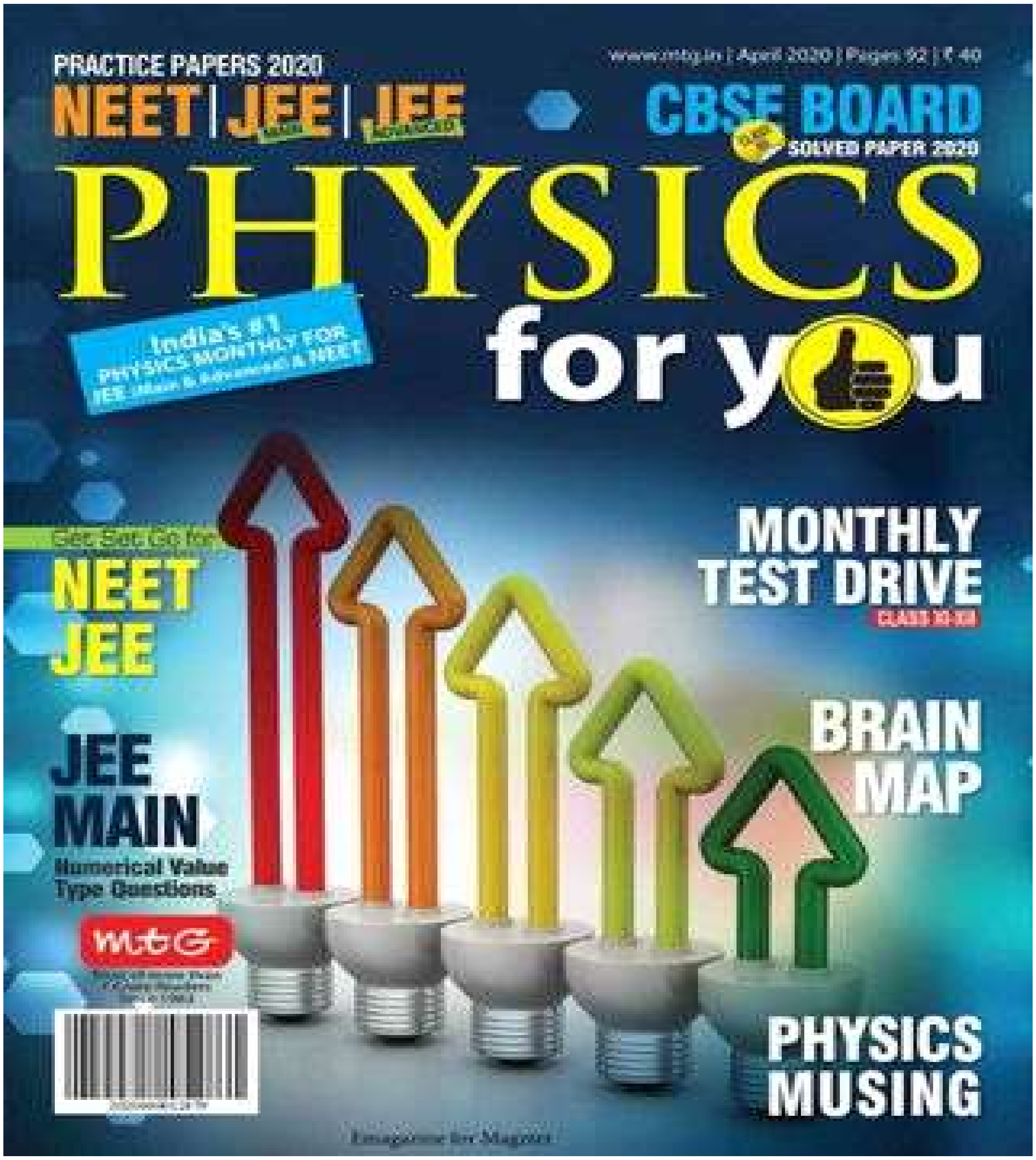

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11. If a planet revolving around the Sun with time period T, is suddenly stopped in its orbit supposed to be circular. It would fall onto the Sun in a time

