PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 11

Total Marks : 33

Max. Time : 34 min.

Topics : Geometrical Optics, Fluid, Work, Power and Energy, Center of Mass, Circular Motion, Heat and Thermodynamics, Rigid Body Dynamics

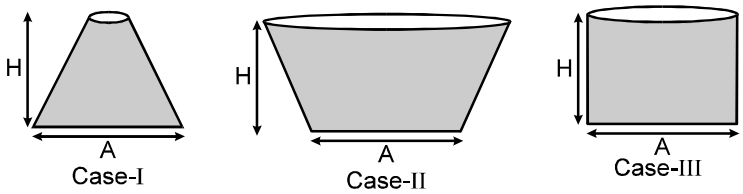
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Multiple choice objective ('–1' negative marking) Q.6 to Q.7	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.8	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.9 to Q.10	(3 marks, 3 min.)	[6, 6]

1. An object moves in front of a fixed plane mirror. The velocity of the image of the object is
(A) Equal in the magnitude and in the direction to that of the object.
(B) Equal in the magnitude and opposite in direction to that of the object.
(C) Equal in the magnitude and the direction will be either same or opposite to that of the object.
(D) Equal in magnitude and makes any angle with that of the object depending on direction of motion of the object.

2. A point object is moving along principal axis of a concave mirror with uniform velocity towards pole. Initially the object is at infinite distance from pole on right side of the mirror as shown. Before the object collides with mirror, the number of times at which the distance between object and its image is 40 cm are.

(A) one time (B) two times (C) three times (D) Data insufficient

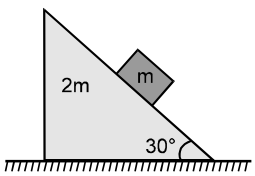
3. Three containers of same base area, same height are filled with three different liquids of same mass as shown in the figure. If F_1, F_2, F_3 are the force exerted by the liquid on the base of the container in case I, II and III respectively, then we have the relation:

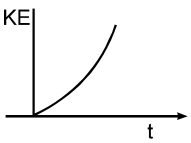


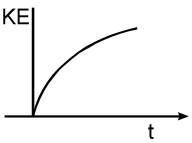
(A) $F_1 = F_2 = F_3$ (B) $F_1 > F_2 > F_3$ (C) $F_3 > F_2 > F_1$ (D) $F_2 < F_3 < F_1$

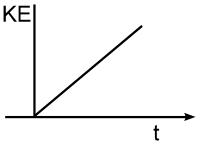
4. A particle is projected with a velocity u making an angle θ with the horizontal. The instantaneous power of the gravitational force
(A) varies linearly with time (B) is constant throughout
(C) is negative for complete path (D) None of the above

5. A body of mass 'm' sliding down a movable inclined plane of mass 2 m, assuming friction is absent everywhere the kinetic energy of 2 m as a function of time is: (m remains on 2m)



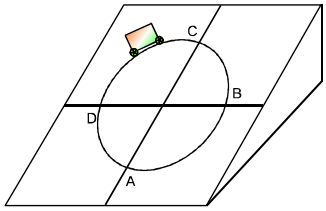
(A) 

(B) 

(C) 

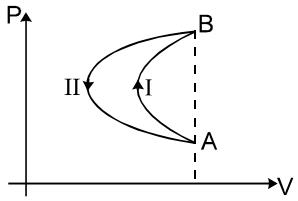
(D) none of these

6. A car is moving along a circle with constant speed on an inclined plane as shown in diagram. Then friction force on car may be in horizontal direction at least at one point :

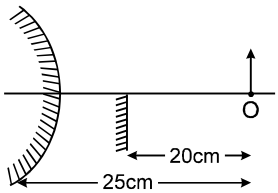


(A) in portion 'AB' including point A and B
(B) in portion 'BC' including point B and C
(C) in portion 'CD' including point C and D
(D) in portion 'DA' including point D and A

7. In a cyclic process, a gas is taken from state A to B via path-I as shown in the indicator diagram and taken back to state A from state B via path-II. In the complete cycle :
(A) work is done on the gas.
(B) heat is given to the gas
(C) no work is done by the gas.
(D) nothing can be said about work as data is insufficient

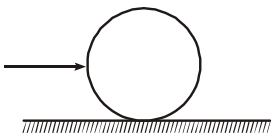


8. In the figure, an object is placed at distance 25 cm from the surface of a convex mirror, and a plane mirror is set so that the image formed by the two mirrors lie adjacent to each other in the same plane. The plane mirror is placed at 20 cm from the object. What is the radius of curvature of the convex mirror?



