JEE Main (Phase-II) 2020

Memory Based Questions & Solutions

SUBJECT

PHYSICS

Date: 04 September, 2020 (Shift-2)

Time: 3 PM to 6 PM

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1. Two disc made of same material and same thickness having radius R and αR. Their moment of inertia about their own central axis are in ratio 1 : 16. Calculate the value of α.

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

Ans. (1)

Sol. Moment of inertia of disc is given by

$$I = \frac{MR^2}{2} = \frac{[\rho(\pi R^2)t]R^2}{2}$$

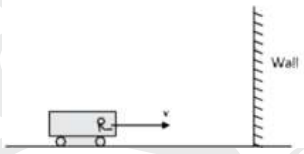
$$I \propto R^4$$

$$\frac{I_2}{I_1} = \left(\frac{R_2}{R_1}\right)^4$$

$$\frac{16}{1} = \alpha^4$$

$$\alpha = 2$$

2. Bus moving with speed v towards a stationary wall. It produces sound of frequency f = 420 Hz, The heard frequency of reflected sound from wall by driver is 490 Hz. Calculate the speed v of bus. The velocity of sound in air is 330 m/s



(1) 61 Km/hr (2) 71 Km/hr (3) 81 Km/hr (4) 91 Km/hr

Ans. (4)

Sol. Frequency appeared at wall

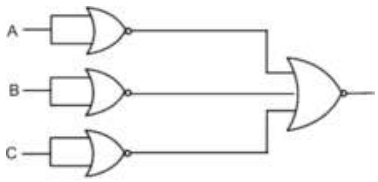
$$f_w = \frac{330}{330 - v}.f$$

$$f' = \frac{330 + v}{330}.f_w = \frac{330 + v}{330 - v}.f$$

$$490 = \frac{330 + v}{330 - v}.420$$

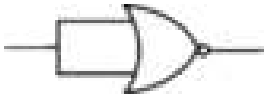
$$v = \frac{330 \times 7}{91} \approx 25.38\, m/s = 91\, Km/hr$$

3. The given circuit behaves like a following single gate



(1) OR (2) AND (3) NAND (4) NOR

Ans. (2)

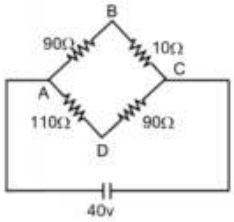
Sol. 

Behaves like a not gate so boolen equation will be

$y = \overline{\overline{A} + \overline{B} + \overline{C}}$

$y = A.\ B.\ C$

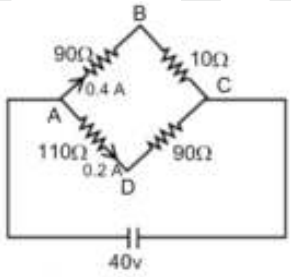
whole arrangement behaves like a AND gate

4. 

In the given circuit calculate the potential difference between points A and B.

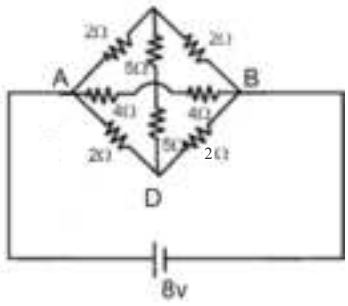
(1) 12 V (2) 24 V (3) 36 V (4) 48 V

Ans .(3)

Sol. 

