PHYSICS

BOOKS - BITSAT GUIDE

QUESTION-PAPERS-2015

Physics

1. An artificial satellite is moving in a circular orbit around the earth with a speed equal to half the magnitude of the escape velocity from

the earth. The height (h) of the satellite above the earth's surface is (Take radius of earth as R_e)

A. $h = R_e^2$

B. $h = R_e$

C. $h = 2R_e$

D. $h = 4R_e$

Answer: B

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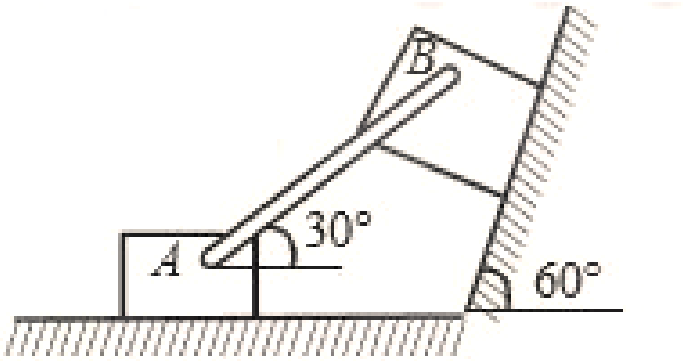
2. In figure, two blocks are separated by a uniform strut attached to each block with frictionless pins. Block A weighs 400N, block B weighs 300N, and the strut AB weigh 200N. If μ= 0.25 under B, determine the minimum coefficient of friction under A to prevent motion.



A. 0.4

B. 0.2

C. 0.8

D. 0.1

Answer: A

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3. Two tuning forks with natural frequencies of $340Hz$ each move relative to a stationary observer. One fork moves away form the observer, while the other moves towards him

at the same speed. The observer hears beats of frequency $3Hz$. Find the speed of the tuning fork.

A. 1.5 m/s

B. 2 m/s

C. 1 m/s

D. 2.5 m/s

Answer: A

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4. The displacement of a particle is given at time t, by:

$x = A\sin(-2\omega t) + B\sin^2\omega t$ Then,

A. the motion of the particle is SHM with an amplitude of $\sqrt{A^2 + \frac{B^2}{4}}$

B. the motion of the particle is not SHM, but oscillatory with a time period of $T = \pi/\omega$

C. the motion of the particle is oscillatory with a time period of $T = \pi/2\omega$

D. none

Answer: A

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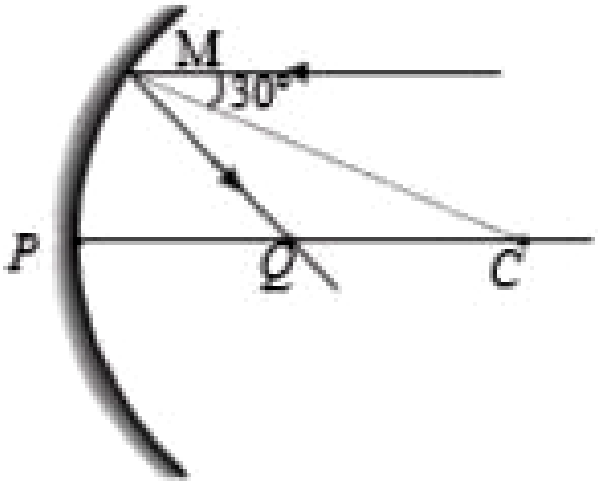
5. A ray parallel to principal axis is incident at 30° from normal on concave mirror having radius of curvature R. The point on principal axis where rays are focussed is Q such that PQ

is



A. $\frac{R}{2}$

B. $\frac{R}{\sqrt{3}}$

C. $\frac{2\sqrt{R}-R}{\sqrt{2}}$

D. $R\left(1-\frac{1}{\sqrt{3}}\right)$

Answer: D

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6. A solid sphere of radius R has a charge Q distributed in its volume with a charge density $\rho = kr^a$, where k and a are constants and r is the distance from its centre. If the electric field at $r = \frac{R}{2}$ is $\frac{1}{8}$ times that $r = R$, find the value of a.

A. 3

B. 5

C. 2

D. 7

Answer: C

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7. A charged particle is moving in a uniform magnetic field and losses 4% of its KE. The radius of curvature of its path change by

A. 2%

B. 4%

C. $10\ \%$

D. $12\ \%$

Answer: A

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8. Calculate the wavelength of light used in an interference experiment from the following data: Fringe width = 0.03 cm. Distance between slits and eyepiece through which the interference pattern is observed is 1 m.

