41 YEARS OF EXCELLENCE

NARAYANA
EDUCATIONAL INSTITUTIONS

NARAYANA
100 PERCENTILE
JEE MAIN - 2020 (JAN)

NARAYANA'S SENSATIONAL SUCCESS ACROSS INDIA

TOTAL / MATHS	PHYSICS	MATHS / PHYSICS	MATHS / PHYSICS	MATHS / PHYSICS	PHYSICS
PARTH DWIVEDI	D. SANDEEP VARMA	M. VIRANCHI	M. LIKHITH REDDY	RAGHAVENDRA CHOWDARY	MD. RIZAN FAROOQUI
200310166791	200310233232	200310512964	200310574091	200310238062	200310153345

and many more...

ADMISSIONS OPEN (2020-21)

OUR REGULAR CLASSROOM PROGRAMME

One Year Classroom Program
JEE/NEET-2021
(for students moving from XI to XII)

Two Year Classroom Program
JEE/NEET-2022
(for students moving from X to XI)

Three Year Integrated Classroom Program
JEE/NEET-2023
(for students moving from IX to X)

Four Year Integrated Classroom Program
JEE/NEET-2024
(for students moving from VIII to IX)

FOUNDATION PROGRAMMS
For NTSE, NSEJS, JSTSE, Olympiads & School/Board Exams
(for students moving to Class VI, VII, VIII, IX & X)

APEX BATCH
Two years school Integrated Classroom Program - 2022
For JEE (Main & Advanced) / NEET [For XI Styding Students]
Course Feature
• Complete Coverage of CBSE • Regular Classes • Weekly Test & Result Analysis • Lab facility • Motivation & counseling • Competitive Exam Prep. • Ample time for sell study

Online Classes for IIT/NEET/Foundation/Olympiads

- Access Recording of Past Classes on n-Learn App
- Online Parent Teacher Meeting
- Personalized Extra Classes & Live Doubt Solving
- Hybrid/Customized Class room model
- Video Solution of Weekly/Fortnightly Test
- Printed Study Material will be sent by us
- n-Learn App
- Couselling/Motivational sessions
- Affordable Fee
- Doubt Classes / Practice Classes
- Provision to Convert from online to regular classroom programme
- Once Classes resume by just paying nominal fee

Online Test

- Micro & Macro Analysis
- Relative performance (All India Ranking)
- Question wise Analysis
- Unlimited Practice Test
- Grand Test

NARAYANA
Digital Classes
STUDY ONLINE FROM HOME

For Class 7^{th} to 12^{th} +

TOLL FREE : 1800 102 3344 | visit us at : www.narayanagroup.com

(Memory Based)
JEE MAIN – 2020
September Session
03-09-2020 (Shift-II)
(PHYSICS)

01. A multimeter is used to measure the behavior of

1) resistor 2) capacitor 3) LED 4) Metal Rod

Key: 1

Sol: Multimeter measures voltage, current and resistance.

02. Two point sources each of power 200W emit photons of different wavelengths 500 nm and 1 nm respectively. Find the ratio of photon density of first source to that of second source?

1) 200 2) 500 3) 250 4) 0.4

Key: 2

Sol: $P = \frac{nhC}{\lambda}$

Since P is same $\frac{n_1}{n_2} = \frac{\lambda_1}{\lambda_2} = 500$

03. A point object is placed in front of a spherical mirror at a distance 30 cm from mirror and the mirror forms its image at a distance of 10 cm from it. If the object starts moving with a velocity 9 cm s^{-1}, the velocity of corresponding image is

1) –9 cm 2) –4 cm 3) –1 cm 4) –3 cm

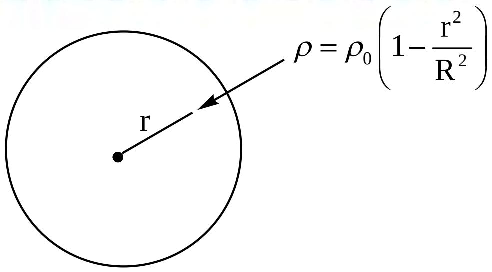
Key: 3

Sol: Velocity of image $v_i = -\frac{v^2}{u^2} \times v_0$

$= \frac{10^2}{30^2}(9)$

$= -1 \text{cm/sec}$

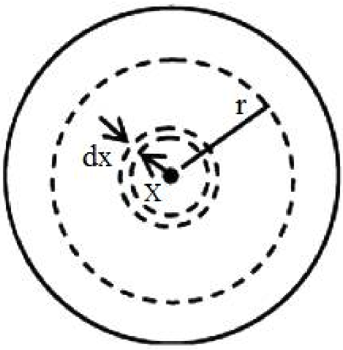
04. Mass density of a sphere having radius R varies as $\rho = \rho_0\left(1 - \frac{r^2}{R^2}\right)$, where 'r' is the distance from the centre of sphere. Find maximum magnitude of gravitational field.



