PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 65

Total Marks : 26

Max. Time : 27 min.

Topics : Center of Mass, Magnetic Effect of Current and Magnetic Force on Charge/current, Gravitation, Heat, Rotation

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Multiple choice objective ('–1' negative marking) Q.4	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.5	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

1. A man of mass M stands at one end of a plank of length L which lies at rest on a frictionless horizontal surface . The man walks to the other end of the plank. If the mass of the plank is M/3, the distance that the man moves relative to the ground is

(A) 3 L/4 (B) 4 L/5 (C) L/4 (D) none of these

2. A particle is moving with velocity $\vec{v} = \hat{i} + 3\hat{j}$ and it produces an electric field at a point given by $\vec{E} = 2\hat{k}$. It will produce magnetic field at that point equal to (all quantities are in S.I. units and speed of light is c)

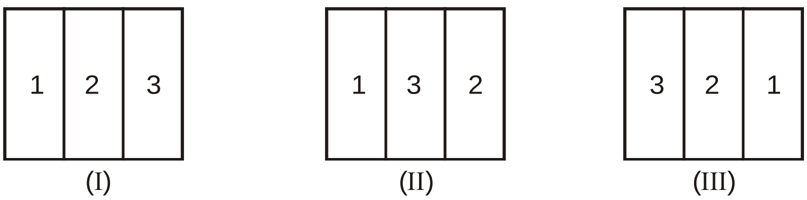
(A) $\frac{6\hat{i} - 2\hat{j}}{c^2}$ (B) $\frac{6\hat{i} + 2\hat{j}}{c^2}$

(C) zero (D) can not be determined from the given data

3. Maximum height reached by a rocket fired with a speed equal to 50% of the escape velocity from earth's surface is:

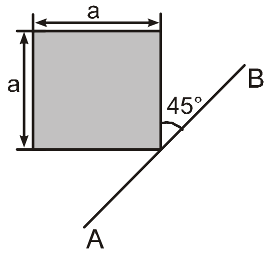
(A) R/2 (B) 16R/9 (C) R/3 (D) R/8

4. Figure shows three different arrangements of materials 1, 2 and 3 (identical in shape) to form a wall. The thermal conductivities are K_1, K_2 and K_3 respectively and $K_1 > K_2 > K_3$. The left side of the wall is 20°C higher than the right side.



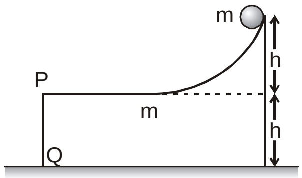
(A) In steady state, rate of energy conduction through the wall III is greatest.
(B) In steady state, rate of energy conduction through all the walls (I), (II) and (III) are same.
(C) In steady state, temperature difference across material 1 is greatest in wall II.
(D) In steady state, temperature difference across material 1 is same in all the walls.

5. Find the moment of inertia (in kg.m^2) of a thin uniform square sheet of mass M = 3kg and side a = 2m about the axis AB which is in the plane of sheet :



COMPREHENSION

A small ball (uniform solid sphere) of mass m is released from the top of a wedge of the same mass m. The wedge is free to move on a smooth horizontal surface. The ball rolls without sliding on the wedge. The required height of the wedge are mentioned in the figure.



6. The speed of the wedge when the ball is just going to leave the wedge at point 'P' of the wedge is

(A) $\sqrt{\frac{5gh}{9}}$ (B) $\sqrt{gh}$ (C) $\sqrt{\frac{5gh}{6}}$ (D) None of these

7. The total kinetic energy of the ball just before it falls on the ground

(A) 2 mgh (B) mgh (C) $\frac{13}{18}$mgh (D) None of these

8. The horizontal separation between the ball and the edge 'PQ' of wedge just before the ball falls on the ground is

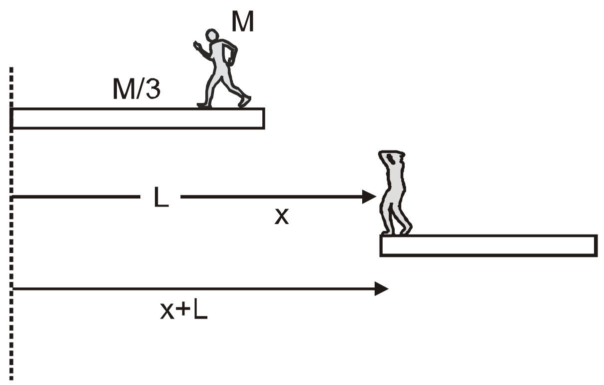
(A) $\frac{3\sqrt{10}}{2}h$ (B) $\frac{2\sqrt{10}}{3}h$ (C) 2 h (D) None of these

Answers Key

1.	(C)	**2.**	(A)	**3.**	(C)	**4.**	(B) (D)
5.	7	**6.**	(A)	**7.**	(D)	**8.**	(B)

Hints & Solutions

1.



$$Mx + \frac{M}{3}(x + L) = 0$$

$$\frac{4M}{3}x = -\frac{ML}{3} \qquad x = -\frac{L}{4}$$

2. $\vec{B} = \frac{\mu_0}{4\pi} q \frac{\vec{v} \times \vec{r}}{r^3}$ and $\vec{E} = \frac{1}{4\pi \epsilon_0} \frac{q\vec{r}}{r^3}$

$$\therefore \quad \vec{B} = \mu_0 \epsilon_0 (\vec{v} \times \vec{E}) = \frac{\vec{v} \times \vec{E}}{c^2}$$

3. $v = \frac{50}{100} V_e = \frac{1}{2}\sqrt{\frac{2GM}{R}}$

Applying energy conservation

$$\Rightarrow \quad -\frac{GMm}{R} + \frac{1}{2}mv^2 = -\frac{GMm}{(R+h)}$$

$$v^2 = \frac{2GM}{R} - \frac{2GM}{R+h}$$

$$\Rightarrow \quad \frac{1}{4} \cdot \frac{2GM}{R} = 2GM\left(\frac{1}{R} - \frac{1}{R+h}\right)$$

$$\Rightarrow \quad \frac{1}{4R} = \frac{h}{R(R+h)}$$

$\Rightarrow$ R + h = 4h

$\Rightarrow$ h = R/3

4. $K_{eq.}$ is same in all three cases. All other parameter being same, rate of energy conduction is same in all three cases.
Simlarly temperature difference across any material in any wall is also same.

5. $I = \frac{ma^2}{12} + m\left(\frac{a}{\sqrt{2}}\right)^2 = \frac{7ma^2}{12} = 7.$

6. $mgh = \frac{1}{2}mv^2 + \frac{1}{2}mv^2 + \frac{1}{2}.\frac{2}{5}mv^2\left(\frac{2v}{r}\right)^2$

$= \frac{1}{2}mv^2\,[1 + 1 + \frac{8}{5}] = \frac{1}{2}mv^2\,\frac{18}{5} = \frac{9mv^2}{5}$

$\Rightarrow\ v = \sqrt{\frac{5}{9}gh}$

7. KE of the ball $= \frac{1}{2}\ mv^2 + \frac{1}{2}\ \frac{2}{5}\ mv^2\left(\frac{2v}{r}\right)^2 = \frac{13}{18}$

mgh

8. $X = 2vt\ = 2v\sqrt{\frac{2h}{g}}$

$= 2.\sqrt{\frac{5}{9}gh}\sqrt{\frac{2h}{g}} = \frac{2\sqrt{10}}{3}h$