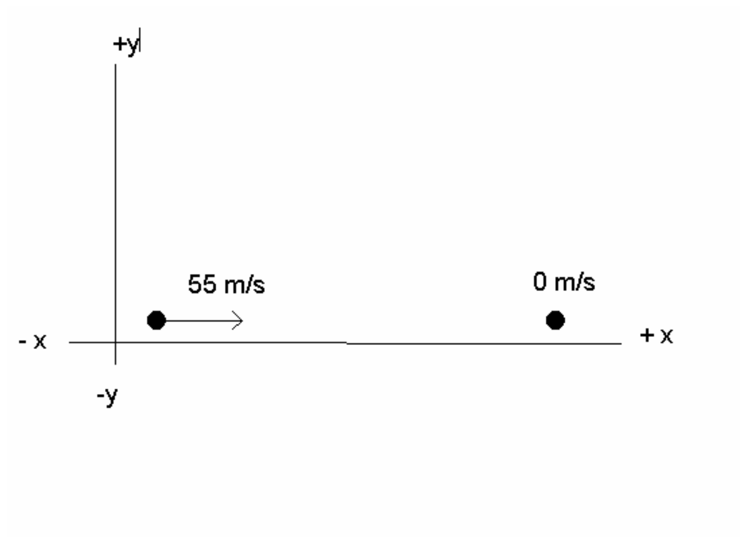
Physics 590 Homework, Week 2

Week 2, Homework 1

Prob. 2.1.1

A race car can be slowed with a deceleration of -11. m/s2. (a) If it is going +55. m/s, how many meters will it take to stop? (b) Repeat part (a) for a car going 110 m/s.

a) $v_f^2 = v_i^2 + 2ad$
v final = 0m/s
v initial = 55.m/s
a = -11m/s^2
d = ?



(o m/s)^2 = (55. m/s)^2 + 2(-11 m/s^2)d

0 = (3025 m^2/s^2) – 22 m/s^2 * d

(-3025 m^2/s^2) = - 22 m/s^2 * d

$\frac{(-3025 \text{ m}^2/\text{s}^2)}{(-22 \text{ m/s}^2)}$ = d → 137.5 m = d → **d= 1.4 x 10^2 m**

b) $v_f^2 = v_i^2 + 2ad$
v final = 0m/s
v initial = 110m/s
a = -11m/s^2
d = ?
(o m/s)^2 = (110 m/s)^2 + 2(-11 m/s^2)d

0 = (12100 m^2/s^2) – 22 m/s^2 * d

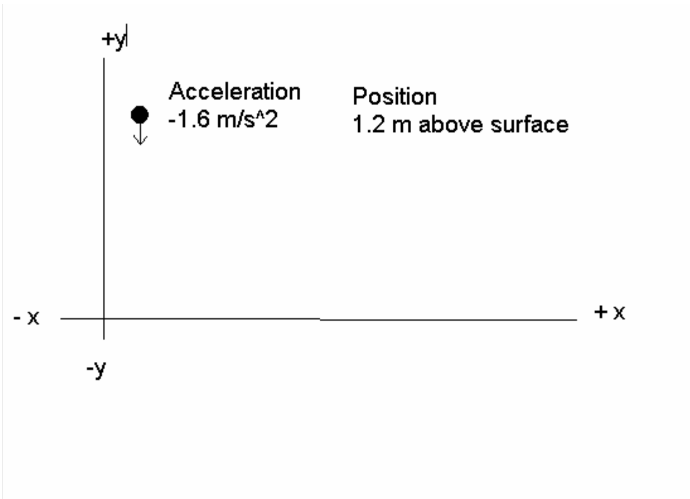
(-12100m^2/s^2) = – 22 m/s^2 * d

(-12100m^2/s^2) = d → 550 m = d →   **d= 5.5 x10^2 m**
– 22 m/s^2

Prob. 2.1.2

An astronaut dropped a feather from 1.2 m above the surface of the moon. If the acceleration of gravity on the moon is 1.6 m/s^2, how long did it take to hit the surface?