1) $\frac{4}{3}\pi G\rho_0 R$ 2) $\frac{2\sqrt{3}}{5}\pi G\rho_0 R$ 3) $\frac{8\sqrt{5}}{27}\pi G\rho_0 R$ 4) $\frac{2\sqrt{5}}{27}\pi G\rho_0 R$

Key: 3

Sol:



$$dm = \rho \times 4\pi X^2 dx$$

$$= \rho_0\left(1-\frac{x^2}{r^2}\right)\times 4\pi X^2 dx$$

$$m = 4\pi\rho_0\int_0^r\left(x^2-\frac{x^4}{R^2}\right)dx$$

$$m = 4\pi\rho_0\left|\frac{r^3}{3}-\frac{r^5}{5R^2}\right|$$

$$E = \frac{Gm}{r^2}$$

$$= \frac{G}{r^2}\times 4\pi\rho_0\left(\frac{r^3}{3}-\frac{r^5}{5R^2}\right)$$

$$E = 4\pi G\rho_0\left(\frac{r}{3}-\frac{r^3}{5R^2}\right)$$

E is maximum when $\frac{dE}{dr}=0$ $\Rightarrow \frac{dE}{dr} = 4\pi G\rho_0\left(\frac{1}{3}-\frac{3r^2}{5R^2}\right)=0$

$$\Rightarrow r = \frac{\sqrt{5}}{3}R$$

$$E_{max} = 4\pi G\rho_0 \times \frac{\sqrt{5}}{3}R$$

$$E_{max} = \frac{8\sqrt{5}}{27}\pi G\rho_0.R$$

05. Two light rays having the same wavelength λ in vacuum are in same phase initially. Then the first ray travels a path L_1 through a medium of refractive index n_1 while the second ray travels a path of length L_2 through a medium of refractive index n_2. The two waves are then superposed to produce interference. The phase difference between the two waves is

1) $\frac{2\pi}{\lambda}(L_2-L_1)$ 2) $\frac{2\pi}{\lambda}(n_1L_1-n_2L_2)$ 3) $\frac{2\pi}{\lambda}(n_2L_1-n_1L_2)$ 4) $\frac{2\pi}{\lambda}\left(\frac{L_1}{\lambda}-\frac{L_2}{n_2}\right)$

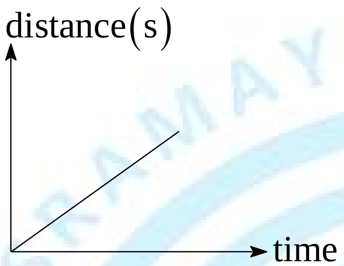
Key: 2

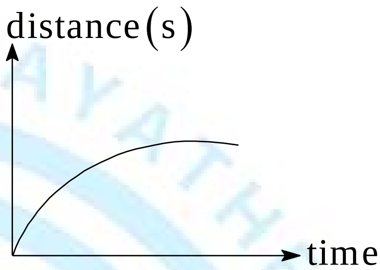
Sol: By definition when light travels a distance $'x'$ is a medium of refractive index $'\mu'$ the equivalent distance travelled is vacuum is called optical path

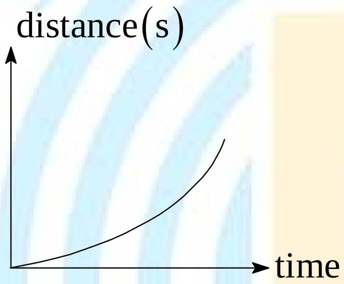
$$\Rightarrow \Delta x = n_1L_1 - n_2L_2)$$

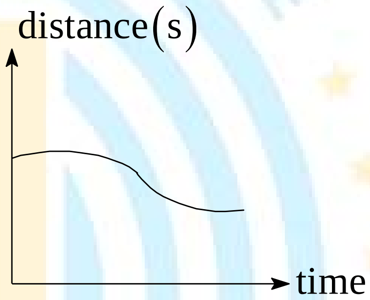
$$\Rightarrow \Delta\phi = \frac{2\pi}{\lambda}\left(n_1L_1 - n_2L_2\right)$$

