PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 6

Total Marks : 36

Max. Time : 39 min.

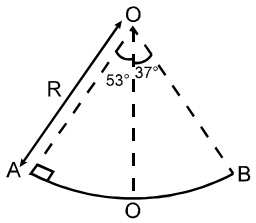
Topics : Centre of Mass, Circular Motion, Geometrical Optics., Kinetic Throry of Gases and Thermodynamics

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Subjective Questions ('–1' negative marking) Q.6	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.7 to Q.9	(3 marks, 3 min.)	[9, 9]
Match the Following (no negative marking) (2 × 4) Q.10	(8 marks, 10 min.)	[8, 10]

1. If a ball is dropped from rest, it bounces from the floor repeatedly. The coefficient of restitution is 0.5 and the speed just before the first bounce is $5ms^{-1}$. The total time taken by the ball to come to rest finally is :

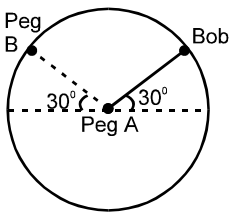
(A) 1.5s (B) 1s (C) 0.5s (D) 0.25s

2. A section of fixed smooth circular track of radius R in vertical plane is shown in the figure. A block is released from position A and leaves the track at B. The radius of curvature of its trajectory when it just leaves the track at B is:



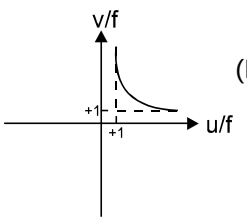
(A) R (B) $\frac{R}{4}$ (C) $\frac{R}{2}$ (D) none of these

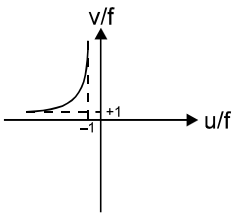
3. A bob is attached to one end of a string other end of which is fixed at peg A. The bob is taken to a position where string makes an angle of 30^0 with the horizontal. On the circular path of the bob in vertical plane there is a peg 'B' at a symmetrical position with respect to the position of release as shown in the figure. If V_c and V_a be the minimum tangential velocity in clockwise and anticlockwise directions respectively, given to the bob in order to hit the peg 'B' then ratio $V_c : V_a$ is equal to :

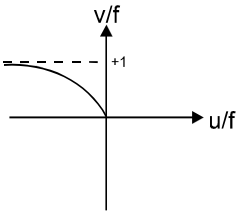


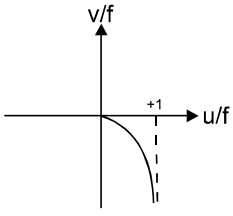
(A) 1 : 1 (B) 1 : $\sqrt{2}$ (C) 1 : 2 (D) 1 : 4

4. A virtual erect image in a concave mirror is represented, in the above figures, by

(A) 

(B) 

(C) 

(D) 

5. A driving mirror on a car is never concave because :

(A) its field of view is too small

(B) the image would be inverted

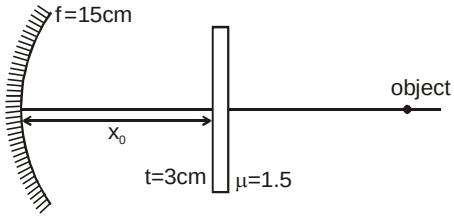
(C) the image would be virtual and therefore useless for the driver

(D) only a plane mirror forms true images.

6. A point object is placed at a distance 20 cm from the focus of a concave mirror of radius of curvature 20 cm. Find the distance (in cm) of the image from the focus.

COMPREHENSION

A point object is placed on principal axis of a concave mirror (of focal length 15 cm) at a distance u = 61 cm from pole. A slab of thickness t = 3 cm and refractive index $\mu = 1.5$ is placed with two sides perpendicular to principal axis, such that its nearest face is x_0 cm from pole. The final image of object is to be considered after refraction by slab, reflection by mirror and final refraction by slab.



