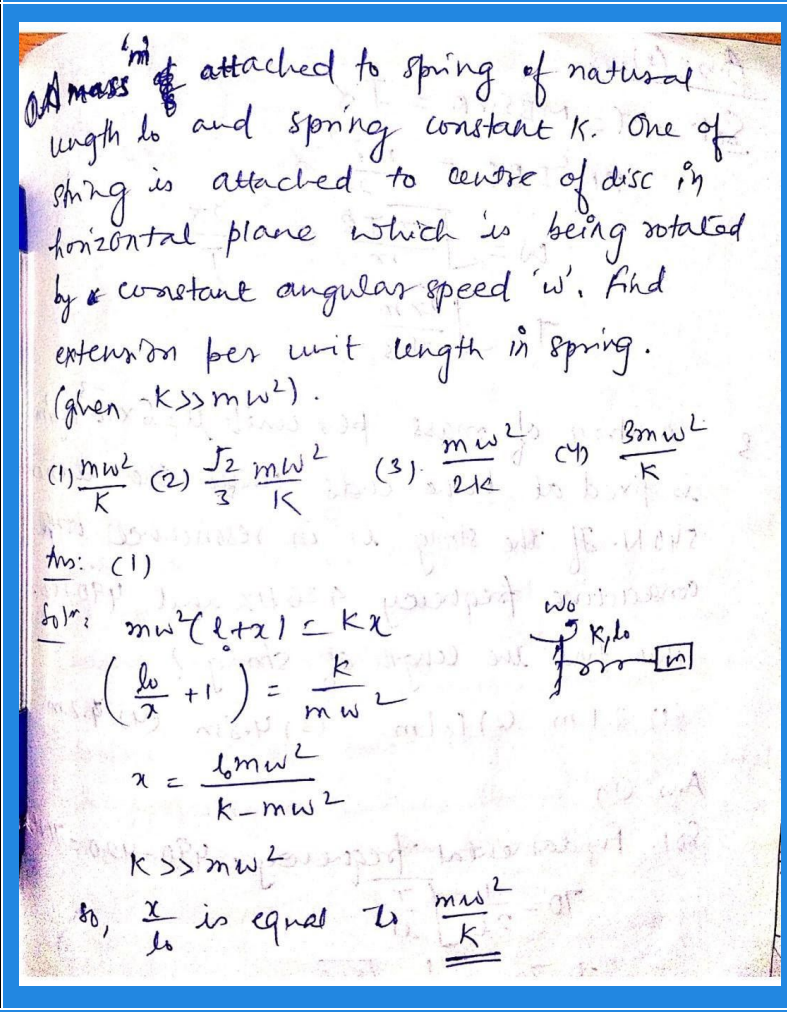


Jan 9 2020 shift 2 Physics prepared by KUNDUZ tutors

https://kunduz.com/en/

Question no.	Questions and Answers
1	

A mass 'm' attached to spring of natural length l_0 and spring constant K. One of spring is attached to centre of disc in horizontal plane which is being rotated by a constant angular speed 'w'. Find extension per unit length in spring. (given $K >> mw^2$).

(1) $\frac{mw^2}{K}$ (2) $\frac{2}{3}\frac{mw^2}{K}$ (3) $\frac{mw^2}{2K}$ (4) $\frac{3mw^2}{K}$

Ans: (1)

Solⁿ: $mw^2(l+x) = Kx$

$\left(\frac{l_0}{x}+1\right) = \frac{K}{mw^2}$

$x = \frac{l_0 mw^2}{K - mw^2}$

$K >> mw^2$

So, $\frac{x}{l_0}$ is equal to $\frac{mw^2}{K}$

2

(2) A loop of radius R and mass m is placed in a uniform magnetic field B with its plane perpendicular to the field. Current I is flowing in it. Now loop is slightly rotated about its diameter and released. Find time period of oscillations.