(a) $t = \left(\frac{2}{7}\right)T$ (b) $t = \left(\frac{\sqrt{2}}{8}\right)T$

(c) $t = \left(\frac{2\pi}{7}\right)T$ (d) $t = \left(\frac{\pi}{2}\right)T$

12. The coordinates of a particle moving in a plane are given by $x(t) = a\cos(pt)$ and $y(t) = b\sin(pt)$ where a, b and p are positive constants of appropriate dimensions. Then,

(a) the path of the particle is an ellipse.

(b) the velocity and acceleration of the particle are normal to each other at $t = \pi/(2p)$.

(c) the acceleration of the particle is always directed towards the origin.

(d) the distance travelled by the particle in time interval $t = 0$ to $t = \pi/(2p)$ is a.

SECTION 3 (Maximum Marks : 18)

- *This section contains SIX (06) questions. The answer to each question is a NUMERICAL VALUE.*
- *For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.*
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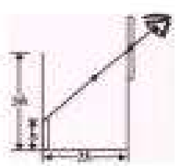
Full Marks : +3 *If ONLY the correct numerical value is entered.*

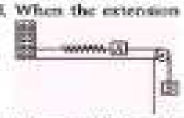
Zero Marks : 0 *In all other cases.*

13. An observer can see the top of a thin rod of height h through a pinhole situated at the top of beaker as shown in the figure. The beaker height is $3h$ and its radius is h. When the beaker is filled with a liquid upto a height $2h$, he can see the lower end of the rod. The refractive index of the liquid is ________.



14. There is a stream of neutrons with a kinetic energy of 0.0327 eV. The half life of neutrons is 700 s. Fraction of neutrons that decay before they travel distance of 10 m is 3.9×10^{-p}, then the value of p is ______. (mass of neutron = 1.675×10^{-27} kg)

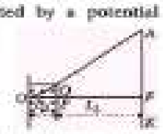
15. Consider the situation shown in the figure. Mass of block A is 6 kg and that of block B is 12 kg. The force constant of spring is 50 $N\ m^{-1}$. Friction is absent everywhere. System is released from rest with the spring unstretched. When the extension in the spring is $x = \frac{x_m}{2}$, x_m = maximum extension of spring, the speed of block A (in m s^{-1}) is ______.



16. A steel wire of length 2 m and diameter 0.8 mm is stretched horizontally between a rigid support attached at its ends. When a load is hung from midpoint of wire, it is found that a depression of 1.0 cm is produced. If Young's modulus for steel is 2×10^{12} dyne cm^{-2}, the load (in gm-wt) on the wire is ______.

17. A man stands at top of a tower and throws a ball at a speed of v at an angle θ to the horizontal. The height of the tower is v^2/g and the ball strikes the ground at a distance of d from the foot of the tower. The value of θ (in degrees) for which d is maximum if $v = 10$ m s^{-1} is ______. (Take $g = 10$ m s^{-2})

18. A beam of particle accelerated by a potential difference of V flies into a homogeneous magnetic field applied perpendicular to the plane of the paper and towards the observer. The width of the magnetic field is OP. In the absence of magnetic field, the electron beam produces a spot at a point F on fluorescent screen AK, which is at a distance of L_2 from the edge of the magnetic field. When the magnetic field is switched on, the spot moves on to A along the path OQA. If the induction of the magnetic field is B the displacement FA (in m) of the spot is ______.



