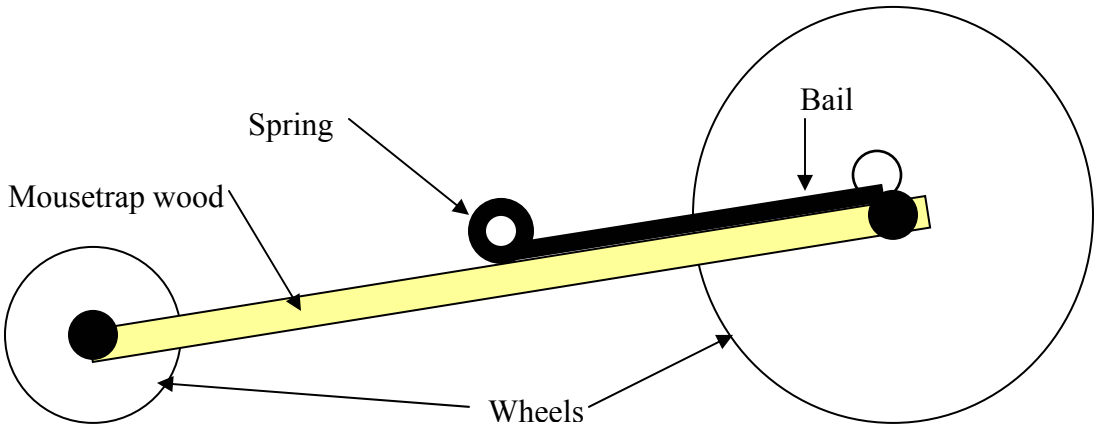
Mouse Trap Math



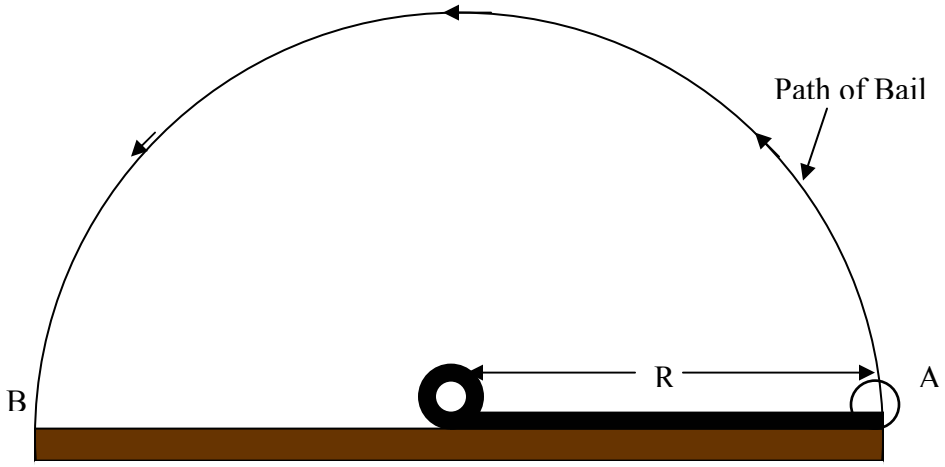
Basic Math:
Diameter (D) = 2 x R
Circumference (C) = πd
Radius (R)= ½ d

In mousetrap terms:
Radius = length of bail
Or = length from center of wheel to rim
One wheel turn = circumference

Initial Rotation

The changes in distance of the bail from initial point A → B.

Figure 1



Thus, distance change of a string from point A→ B is simply the diameter of the circle shown.

Find the length the string is pulled if the bail is:

A) 2 in. _____
B) 4.2 cm _____
C) 3.11 mm _____
D) 5.2 cm _____

How does the length of the bail affect the distance a mousetrap car runs?

How far will the Mousetrap go?