(1) $2\sqrt{\frac{\pi m}{IB}}$ (2) $\sqrt{\frac{2\pi m}{IB}}$ (3) $2\sqrt{\frac{m}{\pi BI}}$ (4) $\sqrt{\frac{m}{\pi IB}}$

Ans: (2)

Sol: $\tau = MB\sin\theta = I\alpha$

$$\pi R^2 IB\theta = \frac{mR^2}{2}\alpha$$

$$\omega = \sqrt{\frac{2\pi IB}{m}} = \frac{2\pi}{T}$$

$$T = \sqrt{\frac{2\pi m}{IB}}$$

3

3. A string of mass per unit $\mu = 6 \times 10^{-3}$ kg/m is fixed at both ends under the tension 540 N. If the string is in resonance with consecutive frequency 420 Hz and 490 Hz. Then find the length of string ?

(1) 2.1 m (2) 1.1 m (3) 4.8m (4) 4.2m

Ans: (1)

Sol. Fundamental frequency : $490 - 420 = 70$ Hz

$$70 = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}}$$

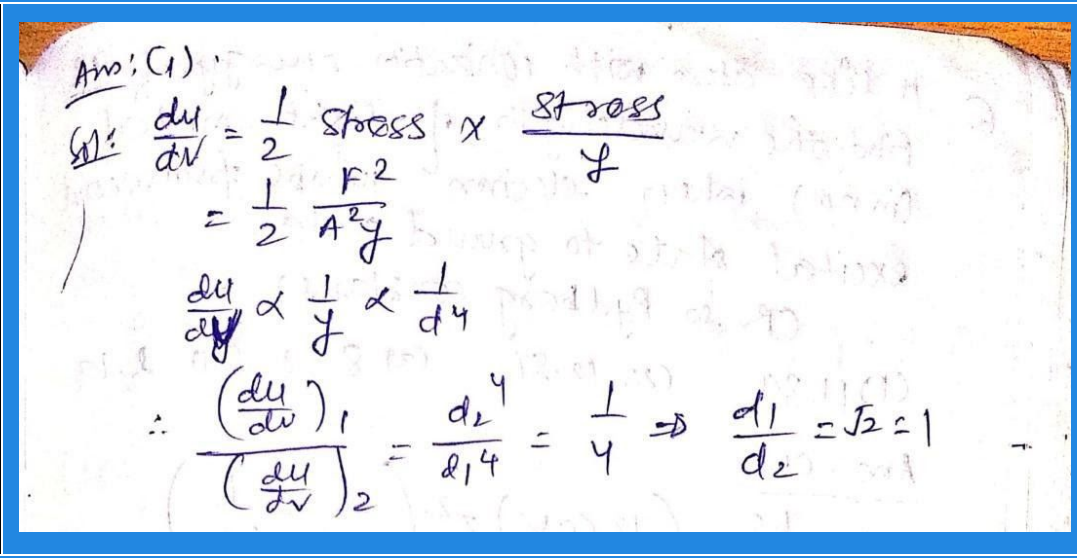
$$\Rightarrow 70 = \frac{1}{2\ell}\sqrt{\frac{540}{6\times10^{-3}}}$$

$$\ell = \frac{300}{140} \simeq 2.14$$

4

1. Ratio of energy density of two steel rods is 1 : 4 when same mass is suspended from the rods. If length of both rod is same then ratio of diameter will be.

(1) $\sqrt{2}:1$ (2) $1:\sqrt{2}$ (3) $1:2$ (4) $2:1$



Ans: (1)

Sol: $\frac{du}{dV} = \frac{1}{2} \text{ Stress} \times \frac{\text{Stress}}{Y}$

$= \frac{1}{2} \frac{F^2}{A^2 Y}$

$\frac{du}{dV} \propto \frac{1}{Y} \propto \frac{1}{d^4}$

$\therefore \frac{\left(\frac{du}{dV}\right)_1}{\left(\frac{du}{dV}\right)_2} = \frac{d_2^4}{d_1^4} = \frac{1}{4} \Rightarrow \frac{d_1}{d_2} = \sqrt{2} = 1$

5

5. A particle is projected from the ground with speed u at angle 60° from horizontal. It collides with a second particle of same mass moving with horizontal speed u in same direction at highest point of its trajectory. If collision is perfectly inelastic then find horizontal distance travelled by them after collision when they reached at ground.