(Take $B = 1$ T, $\frac{2Vm}{q} = 1$, $L_1 = \frac{\sqrt{3}}{2}$ m, $L_2 = 3\frac{\sqrt{3}}{2}$ m)

COMIC CAPSULE

SECTION 1 (Maximum Marks : 32)

- *This section contains EIGHT (08) questions.*
- *Each question has FOUR options. ONE OR MORE THAN ONE of these four option(s) is (are) correct answer(s).*
- *For each question, choose the option(s) corresponding to (all) the correct answer (s).*
- *Answer to each question will be evaluated according to the following marking scheme:*

Full Marks : +4 *If only (all) the correct option(s) is (are) chosen.*

Partial Marks : +3 *If all the four options are correct but ONLY three options are chosen.*

Partial Marks : +2 *If three or more options are correct but ONLY two options are chosen and both of which are correct.*

Partial Marks : +1 *If two or more options are correct but ONLY one option is chosen and it is a correct option.*

Zero Marks : 0 *If none of the options is chosen (i.e. the question is unanswered).*

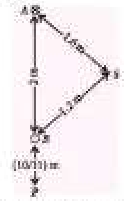
Negative Marks : −2 *In all other cases.*

- *For example, in a question, if (a), (b) and (d) are the ONLY three options corresponding to correct answers, then choosing ONLY (a), (b) and (d) will get +4 marks; choosing ONLY (a) and (b) will get +2 marks; choosing ONLY (a) and (d) will get +2 marks; choosing ONLY (b) and (d) will get +2 marks; choosing ONLY (a) will get +1 mark; choosing ONLY (b) will get +1 mark; choosing ONLY (d) will get +1 mark; choosing no option (i.e. the question is unanswered) will get 0 marks ; and choosing any other combination of options will get −1 mark.*

1. Figure shows a triangular prism of refracting angle 90°. A ray of light incident at face AB at an angle θ refracts at point Q with an angle of refraction 90°. Which of the following statements is/are correct?

(a) The refractive index of the prism is $\sqrt{1+\sin^2\theta}$.
(b) The maximum value of the refractive index is $\sqrt{2}$.
(c) The light at Q emerges into air if the incident angle θ is increased slightly.
(d) The light at Q emerges into air if the incident angle θ is decreased slightly.

2. Two long straight parallel wires are 2 m apart, perpendicular to the plane of the paper (see figure). The wire A carries a current of 9.6 A, directed into the plane of the paper. The wire B carries a current such that the net magnetic field of induction at the point P, at distance of (10/11) m from the wire B, is zero.



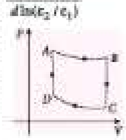
(a) The current in B is 3A and is directed perpendicular to the paper outwards.
(b) The magnitude of the magnetic field of induction at the point S is 1.3×10^{-6} T.
(c) The force per unit length on the wire B is 5.76×10^{-6} N m^{-1}.
(d) The magnitude of the magnetic field of induction at point S is 2.4×10^{-6} T.

3. The gap between the plates of a parallel-plate capacitor is filled with isotropic dielectric whose permittivity ε varies linearly from ε_1 to $\varepsilon_2 (\varepsilon_2 > \varepsilon_1)$ in the direction perpendicular to the plates. The area of each plate equals A, the separation between the plates is equal to d. Then the capacitance of the capacitor will be given by

(a) $\frac{(\varepsilon_2 - \varepsilon_1)\varepsilon_0 A}{d \ln(\varepsilon_2/\varepsilon_1)}$ (b) $\frac{(\varepsilon_2 - \varepsilon_1)\varepsilon_0 A}{d}$

(c) $\frac{\varepsilon_2 \varepsilon_0 A}{d}$ (d) $\frac{(\varepsilon_1 + \varepsilon_2)\varepsilon_0 A}{d \ln(\varepsilon_2/\varepsilon_1)}$

4. One mole of a monatomic ideal gas is taken through the cycle as shown in figure.



$A \rightarrow B$: adiabatic expansion
$B \rightarrow C$: cooling at constant volume
$C \rightarrow D$: adiabatic compression
$D \rightarrow A$: heating at constant volume.

The pressure and temperature at A, B, etc. are denoted by P_A, T_A, P_B, T_B etc., respectively. If $T_A = 1000$ K, $P_B = (2/3)P_A$ and $P_C = (1/3)P_A$, then [Given: $(2/3)^{2/5} = 0.85$]

(b) (i) $F = \frac{B^2l^2v}{R}$ (ii) $P = \frac{B^2l^2v^2}{R}$

36. (a) *Refer to answer 100, Page no. 229,* (MTG CBSE Champion Physics Class 12).

