



PHYSICS

BOOKS - MTG PHYSICS (BENGALI ENGLISH)

QUESTION PAPER 2015

Physics Category I

1. A hollow sphere of external radius R and thickness t ($t \ll R$) is made of a metal of

density ρ . The sphere will float in water if

A. $t \leq \frac{R}{\rho}$

B. $t \leq \frac{R}{3\rho}$

C. $t \leq \frac{R}{2\rho}$

D. $t \geq \frac{R}{3\rho}$

Answer:



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2. A metal wire of circular cross - section has a resistance R_1 . The wire is now stretched without breaking so that its length is doubled and the density is assumed to remain the same. If the resistance of the wire now becomes R_2 then $R_2 : R_1$ is

A. 1 : 1

B. 1 : 2

C. 4 : 1

D. 1 : 4

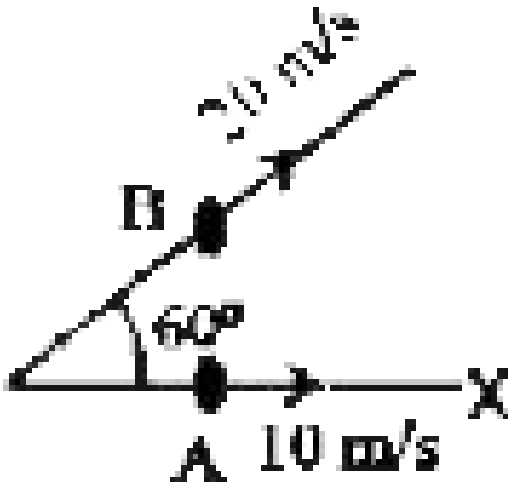
Answer:



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3. Particle A moves along X-axis with a uniform velocity of magnitude of m/s . Particle B moves with uniform velocity 20 m/s along a direction making an angle of 60° with the positive direction of X - axis as shown in the figure. The relative velocity of B with respect to that of A

is



A. 10 m/s along X - axis

B. $10\sqrt{3}$ m/s along Y-axis (perpendicular to
A - axis)

C. $10\sqrt{5}$ m/s along the bisection of the
velocity of A and B

D. 30 m/s along negative X-axis

Answer:



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4. When light is refracted from a surface, which of its following physical parameters does not change ?

A. velocity

B. amplitude

C. frequency

D. wavelength

Answer:



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5. A solid maintained at t_1^0 is kept in an evacuated chamber at temperature t_2^0 ($t_2 > t_1$). Rate of heat absorbed by the body

A. $t_2^4 - t_1^4$

B. $(t_2^4 + 273) - (t_1^4 + 273)$

C. $t_2 - t_1$

D. $t_2^2 - t_1^2$

Answer:



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6. Two particles of mass m_1 and m_2 .

Approach each other due to their mutual gravitational attraction only. Then

A. accelerations of both the particles are equal.

B. acceleration of the particle of mass m_1 is proportional to m_2 .

C. acceleration of the particle of mass m_1 is proportional to m_2 .

D. acceleration of the particle of mass m_2 is inversely proportional to m_2 .

Answer:



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7. Three bodies of the same material and having masses m , m and $3m$ are at temperatures $40^\circ C$, $50^\circ C$ and $60^\circ C$ respectively. If the bodies are brought in thermal contact, the final temperature will be

A. $45^\circ C$

B. $54^\circ C$

C. $52^\circ C$

D. $48^\circ C$

Answer:



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8. A satellite has kinetic energy K , potential energy V and total energy E . Which of the following statements is true ?

A. $K = V/2$

B. $K = V/2$

C. $E = K/2$

D. $E = - K/2$

Answer:



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9. The r.m.s speed of oxygen is v at a particular temperature. If the temperature is doubled and oxygen molecules dissociate into oxygen atoms the r.m.s speed becomes

A. v

B. $\sqrt{2}v$

C. $2v$

D. $4v$

Answer:



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10. Two particles , A and B, having equal charges ,after being accelerated through the same potential difference enter a region of uniform magnetic field and the particles describe circular paths of radii R_1 and R_2

respectively. The ratio of the masses of A and B is

A. $\sqrt{R_1 / R_2}$

B. $R_1 R_2$

C. $(R_1 / R_2)^2$

D. $(R_2 / R_1)^2$

Answer:



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11. A large number of particles are placed the origin, each at a distance R from the origin
The distance of the centre of mass of system from the origin is

