A parachutist drops from a height of 3.1×10^3 m and falls freely for 10 s. She then opens her parachute, and for the next 20 s slows down uniformly at 4.5 m/s^2. After that, she falls the rest of the distance to the ground at a uniform velocity.

How long is she in the air?

Part 1:

$v_i = 0$

$a = 9.8\ m/s^2$ [down]

$\Delta t = 10\ s$

$v_f = ?$

$\Delta d = ?$

$v_f = v_i + a\Delta t$

$= 0 + (-9.8)(10)$

$= -98$

$v_f = 98\ m/s$ [down]

$\Delta d = v_i \Delta t + \frac{1}{2} a (\Delta t)^2$

$= \frac{1}{2}(-9.8)(10)^2$

$= -490$

$\Delta d = 490\ m$ [down]

Part 2

$v_i = 98\ m/s$ [down]

$a = 4.5\ m/s^2$ [up]

$\Delta t = 20\ s$

$v_f = ?$

$\Delta d = ?$

$v_f = v_i + a\Delta t$

$= -98 + 4.5(20)$

$= -8$

$v_f = 8\ m/s$ [down]

$\Delta d = v_i \Delta t + \frac{1}{2} a (\Delta t)^2$

$= -98(20) + \frac{1}{2}(4.5)(20)^2$

$= -1060$

$= 1060\ m$ [down]

Part 3

$v = 8\ m/s$

$\Delta d = ?$

$\Delta t = ?$

$\Delta d = 3.1 \times 10^3 - (490 + 1060)$

$= 3100 - 1550$

$= 1550$

$v = \frac{\Delta d}{\Delta t}$

$\Delta t = \frac{1550}{8} = 193.75$

Total time $= 10 + 20 + 193.75$

$= 223.75\ s$