(b) (i) Angular magnification, $m = \frac{-f_o}{f_e}$

(ii) $\beta = m \times \alpha$, $D' = 0.01 \times \tan\beta$

OR

(a) *Refer to answer 14, Page no. 215* (MTG CBSE Champion Physics Class 12).

(b) Using lens maker's formula,

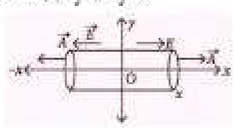
$$\frac{1}{f} = (\mu - 1)\left[\frac{1}{\infty} - \frac{1}{-R}\right] = 0.5 \times \frac{1}{20} = \frac{1}{40} \Rightarrow f = 40 \text{ cm}$$

Now using thin lens formula,

$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{40} + \frac{1}{-30} \Rightarrow v = -120 \text{ cm}$$

37. (a) *Refer to answer 53, Page no. 17* (MTG CBSE Champion Physics Class 12).

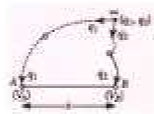
(b) (i) Net flux, $\phi = \int E.A + \int E.A$



(ii) The net charge enclosed, $q = \phi_1 \varepsilon_0$

OR

(a) Potential energy of a system of two charges in an external field



$W_1 = q_1(V_A - 0) = q_1 V_A$

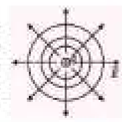
$$V_B = \frac{1}{4\pi\varepsilon_0}\frac{q_1}{x}$$

$$W_2 = q_2 V_B + \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{x}$$

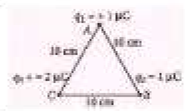
Total work done in assembling the configuration of two charges in an electric field is

$W = W_1 + W_2$

(b) For an isolated charge the equipotential surfaces are concentric spherical shells and the separation between consecutive equipotential surfaces increases in the weaker electric field.



(c) $W_A = 0$.



$$W_B = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r}$$

$$= \frac{1}{4\pi\varepsilon_0}\frac{-1 \times 10^{-12}}{10 \times 10^{-2}}$$

$$W_C = \frac{1}{4\pi\varepsilon_0}\frac{1 \times 2 \times 10^{-12}}{10 \times 10^{-2}} + \frac{1}{4\pi\varepsilon_0}\frac{1 \times (-1) \times 10^{-12}}{10 \times 10^{-2}}$$

$\therefore$ Total work done, $W = W_A + W_B + W_C$

(For complete solutions, refer to MTG CBSE Champion Physics Class 12)

GET SET GO *for* NEET

Exam on May 3, 2020

with exclusive and brain storming MCQs

1. A body of mass 6 kg is hanging from another of mass 10 kg as shown in figure. This combination is being pulled up by a string with an acceleration of 2 m s^{-2}. The tension T_1 is (g = 10 m s^{-2})

(a) 240 N (b) 150 N
(c) 220 N (d) 192 N

2. A spherical soap bubble of radius 1 cm is formed inside another bubble of radius 3 cm. The radius of a single soap bubble which maintains the same pressure difference as inside the smaller and outside the larger soap bubble is
(a) 0.75 cm (b) 0.75 m (c) 7.5 cm (d) 7.5 m

3. If the length of a simple pendulum is comparable to the radius of the Earth, the period of the pendulum is
(a) $T = 2\pi\sqrt{\dfrac{1}{g\left(\dfrac{1}{L}+\dfrac{1}{R}\right)}}$ (b) $T = 2\pi\sqrt{\dfrac{L}{g}}$
(c) $T = 2\pi\sqrt{\dfrac{R}{g}}$ (d) $T = 2\pi\sqrt{\dfrac{\dfrac{1}{L}+\dfrac{1}{R}}{g}}$

