PHYSICS

BOOKS - MTG PHYSICS (BENGALI ENGLISH)

QUESTION PAPER 2021

Physics Category I

1. A spherical convex surface of power 5 dioptre separates object and image space of

refractive indices 1.0 and $\frac{4}{3}$ respectively. The radius of curvature of the surface is

A. 20cm

B. 1 cm

C. 4 cm

D. 5 cm

Answer:

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2. In Young's double slit experiment, light of wavelength λ passes through the double-slit and forms interference fringes on a screen 1.2 m away. If the difference between 3rd order maximum and 3rd order minimum is 0.18 cm and the slits are 0.02 cm apart, then λ is

A. 1200 nm

B. 450 nm

C. 600 nm

D. 300 nm

Answer:

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3. A 12.5 ev electron beam is used to bombard gaseous hydrogen at ground state. The energy level upto which the hydrogen atoms would be excited is

A. 2

B. 3

C. 4

D. 1

Answer:

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4. Let r, v, E be the radius of orbit, speed of electron and total energy of electron respectively in a H-atom. Which of the following quantities according to Bohr theory, is proportional to the quantum number n ?

A. vr

B. rE

C. $\frac{r}{E}$

D. $\frac{r}{v}$

Answer:

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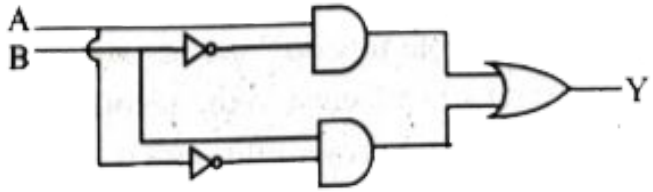
5.



For the given logic circuit, the output Y for

inputs (A = 0, B = 1) and (A = 0, B = 0) respectively are

A. 0,0

B. 0,1

C. 1,0

D. 1,1

Answer:

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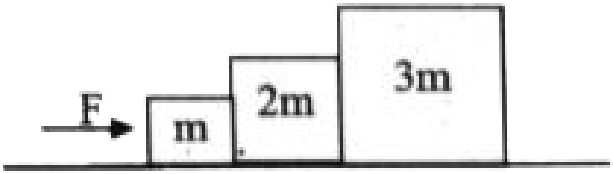
6. 

Three blocks are pushed with a force F across a frictionless table as shown in figure . Let N_1 be the contact force between the left two blocks and N_2 be the contact force between the right two blocks. Then

A. $F > N_1 > N_2$

B. $F > N_2 > N_1$

C. $F > N_1 = N_2$

D. $F = N_1 = N_2$

Answer:

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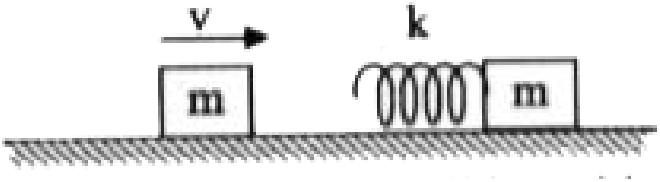
7.



A block of mass m slides with speed v on a frictionless table towards another stationary block of mass m. A massless spring with spring constant k is attached to the second block as

shown in figure. The maximum distance the spring gets compressed through is

A. $\sqrt{\frac{m}{k}}v$

B. $\frac{\sqrt{m}}{2k}v$

C. $\sqrt{\frac{k}{m}}v$

D. $\sqrt{\frac{k}{2m}}v$

Answer:

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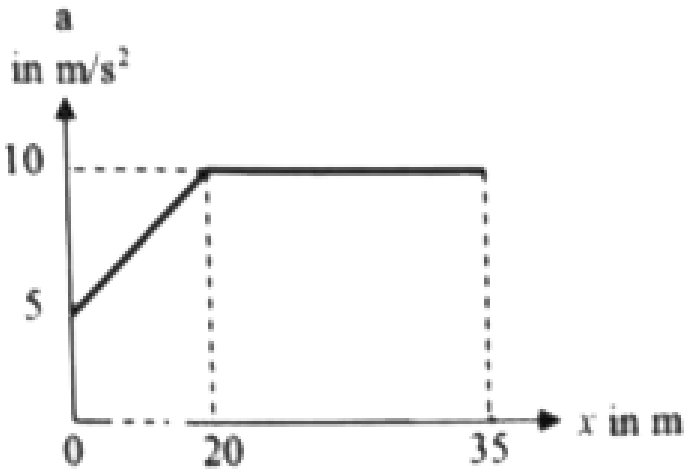
8.