Distance between the images of the virtural when a convex lens of focal length 16 cm is used at a distance of 80 cm from the eyepiece is 0.8 cm.

A. 0.0006 Å

B. 0.0006 m

C. 600 cm

D. 6000 Å

Answer: D

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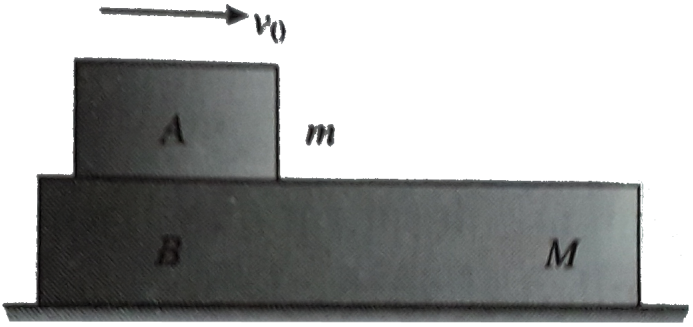
9. The masses of the block A and B are m and M Between A and B there is a constant force F but B can slide frictionlessly on the horizontal surface A is set in motion with velocity v_0 while B is at rest . What is the distance moved by A relative to B before they move with the same velocity



A. $\frac{mMv_0^2}{F(m-M)}$

B. $\frac{mMv_0^2}{2F(m-M)}$

C. $\frac{mMv_0^2}{F(m+M)}$

D. $\frac{mMv_0^2}{2F(M+m)}$

Answer: D

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10. An elastic spring of unstretched length L and spring constant K is stretched by a small

length x. It is further stretched by another small length y. the work done in second stretcing is

A. $1/2Ky^2$

B. $1/2Ky(2x+y)$

C. $1/2K\left(x^2+y^2\right)$

D. $1/2k(x+y)^2$

Answer: B

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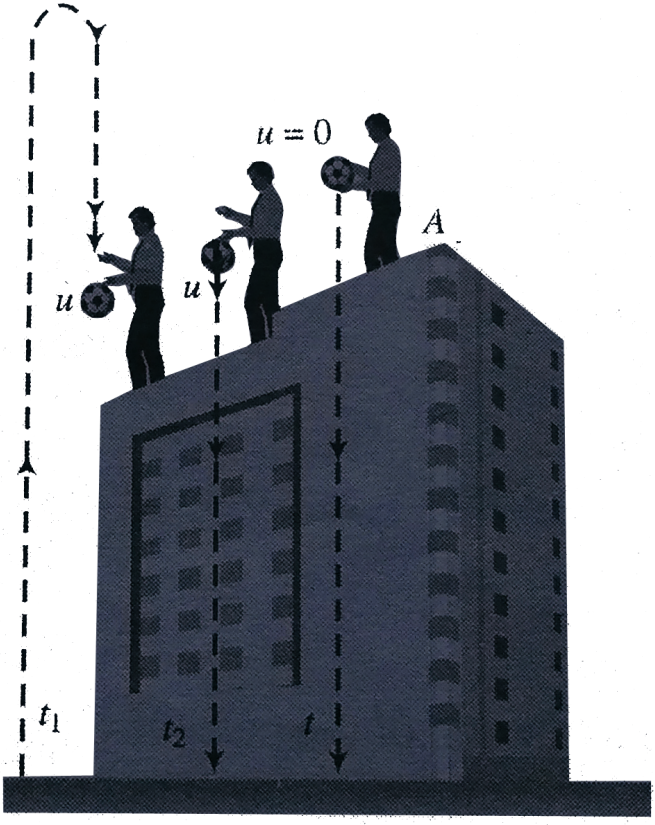
11. A body is thrown vertically upwards from A. The top of a tower . It reaches the ground in time t_1. It it is thrown vertically downwards from A with the same speed it reaches the ground in time t_2, If it is allowed to fall freely from A. then the time it takes to reach the

ground.