From ohm's law $V_{AB} = 90 \times 0.4 = 36V$

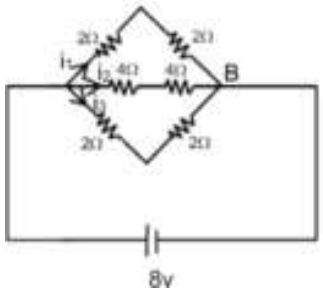
5. Find current through 4Ω resistance



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

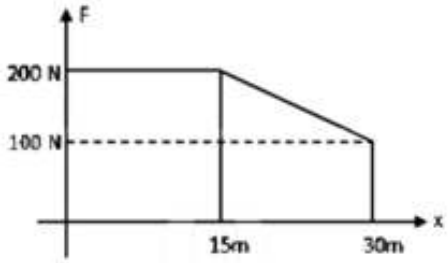
Ans. (1)

Sol.



$$i_2 = \frac{8}{4+4} = 1\,\text{Amp}$$

6. Force on a particle varies with position (x) of particle as shown, calcuate work done by force from x = 0 to x = 30 m



(1) 5250 J (2) 4250 J (3) 7500 J (4) 3750 J

Ans. (1)

Sol. $W = \text{area} = (200\times 15) + \frac{1}{2}(100+200)\times 15$

$= 3000 + 2250$

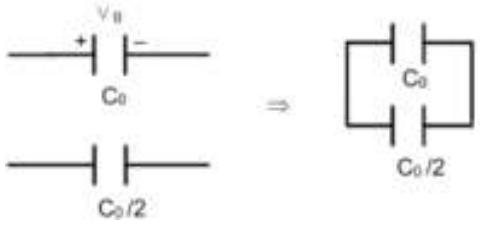
$W = 5250$ J

7. A capacitor of capacitance C_0 is charged to potential V_0. Now it is connected to another uncharged capacitor of capacitance $\frac{C_0}{2}$. Calculate the heat loss in this process.

(1) $\frac{1}{2}C_0V_0^2$ (2) $\frac{1}{3}C_0V_0^2$ (3) $\frac{1}{6}C_0V_0^2$ (4) $\frac{1}{8}C_0V_0^2$

Ans. (3)

Sol.



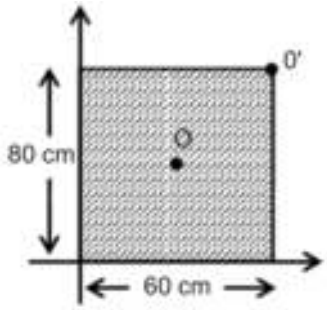
heat loss

$$H = \frac{C_1C_2}{2(C_1+C_2)}(V_1 - V_2)^2$$

$$= \frac{C \times \frac{C}{2}}{2\left(C + \frac{C}{2}\right)}(V_0 - 0)^2 = \frac{C}{6}V_0^2$$

$$H = \frac{1}{6}C_0V_0^2$$

8. Find the ratio of moment of inertia about axis perpendicular to rectangular plate passing through O & O'



(1) $\frac{1}{2}$ (2) $\frac{1}{3}$ (3) $\frac{1}{4}$ (4) $\frac{1}{8}$

Ans. (3)

Sol. $\frac{I_O}{I_{O'}} = \frac{\frac{M}{12}(a^2 + b^2)}{\frac{M}{12}(a^2 + b^2) + m\left(\frac{a^2}{4} + \frac{b^2}{4}\right)}$

$$\frac{\frac{M}{12}(a^2 + b^2)}{\frac{M}{3}(a^2 + b^2)} = \frac{1}{4}$$

$$\frac{I_O}{I_{O'}} = \frac{1}{4}$$

9. A charged particle of charge q released in electric field $E = E_0\left(1 - ax^2\right)$ from origin. Find position when its kinetic energy again becomes zero.

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

Ans. (3)

Sol. $W_{ex} = \Delta K \qquad K_f - K_i = 0$

$$\int_0^x qEdx = 0$$

$$q\int_0^x E_0(1-ax^2)dx = 0$$

$$qE_0\int_0^x (1-ax^2)dx = 0$$

$$x - \frac{ax^3}{3} = 0$$

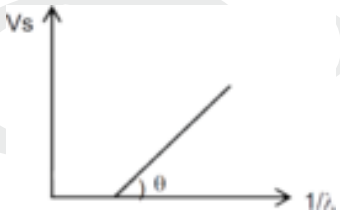
$$1 - \frac{ax^2}{3} = 0$$

$$\frac{ax^2}{3} = 1$$

$$x^2 = \frac{3}{a}$$

$$x = \pm\sqrt{\frac{3}{a}}$$

10. A light is incident on a metallic surface. Graph between stopping potential V_S and $1/\lambda$ is as shown in figure. When intensity of light is increased at given frequency then:



(1) Graph does not change (2) Graph steeper

(3) V_S intercept change (4) Graph gets narrower

Ans. (1)

Sol. $eV_S = h\nu - w$

$$V_S = \frac{h\nu}{e\lambda} - \frac{w}{e}$$

Freqeuncy and work function are constant therefore graph does not change.

11. A ball is thrown with velocity v_0 from ground in vertical upward direction. If particle experiences resistance force mkv^2. Where v is the speed of particle, m mass of the particle and k is a positive constant. Find maximum height reached.

(1) $\frac{1}{2K}\ell n\left(\frac{g+kv_0^2}{g}\right)$ (2) $\frac{1}{3K}\ell n\left(\frac{g+kv_0^2}{g}\right)$ (3) $\frac{2}{3K}\ell n\left(\frac{g+kv_0^2}{g}\right)$ (4) $\frac{1}{K}\ell n\left(\frac{g+kv_0^2}{g}\right)$

Ans. (1)

Sol. $F_{net} = ma$

$$-mg - mkv^2 = mv\frac{dv}{ds}$$

$$-\int_{V_0}^{0} \frac{vdv}{g+kv^2} = \int_{0}^{h_{max}} ds = h_{max}$$

$$h_{max} = \frac{1}{2k}\ell n\left(\frac{g+kv_0^2}{g}\right)$$

12. Light of wavelength 6000×10^{-10} m passes through a single slit of width 0.6×10^{-4} m. Find the highest order of minima on both side of central maxima

(1) 10 (2) 20 (3) 100 (4) 200

Ans. (3)

Sol. Light of wavelength 6000×10^{-10} m passes through a single slit of width 0.6×10^{-4} m. Find height of highest order of minima on bot hside central maxima

for minima

$$d\sin\theta = n\lambda$$

$$n \le \frac{d}{\lambda}$$

$$n \le \frac{0.6\times10^{-4}}{6000\times10^{-10}}$$

$$n \le 100$$

13. Maximum wave length of Lyman series photon for hydrogen is λ, then minimum wavelength of Balmer series photon for He^+ ion.

(1) $\frac{\lambda}{4}$ (2) $\frac{3\lambda}{4}$ (3) $\frac{5\lambda}{4}$ (4) $\frac{2\lambda}{4}$

Ans. (2)

Sol. $$\frac{1}{\lambda_{He^+}} = R(4)\left(\frac{1}{4}-\frac{1}{\infty}\right) = R$$

$$\lambda_{He^+} = \frac{1}{R}$$

$$\frac{1}{\lambda} = R\left(1-\frac{1}{4}\right)\text{given}$$

$$\frac{1}{\lambda} = \frac{3R}{4}$$

$$R = \frac{4}{3\lambda}$$

$$\therefore \lambda_{He^+} = \frac{3\lambda}{4}$$

14. Electric field in EM waves is $E = E_0\left(\hat{i}+\hat{j}\right)\sin(kz-\omega t)$ then equation of magnetic field is :

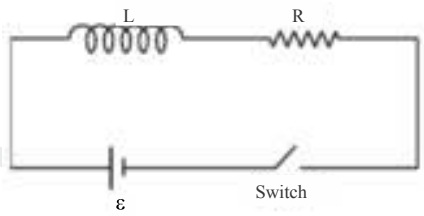
(1) $B = B_0\left(-\hat{i}+\hat{j}\right)\sin(kz-\omega t)$ (2) $B = B_0\left(\hat{i}+\hat{j}\right)\sin(kz-\omega t)$

(3) $B = B_C\left(\hat{j}+\hat{k}\right)\sin(kz-\omega t)$ (4) $B = -B_0\left(\hat{i}+\hat{j}\right)\sin(kz-\omega t)$