The acceleration vs distance graph for a particle moving with initial velocity 5 m/s is shown in the figure. The velocity of the particle at x = 35 m will be

A. 20.62 m/s

B. 20 m/s

C. 25 m/s

D. 50 m/s

Answer:

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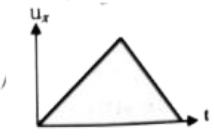
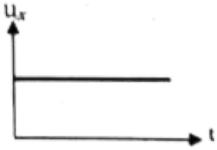
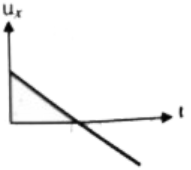
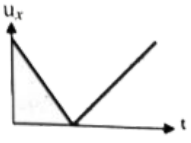
9. In case of projectile motion, which one of the following figures represent variation of horizontal component of velocity (u_x) with time t ? (assume that air resistance is negligible)

A. 

B. 

C. 

D. 

Answer:

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10. Centre of mass (C.M.) of three particles of masses 1 kg, 2 kg and 3 kg lies at the point (1, 2, 3) and C.M. of another system of particles of 3 kg and 2 kg lies at the point (-1,3,-2). Where should we put a particle of mass 5 kg so that the C.M. of entire system lies at the C.M. of the first system?

A. A. (3,1,8)

B. B. (0,0,0)

C. C. (1,3,2)

D. D. (-1,2,3)

Answer:

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11. A body of density $1.2 \times 10^3 kg/m^3$ is dropped from rest from a height 1 m into a liquid of density $2.4 \times 10^3 kg/m^3$. Neglecting all dissipative effects, the maximum depth to which the body sinks before returning to float on the surface is

A. 0.1 m

B. 1 m

C. 0.01 m

D. 2 m

Answer:

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12. Two solid spheres S_1 and S_2 of same uniform density fall from rest under gravity in a viscous medium and after some time, reach

terminal velocities v_1 and v_2 respectively. If ratio of masses $\frac{m_1}{m_2} = 8$, then $\frac{v_1}{v_2}$ will be equal to

A. 2

B. 4

C. $\frac{1}{2}$

D. $\frac{1}{4}$

Answer:

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13. If pressure of real gas CO_2 in a container is given by $P = \frac{RT}{2V - b} - \frac{a}{4b^2}$, then the mass of the gas in the container is

A. 22 gm

B. 11 gm

C. 4 gm

D. 44 gm

Answer:

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14. 300 gm of water at 25° C is added to 100 gm of ice at 0° C. The final temperature of the mixture is

A. $12.5^\circ C$

B. $0^\circ C$

C. $25^\circ C$

D. $50^\circ C$

Answer:

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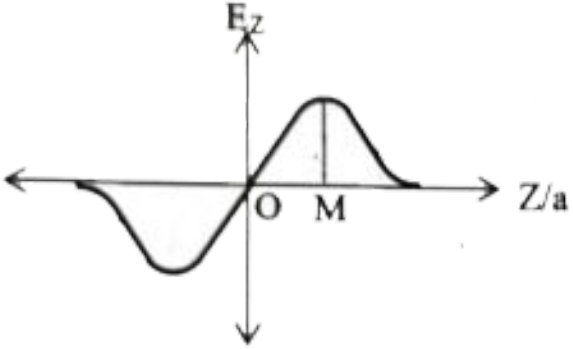

15.

The variation of electric field along the Z-axis due to a uniformly charged circular ring of radius 'a' in XY plane is shown in the figure. The value of coordinate M will be

A. $\frac{1}{2}$

B. $\sqrt{2}$

C. 1

D. $\frac{1}{\sqrt{2}}$

Answer:

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16. A metal sphere of radius R carrying charge q is surrounded by a thick concentric metal shell of inner and outer radii a and b respectively. The net charge on the shell is zero. The potential at the centre of the sphere,

when the outer surface of the shell is grounded will be

A. $\frac{q}{4\pi \in_0}\left(\frac{1}{a}-\frac{1}{b}\right)$

B. $\frac{q}{4\pi \in_0}\frac{1}{a}$

C. $\frac{q}{4\pi \in_0}\left(\frac{1}{R}-\frac{1}{a}\right)$

D. $\frac{q}{4\pi \in_0}\frac{1}{R}$

Answer:

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17. Three infinite plane sheets carrying uniform charge densities $-\sigma, 2\sigma, 4\sigma$ are placed parallel to XZ plane at Y = a, 3a, 4a respectively. The electric field at the point (0, 2a, 0) is

A. A. $\frac{5\sigma}{2\varepsilon_0}\hat{j}$

B. B. $-\frac{7\sigma}{2\varepsilon_0}\hat{j}$

C. C. $\frac{\sigma}{2\varepsilon_0}\hat{j}$

D. D. $\frac{5\sigma}{-2\varepsilon_0}\hat{j}$

Answer:

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18. Two point charges $+q_1$ and $+q_2$ are placed a finite distance 'd' apart. It is desired to put a third charge q_3 in between these two charges so that q_3 is in equilibrium. This is

A. A. possible only if q_3 is negative.

B. B. possible only if q_3 is positive

C. C. possible irrespective of the sign of q_3.

D. D. not possible at all.

Answer:

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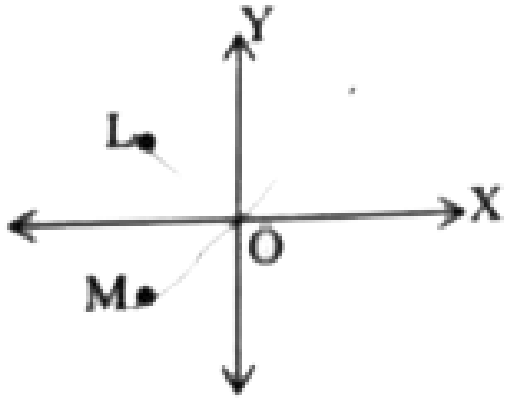
19.



Consider two infinitely long wires parallel to Z-axis carrying same current I in the incitive z direction. One wire passes through the point L at coordinates (-1, +1) and the other wire

passes through the point M at coordinates (-1, -1). The resultant magnetic field at the origin O will be

A. (A) $\frac{\mu_0 I}{2\sqrt{2}\pi}\hat{j}$

B. (B) $\frac{\mu_0 I}{2\pi}\hat{j}$

C. (C) $\frac{\mu_0 I}{2\sqrt{2}\pi}\hat{i}$

D. (D) $\frac{\mu_0 I}{4\pi}\hat{i}$

Answer:

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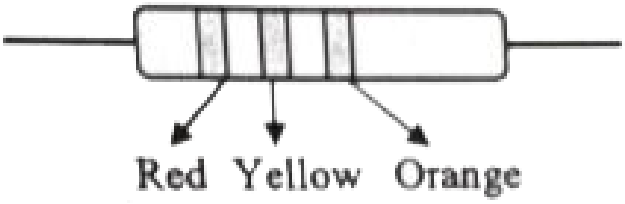

20.

A carbon resistor with colour code is shown in the figure. There is no fourth band in the resistor. The value of the resistance is

A. $24M\Omega \pm 20\ \%$

B. $14k\Omega \pm 5\ \%$

C. $24k\Omega \pm 20\ \%$

D. $34k\Omega \pm 10\ \%$

Answer:

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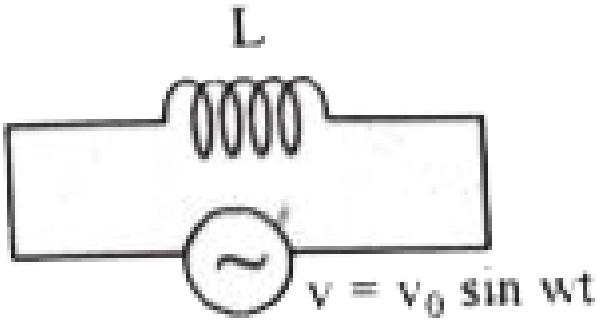
21.



Consider a pure inductive A.C. circuit as shown in the figure. If the average power consumed is P, then

A. $P > 0$

B. $P < 0$

C. $P = 0$

D. P is infinite

Answer:

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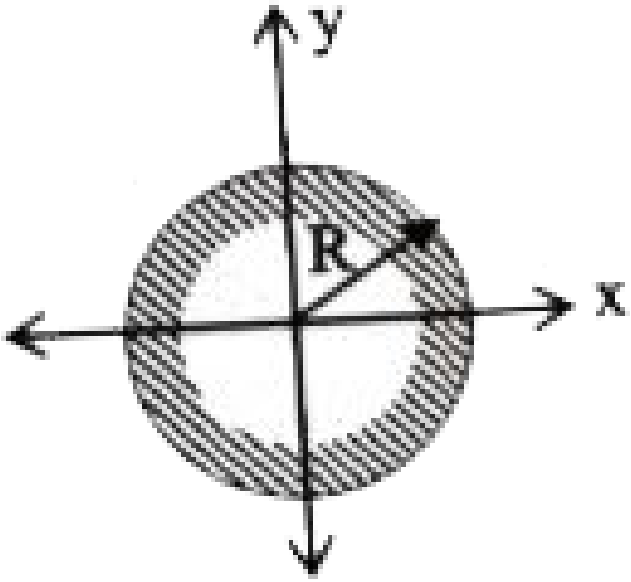

22.