06. A machine delivering constant power drives a particle of mass 'm' which is initially at rest. If the particle exhibits linear motion, the distance travelled by the particle varies with time as

1) 

2) 

3) 

4) 

Key: 3

Sol: When power delivered is constant

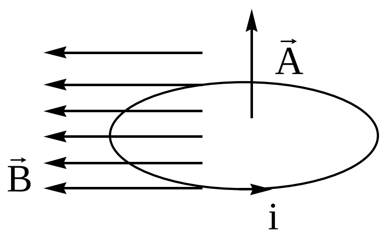
$$p\times t = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{\frac{2pt}{m}} \qquad \Rightarrow S = \int_0^t \sqrt{\frac{2pt}{m}} = \sqrt{\frac{8p}{9m}}\; t^{3/2}$$

07. A loop of area 'S' m^2 and N turns carrying electric current '*i*' is placed in a uniform magnetic field 'B' with its plane parallel to $\vec{B}$. If torque 'τ' is experienced by loop due to magnetic field, find $\left|\vec{B}\right|$

1) $\frac{\tau}{NiS}$ 2) $\frac{N\tau}{iS}$ 3) $\frac{i\tau}{NS}$ 4) $\frac{S\tau}{Ni}$

Key: 1

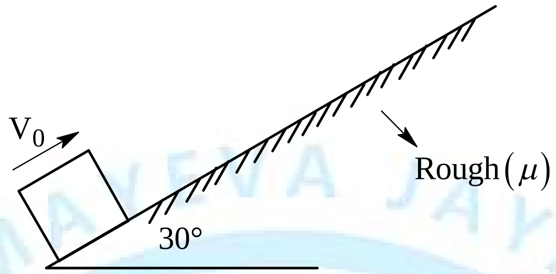
Sol:



$\tau = BSNi \qquad B = \frac{\tau}{iSN}$

08. A block starts going up the plane from bottom of a rough inclined plane with speed V_0 as shown in figure. After some time it reaches to starting point again, with a speed $\frac{V_0}{2}$. Find coefficient of friction 'μ'.

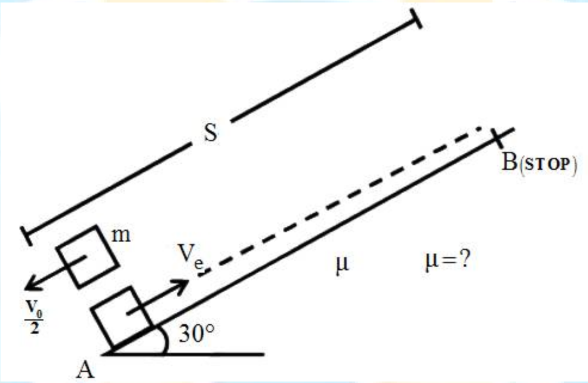
Given g = 10 m/s^2.



1) 0.15 2) 0.35 3) 0.75 4) 0.80

Key: 2

Sol:



While ascending retardation is $a = g(\sin\theta + \mu\cos\theta)$

While descending $a = g(\sin\theta - \mu\cos\theta)$

$$v_0^2 = 2g\left[\frac{1}{2} + \frac{\sqrt{3}}{2}\mu\right]s$$

$$\frac{v_0^2}{4} = 2g\left[\frac{1}{2} - \frac{\sqrt{3}}{2}\mu\right]s$$

$$\Rightarrow 4 = \frac{1+\sqrt{3}\mu}{1-\sqrt{3}\mu} \qquad \Rightarrow 4 - 4\sqrt{3}\mu = 1 + \sqrt{3}\mu$$

$$3 = 5\sqrt{3}\mu$$

$$\mu = \frac{\sqrt{3}}{5} = \frac{1.732}{5} = 0.3464$$

$$= 0.35$$

09. An ideal gas is heated by 160 J at constant pressure, its temperature rises by 50°C and if 240J of heat is supplied to same gas at constant volume, temperature rises by 100°C, then its degree of freedom should be:

1) 3 2) 5 3) 6 4) 7

Key: 3

Sol: $dQ = \mu C_P (dT)$

$dU = \mu C_V (dT)$

$\Rightarrow \frac{160}{240} = \frac{1}{2}8$

$\Rightarrow 8 = \frac{4}{3}$

$\Rightarrow 1 + \frac{2}{f} = \frac{4}{3}$

$\Rightarrow f = 6$

10. A p-n junction becomes active when photons of wavelength 400 nm falls on it. Find the energy band gap? (Given hc = 1237.5 eV –nm)

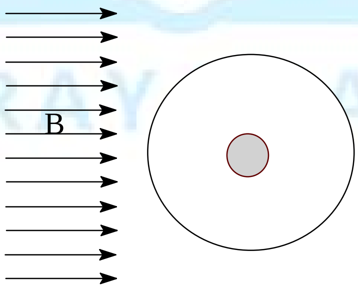
1) 3.09 eV 2) 4.51 eV 3) 2.45 eV 4) 5.34 eV

Key: 1

Sol: $\lambda = 400\,\text{nm}$

$\text{Band gap } E_g = \frac{hc}{\lambda} = \frac{1237.5}{400} = 3.09\text{eV}$

11. In a diamagnetic sphere, a cavity is made at its centre and now paramagnetic material is inserted in the cavity. The sphere is kept in a external magnetic field at centre

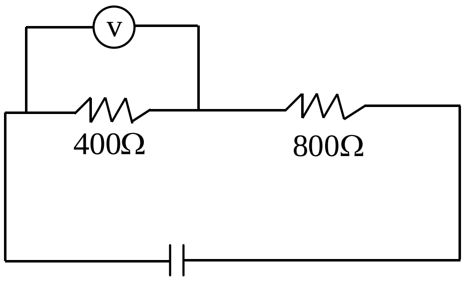


1) 0 2) B 3) $B_0 > B$ 4) $B_0 < B$

Key: 1

Sol: When magnetic field is applied diamagnetic substance produces magnetic filed in opposite direction so net magnetic field will be zero.

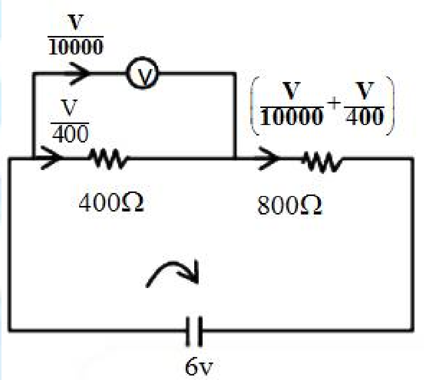
12. In the given diagram resistance of voltmeter is $10K\Omega$. Find reading of voltmeter.



1) 4V 2) 3.23V 3) 1.95V 4) 1.26V

Key: 3

Sol:



$V_1 : V_2 = R_1 : R_2$

$R_1 = \frac{400 \times 10000}{10400}$

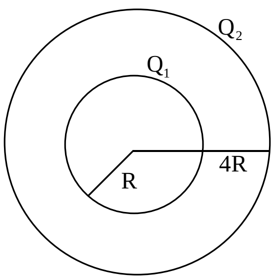
$\Rightarrow R_1 : R_2 = \frac{400 \times 10000}{10400} : 800$

$\Rightarrow R_1 : R_2 = 25 : 52 \Rightarrow V_1 = \frac{R_1}{R_1 + R_2} V$

$\Rightarrow V = \frac{25}{77} \times 6 = \frac{150}{77} = 1.948\,V$

$\Rightarrow 1.95V$

13. In the given figure, there are two concentric spherical shells, find potential difference between the shells



1) $\frac{3}{8\pi \in_0} \cdot \frac{Q_1}{R}$ 2) $\frac{3}{16\pi \in_0} \cdot \frac{Q_2}{R}$ 3) $\frac{3}{4\pi \in_0} \cdot \frac{Q_1}{R}$ 4) $\frac{3}{16\pi \in_0} \cdot \frac{Q_1}{R}$

Key: 4

Sol: Potential of inner sphere $V_i = \frac{1}{4\pi \in_0}\left(\frac{Q_1}{R} + \frac{Q_2}{4R}\right)$

Potential of outer sphere $V_0 = \frac{1}{4\pi \in_0}\left(\frac{Q_1 + Q_2}{4R}\right)$

$\Rightarrow V = V_i - V_0$

$\frac{1}{4\pi \in_0}\left[\frac{Q_1}{R} + \frac{Q_2}{4R}\right] - \frac{1}{4\pi \in_0}\left(\frac{Q_1 + Q_2}{4R}\right)$