A. $t = \dfrac{t_1 + t_2}{2}$

B. $t = \dfrac{t_1 - t_2}{2}$

C. $t = \sqrt{t_1 t_2}$

D. $t = \sqrt{\frac{t_1}{t_2}}$

Answer: C

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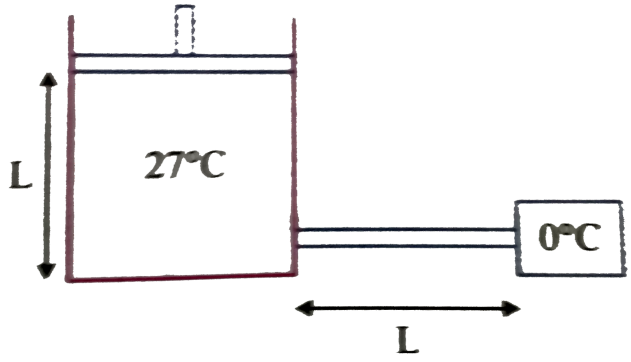
12. 0.5 mole of an ideal gas at constant temperature $27^\circ C$ kept inside a cylinder of length L and cross-section area A closed by a massless piston The cylinder is attached with a conducting rod of length L cross-section area $(1/9)m^2$ and thermal conductivity k whose

other end is maintained at $0^\circ C$ If piston is moved such that rate of heat flow through the conducing rod is constant then find velocity of piston when it is at height $L/2$ from the bottom of cylinder [Neglect any kind of heat loss from system



A. $\left(\frac{k}{R}\right) m/\sec$

B. $\left(\frac{k}{10R}\right) m/\sec$

C. $\left(\frac{k}{100R}\right) m/\sec$

D. $\left(\frac{k}{1000R}\right) m/\sec$

Answer: C

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13. A conducting square loop is placed in a magnetic field B with its plane perpendicular to the field. Now the sides of the loop start shrinking at a constant rate α. the induced

emf in the loop at an instant when its side is a

is

A. $2a\alpha B$

B. $a^2\alpha B$

C. $2a^2\alpha B$

D. $a\alpha B$

Answer: A

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14. A beam of light has three $\lambda, 4144Å, 4972Å and 6216Å$ with a total intensity of $3.6 \times 10^{-3} Wm^{-2}$ equally distributed amongst the three λ. The beam falls normally on an area $1.0 cm^2$ of a cleam metallic surface of work function 2.3 eV. Assume that there is no loss of light by reflection etc. Calculate the no. of photoelectrons emitted in 2 sec, in scientific notation,$x \times 10^y$ find the value of y.

A. 2×10^9

B. 1.075×10^{12}

C. 9×10^{8}

D. 3.75×10^{6}

Answer: B

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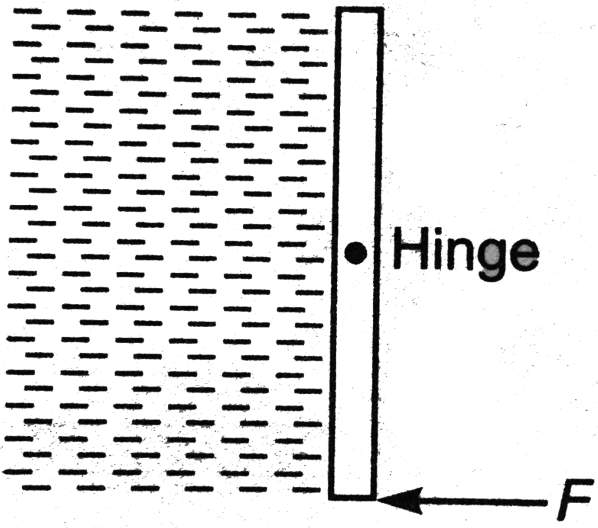
15. A square gate of size $1m \times 1m$ is hinged at its mid point. A fluid of density ρ fill the space to the left of the gate. The force F required to

hold the gate stationary is



A. $\frac{\rho g}{3}$

B. $\frac{\rho g}{2}$

C. $\frac{\rho g}{6}$

D. $\frac{\rho g}{8}$

Answer: C

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16. When 0.50 Å X-ray strike a material , the photoelectron from the K shell are observed to move in a circle of radius $2.3nm$ in a magnetic field of 2×10^{-2} tesle acting perpendicular to direct of emission of photoelectron . What is the binding elergy of $k - shell$ electron?

