Start with y'' = -300000 / y^2.

With the substitution, this becomes v * v' = -300,000 / y^2

Integrate both sides and we get v^2 = 600,000 / y + C

Using v(6400) = 9, we can solve for C:

In[28]:= `9 ^ 2 - 600 000 / 6400`

Out[28]= $-\frac{51}{4}$

In[29]:= `N[%]`

Out[29]= -12.75

So (y')^2 = 600,000 / y - 12.75

In solving (b), we know that y' = 0 at the maximum, so solving for y we get:

In[30]:= `4 * 600 000 / 51`

Out[30]= $\frac{800\,000}{17}$

In[31]:= `N[%]`

Out[31]= 47 058.8

We know y' > 0 before the maximum value of y. Thus y' = sqrt((600,000 - 12.75 * y) / y)

Then y' * sqrt(y / (600,000 - 12.75 y))= 1.

We integrate both sides with respect to t from t = 0 to t = t_0, where t_0 is the time where the squirrel is furthest. Using substitution, the left hand side is then integrated from y = 6400 to y = 47,058, and the righthand side is equal to t_0:

In[46]:= `Integrate[Sqrt[y / (600 000 - 51 * y / 4)], {y, 6400, 800 000 / 17}]`

Out[46]= $\frac{12\,800}{867}\left(306 + 125\sqrt{51}\,\text{ArcSec}\left[5\sqrt{\frac{5}{17}}\right]\right)$

In[47]:= `N[%]`

Out[47]= 20 241.6