4. A player throws a ball upwards with an initial speed 30 m s^{-1}. To what height does the ball rise and after how long does the ball return to the player's hands? (Take g = 10 m s^{-2} and neglect air resistance).
(a) 45 m, 6 s (b) 45 m, 3 s
(c) 20 m, 6 s (d) 20 m, 3 s

5. The ratio of radii of Earth to another planet is 2/3 and the ratio of their mean densities is 4/5. If an astronaut can jump to a maximum height of 1.5 m on the Earth, with the same effort, the maximum height he can jump on the planet is
(a) 1 m (b) 0.8 m (c) 0.5 m (d) 1.25 m

6. Heat is supplied to a diatomic gas at constant pressure. The ratio of $\Delta Q : \Delta U : \Delta W$ is
(a) 5 : 3 : 2 (b) 7 : 5 : 2
(c) 2 : 3 : 5 (d) 2 : 5 : 7

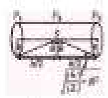
7. A circular disc of radius R is removed from a bigger circular disc of radius $2R$, such that the circumferences of the discs coincide. The centre of mass of the new disc is αR from the centre of the bigger disc. The value of α is
(a) $\dfrac{1}{4}$ (b) $\dfrac{1}{3}$ (c) $\dfrac{1}{2}$ (d) $\dfrac{1}{6}$

8. A ball is allowed to fall down with initial speed u from a height of 10 m. It loses 50% kinetic energy after striking the floor and reaches to the same

6. **(8.26)** : From equation $y = ax^2$,
$h_A = 1 \times (-2)^2 = 4$ m and $h_B = 1 \times (1)^2 = 1$ m
Let v be the velocity at point B.
From energy conservation between points A and B,
we get, $mgh_A = mgh_B + \frac{1}{2}mv^2$
$v = \sqrt{2g(h_A - h_B)} = \sqrt{2 \times 10(4-1)} = 2\sqrt{15}$ m s^{-1}
Slope of the path at B is $\frac{dy}{dx} = 2ax = \tan\theta$
$\therefore \tan\theta = 2 \qquad (\because x = 1, a = 1)$

$\therefore \sin\theta = \frac{2}{\sqrt{5}}$ and $\cos\theta = \frac{1}{\sqrt{5}}$
Let t be the time of flight of ball from B to C. The vertical displacement of ball is 1 m. So
$-h = v_y t - \frac{1}{2}gt^2;\ -1 = v\sin\theta t - \frac{1}{2}gt^2 \Rightarrow t = 1.52$ s
$\therefore$ The horizontal distance travelled is 5.26 m
$\therefore D = 2 + 1 + 5.26 = 8.26$ m

7. **(70)** : Total power, $P = P_1 + P_2 + P_3$
As the end caps are placed symmetrically relative to the source, $P_1 = P_2$.
Thus, $P_3 = P - (P_1 + P_2) = P - 2P_1$
From figure, power flow through ring



$P_1 = \frac{P}{4\pi} \times [2\pi(1 - \cos\theta)] = \frac{P}{2}\left[1 - \frac{h}{\sqrt{h^2 + 4R^2}}\right]$
$\therefore P_3 = P - 2 \times \frac{P}{2}\left[1 - \frac{h}{\sqrt{h^2 + 4R^2}}\right] = \frac{Ph}{\sqrt{h^2 + 4R^2}}$
$= \frac{0.1 \times 2}{\sqrt{(2)^2 + 4(1)^2}} \Rightarrow P_3 = 0.07$ W $= 70$ mW

8. **(6.3)** : As initially torque about P is zero, angular momentum of the system is conserved.
$\therefore mv \times 2L = I\omega$ ...(i)
Here $I = I_b + I_A + I_B$
$I = m(L_A + L_B)^2 + M_B\left[\frac{L_B^2}{12} + \left(\frac{L_B}{2} + L_A\right)^2\right] + M_A\frac{L_A^2}{3}$
Substituting the given values, we get $I = 0.09$ kg m^2
Thus, $0.05 \times v \times 1.2 = 0.09\omega \Rightarrow \omega = \frac{2}{3}v$