A. 3.5 keV

B. 6.2 keV

C. 2.9 keV

D. 5.5 keV

Answer: B

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17. In a CE transistor amplifier, the audio signal voltage across the collector resistance of $2k\Omega$ is $2V$. If the base resistance is $1k\Omega$ and the

current amplification of the transistor is 100, the input signal voltage is:

A. 2mV

B. 3 mV

C. 10 mV

D. 0.1 mV

Answer: C

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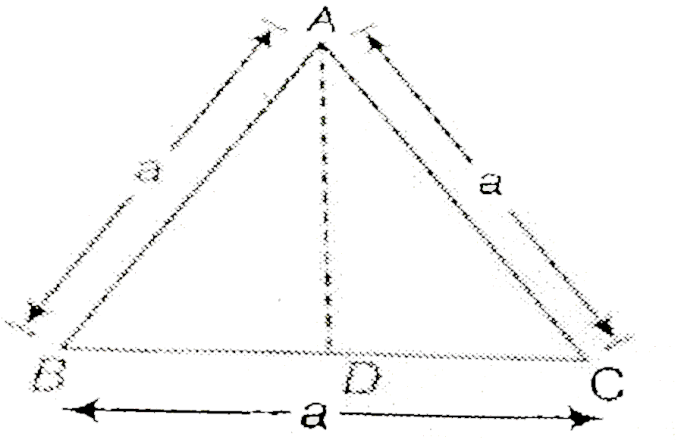
18. At the corners of an equilateral tringle of side a =1 m, three point charge are placed (each of 0.1 C). If this system is supplied energy at the rate of 1 kW, then calculate the time required to move one of charges to the mid-point of the line joining the other two.



A. 50 h

B. 60 h

C. 48 h

D. 54 h

Answer: A

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19. A vessel of volume $20L$ contains a mixture o hydrogen and helium at temperature of $27^{\circ}C$ and pressure $2.0atm$ The mass of the mixture is $5g$. Assuming the gases to be ideal,

the ratio of the mass of hydrogen to heat of helium in the given mixture will be

A. $1:2$

B. $2:3$

C. $2:1$

D. $2:5$

Answer: D

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20. The resistance of a wire is R. It is bent at the middle by 180° and both the ends are twisted together to make a shorter wire. The resistance of the new wire is

A. 2R

B. $R/2$

C. $R/4$

D. $R/8$

Answer: C

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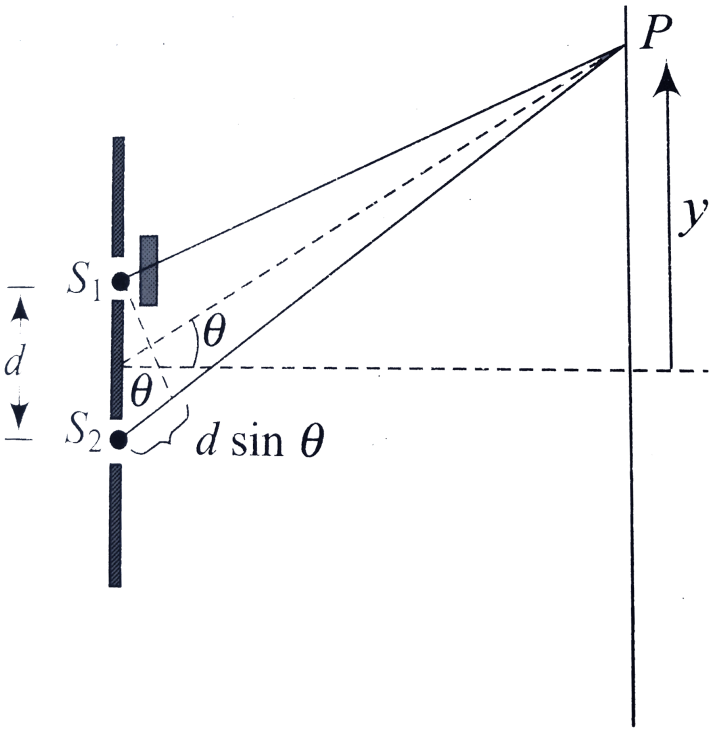
21. In YDSE, light of wavelength $\lambda = 5000\text{Å}$ is used, which emerges in phase from two slits distance $d = 3 \times 10^{-7}m$ apart. A transparent sheet of thickness $t = 1.5 \times 10^{-7}m$, refractive index $n = 1.17$, is placed over one of the slits. Where does the central maxima of the interference now appear from the center

of the screen? (Find the value of y?)