$\frac{1}{4\pi \in_0} \quad \frac{Q_1 3}{4R} = \frac{3Q_1}{16\pi \in_0 R}$

14. A body cools from 50°C to 40°C. Find temperature of body in next 5 munities,if surrounding temperature is 20°C.

1) 13.3°C 2) 23.3°C 3) 43.3°C 4) 33.3°C

Key: 4

Sol: According Newton's law of cooling $-\frac{d\theta}{dt} = k\left[\frac{\theta_1 + \theta_2}{2} - \theta_0\right]$

$\frac{10}{5} = K[45 - 20]$

$\frac{40 - \theta}{5} = K\left[\frac{40 + v}{2}\right]$

$\frac{10}{40 - \theta} = \frac{25}{\frac{\theta}{2}} \quad \Rightarrow \frac{10}{40 - \theta} = \frac{50}{\theta}$

$\Rightarrow 200 - 5\theta = \theta$

$\theta = \frac{100}{3}°C = 33.3°C$

15. Electric field of an electromagnetic wave $\vec{E} = E_0 \cos(\omega t - kx)\hat{j}$. The equation of corresponding magnetic field at t = 0 should be:

1) $\vec{B} = E_0\sqrt{\mu_0 \in_0}(\cos kx)\hat{k}$ 2) $\vec{B} = \frac{E_0}{\sqrt{\mu_0 \in_0}}(\cos kx)\hat{k}$

3) $\vec{B} = E_0\sqrt{\mu_0 \in_0}(\cos kx)(-\hat{k})$ 4) $\vec{B} = \frac{E_0}{\sqrt{\mu_0 \in_0}}(\cos kx)(-\hat{k})$

Key: 1

Sol: $\vec{E} = E_0(\cos)(wt - kx)\hat{j}$

$\frac{1}{\sqrt{\mu_0 E_0}} = C$ and $\frac{E_0}{B_0} = C$

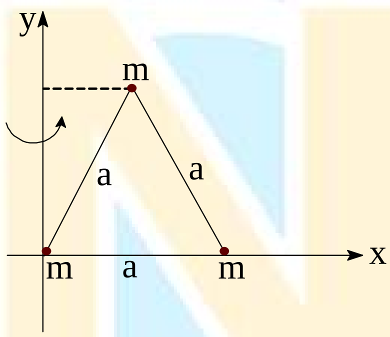
$\vec{E} \times \vec{B}$ is the direction of propagation of the wave $(x - axis)$

$\Rightarrow \vec{B}$ Should lie along $z\,axis(\hat{k})$

$\Rightarrow \vec{B} = E_0\sqrt{\mu_0\varepsilon_0}\cos(-kx)k$

$\vec{B} = E_0\sqrt{\mu_0\varepsilon_0}\cos kx\,\hat{k}$

16. As shown in the diagram three point masses 'm' each are fixed at the corners of an equilateral triangle, by means of mass less rigid rods. Moment of inertia of the system about y-axis is $\frac{N}{20}ma^2$, N is



1) 25 2) 50 3) 75 4) 100

Key: 1

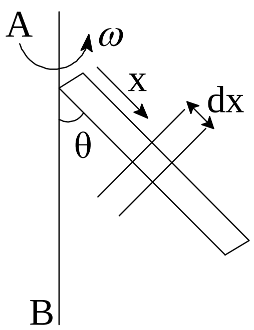
Sol: $I = \sum ml^2$

$= m\left[0^2 + a^2 + \frac{a^2}{4}\right]$

$= \frac{5ma^2}{4}$

$\Rightarrow N = 25$

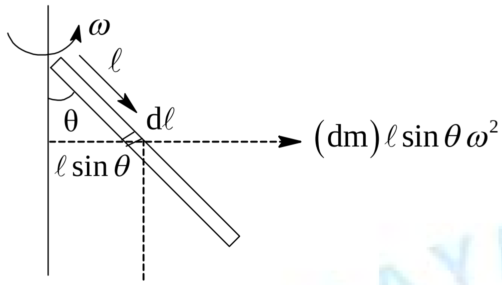
17. A uniform rod of mass 'm' and length 'l' rotates around an axis AB with constant angular velocity 'ω'. The angle made by the rod with AB is 'θ'. Then the value of $\cos\theta$ is ____



1) $\frac{g}{2\ell\omega^2}$ 2) $\frac{g}{\ell\omega^2}$ 3) $\frac{2g}{\ell\omega^2}$ 4) $\frac{3g}{2\ell\omega^2}$

