Answer on Question 55001, Physics, Mechanics | Kinematics | Dynamics

Question:

Launched from the ground, a rocket accelerates vertically upward at $4.6\,m/s^2$. It passes through a band of clouds $5.3km$ thick, extending upward from an altitude of $1.9km$. How long is it in the clouds?

Solution:

Let's first find the time when the rocket enters the clouds. Because the initial velocity of the rocket $v_0 = 0$ (the rocket launched from rest) we can write:

$$y_1 = \frac{1}{2}at_1^2,$$

where, y_1 is the height from which the rocket enters the clouds, a is the acceleration of the rocket and t_1 is the time when the rocket enters the clouds.

From this formula we can calculate t_1:

$$t_1 = \sqrt{\frac{2y_1}{a}} = \sqrt{\frac{2 \cdot 1.9 \cdot 10^3 m}{4.6\frac{m}{s^2}}} = 28.7s.$$

Then, we can find the time when the rocket leaves the clouds from the same formula:

$$y_2 = \frac{1}{2}at_2^2,$$

where, y_2 is the height from which the rocket leaves the clouds, a is the acceleration of the rocket and t_2 is the time when the rocket leaves the clouds.

So, we can calculate t_2:

$$t_2 = \sqrt{\frac{2y_2}{a}} = \sqrt{\frac{2 \cdot (1.9 \cdot 10^3 m + 5.3 \cdot 10^3 m)}{4.6\frac{m}{s^2}}} = 56.0s.$$

Finally, we can find the time spent in the clouds:

$$t = t_2 - t_1 = 56.0s - 28.7s = 27.3s.$$

Answer: $t = 27.3s$.