PHYSICS

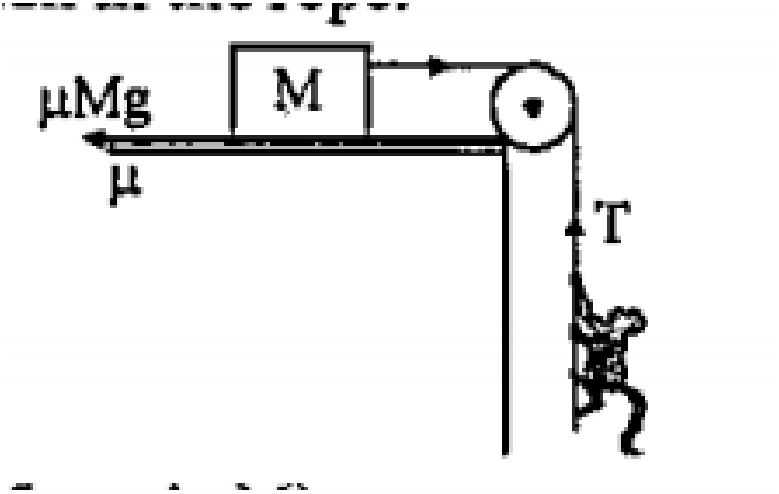
BOOKS - KVPY PREVIOUS YEAR

MOCK TEST 2

Exercise

1. A monkey of mass 'm' climbs up to a rope hung over a fixed pulley with an acceleration relative to the rope g/4. The opposite end of

the rope is tied to a bock of mass M lying on a rough horizontal plane. The coeffient of friction between the block and horizontal plane is μ. Find the tension in the rope



A. $\frac{m(5M-4\mu M(g))}{4(M+m)}+\mu Mg$

B. $\frac{m(5M-4\mu M)g}{4(M+m)}+\mu Mg$

C. $\frac{M(5m-5\mu M)g}{4(M+m)}-\mu Mg$

D. None of these

Answer:

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2. Condenser A has a capacityof $15\mu F$ when it is filled with a medium of dielectric constant 15. Another condenser B has a capacity of $1\mu F$ with air between the plates. Both are charged separately by a battery of 100 V. After charging, both are connnected in parallel

without the battery and the dielectric medium being removed. The common potential now is

A. 400 V

B. 800 V

C. 1200 V

D. 1600 V

Answer:

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3. When an object is placed at a distance of 25 cm from a mirror, the magnification is m_1. The object is moved 15 cm further away with respect to the earlier position, and the magnification becomes m_2. If $m_1/m_2 = 4$, the focal length of the mirror is

A. 10 cm

B. -30 cm

C. 15 cm

D. -20 cm

Answer:

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4. Two wires are of same length and same area of cross-section. If first wire has resistivity ρ_1 and temperature coefficient of resistance α_1 but second wire has resistivity ρ_2 and temperature coefficient of resistance α_2. Their series equivalent resistance is independent of small temperature changes. Then

A. $\alpha_1 + \alpha_2 = 0$

B. $\rho_1\alpha_1 = \rho_2\alpha_2$

C. $\rho_1\alpha_1 + \rho_2\alpha_2 = 0$

D. $\rho_1\alpha_2 + \rho_2\alpha_1 = 0$

Answer:

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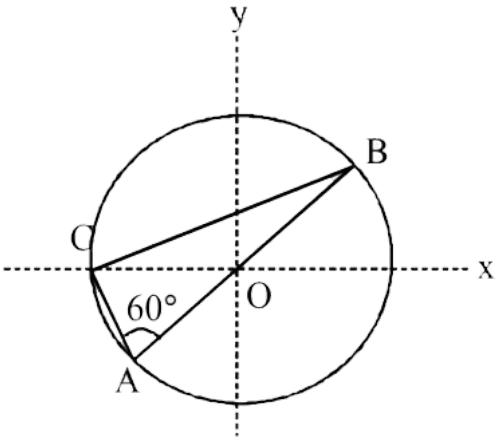
5. Conisder a system of three charges $q/3, q/3$ and $-2q/3$ placed at point A, B and C, respectively, as shown in the figure. Take O to

be centre of the circle of radius R and angle

$CAB = 60^\circ$



A. The electric field at point O is $\frac{q}{8\pi \in_0 R^2}$

directed along the negative x-axis.