A. 4.9° and $\dfrac{D(\mu-1)t}{2d}$

B. 4.9° and $\dfrac{D(\mu-1)t}{d}$

C. 3.9° and $\dfrac{D(\mu+1)t}{d}$

D. 2.9° and $\frac{2D(\mu+1)t}{d}$

Answer: B

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22. The position of a projectile launched from the origin at t = 0 is given by $s=\left(40\hat{i}+50\hat{j}\right)m$ at $t=2s$. if the projectile was launched at an angle θ from the horizontal, then $\theta$is (take g = 10 ms^{-2}

A. $\tan^{-1}\frac{2}{3}$

B. $\tan^{-1}\frac{3}{2}$

C. $\tan^{-1}\frac{7}{4}$

D. $\tan^{-1}\frac{4}{5}$

Answer: C

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23. Water is flowing on a horizontal fixed surface, such that its flow velocity varies with y (vertical direction) as $v = k\left(\frac{2y^2}{a^2} - \frac{y^3}{a^3}\right)$. If coefficient of viscosity for water is η, what will

be shear stress between layers of water at y =a.

A. $\frac{\eta k}{a}$

B. $\frac{\eta}{ka}$

C. $\frac{\eta a}{k}$

D. None of these

Answer: A

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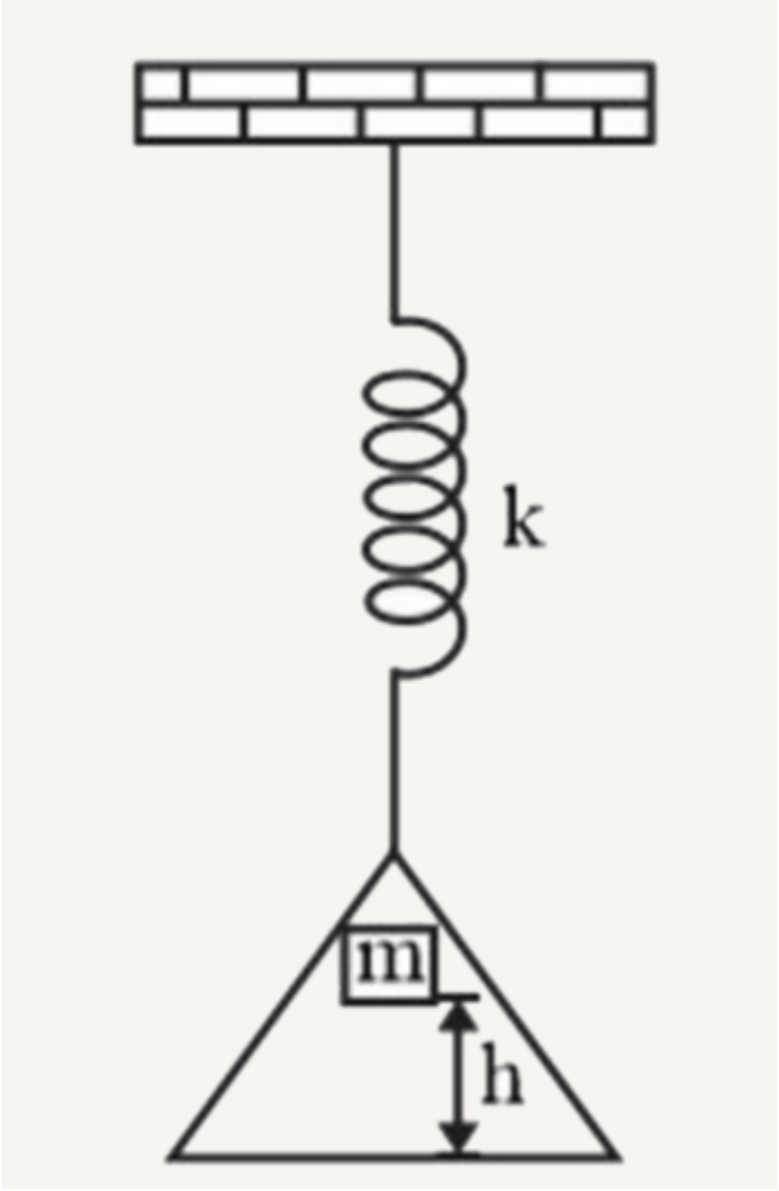
24. A load of mass m falls from a height h on to the scale pan hung from a spring , as shown in the figure . If the spring constant is k , mass of the not bounce , relative to the pan , then