(1) $\frac{3\sqrt{6}u^2}{8g}$ (2) $\frac{3\sqrt{3}u^2}{8g}$ (3) $\frac{u^2}{8g}$ (4) $\frac{\sqrt{3}u^2}{g}$

Ans: (2)

Sol: $P_i = P_f$

$mu + mu\cos\theta = 2mv$

So horizontal range after collision $= v\sqrt{\frac{2H_{max}}{g}}$

$= \frac{3}{4}u\sqrt{\frac{2u^2\sin^2 60}{2g^2}}$

$= \frac{3}{4}u^2\frac{\sqrt{3}}{g} = \frac{3\sqrt{3}}{8}\frac{u^2}{g}$

6

6. H like atom with ionization energy of 9R. Find the wavelength of light emitted (in nm) when electron jumps from second excited state to ground state.
(R is Rydbesg constant)

(1) 11.39 (2) 12.86 (3) 8.02 (4) 2.19

Ans: (1)

Soln: $\frac{hc}{\lambda} = (13.6eV) z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$.

$\frac{hc}{\lambda} = (13.6)(9)\left(\frac{8}{9}\right)$

$n_1 = 1$
$n_2 = 3$
$Z = 3$

$\frac{hc}{\lambda}$ wavelength $= \frac{1240}{8 \times 13.6}$ nm

$\lambda = 11.39$ nm.

7

7. Two planets of masses M and $\frac{M}{2}$ have radii R and $\frac{R}{2}$ respectively. If ratio of escape velocities from their surfaces $\frac{V_1}{V_2}$ is $\frac{n}{4}$. Then find n:

(1) 3 (2) 2 (3) 2 (4) 4

Ans: 4

Sol: $V_e = \sqrt{\frac{2GM}{R}}$

$$\frac{V_1}{V_2} = \frac{\sqrt{\frac{2GM}{R}}}{\sqrt{\frac{2GM/2}{R/2}}} = 1 = \frac{n}{4}$$

8

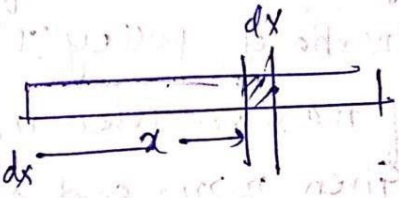
1. find centre of mass of given rod of linear mass density $\lambda = \left(a + b\left(\frac{x}{l}\right)\right)$, x is distance from one of its end. length of the rod is l.

(1) $\frac{3l}{4}\left(\frac{3a+b}{2a+b}\right)$ (2) $\frac{3l}{4}\left(\frac{2a+b}{3a+b}\right)$

(3) $\frac{l}{4}\left(\frac{2a+b}{3a+b}\right)$ (4) $l\left(\frac{2a+b}{3a+b}\right)$

Ans: (2)

Sol: $x_{cm} = \frac{1}{m}\int_0^l x\,dM$



$dM = \lambda\,dx = \left(a + \frac{bx^2}{l^2}\right)dx$

$x_{cm} = \frac{\int x\,dM}{\int dM} = \frac{\int_0^l x\left(a + \frac{bx^2}{l^2}\right)dx}{\int_0^l \left(a + \frac{bx^2}{l^2}\right)dx}$

$= \frac{a\frac{l^2}{2} + b\frac{l^2}{4}}{al + \frac{bl}{3}} = \left(\frac{2a+b}{3a+b}\right)\frac{3l}{4}$

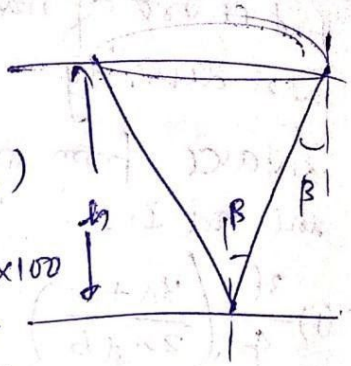
9

9. If a point source is placed at a depth h in a liquid of refractive index $\frac{4}{3}$. find percentage of energy light that escapes from liquid. (Assuming 100% transmission of emerging light).