Ans. (1)

sol. $\vec{E}\times\vec{B} \,||\, \vec{C}$

15. The circuit is switched on at t=0,Find the time when energy stored in inductor becomes $\frac{1}{n}$ times of maximum energy stored in it :



(1) $\frac{L}{R}\ln\frac{\sqrt{n}}{\sqrt{n}+1}$ (2) $\frac{L}{R}\ln\frac{\sqrt{n}}{\sqrt{n}-1}$ (3) $\frac{L}{R}\ln\frac{\sqrt{n}+1}{\sqrt{n}}$ (4) $\frac{L}{R}\ln\frac{\sqrt{n}-1}{\sqrt{n}}$

Ans. (2)

sol. Potential energy stored in inductor is given by $U = \frac{1}{2}LI^2$

$U \propto I^2$

$\frac{U}{U_0} = \left(\frac{I}{I_0}\right)^2$

$\frac{1}{n} = \left(\frac{I}{I_0}\right)^2$

$\frac{I}{I_0} = 1-e^{-RT/L} = \frac{1}{\sqrt{n}}$

$t = \frac{L}{R}\ln\frac{\sqrt{n}}{\sqrt{n}-1}$

16. A satelite is revolving around the earth.Ratio of its orbital speed and escape velocity will be.

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

Ans. (1)

sol. $\frac{v_0}{v_e} = \frac{\sqrt{\frac{Gm}{r}}}{\sqrt{\frac{2Gm}{r}}} = \frac{1}{\sqrt{2}}$

17. Binding energy per nucleon of $_{50}Sn^{120}$ approximately will be. [Atomic mass of Sn^{120} is 120.500 u and that of ^1H is 1.007 u .Mass of neutron =1.008 u, 1u=931Mev]

Ans. 3.18 Mev

sol. The number of protons in $_{50}Sn^{120} = 50$ and the number of neutron =120-50=70. The binding energy of $_{50}Sn^{120}$ is

$= [50 \times 1.007u + 70 \times 1.008u - 120.500u]c^2 = (0.41u)c^2$

$= (0.41u)(931MeV/u) = 381.71MeV$

Binding energy per nucleon $= \frac{381.71}{120} = 3.18MeV$

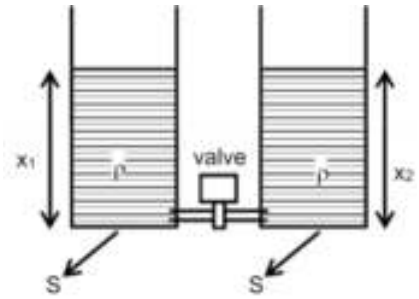
18. If I is moment of inertia, F is force, v is velocity, E is energy and L is lenght then, dimension of $\frac{IFv^2}{EL^4}$ will be

(1) Energy density (2) Viscosity (3) Young modulus (4) Torque

Ans. (1)

sol. $\frac{IFv^2}{EL^4} = \frac{(M^1L^2)(M^1L^1T^{-2})(L^1T^{-2})^2}{(M^1L^2T^{-2})(L^4)} = M^1L^{-1}T^{-2} = Energy\ density$

19. Find the loss in gravitational potential energy of cylinder when valve is opened and level of liquid in both cylinder become same



(1) $\frac{\rho Ag(x_1 - x_2)^2}{4}$ (2) $\frac{\rho Ag(x_1 + x_2)^2}{4}$ (3) $\frac{\rho Ag(x_1^2 - x_2^2)^2}{4}$ (4) $\frac{\rho Ag(x_1^2 + x_2^2)^2}{4}$

Ans. (1)