B. The potential energy of the system is

zero

C. The magnitude of the force between the charges at C and B is $\frac{q^2}{54\pi \in_0 R^2}$

D. The potential at point O is $\frac{q}{12\pi \in_0 R^2}$

Answer:

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6. A wedged shaped air film having an angle of 40 second is illuminated by a monochramatic light and the fringes are observed vertically down through a microscope. The fringe

separation between two consecutive bright fringes is 0.12 cm. The wavelength of light is

A. 5545 Å

B. 6025 Å

C. 4925 Å

D. 4655 Å

Answer:

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7. A bimetallic strip is formed out of two identical strips one of copper and the other of brass. The co-efficients of linear expansion of the two metals are α_C and α_B. On heating, the the strip bends to form an are of radius of curvature R. Then R is

A. $t/(\alpha_B + \alpha_C)\Delta t$

B. $\Delta t/(\alpha_B + \alpha_C)t$

C. $t/(\alpha_B - \alpha_C)\Delta t$

D. $\dfrac{(\alpha_B - \alpha_C)t}{\Delta t}$

Answer:

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8. A rocket is launched normal to the surface of the earth, away from the sun, along the line joining the sun and the earth. The sun is 3×10^5 times heavier than the earth and is at a distance 2.5×10^4 times larger than the radius of the earth. the escape velocity from earth's gravitational field is $u_e = 11.2 kms^{-1}$. The minmum initial velocity

$(u_e) = 11.2kms^{-1}$. the minimum initial velocity (u_s) required for the rocket to be able to leave the sun-earth system is closest to (Ignore the rotation of the earth and the presence of any other planet

A. $v_s = 22kms^{-1}$

B. $v_s = 42kms^{-1}$

C. $v_s = 62kms^{-1}$

D. $v_s = 72kms^{-1}$

Answer:

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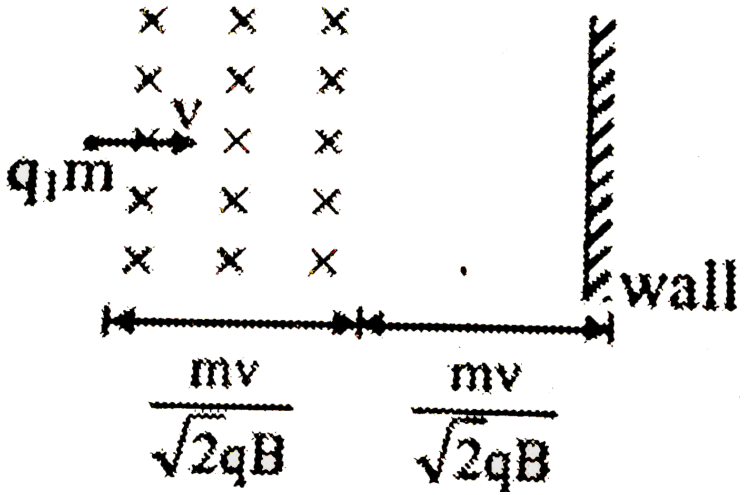
9. A particle of mass m and charge q enters a region of magnetic field (as shown) with speed v at t = 0. There is a region in which the magnetic field is absent as shown. The particle after entering the region collide elastically with a rigid wall. Time t after which the velocity of particle become antiparallel to its

initial velocity is -



A. $\frac{m}{2qB}(\pi + 4)$

B. $\frac{m}{qB}(\pi + 2)$

C. $\frac{m}{4qB}(\pi + 2)$

D. $\frac{m}{4qB}(2\pi + 3)$

Answer:

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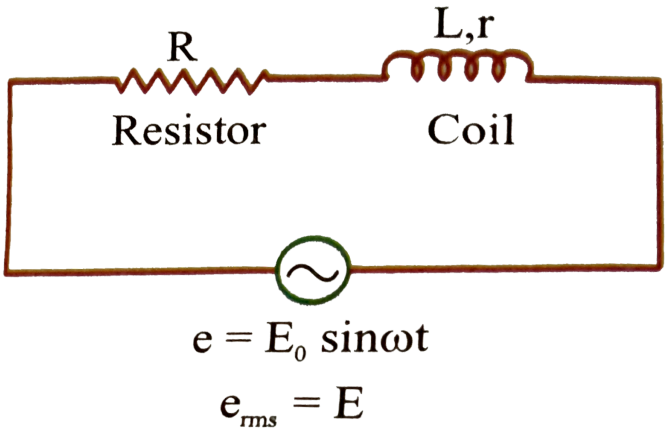
10. For the circuit shown in the figure the rms value of voltage across R and coil are E_1 and E_2 respectively.