Now due to angular velocity ω the system will rotate and kinetic energy of rotation will be converted into potential energy.
$\Delta U = mgh + M_B g\left[L_A + \frac{L_B}{2}\right] + M_A g\frac{L_A}{2}$
$\Delta U = 0.081 \times 9.8$ J
By conservation of mechanical energy (after collision), we get
$\frac{1}{2}I\omega^2 = \Delta U = 0.081 \times 9.8$ J
$\Rightarrow v = 6.3$ m s^{-1}

9. **(d)** : Suppose final temperature of gases $= T$
Heat rejected by gas in lower compartment
$= nC_V\Delta T = 2 \times \frac{3}{2}R(700 - T)$ ...(i)
Heat received by gas in upper compartment,
$= nC_P\Delta T$ (as piston is movable, so pressure is constant)
$= 2 \times \frac{7}{2}R(T - 400)$ ...(ii)
From eqn. (i) and (ii), $T = 490$ K

10. **(d)** : Let equilibrium temperature of the gases in the two compartments $= T$
Pressure of the gases in each compartment is constant and same.
Heat given by lower compartment $= nC_P\Delta T$
$= 2 \times \frac{5}{2}R(700 - T)$ ...(i)
Heat taken by upper compartment $= nC_P\Delta T$
$= 2 \times \frac{7}{2}R(T - 400)$ ...(ii)
From eqn. (i) and (ii), $T = 525$ K
In isobaric process, work done by gas, $\Delta W = nR\Delta T$
For lower compartment, $\Delta W_1 = -350R$
For upper compartment, $\Delta W_2 = 250R$
Net work done by gases to attain equilibrium
$= \Delta W_1 + \Delta W_2 = -100R$

11. If a planet revolving around the Sun with time period T, is suddenly stopped in its orbit supposed to be circular. It would fall onto the Sun in a time

(a) $t=\left(\frac{2}{7}\right)T$ (b) $t=\left(\frac{\sqrt{2}}{8}\right)T$

(c) $t=\left(\frac{2\pi}{7}\right)T$ (d) $t=\left(\frac{\pi}{2}\right)T$

12. The coordinates of a particle moving in a plane are given by $x(t) = a\cos(pt)$ and $y(t) = b\sin(pt)$ where a, b and p are positive constants of appropriate dimensions. Then,

(a) the path of the particle is an ellipse.
(b) the velocity and acceleration of the particle are normal to each other at $t = \pi/(2p)$.
(c) the acceleration of the particle is always directed towards the origin.
(d) the distance travelled by the particle in time interval $t = 0$ to $t = \pi/(2p)$ is a.

SECTION 3 (Maximum Marks : 18)

- *This section contains SIX (06) questions. The answer to each question is a NUMERICAL VALUE.*
- *For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.*
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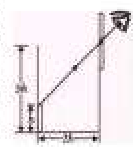
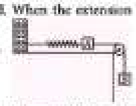
13. An observer can see the top of a thin rod of height h through a pinhole situated at the top of beaker as shown in the figure. The beaker height is $3h$ and its radius is h. When the beaker is filled with a liquid upto a height $2h$, he can see the lower end of the rod. The refractive index of the liquid is _______.



14. There is a stream of neutrons with a kinetic energy of 0.0327 eV. The half life of neutrons is 700 s. Fraction of neutrons that decay before they travel distance of 10 m is 3.9×10^{-p}, then the value of p is _____. (mass of neutron = 1.675×10^{-27} kg)

15. Consider the situation shown in the figure. Mass of block A is 6 kg and that of block B is 12 kg. The force constant of spring is 50 N m^{-1}. Friction is absent everywhere. System is released from rest with the spring unstretched. When the extension in the spring is $x = \frac{x_m}{2}$, x_m = maximum extension of spring, the speed of block A (in m s^{-1}) is _____.



