

File Edit Style Item Page View Utilities Autopage®

Page Control

Page Depth Variation Control:

- Minimum Page Depth: **51p6**
- Optimum Page Depth: **52p6.99**
- Maximum Page Depth: **53p6**
- Max Depth Variation: **1p**
- Flag Variations Greater Than: **0p**

Allow ragged columns at page bottom
 Allow ragged columns at layout change
 Allow non-optimum first page

Flag more than **4** consecutive non-optimum spreads.

Units: Picas Points 1/1000 Points
 Cicero Didot 1/1000 Didot
 MM

Options

Maximum number of pages to back up: **2** Pages
 Maximum layouts to try in backup range: **10000**

Vertically Justify Column Breaks
 Vertically Justify Page Breaks
 Remove variable space between consecutive heads
 Remove variable space between head and paragraph

Autopage Document

End Job On:

- Left Page
- Right Page
- Either Page

Minimum Lines Required:

- Last Column: **10**

Body Text Columns:

- Minimum depth: **2p**

EXAMPLE 10-6

A primitive yo-yo. In Fig. 10-15, we wrap a string several times around a solid cylinder with mass M and radius R . We hold the end of the string stationary while rotating the cylinder with no initial motion.



10-15 Calculating the velocity of a primitive yo-yo.

SOLUTION As in Example 9-8 (Section 9-2), there is friction between the string and the cylinder, but mechanical energy is nonetheless conserved because the string never slips on the surface of the cylinder. The potential energy are $U_i = Mgh$ and $U_f = 0$. The initial kinetic energy K_i is zero, and the final kinetic energy K_f is given by Eq. (10-13).

$$But \omega = v/mR \text{ from Eq. (10-16), and } I_m = \frac{1}{2}MR^2, \text{ so}$$

$$\textcolor{red}{\underline{K_f = \frac{1}{2}MR\omega^2 + \frac{1}{2}\left(\frac{1}{2}MR^2\right)\left(\frac{v}{mR}\right)^2}}$$

$$= \frac{3}{4}MRv^2.$$

Finally, conservation of energy gives

This is less than the speed (v_0) that a dropped object would have, because one-third of the potential energy released due to the cylinder falling appears as rotational kinetic energy.

EXAMPLE 10-7

Base of the rolling body

In physics lab demonstrations, an instructor "pushes" various round objects by pushing them from rest at the top of an inclined plane (Fig. 10-16). What shape should a body have to reach the bottom of the incline first?



10-16 Which to roll down the plane faster, a cube or a cylinder?

SOLUTION We can ignore conservative energy because there is no sliding. Either the cube or the cylinder rolls over the inclined plane. Σ

the body will roll without slipping, then no work is done by friction. If the bodies are on the surface on which they roll without slipping (Fig. 10-17), we would have to include the effect of rolling friction. This will discuss the theory. Each body starts from rest at the top of an incline with height h , so $K_i = 0$, $U_i = Mgh$, and $U_f = 0$. From Eq. (10-13),

$$\textcolor{red}{\underline{K_f = \frac{1}{2}MR\omega^2 + \frac{1}{2}I_m\omega^2}}$$

If the body rolls without slipping, $\omega = v/mR$. The moment of inertia of all the round bodies in Table 9-2 (about axes through their centers of mass) can be expressed as $I_m = CMR^2$, where C is a pure number between 0 and 1 that depends on the shape of the body. Then from conservation of energy,

$$\textcolor{red}{\underline{K_f + U_i = K_f + U_f}}$$

$$0 + Mgh = \frac{1}{2}MR\omega^2 + \frac{1}{2}CMR^2\left(\frac{v}{mR}\right)^2$$

$$= \frac{1}{2}(1+C)Mv^2.$$

so the speed at the bottom of the incline is

$$\textcolor{red}{\underline{v_{\text{fin}} = \sqrt{\frac{2gh}{1+C}}}}$$

This is a fairly amazing result; the velocity doesn't depend on either the mass M of the body or its radius R . All uniform solid

CursorPos

X: **2p7.745**
 Y: **p6.291**