the amplitude of vibration is



A. mg/d

B. $\frac{mg}{k}\sqrt{\left(\frac{1+2hk}{mg}\right)}$

C. $\frac{mg}{k}+\frac{mg}{k}\sqrt{\left(\frac{1+2hk}{mg}\right)}$

D. $\frac{mg}{k}\sqrt{\left(\frac{1+2hk}{Mg}-\frac{mg}{k}\right)}$

Answer: B

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25. In an ore containing Uranium, the ratio of U^{238} to Pb^{206} nuceli is 3. Calculate the age of the ore, assuming that alll the lead present in

the ore is the final stable, product of U^{238}.

Take the half-like of U^{238} to be 4.5×10^9 years.

In $(4/3) = 0.288$.

A. $1.6 \times 19^3 yr$

B. $1.5 \times 10^4 yr$

C. $1.867 \times 10^9 yr$

D. $2 \times 10^5 yr$

Answer: C

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26. A direct current of 5A is superimposed on an alternating current I = 10 $\sin \omega t$ flowing through a wire . The effective value of the resulting current will be

A. $(15/2)A$

B. $5\sqrt{3}A$

C. $5\sqrt{5}A$

D. 15A

Answer: B

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27. A plano-convex lens fits exactly into a plano-concave lens. Their plane surfaces are parallel to each other. If the lenses are made of different material of refractive indices μ_1 and μ_2 and R is the radius of curvature of the curved surface of the lenses, then focal length of the combination is

A. $\frac{R}{\mu_1 - \mu_2}$

B. $\frac{2R}{\mu_1 - \mu_2}$

C. $\frac{R}{2(\mu_1 - \mu_2)}$

D. $\frac{R}{2-(\mu_1+\mu_2)}$

Answer: A

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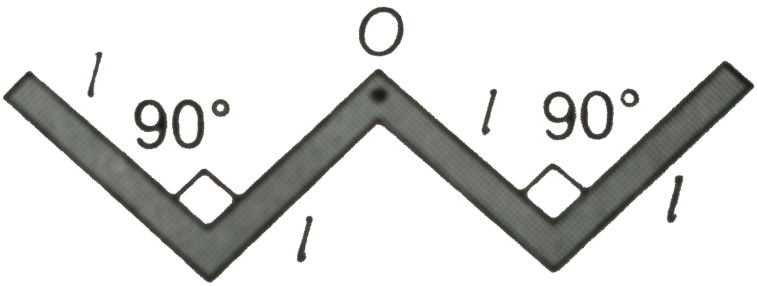
28.



A thin rod of length 4l, mass 4 m is bent at the point as shown in the figure. What is the moment of inertia of the rod about the axis

passing through O and perpendicular to the plane of the paper?

A. $\frac{Ml^2}{3}$

B. $\frac{10Ml^2}{3}$

C. $\frac{Ml^2}{12}$

D. $\frac{Ml^2}{24}$

Answer: B

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29. One of the lines in the emission spectrum of Li^{2+} has the same wavelength as that of the 2nd line of Balmer series in hydrogen spectrum. The electronic transition corresponding to this line is n = 12 $\rightarrow$ n=x. Find the value of x.

A. 8

B. 6

C. 7

D. 5

Answer: B

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30. Two particles X and Y having equal charges, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2, respectively. The ratio of masses of X and Y is

A. $(R_1 / R_2)^{1/2}$

B. (R_2 / R_1)

C. $(R_1 / R_2)^2$

D. (R_1 / R_2)

Answer: C

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31. A glass capillary tube of internal radius $r = 0.25mm$ is immersed in water. The top end of the tube projects by $2cm$ above the surface of water. At what angle does the liquid

meet the tube? Surface tension of water $= 0.7Nm^{-1}$.

A. $\theta = 90^\circ$

B. $\theta = 70^\circ$

C. $\theta = 45^\circ$

D. $\theta = 35^\circ$

Answer: B

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32. A particle of mass $2m$ is projected at an angle of 45° with horizontal with a velocity of $20\sqrt{2}m/s$. After $1s$ explosion takes place and the particle is broken into two equal pieces. As a result of explosion one part comes to rest. Find the maximum height attained by the other part. Take $g = 10m/s^2$.