(1) 15% (2) 17% (3) 21% (4) 34%

Ans: (2)

Sol: $\sin\beta = \frac{3}{4}$ $\cos\beta = \frac{\sqrt{7}}{4}$



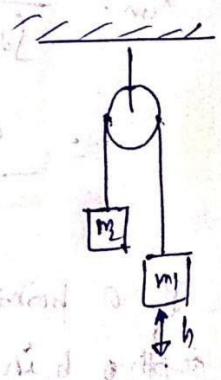
solid angle, $d\Omega = 2\pi R^2(1-\cos\beta)$

percentage of light: $\frac{2\pi R^2(1-\cos\beta)}{4\pi R^2} \times 100$

$= \frac{1-\cos\beta}{2} \times 100 = \frac{4-\sqrt{7}}{8} \times 100 = 17\%$

10

10. System is released from rest. Moment of inertia of pulley 'I'. find angular speed of mass m when m_1 block falls by 'h'. (Given $m_1 > m_2$ and assume no slipping between string & pulley).



(1) $\frac{1}{R}\sqrt{\frac{2(m_2-m_1)gh}{\left(m_1+m_2+\frac{I}{R^2}\right)}}$

(2) $\frac{1}{R}\sqrt{\frac{2(m_1+m_2)gh}{\left(m_1+m_2+\frac{I}{R^2}\right)}}$

(3) $\frac{1}{R}\sqrt{\frac{(m_2-m_1)gh}{\left(m_1+m_2+\frac{I}{R^2}\right)}}$

(4) $\frac{1}{R}\sqrt{\frac{(m_1+m_2)gh}{\left(m_1+m_2+\frac{I}{R^2}\right)}}$

Ans (1)

Sol: $K_i + V_i = K_f + U_f$.

$$0 + 0 = \frac{1}{2} m_2 v^2 + \frac{1}{2} m_1 v^2 + \frac{1}{2} I\omega^2 - m_2 gh + m_1 gh.$$

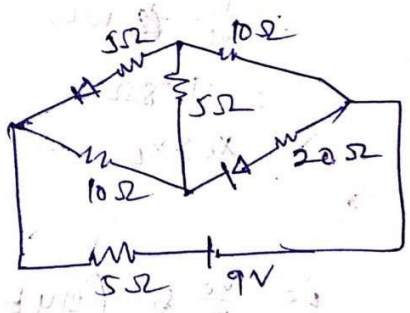
$$(m_2 - m_1)gh = \frac{1}{2} m_2 (\omega R)^2 + \frac{1}{2} m_1 (\omega R^2) + \frac{1}{2} I\omega^2$$

$$\omega = \sqrt{\frac{2(m_2 - m_1)gh}{\left(m_1 + m_2 + \frac{I}{R^2}\right)R^2}}$$

$$\omega = \frac{1}{R}\sqrt{\frac{2(m_2 - m_1)gh}{\left(m_1 + m_2 + \frac{I}{R^2}\right)}}$$

11

11. Find the current supplied by the battery



(1) 0.1 A (2) 0.3 A

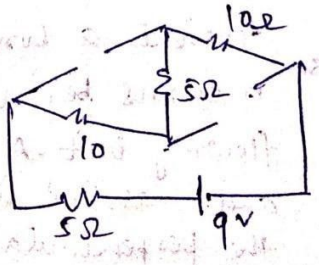
(3) 0.4 A (4) 0.5 A

Ans: (2)

Sol: Both diods are in reverse based.

$$\therefore I = \frac{9}{5+5+10+10} = \frac{9}{30}$$

$$= 0.3\,A$$



12

12. An AC source is connected to the LC series circuit with $V = 10\sin(314t)$. Find the current in the circuit as function of time? ($L = 40mH$, $C = 100\mu F$).

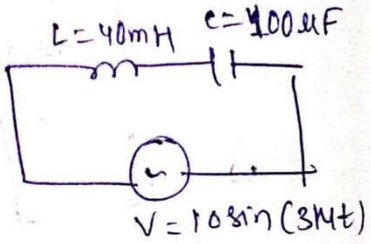
(1) $10\sin(314t)$ (2) $5.2\sin(314t)$.

(3) $0.52\sin(314t)$ (4) $0.52\cos(314t)$.