$d = v_i*t + 1/2at^2$
d = 1.2 m
a=1.6 m/s^2
v initial = 0 m/s
t = ?



1.2 m = (0 m/s)*t + ½(1.6 m/s^2) * t^2

1.2 m = ½(1.6 m/s^2) * t^2

(1.2 m)*2 = (1.6 m/s^2) * t^2

(2.4 m) = (1.6 m/s^2) * t^2

2.4 m = t^2
(1.6 m/s^2)

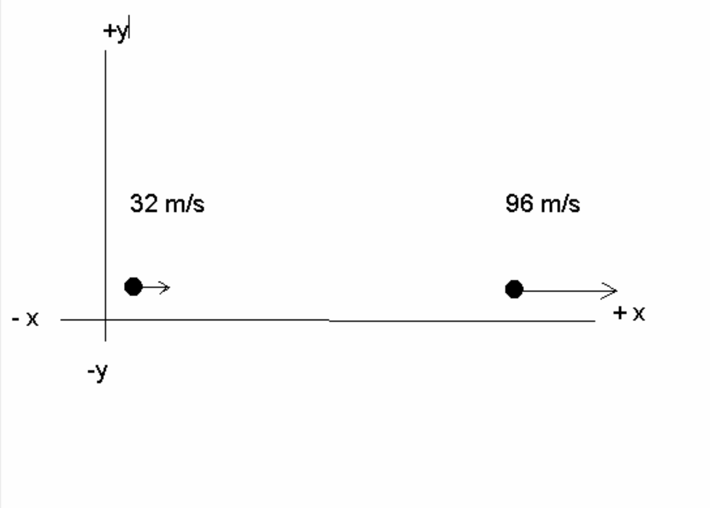
1.5 s^2 = t^2

1.2247 s = t →   **t = 1.2 x 10^0 s**

Prob. 2.1.3

Find the uniform acceleration that will cause an object's speed to change from 32. m/s to 96. m/s in an 8.0 s period.

$v_f = v_i + at$
v final = 96 m/s
v initial = 32 m/s
t = 8.0 s
a= ?



96 m/s = 32 m/s + a(8.0 s)

96 m/s – 32 m/s = a(8.0 s)

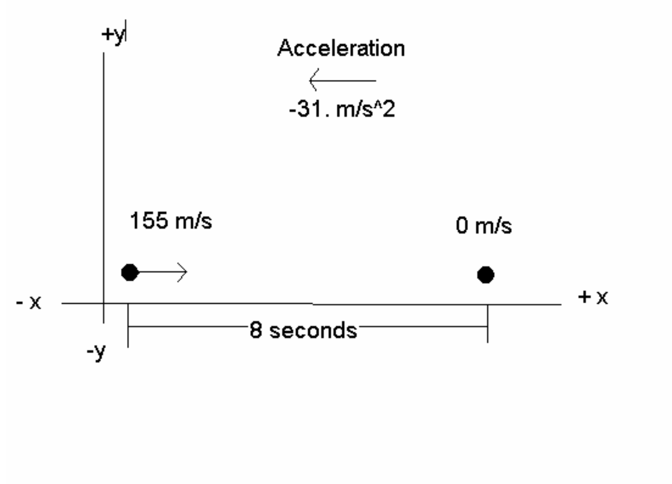
64 m/s = a(8.0 s)

$\frac{64 \text{ m/s}}{8.0 \text{ s}} = a$ → **a = 8.0 x 10^0 m/s^2**

Prob. 2.1.4

A rocket traveling at +155. m/s is decelerated at a rate of −31. m/s2. (a) How long will it take before the instantaneous speed is 0 m/s? (b) How far will it travel during this time? (c) What will be its velocity after 8.0 s?

