

Physics Rocket Problem

Engine Burning $t = 4s$

$$a = (-1.2t^2 + 15) \text{ m/s}^2 \quad x_0 = 0 \text{ m}$$

$$t_E = 4.0 \text{ s}$$

$$V_0 = 0 \text{ m/s}$$

$$x = 94.4 \text{ m}$$

$$t = 4 \text{ s}$$

$$v = 34.4 \text{ m/s}$$

○ = Found

$$a = \frac{dv}{dt}$$

$$\Delta v = \int_0^4 a(dt)$$

$$\Delta v = \int_0^4 (-1.2t^2 + 15) dt$$

$$\Delta v = [-0.4t^3 + 15t]_0^4$$

$$\Delta v = V_f - V_0 = V - 0 = V$$

$$V = [-0.4t^3 + 15t]_0^4$$

$$V = -0.4t^3 + 15t$$

$$V = -0.4(4^3) + 15(4)$$

$$V = -25.6 + 60$$

$$V = 34.4 \text{ m/s}$$

$$\Delta x = \int_0^4 v(dt)$$

$$\Delta x = \int_0^4 (-0.4t^3 + 15t) dt$$

$$\Delta x = [-0.1t^4 + 7.5t^2]_0^4$$

$$\Delta x = X - X_0 = X - 0 = X$$

$$X = [-0.1t^4 + 7.5t^2]_0^4$$

$$X = -0.1(4^4) + 7.5(4^2)$$

$$X = -25.6 + 120$$

$$X = 94.4 \text{ m}$$

Free Fall (Upwards)

$$a = -9.8 \text{ m/s}^2$$

$$t = 3.51 \text{ s}$$

$$V_0 = 34.4 \text{ m/s}$$

$$X = 154.7755 \text{ m}$$

$$X_0 = 94.4 \text{ m}$$

$$V = 0 \text{ m/s}$$

○ = Found

$$V = V_0 + at$$

$$0 = 34.4 - 9.8t$$

$$-34.4 = -9.8t$$

$$3.51 = t$$

$$V^2 = V_0^2 + 2a\Delta x$$

$$0 = 1183.36 - 19.6\Delta x$$

$$-1183.36 = -19.6\Delta x$$

$$60.3755 \text{ m} = \Delta x$$

$$60.3755 \text{ m} + 94.4 \text{ m} = 154.7755 \text{ m}$$

Physics Rocket Problem

Freefall (Downward)

$$a = -9.8 \text{ m/s}^2$$

$$v_0 = 0 \text{ m/s}$$

$$v = 40.57585 \text{ m/s}$$

$$x_0 = 154.7755 \text{ m}$$

$$\Delta x = 84 \text{ m}$$

$$t = 4.1439 \text{ s}$$

$$x = 70.7755 \text{ m}$$

○ = Found

$$\Delta x = v_0 t + \frac{1}{2} a t^2$$

$$-84 = \frac{1}{2} (-9.8) t^2$$

$$-84 = -4.9 t^2$$

$$17.142 = t^2$$

$$4.14039 = t$$

$$v^2 = v_0^2 + 2 a \Delta x$$

$$v^2 = 2(-9.8)(84)$$

$$v^2 = -1646.4$$

$$v^2 = 1646.4$$

$$v = 40.57585 \text{ m/s}$$

$$3.81$$

$$4.14$$

$$7.65039$$

$$7.650597436$$

Freefall (Total) *Checking

$$t = 7.65039 \text{ s}$$

$$x_0 = 94.4 \text{ m}$$

$$x = 70.77551 \text{ m}$$

$$v_0 = 34.4 \text{ m/s}$$

$$v = 40.57585 \text{ m/s}$$

$$a = 9.8 \text{ m/s}^2$$

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

$$x = 94.4 + 34.4t + \frac{1}{2} (-9.8)t^2 \quad \leftarrow \text{Graphing Calculator to check}$$

Parachute!

$$t = 11.53874 \text{ s}$$

$$v_0 = -20(1 - e^{-t/8})$$

$$X = 0$$

$$a = 0$$

$$v = -20(1 - e^{-t/8})$$

$$x_0 = 70.77551 \text{ m}$$

$$v_p = -20(1 - e^{-t/8})$$

$$v_p = -20 + 20e^{-t/8}$$

$$v_p = \frac{dx}{dt} = \int -20 + 20e^{-t/8} \Big|_0^t$$

$$\Delta x = [-20t - 160e^{-t/8}]_0^t$$

$$\Delta x = -20t - 160e^{-t/8} - (-20(0) - 160e^{(0/8)})$$

$$\Delta x = -20t - 160e^{-t/8} + 160$$

$$0 = -160e^{-t/8} - 20t + 230.77551$$

$$t = 8.91323$$

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Physics Rocket Problem

Total Time

Engine Burning ——— 4.00000

Freefall (Upwards) ——— 3.51020

Freefall (Downwards) ——— 4.14039

Parachute ——— 8.91323

20.56382s

TO 4 SIGNIFICANT
FIGURES

20.56s