The power (thermal) developed across the coil is



A. $\frac{E - E_1^2}{2R}$

B. $\frac{E - E_1^2 - E_2^2}{2R}$

C. $\frac{E^2}{2R}$

D. $\frac{(E - E_1)^2}{2R}$

Answer:

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11. An electron of mass m and charge e initially at rest gets accelerated by a constant electric

field E. The rate of change of de-Broglie wavelength of this electron at time t ignoring relativistic effects is

A. $\frac{-h}{eEt^2}$

B. $\frac{-eht}{E}$

C. $\frac{-mh}{eEt^2}$

D. $\frac{-h}{eE}$

Answer:

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12. A metal sphere of radius R and specific heat C is rotated about an axis passing through its centre at a speed n rotation/second. It is suddenly stopped and 50% of its energy is used in increasing its temperature, then find the rise in temperature of the sphere

A. $\frac{2\pi^2 n^2 R^2}{5C}$

B. $\frac{\pi^2 n^2 R^2}{5C}$

C. $\frac{2\pi^2 n^2 R}{5C}$

D. $\frac{\pi^2 n^2 R}{5C}$

Answer:

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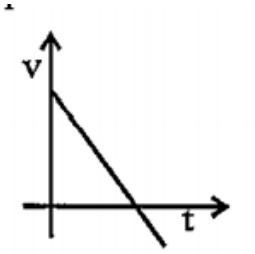
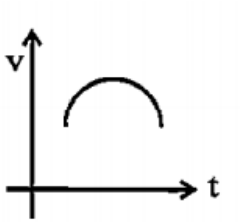
13. A particle is thrown above, then correct $v - t$ graph will be

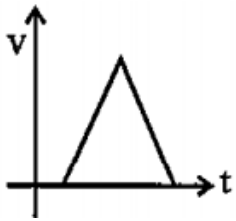
A.



B.



C.



D.

Answer:

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14. The displacement of a particle is moving by $x = (t-2)^2$ where x is in metres and t in second. The distance covered by the particle in first 4 seconds is.

A. 8m

B. 4m

C. 12m

D. 16m

Answer:

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15. A ring is cut from a platinum tube 8.5 cm internal and 8.7 cm external diameter. It is supported horizontally from a pan of a balance so that it comes in contact with the water in a glass vessel. If an extra 3.97 gm-wt. is required to pull it away from water, the surface tension of water is

A. 71.23 dyne/cm

B. 72.13 dyne/cm

C. 31.27 dyne/cm

D. 21.37 dyne/cm

Answer:

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16. A $10kW$ drilling machine is used to drill a bore in a small aluminium block of mass $8.0kg$. How much is the rise in temperature of the block in 2.5 minutes, assuming $50\,\%$ of power is used up in heating the machine itself or lost

to the surrounding? Specific heat of aluminium $= 0.91 J/g^{\circ} C$.

A. $10.23^{\circ} C$

B. $23.10^{\circ} C$

C. $103.02^{\circ} C$

D. $301.02^{\circ} C$

Answer:

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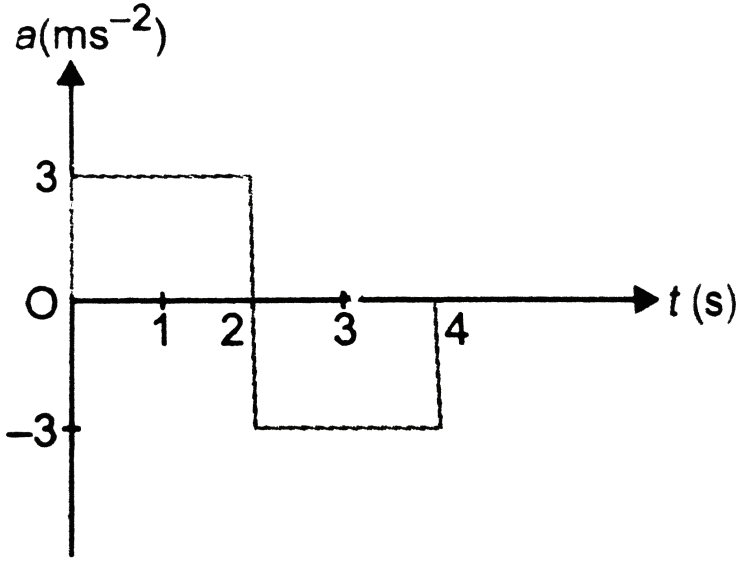
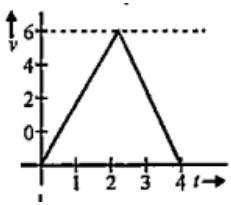
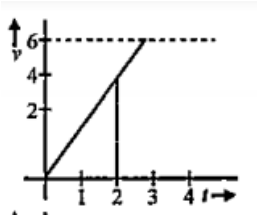
17. A particle starts from rest at $t = 0$ and undergoes and acceleration (a) in ms^{-2} with time (t) in seconds which is shown in Fig. 2 (DF) .16 . Which one of the following plot represents velocity (v) (in ms^{-1}) verses time (in seconds) ?



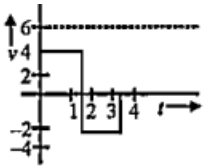
A.



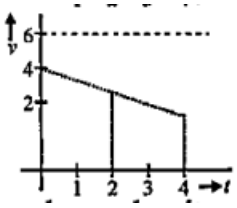
B.



C.



D.



Answer:

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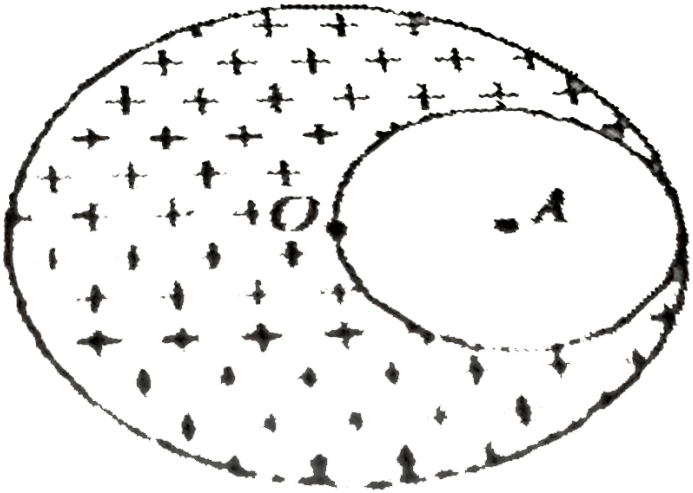
18. A solid sphere having uniform charge density ρ and radius R is shown in figure. A spherical cavity ofradius $\frac{R}{2}$ is made in it.

What is the potential at point O?



A. $\frac{11R^2\rho}{24\varepsilon_0}$

B. $\frac{5}{12}\frac{R^2\rho}{\varepsilon_0}$

C. $\frac{7\rho R^2}{12\varepsilon_0}$

D. $\frac{3}{2}\frac{R^2\rho}{\varepsilon_0}$

Answer:

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19. A cylinder of radius R made of a material of thermal conductivity K_1 is surrounded by a cylindrical shell of inner radius R and outer radius 2R made of a material of thermal conductivity K_2. The two ends of the combined system are maintained at two different temperatures. There is no loss of heat across the cylindrical surface and the system is in steady state. The effective thermal conductivity of the system is

A. $K_1 + K_2$

B. $\frac{K_1 + 3K_2}{4}$

C. $\frac{K_1 . K_2}{K_1 + K_2}$

D. $\frac{3K_1 + K_2}{4}$

Answer:

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20. The counting rate observed from a radioactive source at t=0 second was 1600 counts per second and at t=8 seconds it was

100 counts per second. The counting rate observed, as counts per second at t=6 seconds, willbe

A. 400

B. 300

C. 200

D. 150

Answer:

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21. A ballon starting from the ground has been ascending vertically at a uniform veloctiy for 4.5 sec and a stone let fall from it reaches the ground in 7 sec. Find the velocity of the ballon and its heigth when the stone was let fall.