a) $v_f = v_i + at$
v initial = 155 m/s
v final = 0 m/s
a = -31 m/s^2

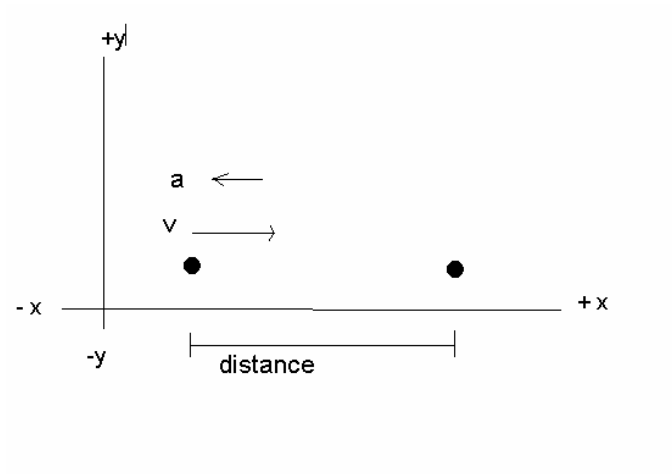


0 m/s = 155 m/s + (-31 m/s^2) * t
-155 m/s = (-31 m/s^2) * t

$$\frac{155 \text{ m/s}}{(-31 \text{ m/s}^2)} = t$$

5 s = t → **t = 5.0 x 10^1 s**

b) $d = \dfrac{v_i + v_f}{2} * t$



v initial = 55 m/s
v final = 0m/s
t = 5.0 s

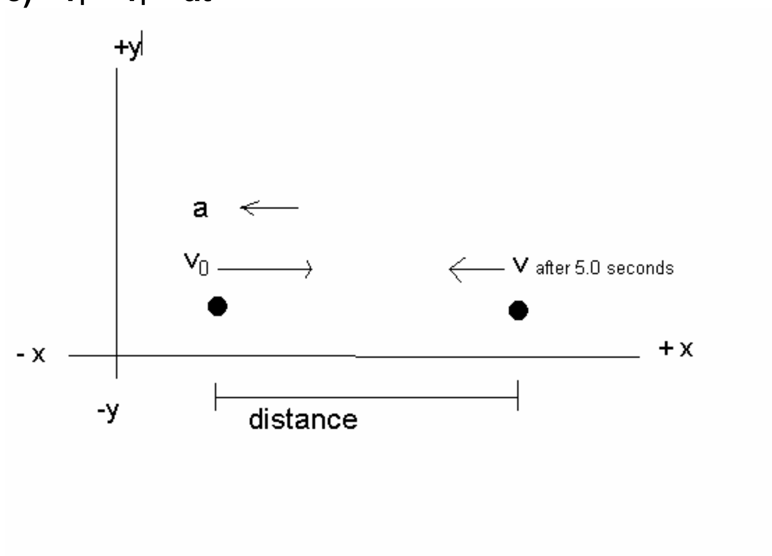
$$d = \frac{(155 \text{m/s}) + (0 \text{ m/s})}{2} * 5.0 \text{ s}$$

$$d = \frac{(155 \text{ m/s})}{2} * 5.0 \text{ s}$$

d = 77.5 m/s * 5.0 s

d = 387.5 m → **d = 3.9 x 10^2 m**

c) $v_f = v_i + at$



v initial = 155 m/s
a= -31 m/s^2
t = 8.0 s

v final = 155 m/s + (-31 m/s^2)(8.0 s)