COMPREHENSION

A uniform ring of radius 4 cm placed on a rough horizontal surface is given a sharp impulse as in figure. As a consequence it acquires a linear velocity of 2 m/s. If coefficient of friction between the ring and the horizontal surface be 0.4. Then answer the following questions based on given information.



9. The velocity of centre of mass after which the ring will start pure rolling is -
(A) 2 m/s (B) 1 m/s (C) 4 m/s (D) 1/2 m/s

10. The time after which the ring will start pure rolling is -
(A) 1/2 s (B) 1 s (C) 1/4 s (D) 2 s

Answers Key

1. (D) **2.** (C) **3.** (D) **4.** (A) **5.** (A)
6. (B), (C) **7.** (A) **8.** R = 75 cm. **9.** (B)
10. (C)

Hints & Solutions

1. When object moves normal to the mirror, image velocity will be opposite to it. When object moves parallel to the mirror, image velocity will be in the same direction.

2. As the object moves from infinity to centre of curvature, the distance between object and image reduces from infinity to zero.
As the object moves from centre of curvature to focus, the distance between object and image increases from zero to infinity.
As the object moves from focus to pole, the distance between object and its image reduces from infinity to zero. Hence the distance between object and its image shall be 40 cm three times.

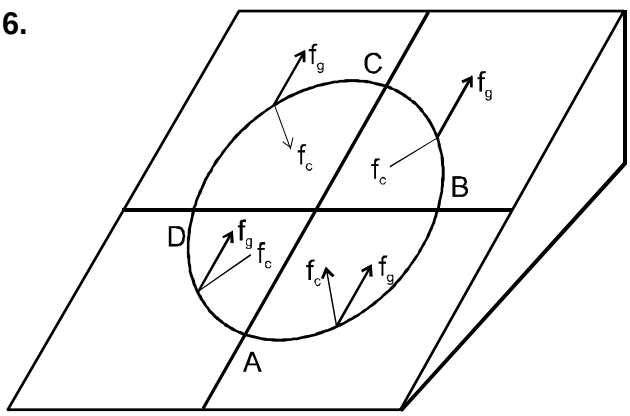
3. Force on bottom surface = $\rho gH \times A$

4. At any time

$\vec{v} = [(u\cos\theta)\hat{i} + (u\sin\theta - gt)\hat{j}]$

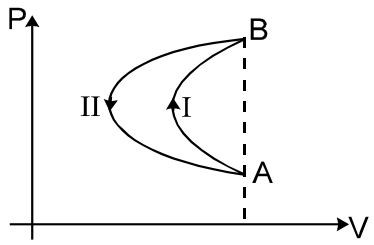
$P = \vec{F}.\vec{v} = (-mg\hat{j}).\left[u\cos\theta\hat{i} + (u\sin\theta - gt)\hat{j}\right]$

6.



Friction force acting on car will be resultant of the components shown in the diagram.
f_g and f_C are components of friction force that balance gravitational pull and provides centripetal force respectively
The resultant of f_g and f_c can be horizontal only for a point at BC and CD
and not for AB and BD

7. As work done in state (II) is more than in state (I)



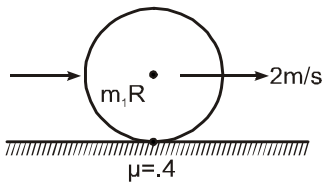
8. Image due to plane mirror will form at a distance of 20 cm left of the mirror.
Since image formed by two mirrrors lie adjacent to each other.
For convex mirror, image position is 15 cm towards left.
u = – 25 cm
v = + 15 cm

using $\frac{1}{v} + \frac{1}{u} = \frac{1}{f} = \frac{2}{R}$

$$\frac{1}{15} - \frac{1}{25} = \frac{2}{R}$$

R = 75 cm.
Ans. R = 75 cm.

9-10. Suppose velocity of ring



When it starts pure rolling is v. Angular momentum can be constant about point of contact as there is no external torque acting about it. Thus

$$m.2.R = m.R^2\left(\frac{v}{R}\right) + mvR$$

$\Rightarrow$ v = 1m/s
using v = u + at
1 = 2 + (–4) t
$\Rightarrow$ t = 1/4 sec. **[Ans.: 1 m/s, 1/4 sec.]**