

Condition:

By trial and error, a frog learns that it can leap a maximum horizontal distance of 1.5 m. If, in the course of an hour, the frog spends 33% of the time resting and 67% of the time performing identical jumps of that maximum length, in a straight line, what is the distance traveled by the frog?

Solution:

Let's find time per jump = T.

Frog's leap can be considered as a motion of projectile. For a maximum horizontal distance frog must leap at angle of 45° to horizontal. So,

$$\text{time per jump } T = \frac{2v_y}{g},$$

horizontal distance $S = v_x T$ and $v_x = v_y$ for angle of 45°

$$\text{We have } T = \frac{2v_y}{g} = \frac{2v_x}{g} = \frac{2S}{gT} \rightarrow T = \sqrt{\frac{2S}{g}} = \sqrt{2 * \frac{1.5}{9.8}} = 0,55 \text{ s}$$

Jumps per hour if jumping 100% of the time = $\frac{60min}{T}$

Total distance per hour if jumping 100 % of the time = (Jumps per hour) x (distance per jump)
 $= \left(\frac{60min}{T}\right) * (1.5m)$

Now multiply this quantity by 67% (since the frog jumps only 67% of the time)

$$\text{So, total distance} = 0.67 * \left(60 \frac{min}{T}\right) * (1.5m) = 0.67 * \left(\frac{3600s}{0,55s}\right) * 1.5m = 6578m \approx 6.6 \text{ km}$$

Answer: total distance \approx 6.6 km.