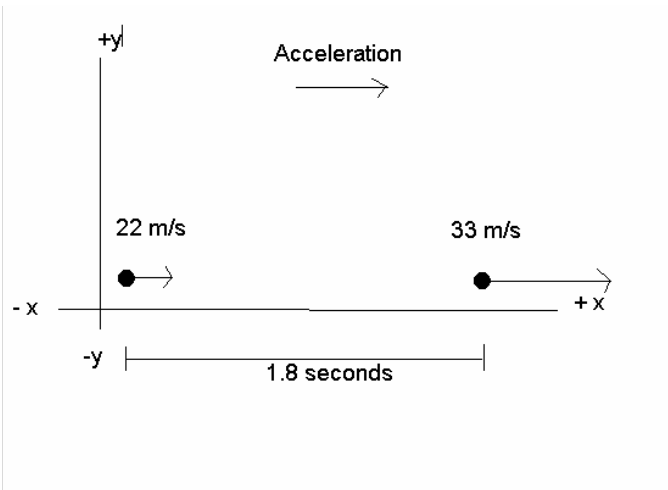
v final = 155 m/s – 248 m/s

v final = -9.3 x 10^1m/s

prob. 2.1.5

A car with a velocity of 22. m/s is accelerated uniformly at the rate of 1.6 m/s^2 for 6.8 s. What is its final velocity?

$v_f = v_i + at$
v initial = 22 m/s
a = 1.6 m/s^2
t = 6.8 s



v final = 22 m/s + (1.6 m/s^2)(6.8 s)

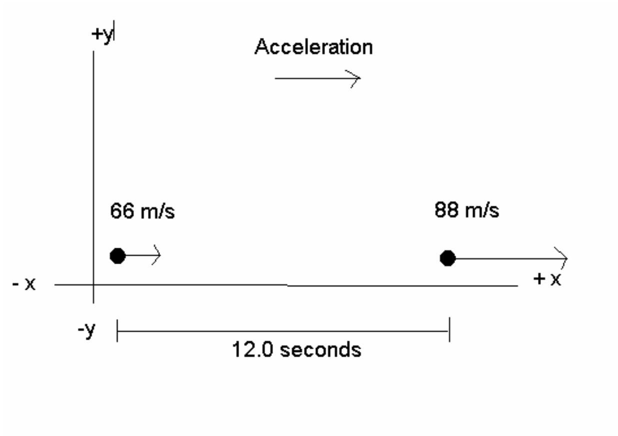
v final = 22 m/s + 10.88 m/s

v final = 32.88 m/s → **v final = 3.3 x 10^1m/s**

Prob. 2.1.6

Determine the displacement of a plane that is uniformly accelerated from 66. m/s to 88. m/s in 12.0 s.

First solve for the acceleration with the formula $v_f = v_i + at$
v final = 88. m/s
v initial = 66.m/s
t= 12.0 s



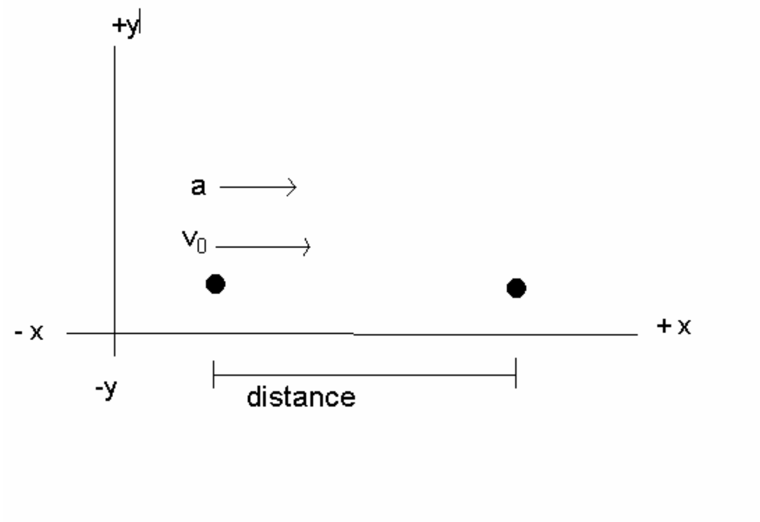
88 m/s = 66 m/s + a(12.0 s)