A. 50 m

B. 25 m

C. 40 m

D. 35 m

Answer: D

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33. A $2-m$ wide truck is moving with a uniform speed $v_0 = 8ms^{-1}$ along a straight horizontal road. A pedestrian starts to cross the road with a uniform speed v when the truck is $4m$ away from him, The minimum

value of v so that he can cross the road safely is .

A. 2.62 m/s

B. 4.6 m/s

C. 3.57 m/s

D. 1.414 m/s

Answer: C

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34. A neutron moving with a speed v makes a head-on collision with a hydrogen in ground state kept at rest which inelastic collision will be take place is (assume that mass of photon is nearly equal to the mass of neutron)

A. 10.2 eV

B. 20.4 eV

C. 12.1 eV

D. 16.8 eV

Answer: B

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35. Vertical displacement of a plank with a body of mass 'm' on it is varying according to law $y = \sin \omega t + \sqrt{3} \cos \omega t$. The minimum value of ω for which the mass just breaks off the plank and the moment it occurs first after $t = 0$ are given by:

($y$is positive vertically upwards)

A. $\sqrt{g/2}, \frac{\sqrt{2}}{6} \frac{\pi}{\sqrt{g}}$

B. $\frac{g}{\sqrt{2}}, \frac{2}{3} \sqrt{\pi / g}$

C. $\sqrt{g/2}, \frac{\pi}{3}\sqrt{2/g}$

D. $\sqrt{2g}, \sqrt{2\pi/3g}$

Answer: A

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36. A parallel plate capacitor of capacitance C is connected to a battery and is charged to a potential difference V. Another capacitor of capacitance 2C is ismilarly charged to a potential difference 2V. The charging battery is

now disconnected and the capacitors are connected in parallel to each other in such a way that the poistive terminal of one is connected to the negative terminal of the other. The final energy of the configuration is

A. Zero

B. $\frac{3}{2}CV^2$

C. $\frac{25}{6}CV^2$

D. $\frac{9}{2}CV^2$

Answer: B

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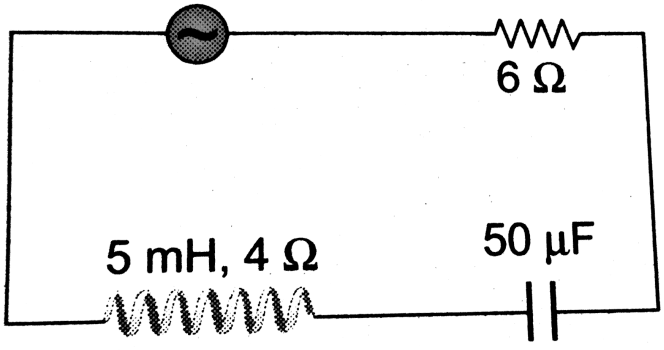
37. In the circuit below, the AC source the voltage $V = 20\cos(\omega t)$ volts with $\omega = 2000 rad/\sec.$ The amplitude of the current will be nearest to



A. 2A

B. 3.3A

C. $2/\sqrt{5}A$

D. $\sqrt{5}A$

Answer: A

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38. A constant voltage is applied between the two ends of a uniform metallic wire. Some heat is developed in it. The heat developed is doubled if

A. both the length and the radius of the wire are halved.

B. both the length and the radius of the wire are doubled.

C. the radius of the wire is doubled.

D. the length of the wire is doubled.

Answer: B

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39. the frequency of a sonometer wire is 10 Hz. When the weight producing th tensions are completely immersed in water the frequency becomes 80 Hz and on immersing the weight in a certain liquid the frequency becomes 60 Hz. The specific gravity of the liquid is

A. 1.42

B. 1.77

C. 1.82

D. 1.21

Answer: B

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40. A long straight wire along the z-axis carries a current I in the negative z-direction. The magnetic vector field $\overrightarrow{B}$ at a point having coordinnates (x, y) in the z = 0 plane is

A. $\frac{\mu_0 I\left(y\hat{i} - x\hat{j}\right)}{2\pi\left(x^2 + y^2\right)}$

B. $\frac{\mu_0 I\left(x\hat{i} + y\hat{j}\right)}{2\pi\left(x^2 + y^2\right)}$

C. $\frac{\mu_0 I\left(x\hat{j}-y\hat{i}\right)}{2\pi\left(x^2+y^2\right)}$

D. $\frac{\mu_0 I\left(x\hat{i}-y\hat{j}\right)}{2\pi\left(x^2+y^2\right)}$

Answer: A

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