

**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  $45^\circ$  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  $45^\circ$

$$\text{We have } T = \frac{2v_y}{g} = \frac{2v_x}{g} = \frac{2S}{gT} \rightarrow T = \sqrt{\frac{2S}{g}} = \sqrt{2 * \frac{1.5}{9.8}} = 0.55 \text{ s}$$

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

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

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

$$\text{So, total distance} = 0.67 * \left(60 \frac{\text{min}}{T}\right) * (1.5m) = 0.67 * \left(\frac{3600\text{s}}{0.55\text{s}}\right) * 1.5m = 6578m \approx 6.6 \text{ km}$$

**Answer: total distance  $\approx 6.6 \text{ km}$ .**