22m/s = a(12.0 s)

1.8 m/s^2

Use the acceleration that was solved for in the previous section in the following formula: $d = v_i * t + 1/2\, at^2$

v initial = 66.m/s
t= 12.0 s
a = 1.8 m/s^2



d = (66. m/s)(12.0 s) + ½ (1.8m/s^2)(12.0 s)^2

d = 792 m + ½(1.8 m/s^2)(144 s^2)

d = 792 m + 129.6 m

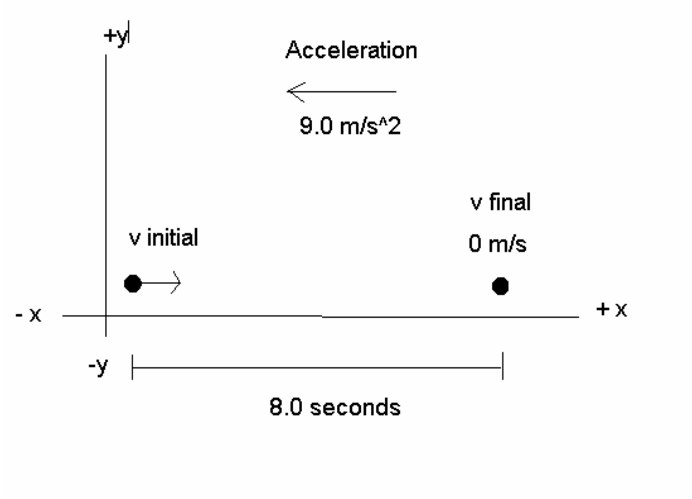
d = 921.6 m → **d = 9.2 x 10^2 m**

Prob. 2.1.7

A car comes to rest after uniform deceleration at the rate of 9.0 m/s^2 for 8.0 s. What distance does it travel during this time?

In order to solve for distance, v initial needs to be solved for first by using the formula: $v_f = v_i + at$

v final = 0 m/s
a = 9.0 m/s^2
t = 8.0 s

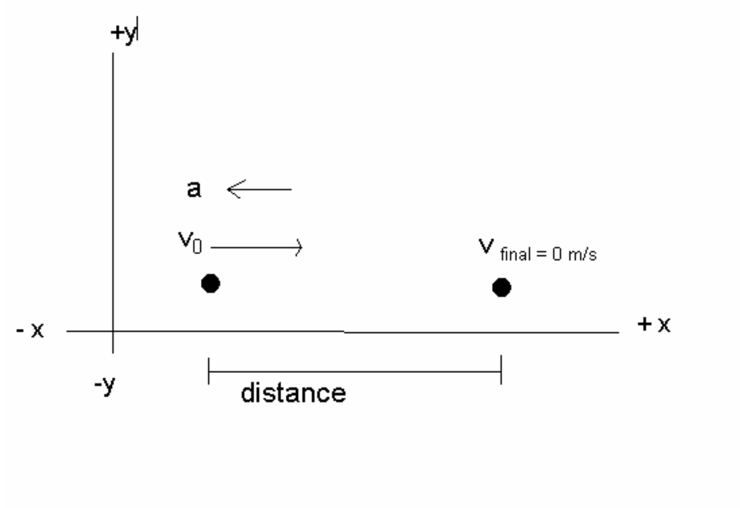


0 m/s = v initial + (-9.0 m/s^2)(8.0 s)

v initial = - (-9.0 m/s^2)(8.0 s)

v initial = 72 m/s

Now that I have v initial; I will use it in the formula: $d = v_i * t + 1/2\ at^2$
To solve for distance



d = (72 m/s)(8.0 s) + 1/2(-9.0 m/s^2)(8.0 s)^2

d = 576 m + (-4.5 m/s^2)(64 s^2)