Ans: (4)

Sol":

$$Z = \sqrt{R^2 + (X_C - X_L)^2}$$



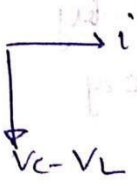
$R = 0.$

$Z = X_C - X_L$

$= \frac{1}{\omega C} - \omega L$

$= 19.28\Omega$

$X_C > X_L$ ∴



$V = \frac{V_0}{Z}\sin\left(314t + \frac{\pi}{2}\right)$.

$i = \frac{V_0}{Z}\cos(314t)$.

$\therefore i = 0.52\cos(314t)$

13

13. There is a long solenoid of radius R having n turns per unit length with current i flowing in it. A particle having charge 'q' and mass 'm' is projected with speed 'v' in the perpendicular direction of axis from a point on its axis. Find maximum value of 'v' so that it will not collide with the solenoid.

(1) $\frac{Rq\mu_0 in}{2m}$ (2) $\frac{2Rq\mu_0 in}{m}$ (3) $\frac{Rq\mu_0 in}{3m}$

(4) $\frac{Rq\mu_0 in}{4m}$

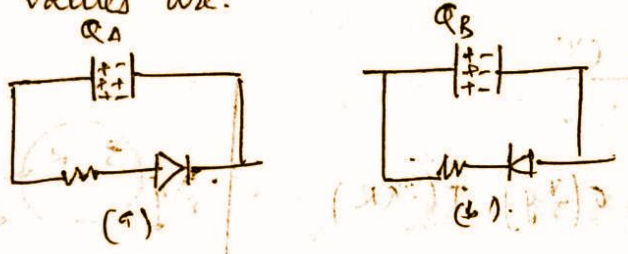
Ans. (1)

Sol. $R_{max} = \frac{R}{2} = \frac{mv_{max}}{q\mu_0 in}$

$v_{max} = \frac{Rq\mu_0 in}{2m}$

14

14: A capacitor C and resistor R are connected to a battery of 5V in series. Now battery is disconnected and a diode is connected as shown in figure (a) & (b) respectively. Then charge on the capacitor after time RC in (a) and (b) respectively is Q_A & Q_B. Their values are.



(1) $5CV, 5CV$ (2) $\frac{5CV}{e}, \frac{5CV}{e}$

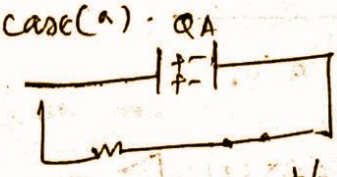
(3) $\frac{5CV}{e}, 5CV$ (4) $5CV, \frac{5CV}{e}$

Ans: (3)

Sol^n: Maximum charge on capacitor $= 5CV$

(a) is forward biased & (b) is reverse biased

for case (a) · Q_A



$Q_B = 5CV$

So, $q = q_{max}(e^{-t/RC})$

$\therefore Q_A = 5CV/e$

15

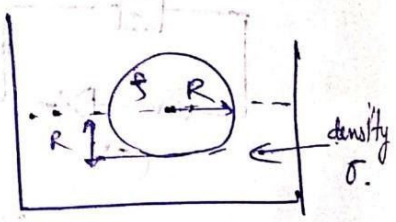
15. A sphere of density ρ is half submerged by a liquid of density σ and surface tension T. The sphere remains in equilibrium. Find radius of the sphere (assume the force due to ~~gravity~~ surface tension acts tangentially to surface of liquid).

(1) $\sqrt{\frac{T}{(\rho-\sigma)g}}$ (2) $\sqrt{\frac{T}{(\rho-2\sigma)g}}$

(3) $\sqrt{\frac{2T}{(2\rho-3\sigma)g}}$ (4) $\sqrt{\frac{3T}{(2\rho-\sigma)g}}$.

Ans: (4).

Sol^{n}:



$$\rho V g = \sigma\left(\frac{V}{2}g\right) + T(2\pi R)$$

$$\rho\frac{4}{3}\pi R^3 g = \sigma\cdot\frac{2}{3}\pi R^3 g + 2\pi R T$$

$$T = \frac{\frac{1}{3}R^2 g(2\rho-\sigma)}{}$$

$$R = \sqrt{\frac{3T}{(2\rho-\sigma)g}}$$

16

16. An EM wave is travelling in $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$ direction. Axis of polarization of EM wave is found to be $\hat{k}$. Then equation of magnetic field will be.

