Question

Catapulting mushrooms. Certain mushrooms launch their spores by a catapult mechanism. As water condenses from the air onto a spore that is attached to the mushrooms, a drop grows on one side of the spore and a film grows on the other side. The spore is bent over by the drop's weight, but when the film reaches the drop, the drop's water suddenly spreads into the film and the spore springs upward so rapidly that it is slung off into the air. Typically, the spore reaches a speed of 1.70 m/s in a 5.40 μm launch; its speed is then reduced to zero in 1.20 mm by the air. Using the data and assuming constant acceleration, find the acceleration in terms of g during (a) the launch and (b) the speed reduction.

Solution

a) v = 1.70 m/s; l = 5.40 μm = 5.4*10^{-6} m; a – ?

$v = v_f$; $v_i = 0$.

$$\begin{cases} l = \dfrac{at^2}{2} \\ v_f = v_i + at \end{cases}$$

$$\begin{cases} l = \dfrac{at^2}{2} \\ v = at \end{cases}$$

$$l = \frac{vt}{2}; \quad t = \frac{2l}{v}; \quad v = at = a\frac{2l}{v};$$

$$a = \frac{v^2}{2l} = \frac{1.7^2}{2*5.4*10^{-6}} \text{ m/s}^2 \approx 267\,592 \text{ m/s}^2.$$

In terms of g: $\mathbf{a_{g1}}$ = a/g = 267 592/9.81 = **27 277 g**

b) v = 1.70 m/s; l = 1.2 mm = 1.2*10^{-3} m ; a – ?

$v = v_i$; $v_f = 0$.

$$\begin{cases} l = \dfrac{at^2}{2} \\ v_f = v_i - at \end{cases}$$

$$\begin{cases} l = \dfrac{at^2}{2} \\ v = at \end{cases}$$

$$l = \frac{vt}{2}; \quad t = \frac{2l}{v}; \quad v = at = a\frac{2l}{v};$$

$$a = \frac{v^2}{2l} = \frac{1.7^2}{2*1.2*10^{-3}} \text{ m/s}^2 \approx 1\,200 \text{ m/s}^2.$$

In terms of g: $\mathbf{a_{g2}}$ = a/g = 1200/9.81 ≈ **122 g**

Answer

a) a_{g1} = 27 277 g ; **b) a_{g2} = 122 g.**