d = 576m - 288 m

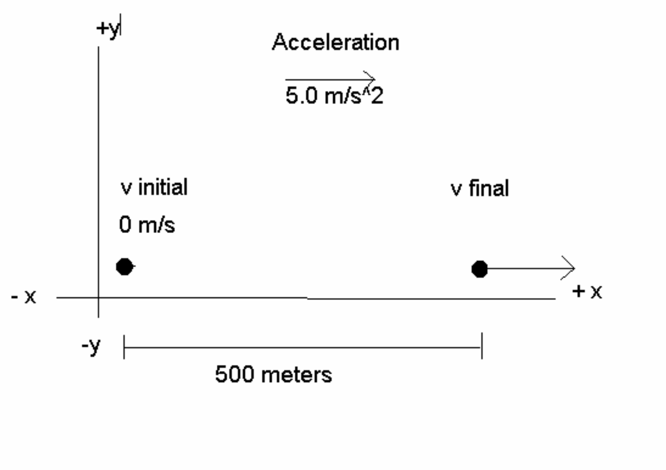
d = 288 m → **d = 2.9 x 10^2 m**

Prob. 2.1.8

A plane travels a distance of 5.0 × 102 m while being accelerated uniformly from rest at the rate of +5.0 m/s2. What final speed does it attain?

$$\mathbf{v_f^2 = v_i^2 + 2ad}$$

v initial = 0 m/s
a = +5.0 m/s^2
d = 5.0 x 10^2 m



v_f^2 = (0 m/s)^2 + 2(5.0 m/s^2)(5.0 x 10^2 m)

v_f^2 = (10.0 m/s^2)(5.0 x 10^2 m)

v_f^2 = 50.0 x 10^2 m^2/s^2

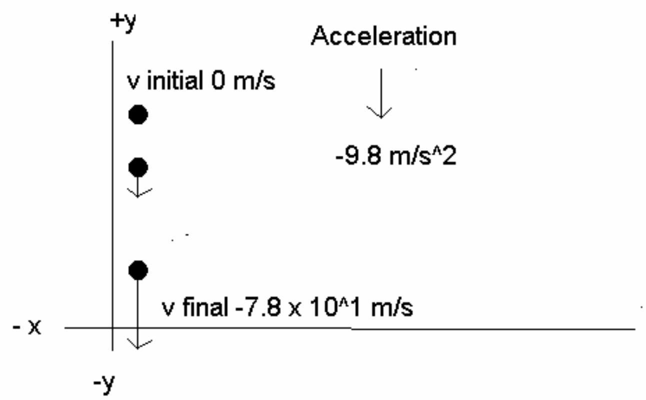
v final = 70.7107 m/s → **V final = 7.1 x 10^1m/s**

Prob. 2.1.9

A stone falls freely from rest for 8.0 s. (a) Calculate its final velocity. (b) What distance does the stone fall during this time?

a) $\mathbf{v_f = v_i + at}$

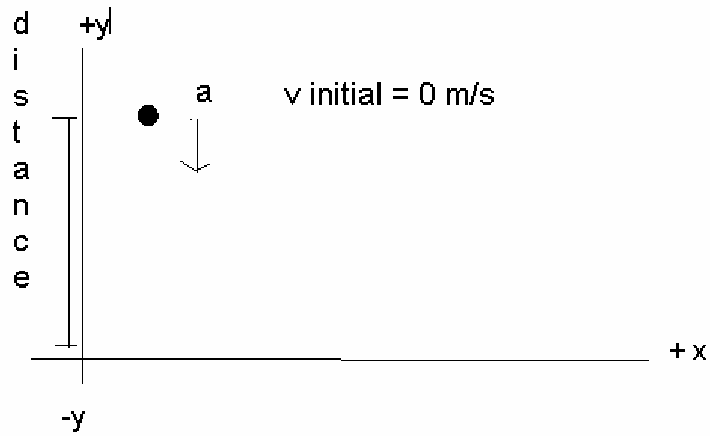
v initial = 0 m/s
a = 9.8 m/s^2
t = 8.0 s