(1) $\frac{\hat{i}+\hat{j}}{\sqrt{2}} \cos\left(\omega t + k\left(\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right)\right)$

(2) $\frac{\hat{i}-\hat{j}}{\sqrt{2}} \cos\left(\omega t - k\left(\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right)\right)$

(3) $\frac{\hat{i}-\hat{j}}{\sqrt{2}} \cos\left(\omega t + k\left(\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right)\right)$

(4) $\hat{k} \cos\left(\omega t - k\left(\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right)\right)$

Ans: (2)

Sol: EM wave is in direction $\rightarrow \frac{\hat{i}+\hat{j}}{\sqrt{2}}$

Electric field is in direction $\rightarrow \hat{k}$

$\vec{E} \times \vec{B} \rightarrow$ direction of propagation of EM wave.

17

17. Different values of A, B, C are given and their sum is d. Arrange the value of d in increasing order.

(1) $d_1 < d_2 < d_3 < d_4$

(2) $d_1 = d_2 = d_3 = d_4$

(3) $d_4 < d_1 < d_2 = d_3$

(4) $d_4 < d_3 < d_2 < d_1$

	a	b	c
1	220.1	20.4567	40.118
2	218.2	22.3625	40.372
3	221.2	20.2435	39.432
4	221.4	18.3625	40.281

Ans: (3)

Sol:

	a	b	c	a+b+c=d	Roundff
1	220.1	20.4567	40.118	d_1 = 280.6747	280.7
2	218.2	22.3625	40.372	d_2 = 280.9345	280.9
3	221.2	20.2435	39.432	d_3 = 280.8755	280.9
4	221.4	18.3625	40.281	d_4 = 280.0435	280.0

18

18. Two gases Ar (40) and Xe (131) at same temperature have same number density. Their diameters are 0.07 nm and 0.10 nm respectively. Find the ratio of their mean free time.

(1) 1.03 (2) 2.04 (3) 3.04 (4) 2.40

Ans: (2)

Sol^n: Mean free time $= \frac{1}{\sqrt{2}n\pi d^2 v_{rms}}$.

$$\frac{t_{Ar}}{t_{Xe}} = \frac{d^2_{Xe}}{d^2_{Ar}} = \left(\frac{0.1}{0.07}\right)^2 = 2.04$$

19

19. A particle starts moving from origin with velocity $\vec{u} = 3\hat{i}$ and acceleration $\vec{a} = 6\hat{i} + 4\hat{j}$. Find x-coordinate at the instant when y-co-ordinate of the particle is 32 m.

(1) 48m (2) 60 (3) 12 (4) 24.

