

FUN WITH FUNDAMENTALS

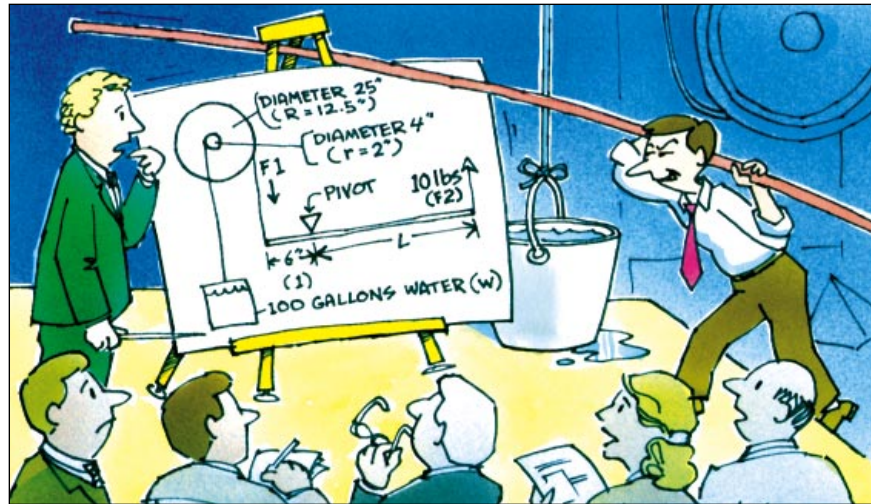
Leveraged buyout

Problem 160 — Getting the short end of the stick can have weighty consequences, as this month's problem by Peter Master-son of Newmarket, N.H., demonstrates.

"Why, it'll be no trouble at all," sang Fin-nagel J. Wurme. The occasion was a client demonstration of the Lee Key Hy-draulic Co.'s new pulleys. Lucius Bluff had constructed a mechanism (see fig-ure) on which he would apply a 10-lb up-ward force to lift 100 gal water. Wurme had offered to make the lever for the ap-paratus.

The day of the demonstration dawned. Wurme was seized with a violent fit of hiccups as he handed the 40-ft long lever to Bluff.

The diameter of the large pulley is 25 ft, and the diameter of the small, 4 ft. Neg-lect stresses and bending in the lever, and the lever's weight. Take 8.336 lb as the weight of 1 gal water. Also neglect the weight of the bucket and frictional forces in the pulley. If the pivot is 6 ft from the



end of the lever to which the pulley rope is attached, what should be the distance from the pivot to where the 10-lb force is applied? Will a 40-ft lever suffice?

Send your answer to:

Fun with Fundamentals
POWER TRANSMISSION DESIGN

Penton Publishing
1100 Superior Ave.
Cleveland, OH 44114-2543

Deadline is May 10! Good luck!

*Technical consultant: Jack Couillard,
Menasha, Wis.*

Solution to last month's problem 159

— You are an expert on target marketing if you answered **143 ft**. Here are the logistics:

We know the velocity of the buckets is 30 fps. Since $\text{Velocity} \times \text{Time} = \text{Distance}$, in order to find the distance the bucket must be from the point under the target, we need to know the total time from the firing of the slingshot to when the ball hits the belt. Let:

t_1 = Time pellet takes to hit target

v_o = Initial velocity of pellet, given as 130 fps

x = Horizontal component of distance pellet travels from gun to target, given as 250 ft

θ = Angle of slingshot from horizontal, given as 35 deg

Using the equations of motion for an unresisted projectile:

$$x = v_o(\cos\theta)t_1$$

$$t_1 = 2.54 \text{ sec}$$

Next we must find the time the ball takes to hit the conveyor belt. Let:

t_2 = Time from release of ball to when it strikes the conveyor belt, sec

s = Distance from target to conveyor belt, given as 80 ft

g = Acceleration due to gravity, given as 32.16 ft/sec²

Here we use the equations for motion of a falling body:

$$s = \left(\frac{1}{2}\right)gt_2^2 + v_0t + c$$

where:

v_o = Initial velocity, 0 fps

$c = 0$, since our reference is the starting point

Solving for t_2 , we get:

$$t_2 = \sqrt{\frac{2(80 \text{ ft})}{32.16 \text{ ft/sec}^2}}$$

$$= 2.23 \text{ sec}$$

The total time is $t_1 + t_2$, or 4.77 sec. The distance the bucket must be is 30 fps \times 4.77 sec = **143 ft**. Fibber McYack's prize turnover is almost nonexistent!

Contest winner — Congratulations to Gunnar Wik of Fremont, Calif., who won our February contest by having his name drawn from the 313 correct responses out of a total of 338 for that month. A TI-68 calculator is in the mail to him.

The TI-68 Advanced Scientific Calculator by Texas Instruments can solve five simultaneous equations with real and complex coefficients and has 40 number functions that can be used in both the rectangular and polar coordinate systems. Other functions include formula programming, integration, and polynomial root finding. The calculator also features a last-equation replay function that lets you double-check your work.



To enter the contest, send your answer on a postcard or letter to POWER TRANSMISSION DESIGN, 1100 Superior Ave., Cleveland, OH 44114-2543.

You can also receive a TI-68 and credit in the magazine if you send in an *original* problem with solution, and we publish it.