Sol. Initial height of liquid in container's of same cross section are x_1 and x_2 respectively. Now value is opened find loss in potential energy when water level become same

loss in PE $= U_i - U_f$

$= \left[\rho(A)x_1\frac{x_1}{2} + \rho Ax_2\frac{x_2}{2}\right]g - \left[\rho A\left(\frac{x_1 + x_2}{2}\right) \times \left(\frac{x_1 + x_2}{4}\right) \times 2\right]g$

$$= \rho Ag\left[\frac{x_1^2}{2}+\frac{x_2^2}{2}-\frac{(x_1+x_1)^2}{4}\right]=\frac{\rho Ag(x_1-x_2)^2}{4}$$

20. A coil has moment of inertia $0.8\,kg/m^2$ released in uniform magnetic field 4T, there is 60^o angle between magnetic field and magnetic moment of coil. Magnetic moment of coil is $20\,A-m^2$. Find the angular speed of coil when it passes through stable equilibrium.

(1) $20\pi\,rad/s^{-1}$ (2) $20\ rad/s^{-1}$ (3) $10\pi\ rad/s^{-1}$ (4) $10\ rad/s^{-1}$

Ans. (4)

Sol. From energy conservation

$$\frac{1}{2}I\omega^2 = U_{in}-U_f$$

$$= -MB\cos 60^o-(-MB)$$

$$\frac{MB}{2}=\frac{1}{2}I\omega^2$$

$$100=\omega^2$$

$$\frac{20\times 4}{2}=\frac{1}{2}(0.8)\omega^2$$

$$100=\omega^2$$

$$\omega = 10\,rad/sec$$

21. Maatch the following

I	*Adiabatic*	(*A*)	$\Delta U=0$
II	*Isothermal*	(*B*)	$\Delta W=0$
III	*Isobaric*	(*C*)	$\Delta Q=0$
IV	*Isochoric*	(*D*)	$\Delta U\neq 0$
			$\Delta Q\neq 0$
			$\Delta W\neq 0$

(1) $I\to A$ $II\to C$ $III\to D$ $IV\to B$ (2) $I\to D$ $II\to B$ $III\to C$ $IV\to A$

(3) $I\to C$ $II\to A$ $III\to D$ $IV\to B$ (4) $I\to B$ $II\to D$ $III\to C$ $IV\to A$

Ans .(3)

22. Intensity of magnetization is 4 unit at temperature 6 K and B=0.4 T. What is the intensity of magnetization at temperature 24K in B=0.3 T

(1) 0.75 (2) 0.25 (3) 0.5 (4) 1

Ans .(1)

sol. Magnetization =4 T=6k, B=0.4 T

(Para magnetic substance) T= 24k, B=0.3 T

$$M=\frac{CB_{ext}}{T}$$

$$\frac{4}{M}=\frac{0.4/6}{0.3/24}=0.75$$

Gravity
Orienting Intelligence

JEE Main - 2020

Best Result in U.P.