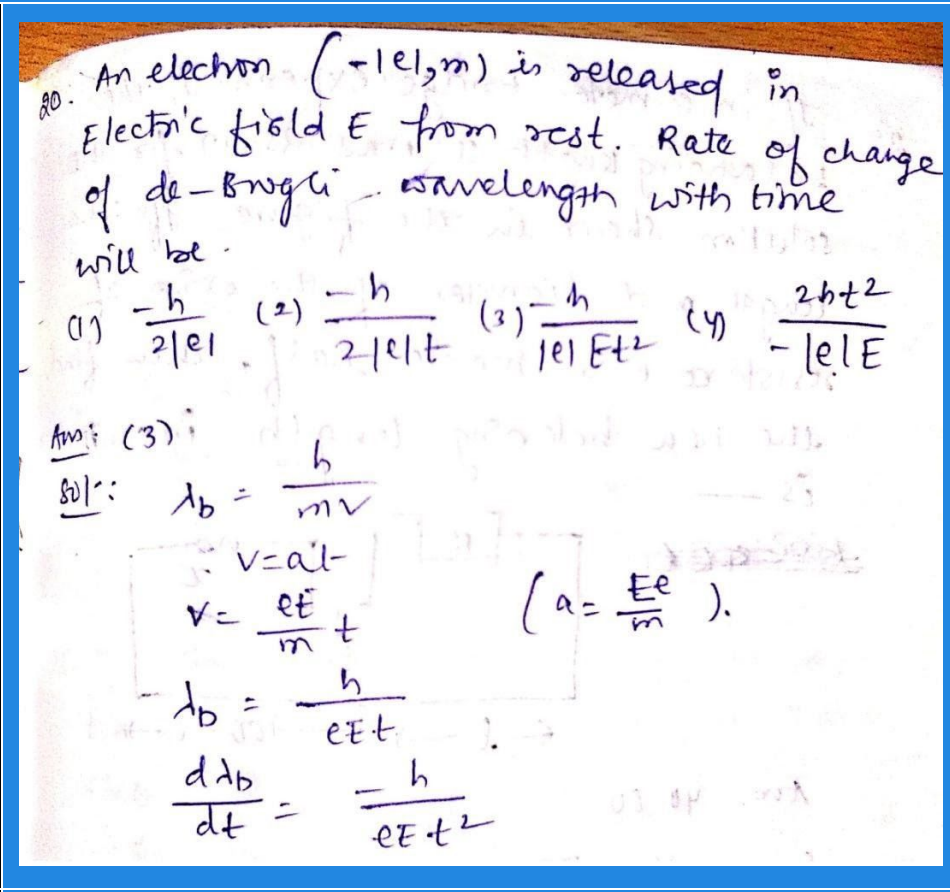
Ans: 2

Sol: $S_y = u_y t + \frac{1}{2} a t^2$

$32 = 0 + \frac{1}{2} \times 4t^2 \Rightarrow t = 4$ sec

$S_x = u_x t + \frac{1}{2} a_x t^2 = 60$ m

20



20. An electron $(-|e|, m)$ is released in Electric field E from rest. Rate of change of de-Broglie wavelength with time will be.

(1) $\frac{-h}{2|e|}$ (2) $\frac{-h}{2|e|t}$ (3) $\frac{-h}{|e|Et^2}$ (4) $\frac{2ht^2}{-|e|E}$

Ans: (3)

Sol: $\lambda_b = \frac{h}{mv}$

$\because v = at$

$v = \frac{eE}{m}t \quad \left(a = \frac{Ee}{m}\right).$

$\lambda_b = \frac{h}{eEt}$

$\frac{d\lambda_b}{dt} = \frac{-h}{eEt^2}$

21

21. In YDSE pattern with light of wavelength $\lambda_1 = 500\,nm$, 15 fringes are obtained on a certain segment of screen. If number of fringes are for light of wavelength λ_2 on same segment of screen is 10, then the value of λ_2 (in nm) is

Ans: 750 nm

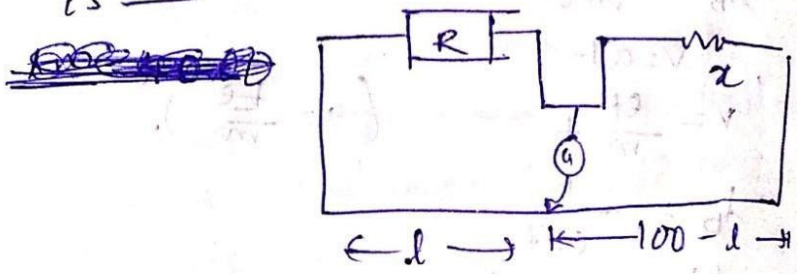
Sol: $15 \times 500 \times \frac{D}{d} = 10 \times \lambda_2 \times \frac{D}{d}$.

$\lambda_2 = 15 \times 50\,nm$

$\boxed{\lambda_2 = 750\,nm}$

22

22. If in a meter bridge experiment, the balancing length ℓ was 25 cm for the solution shown in the figure. If the length and diameter of the wire of resistance R is made half, then find the new balancing length in centimeters is —