7. If x_0 = 30 cm, then the distance of final image from pole is

(A) 19 (B) 21 (C) 23 (D) 24

8. If the slab is shifted parallel to itself by 3 cm then the final image

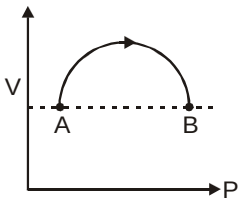
(A) shifts towards left (B) shifts towards right

(C) may shifts towards left or right (D) does not shift

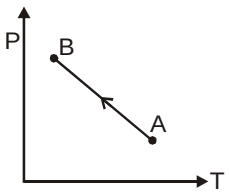
9. If x_0 = 30 cm and the object is given velocity 18 m/s towards left then the speed of image at that instant is

(A) 2 m/s (B) 6 m/s (C) 9 m/s (D) 162 m/s

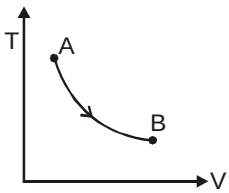
10. A sample of gas goes from state A to state B in four different manners, as shown by the graphs. Let W be the work done by the gas and ΔU be change in internal energy along the path AB. Correctly match the graphs with the statements provided.

(A) 

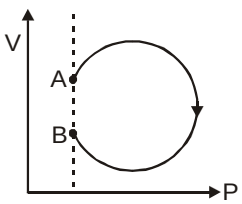
(p) Both W and ΔU are positive

(B) 

(q) Both W and ΔU are negative

(C) 

(r) W is positive whereas ΔU is negative

(D) 

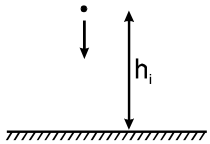
(s) W is negative whereas ΔU is positive

Answers Key

1. (A)
2. (C)
3. (C)
4. (D)
5. (A)
6. 5 cm
7. (B)
8. (D)
9. (A)
10. (A) s (B) q (C) r (D) q

Hints & Solutions

1.



$v = 0 + gt$

$\Rightarrow \quad t = 0.5$ sec

After first collision :

Speed becomes $5\ (0.5) = 2.5$ m/s

$t_1 = 2\ (0.25) = 0.5$

$t_2 = 2\ (0.125) = 0.25$

$t_3 = 0.125$ and so on

[where t_i is the time taken to complete the i^{th} to and fro motion after collision]

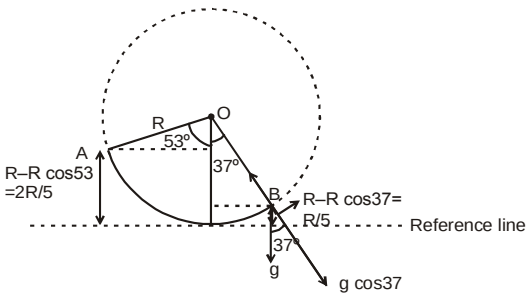
Total time $= 0.5 + [0.5 + 0.25 + 0.125 + ...]$

$= 0.5 + \dfrac{0.5}{1-0.5}$ (Since above is a G.P. with

$a = 0.5$ and $r = 0.5$)

$= 0.5 + 1 = 1.5$ sec.

2.



By energy conservation between A & B

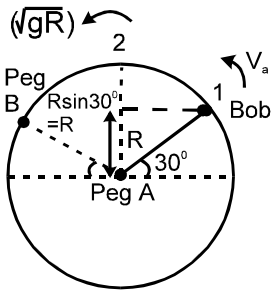
$\Rightarrow \quad Mg\ \dfrac{2R}{5} + 0 = \dfrac{MgR}{5} + \dfrac{1}{2}\ MV^2$

$V = \sqrt{\dfrac{2gR}{5}}$

Now, radius of curvature r

$= \dfrac{V_\perp^2}{} = \dfrac{2gR/5}{} = \dfrac{R}{}$

3. (C) For anti-clockwise motion, speed at the highest point should be $\sqrt{gR}$. Conserving energy at (1) & (2) :