The cross-section of a reflecting surface is represented by the equation $x^2 + y^2 = R^2$ as shown in the figure. A ray travelling in the positive x direction is directed toward positive y direction after reflection from the surface at

point M. The coordinate of the point Mon the reflecting surface is

A. (A) $\left(\frac{R}{\sqrt{2}}, \frac{R}{\sqrt{2}}\right)$

B. (B) $\left(-\frac{R}{2}, -\frac{R}{2}\right)$

C. (C) $\left(-\frac{R}{\sqrt{2}}, \frac{R}{\sqrt{2}}\right)$

D. (D) $\left(\frac{R}{\sqrt{2}}, -\frac{R}{\sqrt{2}}\right)$

Answer:

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Physics Category Ii

1. Two metal wires of identical dimensions are connected in series. If σ_1 and σ_2 are the electrical conductivities of the metal wires respectively, the effective conductivity of the combination is

A. $\sigma_1 + \sigma_2$

B. $\dfrac{\sigma_1\sigma_2}{\sigma_1 + \sigma_2}$

C. $\dfrac{2\sigma_1\sigma_2}{\sigma_1 + \sigma_2}$

D. $\dfrac{\sigma_1 + \sigma_2}{2\sigma_1\sigma_2}$

Answer:

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2. A uniform rod of length L pivoted at one end P is freely rotated in a horizontal plane with an angular velocity ω about a vertical axis passing through P. If the temperature of the system is increased by ΔT, angular velocity becomes $\frac{\omega}{2}$. If coefficient of linear expansion of the rod is $\alpha(a < \ < 1)$, then ΔT will be

A. $\frac{1}{\alpha}$

B. $\frac{1}{2\alpha}$

C. $\frac{1}{4\alpha}$

D. α

Answer:

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3. An ideal gas of molar mass contained in a very tall vertical cylindrical column in the uniform gravitational field. Assuming the gas

temperature to be T, the height at which the centre of gravity of the gas is located is (R: universal gas constant)

A. (A) $\frac{RT}{g}$

B. (B) $\frac{RT}{Mg}$

C. (C) MgR

D. (D) RTg

Answer:

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4. Under isothermal conditionss, two soap bubbles of radii a and b coalesce to form a single bubble of radius c. If the external pressure is P, then surface tension of the bubbles is

A. $\frac{P\left(c^3-a^3+b^3\right)}{4\left(a^2+b^2-c^2\right)}$

B. $\frac{P\left(c^3-a^3-b^3\right)}{4\left(a^2+b^2-c^2\right)}$

C. $\frac{P\left(c^2+a^2-b^2\right)}{4\left(a^3+b^3-c^3\right)}$

D. $\frac{P\left(c^3+a^3-b^3\right)}{4\left(a^2+b^2-c^2\right)}$

Answer:

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5. The potential energy of a particle of mass $0.02\ kg$ moving along x-axis is given by $V = Ax(x-4)\ J$ where x is in metres and A is a constant. Which of the following is/are correct statement (s)?

(A) The particle is acted upon by a constant force.

(B) The particle executes simple harmonic motion.

(C) The speed of the particle is maximum at $x = 2\,m.$

(D) The period of oscillation of the particle is $\frac{\pi}{5}$ sec.

A. The particle is acted upon by a constant force.

B. The particle executes simple harmonic motion.

C. The speed of the particle is maximum at x = 2 m.

D. The period of oscillation of the particle is $\frac{\pi}{5}$ sec.

Answer:

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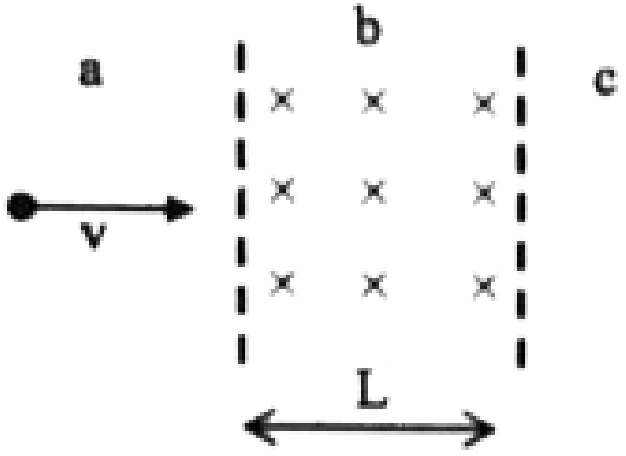
6.



A particle of mass m and charge q moving with

velocity v enters region-b from region-a along the normal to the boundary as shown is in the figure. Region-b has a uniform magnetic field B perpendicular to the plane of the paper. Also, region-b has length L. Choose the correct statements :

A. A. The particle enters region-c only if

$$v > \frac{qLB}{m}$$

B. B. The particle enters region -c only if

$$v < \frac{qLB}{m}$$

C. C. Path of the particle is a circle in region-b

D. D. Time spent in region-b is independent of velocity v

Answer:

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