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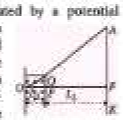
17. A man stands at top of a tower and throws a ball at a speed of v at an angle θ to the horizontal. The height of the tower is v^2/g and the ball strikes the ground at a distance of d from the foot of the tower. The value of θ (in degrees) for which d is maximum if v = 10 m s^{-1} is _____. (Take g = 10 m s^{-2})

18. A beam of particle accelerated by a potential difference of V flies into a homogeneous magnetic field applied perpendicular to the plane of the paper and towards the observer. The width of the magnetic field is OP. In the absence of magnetic field, the electron beam produces a spot at a point F on fluorescent screen AK, which is at a distance of L_2 from the edge of the magnetic field. When the magnetic field is switched on, the spot moves on to A along the path OQA. If the induction of the magnetic field is B the displacement FA (in m) of the spot is ______.



(Take $B = 1$ T, $\frac{2Vm}{q} = 1$, $L_1 = \frac{\sqrt{3}}{2}$ m, $L_2 = 3\frac{\sqrt{3}}{2}$ m)

COMIC CAPSULE

PAPER - II

SECTION 1 (Maximum Marks : 32)

- *This section contains EIGHT (08) questions.*
- *Each question has FOUR options. ONE OR MORE THAN ONE of these four option(s) is (are) correct answer(s).*
- *For each question, choose the option(s) corresponding to (all) the correct answer (s).*
- *Answer to each question will be evaluated according to the following marking scheme:*

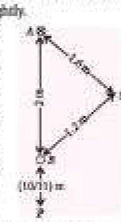
Full Marks :	+4	*If only (all) the correct option(s) is (are) chosen.*
Partial Marks :	+3	*If all the four options are correct but ONLY three options are chosen.*
Partial Marks :	+2	*If three or more options are correct but ONLY two options are chosen and both of which are correct.*
Partial Marks :	+1	*If two or more options are correct but ONLY one option is chosen and it is a correct option.*
Zero Marks :	0	*If none of the options is chosen (i.e. the question is unanswered).*
Negative Marks :	−2	*In all other cases.*

- *For example, in a question, if (a), (b) and (d) are the ONLY three options corresponding to correct answers, then*
  choosing ONLY (a), (b) and (d) will get +4 marks;
  choosing ONLY (a) and (b) will get +2 marks;
  choosing ONLY (a) and (d) will get +2 marks;
  choosing ONLY (b) and (d) will get +2 marks;
  choosing ONLY (a) will get +1 mark;
  choosing ONLY (b) will get +1 mark;
  choosing ONLY (d) will get +1 mark;
  choosing no option (i.e. the question is unanswered) will get 0 marks ; and
  choosing any other combination of options will get −1 mark.

1. Figure shows a triangular prism of refracting angle 90°. A ray of light incident at face *AB* at an angle θ refracts at point Q with an angle of refraction 90°. Which of the following statements is/are correct?

(a) The refractive index of the prism is $\sqrt{1+\sin^2\theta}$.
(b) The maximum value of the refractive index is $\sqrt{2}$.
(c) The light at Q emerges into air if the incident angle θ is increased slightly.
(d) The light at Q emerges into air if the incident angle θ is decreased slightly.

2. Two long straight parallel wires are 2 m apart, perpendicular to the plane of the paper (see figure). The wire *A* carries a current of 9.6 A, directed into the plane of the paper. The wire *B* carries a current such that the net magnetic field of induction at the point *P*, at distance of (10/11) m from the wire *B*, is zero.

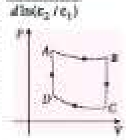


(a) The current in *B* is 3A and is directed perpendicular to the paper outwards.
(b) The magnitude of the magnetic field of induction at the point *S* is 1.3×10^{-6} T.
(c) The force per unit length on the wire *B* is 5.76×10^{-6} N m^{-1}.
(d) The magnitude of the magnetic field of induction at point *S* is 2.4×10^{-6} T.