Ans: 40.00

Sol^n: $\frac{X}{R} = \frac{75}{25} = 3$

$R = \frac{\rho \ell}{A} = \frac{4\rho \ell}{\pi d^2}$

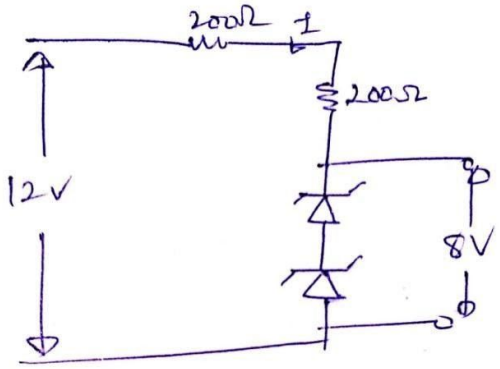
$R' = \frac{4\rho\left(\frac{\ell}{2}\right)}{\pi\left(\frac{d}{2}\right)^2} = 2R$

then $\frac{X}{R'} = \frac{100-\ell}{\ell}$

$\frac{100-\ell}{\ell} = \frac{X}{2R} = \frac{3}{2}$ $\quad \ell = 40.00\text{cm}$

23

23. Find the power loss in each diode (in mW), if potential drop accross the zener diode is 8V.



Ans: 40.

Sol: $i = \frac{12-8}{200+200}$ A $= 10^{-2}$ A

Power loss in each diode $= 4 \times 10^{-2} \times$
$= 40$mW

24

24. An ideal gas at initial temperature 300K is compressed adiabetically ($\gamma = 1.4$) to $\frac{1}{16}^{th}$ of its initial volume. The gas is then expanded adiabatically to double its volume. Then final temperature of gas rounded to nearest integer is —

Ans: 1819 K

Sol: $PV^{\gamma} = \text{constant}$

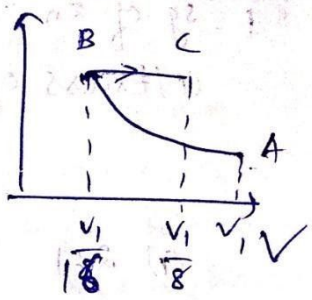
$TV^{\gamma-1} = \text{constant}$

$300(V_1)^{1.4-1} = T_B\left(\frac{V_1}{16}\right)^{2/5}$

$T_B = 300 \times 2^{8/5}$

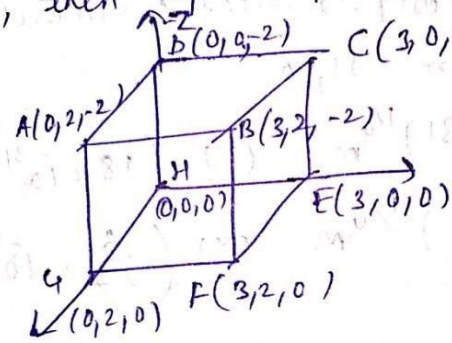
$\frac{V_B}{T_B} = \frac{V_C}{T_C} \Rightarrow T_C = 2 \times 300 \times 2^{8/5}$

$\boxed{T_C = 1819\,K}$



25

If electric field in the space is given by $\vec{E} = 4x\hat{i} - (y^2+1)\hat{j}$ and electric flux through ABCD is ϕ_1 and electric flux through BCEF is ϕ_2, then find $\phi_1 - \phi_2$.



Ans: -48

Sol: Flux via ABCD,

$\phi_1 = \int \vec{E}.d\vec{A} = 0$

Flux via BCEF

$\phi_2 = \int \vec{E}.d\vec{A} = \vec{E}.\vec{A}$

$= (4x\hat{i} - (y^2+1)\hat{j}).4\hat{i} = 16x$, $x = 3$

$\phi_2 = 48\ Nm^2/C$, $\phi_1 - \phi_2 = -48\ \frac{Nm^2}{C}$

Enrolling yourself for coaching classes has long been considered the first step towards cracking the jee. however, this trend is starting to slip. Recent studies show that, for the students who cleared the JEE Main/Advance, the number of students who had joined a coaching class is lower than the number of students who managed the feat with self-study

Preparation for JEE Main/Advance requires a lot of hard work and determination. Be ready to even go through many sleepless nights,

missed birthdays and extracurriculars to finish the vast JEE syllabus. But simply completing the syllabus is not enough! If you want to have an edge over your counterparts you need to step up your game. This means practicing a variety of problems and revising diligently while following a meticulous study plan that recognizes your strengths and takes care of all your weaknesses. To get your doubts solved or questions checked there is no better place than Kunduz.

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