Key: 4

Sol:



Torque due to pseudoforce is

$$T_P = \int_0^{\ell} (dm)\,\ell\sin\theta\,\omega^2\cos\theta\,\ell$$

$$= \int_0^{\ell} \lambda(dl)\,\ell^2\sin\theta\,\omega^2\cos\theta$$

$$T_p = \lambda\,\omega\sin\theta\cos\theta\frac{\ell^3}{3}$$

T_P should be counter balanced by torque due to gravity

$$\chi\omega^2\sin\theta\,\cos\theta\,\frac{\ell^3}{3} = mg\sin\theta\frac{\ell}{2}$$

$$\Rightarrow \cos\theta = \frac{3g}{2\ell\omega^2}$$

18. Dimensional formula of solar constant is:

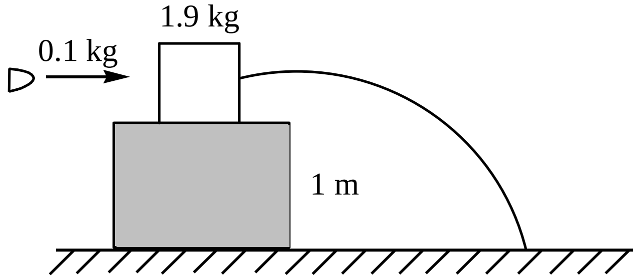
1) $M^1L^0T^{-3}$ 2) $M^1L^1T^{-3}$ 3) $M^0L^0T^3$ 4) $M^1L^2T^{-3}$

Key: 1

Sol: By definition solar constant is energy received per unit time per unit area

$$S = \frac{E}{AT} = \frac{ML^2T^{-2}}{L^2T} = MT^{-3}$$

19. A bullet of mass 0.1 kg moving with speed 20 m/s strikes a block of mass 1.9 kg and gets embedded in it as shown in figure. Find the kinetic energy of bullet-block system, when it strikes the ground. ($g = 10\ m/s^2$)



1) 11 J 2) 21 J 3) 25 J 4) 30 J

Key: 2

Sol: $KE = \frac{1}{2}m\left[v_x^2 + v_y^2\right]$

$= \frac{1}{2}m\left[v_x^2 + 2gy\right]$

$\frac{1}{2}m\left[1^2 + 20\right] = 21J$

20. A particle of mass 'm' is moving in SHM on a line with amplitude 'A' and frequency 'f' in a spring mass system. At the moment when it crosses mean position, half of the mass suddenly detached by itself and stops, then new amplitude becomes 'λA' then 'λ' will be

1) $\frac{1}{2}$ 2) $\frac{1}{\sqrt{2}}$ 3) $\sqrt{2}$ 4) 1

Key: 3

Sol: Using conservation of linear momentum $\cancel{m}v = \frac{\cancel{m}}{2}v'$

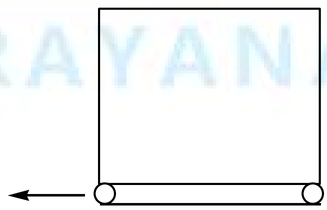
$v' = 2v$

since $v_{max} = A\omega = A\sqrt{\frac{k}{m}}$

$\Rightarrow A'\sqrt{\frac{2\cancel{k}}{\cancel{m}}} = 2A\sqrt{\frac{\cancel{k}}{\cancel{m}}}$

$A' = \sqrt{2}A$

21. A square wire loop of side 30cm and having wire cross section having diameter 4 mm is placed perpendicular to a magnetic field which is changing at the rate 0.2 T/s. Find induced current in the wire loop.(Given: Resistivity of wire material is $1.23\times10^{-8}\,\Omega\,m$)



Key: 15.31 A

Sol: $\in = \frac{d\phi}{dt} = A\frac{dB}{dt}$

$\in = \ell^2\frac{dB}{dt}$

$= 9\times10^{-2}\times0.2 = 18\times10^{-3}V$

$i = \frac{\in}{R} = \frac{18\times10^{-3}A}{\rho\ell} = \frac{18\times10^{-3}\times\pi\times4\times10^{-6}}{1.23\times10^{-8}\times3\times10^{-1}\times4}$

$$= \frac{18 \times 3.14 \times 4}{3.69 \times 4}$$

$$= 15.31\text{A}$$


thank
you