Aditya Pandey

Percentile

99.936

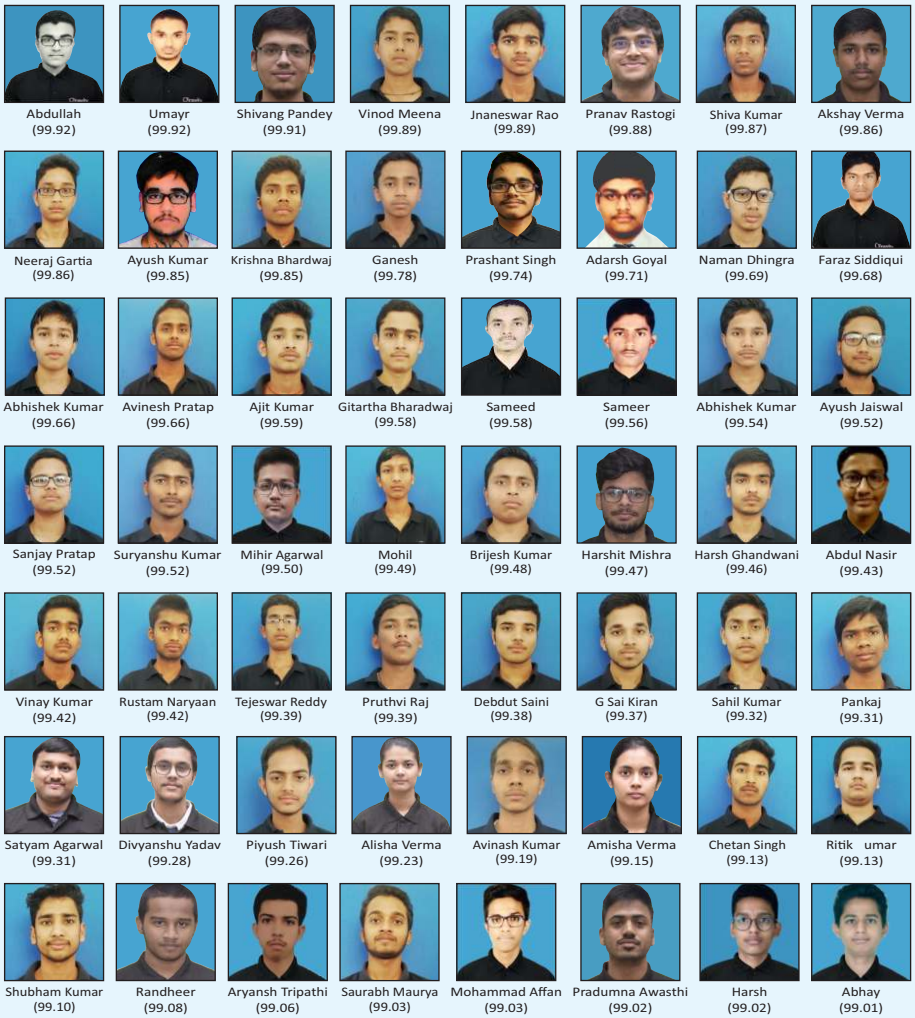
City Topper

Application No. 200310320565
DOB - 23-12-2002

65 Students Above 99 Percentile

145 Students Above 98 Percentile

208 Students Above 97 Percentile



SCHOOL INTEGRATED PROGRAM (SIP)

Tradition of Gravity Continues,
Once Again Historical Result,
100% Students Cracked
JEE Main
(Based on Last Yr Cut off)

2020

80 Out of 80
Cracked JEE Main

We had three Batches
of 55, 15 and 10.

Many Top Ranks are
from these Batches

2019

79 Out of 80 in JEE Main	50 Out of 79 in JEE Adv.

2018

83 Out of 85 in JEE Main	62 Out of 83 in JEE Adv.

2017

80 Out of 85 in JEE Main	63 Out of 80 in JEE Adv.

2016

39 Out of 40 in JEE Main	31 Out of 39 in JEE Adv.

Selections Engineering 2019

gravity
Orienting Intelligence

194 AIR (General)

Tarun

337 AIR (General)

Aniket Agarwal

494 AIR (General)

Shubh Sahu

497 AIR (General)

Shlok Nemani

50 out of 79 Cracked JEE Advanced from SIP (School Integrated Program)

4 Ranks under 500 (General Category) | 2 Ranks under 10 (Reserved Category)

126 Selections in JEE Advanced | 61 Students above 99 Percentile in JEE Main 2019

Sanjana

AIR - 3*

Akash

AIR - 4*

Priyanka

AIR - 68*

Bibek Lakra

AIR - 150*

Neha Raj

AIR - 177*

Arindam

AIR - 809 (General EWS)

Priyam

AIR - 1378 (General)

Mihir Chawla

AIR - 2237 (General)

Madhur Kumar

AIR - 2382 (General)

Manish Kumar

AIR - 2388 (General)

Saumya Raj

AIR - 2656 (General)

Raghav

AIR - 2659 (General)

Ritveek

AIR - 2709 (General)

Vanshaj

AIR - 2787 (General)

Subir Gupta

AIR - 2881 (General)

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AIR - 3600 (General)

Abhisht Bose

AIR - 3784 (General)