3. The gap between the plates of a parallel-plate capacitor is filled with isotropic dielectric whose permittivity ε varies linearly from ε_1 to $\varepsilon_2 (\varepsilon_2 > \varepsilon_1)$ in the direction perpendicular to the plates. The area of each plate equals *A*, the separation between the plates is equal to *d*. Then the capacitance of the capacitor will be given by

(a) $\frac{(\varepsilon_2-\varepsilon_1)\varepsilon_0 A}{d\ln(\varepsilon_2/\varepsilon_1)}$ (b) $\frac{(\varepsilon_2-\varepsilon_1)\varepsilon_0 A}{d}$
(c) $\frac{\varepsilon_2\varepsilon_0 A}{d}$ (d) $\frac{(\varepsilon_1+\varepsilon_2)\varepsilon_0 A}{d\ln(\varepsilon_2/\varepsilon_1)}$

4. One mole of a monatomic ideal gas is taken through the cycle as shown in figure.



$A \to B$: adiabatic expansion
$B \to C$: cooling at constant volume
$C \to D$: adiabatic compression
$D \to A$: heating at constant volume.
The pressure and temperature at *A*, *B*, etc. are denoted by P_A, T_A, P_B, T_B etc., respectively. If $T_A = 1000$ K, $P_B = (2/3)P_A$ and $P_C = (1/3)P_A$, then [Given: $(2/3)^{2/5} = 0.85$]

GET SET GO for NEET

Exam on May 3, 2020

with exclusive and brain storming MCQs

1. A body of mass 6 kg is hanging from another of mass 10 kg as shown in figure. This combination is being pulled up by a string with an acceleration of 2 m s^{-2}. The tension T_1 is ($g = 10$ m s^{-2})

(a) 240 N (b) 150 N
(c) 220 N (d) 192 N

2. A spherical soap bubble of radius 1 cm is formed inside another bubble of radius 3 cm. The radius of a single soap bubble which maintains the same pressure difference as inside the smaller and outside the larger soap bubble is
(a) 0.75 cm (b) 0.75 m (c) 7.5 cm (d) 7.5 m

3. If the length of a simple pendulum is comparable to the radius of the Earth, the period of the pendulum is
(a) $T = 2\pi\sqrt{\frac{1}{g\left(\frac{1}{L}+\frac{1}{R}\right)}}$ (b) $T = 2\pi\sqrt{\frac{L}{g}}$
(c) $T = 2\pi\sqrt{\frac{R}{g}}$ (d) $T = 2\pi\sqrt{\frac{\frac{1}{L}+\frac{1}{R}}{g}}$

4. A player throws a ball upwards with an initial speed 30 m s^{-1}. To what height does the ball rise and after how long does the ball return to the player's hands? (Take $g = 10$ m s^{-2} and neglect air resistance).
(a) 45 m, 6 s (b) 45 m, 3 s
(c) 20 m, 6 s (d) 20 m, 3 s

5. The ratio of radii of Earth to another planet is 2/3 and the ratio of their mean densities is 4/5. If an astronaut can jump to a maximum height of 1.5 m on the Earth, with the same effort, the maximum height he can jump on the planet is
(a) 1 m (b) 0.8 m (c) 0.5 m (d) 1.25 m

6. Heat is supplied to a diatomic gas at constant pressure. The ratio of $\Delta Q : \Delta U : \Delta W$ is
(a) 5 : 3 : 2 (b) 7 : 5 : 2
(c) 2 : 3 : 5 (d) 2 : 5 : 7

7. A circular disc of radius R is removed from a bigger circular disc of radius $2R$, such that the circumferences of the discs coincide. The centre of mass of the new disc is αR from the centre of the bigger disc. The value of α is
(a) $\frac{1}{4}$ (b) $\frac{1}{3}$ (c) $\frac{1}{2}$ (d) $\frac{1}{6}$

8. A ball is allowed to fall down with initial speed u from a height of 10 m. It loses 50% kinetic energy after striking the floor and reaches to the same