A. $= R$

B. $\leq R$

C. $> R$

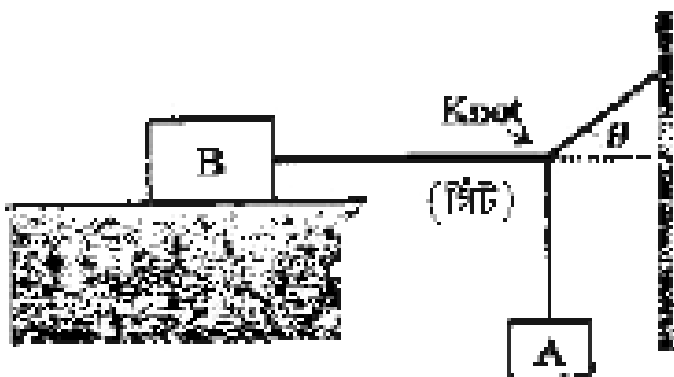
D. $\geq R$

Answer:



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12. Block B lying on a table weighs W . The coefficient of static friction between the block and the table is μ . Assume that the cord between B and the knot is horizontal. The maximum weight of the block A for which the system will be stationary is



A. $\frac{w \tan \theta}{\mu}$

B. $\mu W \tan \theta$

C. $\mu W \sqrt{1 + \tan^2 \theta}$

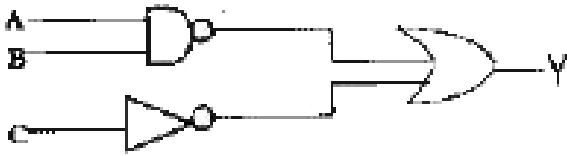
D. $\mu W \sin \theta$

Answer:



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13. The inputs to the digital circuit are shown below. The output Y is



A. $A + B + \bar{C}$

B. $(A + B)\bar{C}$

C. $\bar{A} + \bar{B} + \bar{C}$

D. $\bar{A} + \bar{B} + C$

Answer:



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14. Two particles A and B having different masses are projected from a tower with same speed. A is projected vertically upward and B vertically downward. On reaching the ground

A. velocity of A is greater than of B.

B. velocity of B is greater than that of A.

C. both A and B attain the same velocity.

D. the particle with the larger mass attains
higher velocity.

Answer:



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15. A simple pendulum of length L swings in a vertical plane. The tension of the string when it makes an angle θ with the vertical and the bob of mass m moves with a speed v is (g is the gravitational acceleration)

A. mv^2 / L

B. $mg \cos \theta + mv^2 / L$

C. $mg \cos \theta - mv^2 / L$

D. $mg \cos \theta$

Answer:



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16. The length of a metal wire is L_1 , when the tension is T_1 and l_2 when the tension is T_2 .

The unstretched length of the wire is

A. $\frac{L_1 + L_2}{2}$

B. $\sqrt{L_1 L_2}$

C. $\left(T_2 L_1 - \frac{T_1 L_2}{T_2 - T_1} \right)$

D. $\frac{T_2 L_1 - T_1 L_2}{T_2 - T_1}$

Answer:



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17. A straight conductor 0.1 long moves in a uniform magnetic field 0.1T. The velocity of the conductor is 15 m/s and is directed

perpendicular to the field. The e.m.f. induced between the two ends of the conductor is

A. 0.10 V

B. 0.15 V

C. 1.50 V

D. 15.00 V

Answer:



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18. A ray of light is incident at an angle i on a glass slab of refractive index μ . The angle between reflected and refracted light is 90° .

Then the relationship between I and μ is

A. $I = \tan^{-1} \left(\frac{1}{\mu} \right)$

B. $\tan I = \mu$

C. $\sin I = \mu$

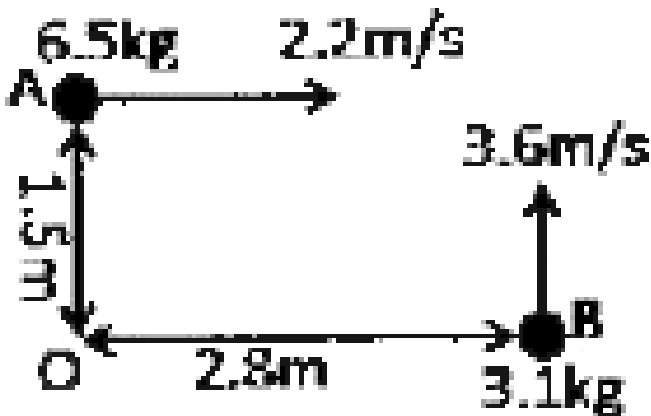
D. $\cos I = \mu$

Answer:



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19. Two particles A and B are moving as shown in the figure. Their total angular momentum about the point O is



A. $9.8 \text{ kgm}^2 / \text{s}$

B. Zero

C. $5.27 \text{kgm}^2 / \text{s}$

D. $37.9 \text{kgm}^2 / \text{s}$

Answer:



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20. The work function of metals is in the range of 2 eV to 5 eV. Find which of the following wavelength of light cannot be used for photoelectric effect. (Consider, Plank constant

$= 4 \times 10^{-15}$ "eVs, velocity of light

$= 3 \times 10^8 m/s)$

A. 510 nm

B. 650 nm

C. 400 nm

D. 570 nm

Answer:



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21. A thin plastic sheet of refractive index 1.6 is used to cover one of the slits of a double slit arrangement. The central point on the screen is now occupied by what would have been the 7th bright fringe before the plastic was used. If the wavelength of light is 600 nm, what is the thickness (in μm) of the plastic?

A. 7

B. 4

C. 8

D. 6

Answer:



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22. The length of an open organ pipe is twice the length of another closed organ pipe. The fundamental frequency of the open pipe is 100 Hz. The frequency of the third harmonic of the closed pipe is

A. 100 Hz

B. 200 Hz

C. 300 Hz

D. 150 Hz

Answer:



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23. A $5\mu F$ capacitor is connected in series with a $10\mu F$ capacitor. When a 300 Volt potential difference is applied across this combination, the total energy stored in the capacitors is

A. 15 j

B. 1.5 j

C. 0.15 j

D. 0.10 j

Answer:



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24. The line AA' is on a charged infinite conducting plane which is perpendicular to the plane of the paper. The plane has a surface

density of charge σ and B is a ball of mass m with a like charge of magnitude q , B is connected by a string from a point on the line AA'. The tangent of the angle (θ) formed between the line AA' and the string is:



A. $\frac{q\sigma}{2\varepsilon_0 mg}$

B. $\frac{q\sigma}{4\pi\varepsilon_0 mg}$

C. $\frac{q\sigma}{2\pi\varepsilon_0 mg}$

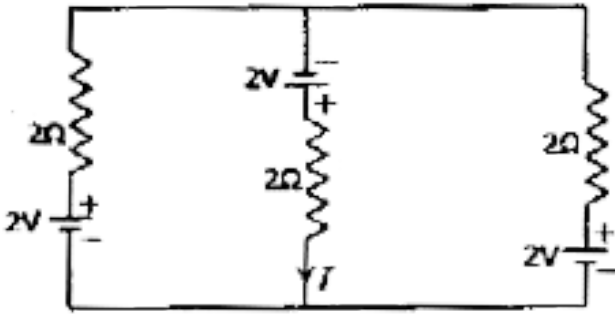
D. $\frac{q\sigma}{\varepsilon_0 mg}$

Answer:



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25. The current I in the circuit shown is



A. 1.33 A

B. Zero

C. 2.00 A

D. 1.00 A

Answer:



26. A 20 cm long capillary tube is dipped vertically in water and the liquid rises upto 10 cm. If the entire system is kept in a freely falling platform, the length of water column in the tube will be

- A. 5 cm
- B. 10 cm
- C. 15 cm
- D. 20 cm

Answer:



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27. A train is moving with a uniform speed of 33 m/s and an observer is approaching the train with the same speed. If the train blows a whistle of frequency 1000 Hz and the velocity of sound is 333 m/s, then the apparent frequency of the sound that the observer hears is

A. 1220 Hz

B. 1099 Hz

C. 1110 Hz

D. 1200 Hz

Answer:



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28. A photon of wavelength 300 nm interacts with a stationary hydrogen atom in ground state. During the interaction, whole energy of

the photon is transferred to the electron of the atom. State which possibility is correct.

