

20-P-WE-JK-225-R14-8

Inspired by Chapter 14 Hibbeler Section 14.6 Conservation of Energy
Review Problem R14-8

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CCYB4.0 Diagram by Brina Schrenk

The blocks A and B are connected by a light, massless cord and ride in frictionless grooves along the tower.

Block A weighs 10 pounds = W_A

Block B weighs 30 lb = W_B

What is the speed of each block after block A moves 6 feet up along the plane, after they are released from rest.

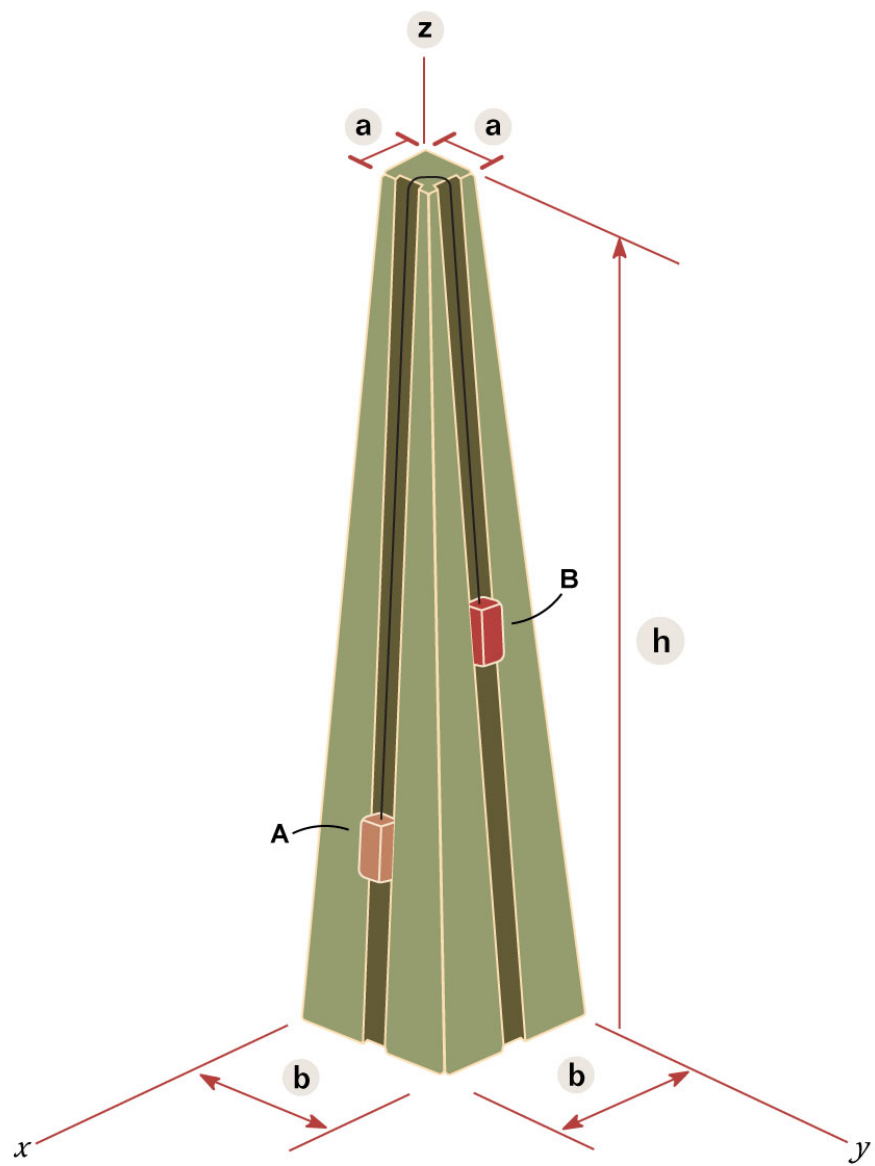
On the diagram

$a = 1$ ft

$b = 3$ ft

$h = h$ tower = 15 feet

$d =$ distance up = 6 feet



Solution

First you need to get the height change, along z to find the change in gravitational potential energy

Do the ratio of d = 6 feet up a tilted tower that is h = 15 feet tall in total

$$d / z = (h^2 + b^2)^{1/2} / h$$

$$6 / z = (15^2 + 2^2)^{1/2} / 15$$

$$z = (d h) / (h^2 + b^2)^{1/2}$$

$$z = 5.9474 = 5.95 \text{ ft}$$

Law of conservation of energy

T = kinetic and V = gravitational potential energy

$$T_1 + V_1 = T_2 + V_2$$

$T_1 = 0$ as it starts from rest

$V_1 = 0$ as we take $h = 0$ at the start of the motion

The masses move together so the v is the same

Weight of A is in pounds so you must convert to slugs. $10 \text{ lb} / 32.2 \text{ ft/s}^2$

$$0 = \frac{1}{2} (W_A/32.2)v_2^2 + \frac{1}{2} (W_B/32.2)v_2^2 + (W_A)(5.95 \text{ ft}) - (W_B)(5.95 \text{ ft})$$

A goes up 5.95 ft, and B goes down 5.95 ft.

$$0 = \frac{1}{2} (W_A/32.2)v_2^2 + \frac{1}{2} (W_B/32.2)v_2^2 + (W_A)(5.95 \text{ ft}) - (W_B)(5.95 \text{ ft})$$

$$v_2^2 = 2 (W_B)(5.95 \text{ ft}) - 2(W_A)(5.95 \text{ ft}) / (W_A/32.2 + W_B/32.2)$$

$$v_2^2 = 64.4 ((W_B)(5.95 \text{ ft}) - (W_A)(5.95 \text{ ft}) / (W_A + W_B))$$

$$V_2 = 13.841 = 13.8 \text{ ft/s}$$

