An archer shoots an arrow straight up from a 150 ft-high cliff. The velocity of the arrow as it leaves the bow is 240 ft/sec. Discounting air resistance:

Q1. How high does the arrow go?

Q2. How long does it take to reach maximum height?

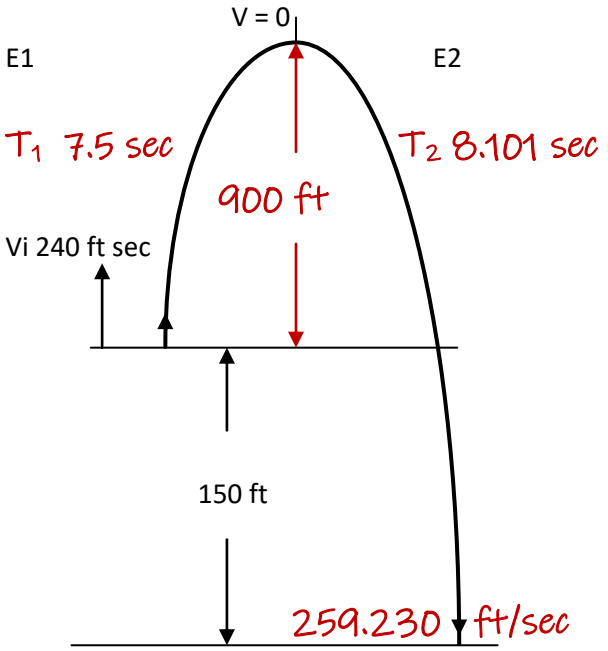
Q3. How long does it take to reach the ground 150 feet below?

Q4. How fast is the arrow travelling when it hits the ground?

Solutions:

Guide:

① **ALWAYS** draw picture 1st:



② **Q1**: How high does the arrow go?

E1:

$V_i = 240$

$V_f = 0$

$a = -32$

$s = ?$

$t = \otimes$

$$s = \frac{V_f^2 - V_i^2}{2a} = \frac{(0^2) - (240^2)}{2(-32)}$$

$$= \frac{-57600}{-64} = \textbf{900 ft}$$

③ **Q2**: How long does it take to reach maximum height?

E1:

$V_i = 240$

$V_f = 0$

$a = -32$

$s = \otimes$

$t = ?$

$$t_{E1} = \frac{V_f - V_i}{a} = \frac{0 - 240}{a - 32} = \textbf{7.5 sec}$$

④ **Q3.** How long does it take to reach the ground 150 feet below?

(Time of E1 + time of E2)

E2:

$V_i = 0$

$V_f = \otimes$

$a = 32$

$s = 900 + 150 = 1050$

$t = ?$

$$t_{E2} = \sqrt{\frac{s}{.5a}} = \sqrt{\frac{1050}{.5(32)}} = \sqrt{\frac{1050}{16}} =$$

$$\sqrt{65.625}$$

$= 8.101$ sec

$+ t_{E1}$ 7.500 sec = **15.601 sec**

⑤ **Q4.** How fast is the arrow travelling when it hits the ground?

E2:

$V_i = 0$

$V_f = ?$

$a = 32$

$s = 900 + 150 = 1050$

$t = \otimes$

$V_f = \sqrt{V_i^2 + 2as} = \sqrt{0^2 + 2(32)(1050)} =$

$\sqrt{67200}$ = **259.230 ft/sec**