What is the change of bail distance from A → B? _____ (2 x R)
What is the diameter of the axle connected to string? _____ (d_1)
What is the diameter of the wheel connected to the axle? _____ (d_2)

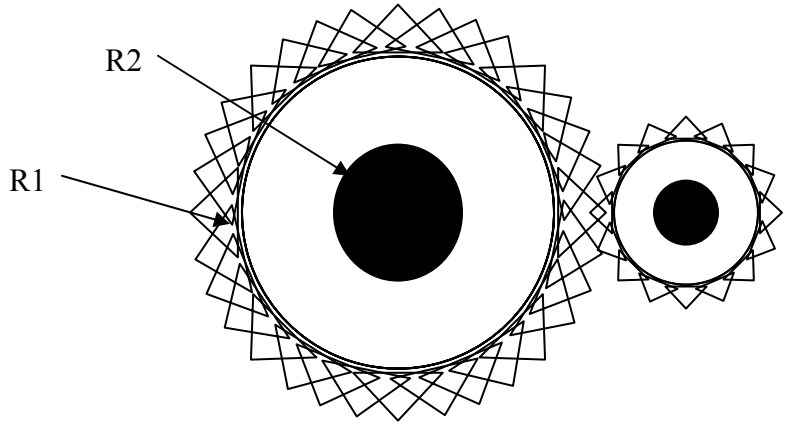
The approximate distance (M) the mousetrap will go is found using the following equation:

$M=(d_2/d_1) \times 2 \times R$

Calculate your M with the materials given.

Amplifying Mousetrap distance

Figure 2



Gears allow for either an increase of decrease in the amount of rotations onto another gear. The rate (speed) at which gears rotate is given as angular rotation (ω).

To determine the amplification we use a ratio as shown

$$\text{Circumference}_1 \times \omega_1 : \text{Circumference}_2 \times \omega_2$$
$$\pi D_1\omega_1 : \pi D_2\omega_2$$
Gears have the same rotation, therefore → $\omega_1 = \omega_2$
$$2\pi R_1\omega_1 : 2\pi R_2\omega_2$$
$$R_1 : R_2 \text{ or } D_1 : D_2$$

Find the ratios of the following gears if:

R_1 = 10 mm R_2 = 5mm Ratio _____:_____

R_1 = .3 in R_2 = .1 in Ratio _____:_____

R_1 = 75 mm R_2 = 5 mm Ratio _____:_____

R_1 = 12 mm R_2 = 2 mm Ratio _____:_____

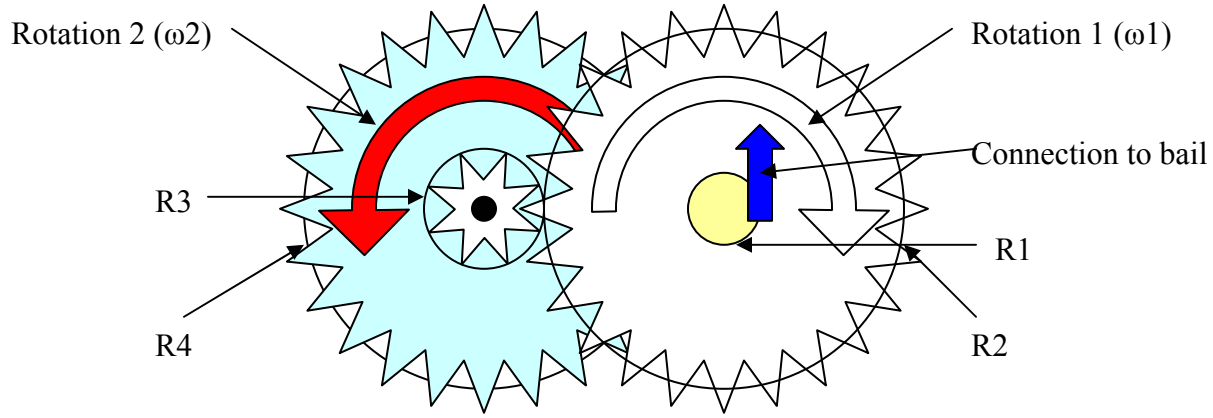
R_1 = 3 ft R_2 = 6 in Ratio _____:_____

R_1 = 1.12 in R_2 = .08 in Ratio _____:_____

Transferring the velocity of gears

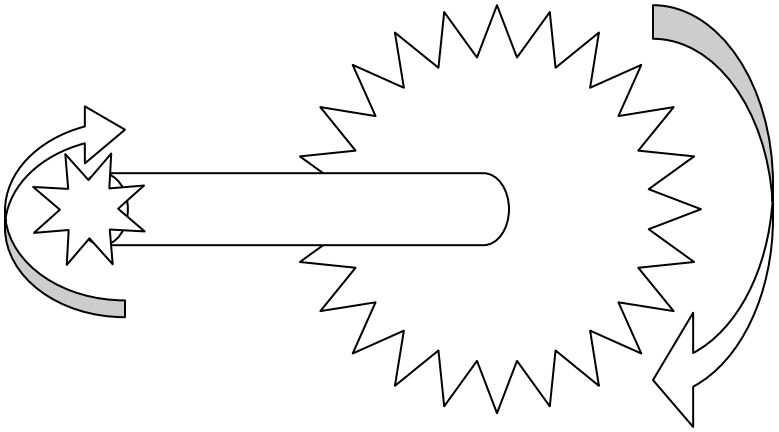
There is one simple rule; the rotation of one gear is proportional to the ratio of gear size of one gear to another.

Figure 3



Let's look at the piece-by-piece portions of a gear.

If the driving force is connected to the smaller radius and is connected to the same shaft/axel to a larger radius gear/wheel, the rotation distance is amplified.



If the driving force is transferred from the bigger wheel to the smaller wheel, then the rotational distances are equal.

$C = 2\pi R_{big} = 2\pi R_{small}$

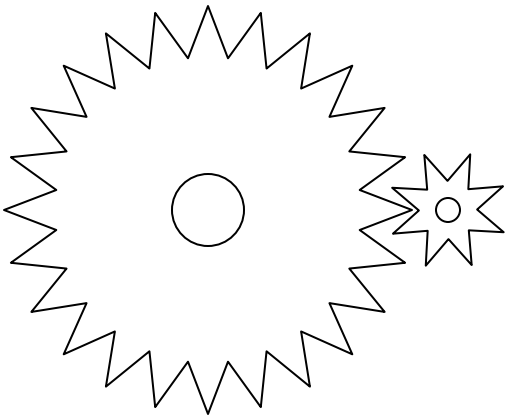
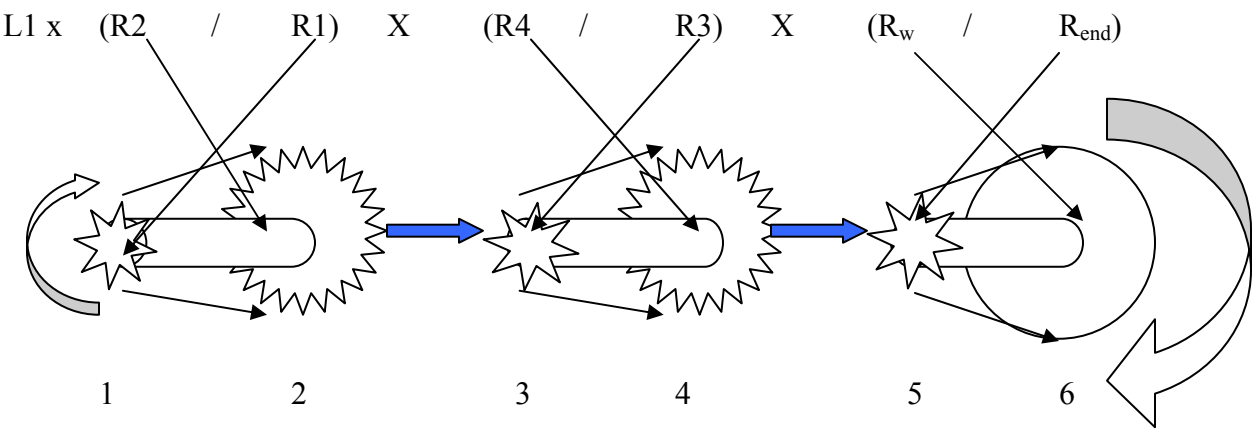


FIGURE 3.1



From the figure above, the mousetrap starts and rotates the length of the movement of the mousetrap bail L1.

So the change in distance of the bail is equal to the movement of R1.
R1 is amplified to R2
The distance R2 moves equals the distance of R3
The distance of R3 is amplified to R4
The distance R4 moves equals to the distance of R5
R5 is amplified to the radius of the wheels.

If you use the following values, what is the final distance?
Length of bail is 4 in.
R1 = .1 in, R2 = .5in, R3 = .2 in, R4 = .6in, R5 = .1 in
wheel radius = 2 in

Final Distance?

Hint: Find the change of bail distance first and work your way through.