A. 20.88 m/s

B. 20 m/s

C. 22 m/s

D. 24 m/s

Answer:

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22. Three bars of equal lengths x and equal area of cross-section A are connected in series. Their thermal conductivities are in the ratio 2:4:3. If the open ends of the first and the last bars are at temperatures $200^\circ C$ and $18^\circ C$, respectively in the steady state, calculate the temperatures of both the junctions.

A. $116^\circ C, 74^\circ C$

B. $120^\circ C, 180^\circ C$

C. $125^\circ C, 50^\circ C$

D. $130^\circ C, 40^\circ C$

Answer:

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23. The electric potential between a proton and as electron is given by $V = V_0 \frac{\ln(r)}{r_0}$, wherer_0 is a constant . Assuming Bohr's model to be applicable , write variation of r_n with n, n being the principal quantum number ?

A. $r_n \propto n$

B. $r_n \propto 1/n$

C. $r_n \propto n^2$

D. $r_n \propto 1/n^2$

Answer:

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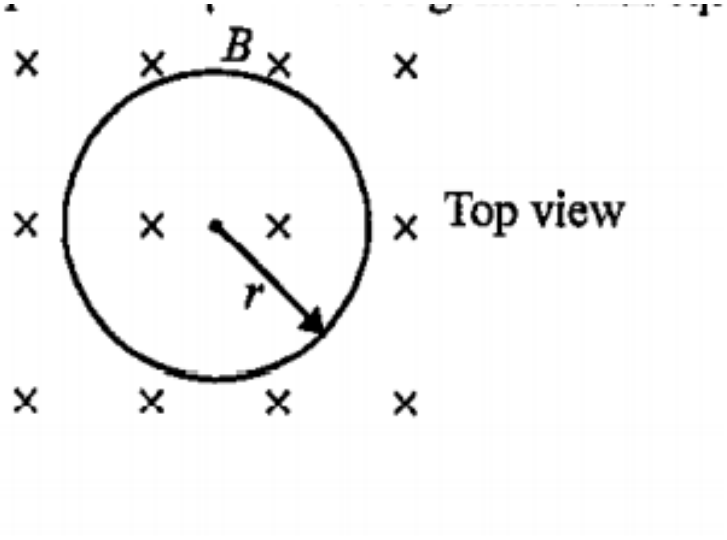
24. A nonconducting ring (of mass m, radius r, having charge Q) is placed on a rough horizontal surface (in a cylindrical region with

transverse magnetic field). The field is increasing with time at the rate R and coefficient of friction between the surface and the ring is μ. For ring to remain in equilibrium μ should be greater than equal to,



A. $\frac{Qr^2R^2}{2mg}$

B. $\frac{QrR}{2mg}$

C. $\frac{Qr^2R}{2mg}$

D. $\frac{QrR^2}{2mg}$

Answer:

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25. A bullet is fired vertically upwards with a velocity v from the surface of a spherical planet when it reaches its maximum height, its acceleration due to the planet's gravity is $\frac{1}{4}th$ of its value at the surface of the planet. If the

escape velocity from the planet is $V_{\text{escape}} = v\sqrt{N}$, then the value of N is : (ignore energy loss due to atmosphere).

A. 44228

B. 2

C. 3

D. 44256

Answer:

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26. An electric heater is used in a room of total wall area $137m^2$ to maintain a temperature of $+20^\circ C$ inside it when the outside temperature is $-10^\circ C$. The walls have three different layers materials . The innermost layer is of wood of thickness 2.5 cm, in the middle layer is od cement of thickness 1.0 cm and the outermost layer is of brick of thickness 25.0 cm. find the power of the electric heater. Assume that there is no heat loss through the floor and the ceiling. The thermal conductives

of wood, cement and brick are $0.125, 1.5$ and $1.0 wa / m / .^{\circ} C$ respectively.

A. 900 W

B. 9000 W

C. 90 W

D. 1900 W

Answer:

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