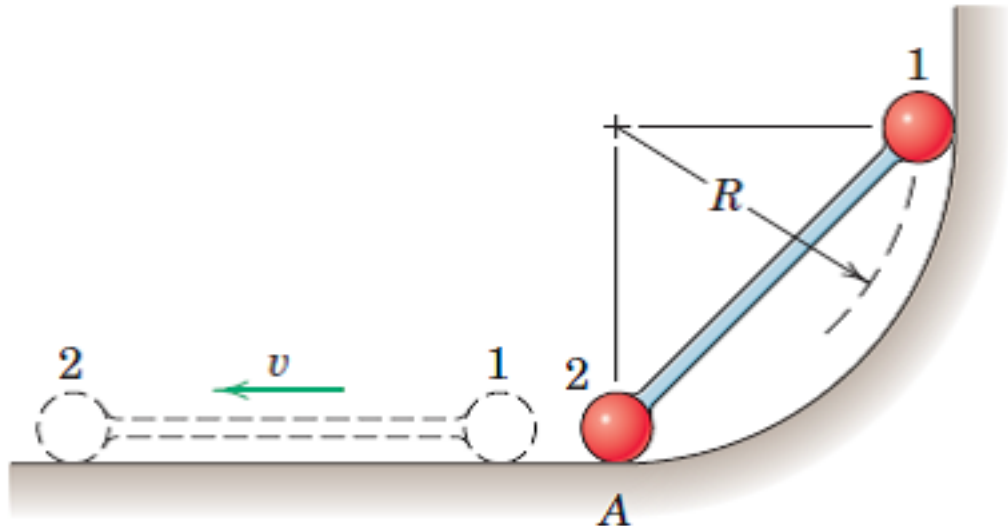


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Problem

The two small spheres, each of mass m , are rigidly connected by a rod of negligible mass and are released from rest in the position shown and slide down the smooth circular guide in the vertical plane. Determine their common velocity v as they reach the horizontal dashed position. Also find the force N between sphere 1 and the supporting surface an instant before the sphere reaches the bottom position A.



Problem 4/6

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Step 1 of 3

Apply conservation of energy.

Therefore, the energy at initial position must be equal to the energy at final position.

$$P.E_1 + K.E_1 = P.E_2 + K.E_2 \dots\dots (1)$$

Here, $P.E$ is potential energy and $K.E$ is kinetic energy and the subscripts 1 and 2 indicate initial and final positions.

Position – 1:

Apply the conditions as follows:

Potential energy is $P.E_1 = mgR$

Kinetic energy is $K.E_1 = 0$

Position – 2:

Apply the conditions as follows:

Potential energy is $P.E_2 = 0$

Kinetic energy is $K.E_2 = \frac{1}{2}(2m)v^2$

Here v is common velocity of the system.

Substitute mgR for $P.E_1$, 0 for $K.E_1$, 0 for $P.E_2$, and $\frac{1}{2}(2m)v^2$ for $K.E_2$ in the equation (1).

$$mgR + 0 = 0 + \frac{1}{2}(2m)v^2$$

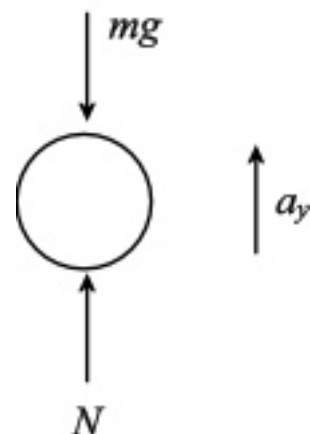
$$v = \sqrt{gR}$$

Therefore, the common velocity of the system is $v = \sqrt{gR}$.

Comment

Step 2 of 3

The sphere – 1 reaches the bottom of the circular surface with acceleration equal to centrifugal acceleration.



Thus, state the acceleration in the vertical direction:

$$a_y = \frac{v^2}{R}$$

Substitute \sqrt{gR} for v .

$$a_y = \frac{gR}{R} = g$$

Comment

Step 3 of 3

Balance the forces in y – direction from the figure as shown:

$$N - mg = ma_y$$

Substitute g for a_y in the above equation.

$$N - mg = mg$$

$$N = 2mg$$

Therefore, the reaction at the instant before sphere reaches the bottom position is $2mg$.

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Was this solution helpful?

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Recommended solutions for you in Chapter 4

Chapter 4, Problem 16P

The two small spheres, each of mass m , and their connecting rod of negligible mass are rotating about their mass center G with...

See solution

Chapter 4, Problem 30P

The carriage of mass $2m$ is free to roll along the horizontal rails and carries the two spheres, each of mass m , mounted on rods...

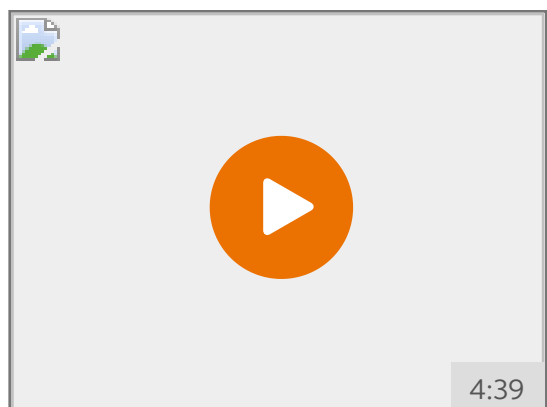
See solution

Chapter 4, Problem 30P

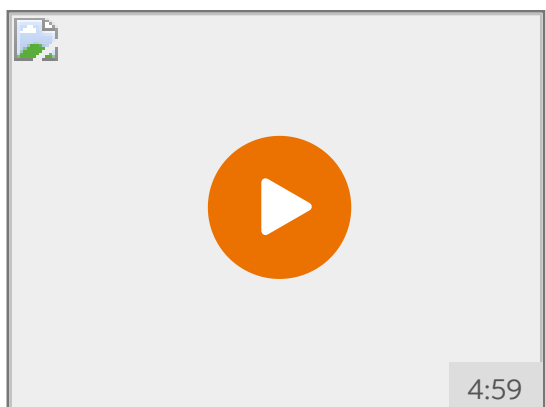
The carriage of mass $2m$ is free to roll along the horizontal rails and carries the two spheres, each of mass m , mounted on rods...

See solution

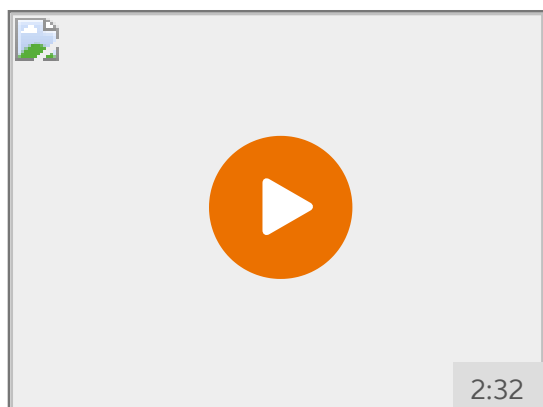
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Examples related to Chapter 4

Example 1

The system of four particles has the indicated particle masses, positions, velocities, and external forces. Determine \ddot{r}_x , \ddot{r}_y , \ddot{r}_z , \ddot{T} , \ddot{G} , \ddot{H}_O , \ddot{H}_G , and \ddot{H}_G .



Show more

Example 2

Example 3

Example 4

Example 5

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