$\frac{1}{2}mv_a^2$

$= mg\frac{R}{2} + \frac{1}{2}m(gR)$

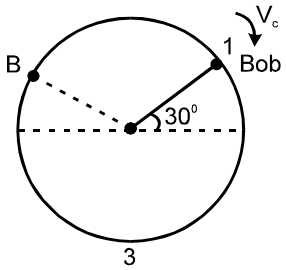
$\Rightarrow \quad v_a^2 = gR + gR = 2gR$

$\Rightarrow \quad v_a$

$= \sqrt{2gR}$

For clock-wise motion, the bob must have atleast that much speed initially, so that the string must not become loose any where until it reaches the peg B. At the initial position :

$T + mg\cos 60^0 = \frac{mv_c^2}{R}$;



V_C being the initial speed in clockwise direction.
For $V_{C\,min}$: Put T = 0 ;

$\Rightarrow \quad V_C = \sqrt{\frac{gR}{2}}$

$\Rightarrow \quad V_C/V_a = \frac{\sqrt{\frac{gR}{2}}}{\sqrt{2gR}} = \frac{1}{2}$

$\Rightarrow \quad V_C : V_a = 1 : 2$ **Ans.**

6. Using newton's formula
$xy = f^2$
$\Rightarrow \quad 20\,y = (10)^2$

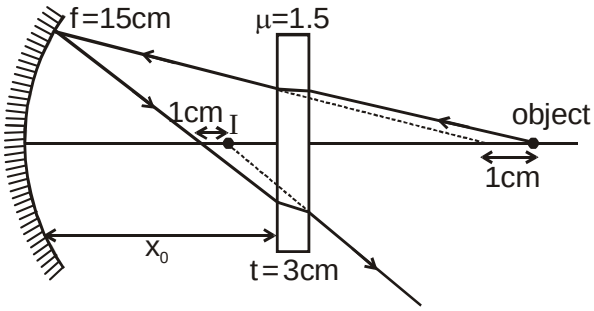
Sol. 7 to 9

The shift due to slab is $t\left(1-\frac{1}{\mu}\right)=3\left(1-\frac{1}{1.5}\right)$

= 1cm towards left. Hence the object appears to mirror at a distance 61 – 1 = 60 cm.

From mirror formula $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$ we get

v =20 cm.

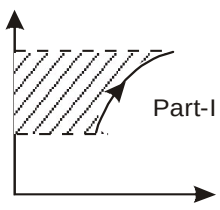


Hence the mirror forms the image at v = 20 cms towards right. The slab again causes a shift of 1cm towards right. hence the final image is formed at a distance of 21 cm from pole.
Shifting of slab towards left does no cause any change to position of final image .
The slab only causes apparent shift, but does not cause any change to velocity of image. Hence the velocity of image is only due to mirror. The object appears at a distance u= 60 cm from mirror and mirror forms its image at v=20 cm. Hence the velocity of image is

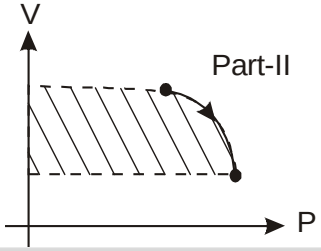
$=-\left(\frac{v}{u}\right)^2$ × velocity of object$=-\left(\frac{20}{60}\right)^2\times 18$

= 2 m/s towards right

10. (A) s (B) q (C) r (D) q
in (A), V is on vertical axis.



As V is icreasing, W is positive.



V is decreasing, W is negative.
As negative work in part-II is greater than positive work in part-I, net work during the process is negative.
Using PV = nRT and as $V_{remains}$ same for initial and final points of the process, it is obvious that final temp. is greater than initial temperature as pressure has increased. Therefore dU is positive.
Hence option (S) is connected with (A).
Similar arguments can be applied to other graphs.