Consider, Plank constant = $4 \times 10^{-15} \text{ eVs}$,

velocity of light = $3 \times 10^8 \text{ m/s}$ ionization

energy of hydrogen = 13.6 eV)

- A. Electron will be knocked out of the atom
- B. Electron will go to any excited state of the atom
- C. Electron will go only to first excited state of the atom

D. Electron will keep orbiting in the ground state of atom

Answer:



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Physics Category Ii

1. The pressure p , volume V and temperature T

for a gas are related by $p = \frac{AT - BT^2}{V}$,

where A and B are constant. The work done

by the gas when the temperature changes from T_1 to T_2 while the pressure remains constant, is given by

A. $A(T_2 - T_1) + B(T_2^2 - T_1^2)$

B. $\frac{A(T_2 - T_1)}{V_2 - V_1} - \frac{B(T_2^2 - T_1^2)}{V_2 - V_1}$

C. $A(T_2 - T_1) - B(T_2^2 - T_1^2)$

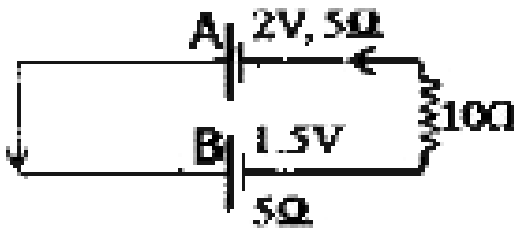
D. $\frac{A(T_2 - T_2^2)}{V_2 - V_1}$

Answer:



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2. Two cells A and B of e.m.f. 2V and 1.5V respectively, are connected as shown in figure through an external resistance 10 ohm. The internal resistance of each cell is 5 ohm. The potential difference E_A and E_B across the terminals of the cells A and B respectively are



A. $E_A = 2.0V$, $E_B = 1.5V$

B. $E_A = 2.125V$, $E_B = 1.375V$

C. $E_A = 1.875V$, $E_g = .625V$

D. $E_A = 1.875V$, $E_g = 1.375V$

Answer:



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3. A charge q is placed at one corner of a cube.

The electric flux through any of the three faces

adjacent to the charge is zero. The flux

through any one of the other three faces is

A. $q/3\epsilon_0$

B. $q/6\epsilon_0$

C. $q/12\epsilon_0$

D. $q/24\epsilon_0$

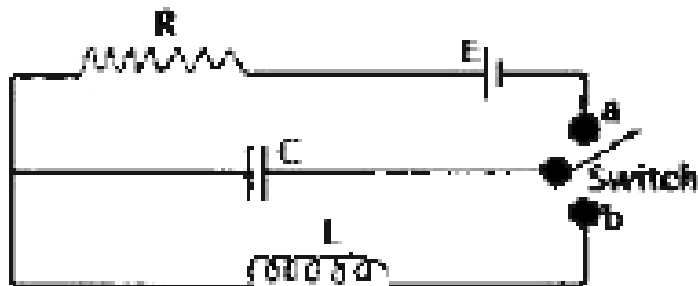
Answer:



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4. In the circuit shown below, the switch is kept in position 'a' for a long time and is then thrown to position 'b'. The amplitude of the

resulting oscillating current is given by



A. $E\sqrt{L/C}$

B. E/R

C. infinity

D. $E\sqrt{C/L}$

Answer:



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Physics Category Iii

1. Find the right condition(s) for Fraunhofer diffraction due to a single slit.

A. Source is at infinite distance and the incident beam has converged at the slit.

B. Source is near to the slit and the incident beam is parallel

C. Source is at infinity and the incident beam is parallel.

D. Source is near to the slit and the incident beam has converged at the slit.

Answer:



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2. Two charges $+q$ and $-q$ are placed at a distance 'o' in a uniform electric field. The dipole moment of the combination is

$2qa(\cos\theta\hat{i} + \sin\theta\hat{j})$ where θ is the angle between the direction of the field and the line joining the two charges. Which of the following statement(s) is/are correct?

- A. The torque exerted by the field on the dipole vanishes.
- B. The net force on the dipole vanishes.
- C. The torque is independent of the choice of coordinates.
- D. The net force is independent of 'd'.

Answer:



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3. Consider two particles of different masses. In which of the following situations the heavier of the two particles will have smaller de Broglie wavelength?

A. Both have a free fall through the same height.

B. Both move with the same kinetic energy.

C. Both move with the same linear momentum.

D. Both move with the same speed.

Answer:



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4. A circular disc rolls on a horizontal floor without slipping and the centre of the disc moves with a uniform velocity v . Which of the following values the velocity at a point on the

rim of the disc can have?

v

$-v$

$2v$

Zero



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5. A conducting loop in the form of a circle is placed in a uniform magnetic field with its plane perpendicular to the direction of the field. An e.m.f. will be induced in the loop if

A. it is translated parallel to itself.

B. it is rotated about one of its diameters.

C. it is rotated about its own axis which is parallel to the field.

D. the loop is deformed from the original shape.

Answer:



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