v final = 0 m/s + (-9.8 m/s^2)(8.0 s)

v final = -78.4 m/s → **V final = -7.8 x 10^1 m/s**

b) distance d= (v final – v initial)/2 * time



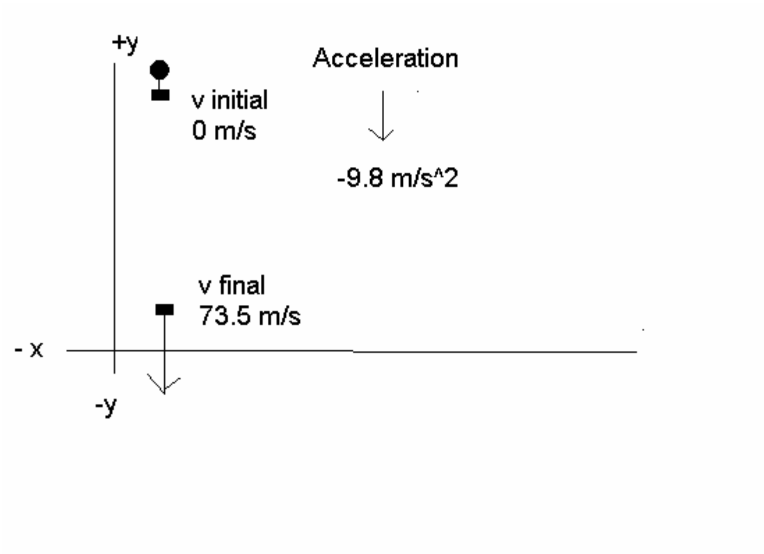
(780 m/s – 0 m/s)/2 * 8.0 s = 310 m. **distance = 3.1 x 10^2 m**

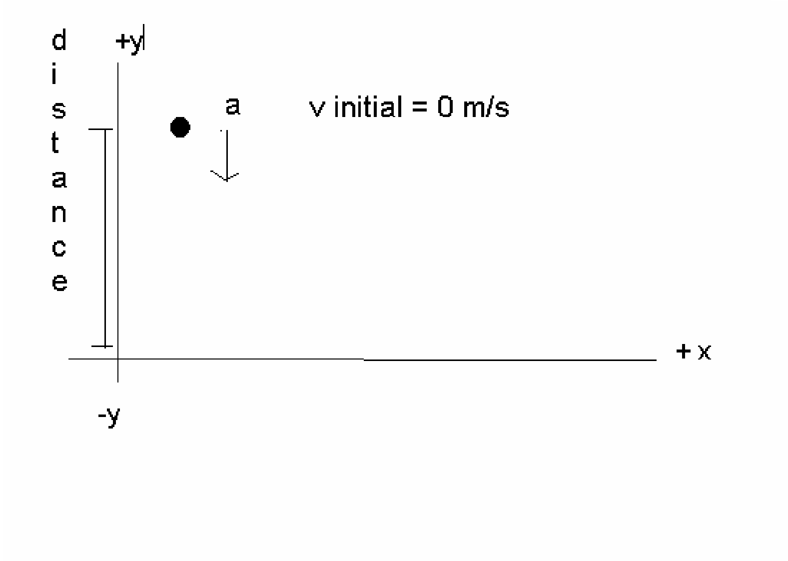
Prob. 2.1.10

A weather balloon is floating at a constant height above the earth when it releases a pack of instruments. (a) If the pack hits the ground with a speed of -73.5 m/s, how far does the pack fall? (b) How long does the pack fall?

a) $v_f^2 = v_i^2 + 2ad$

v initial = 0 m/s
v final = 73.5 m/s
a = 9.8 m/s^2





$(0\ m/s)^2 = -(73.5\ m/s)^2 + 2(-9.8\ m/s^2)d$

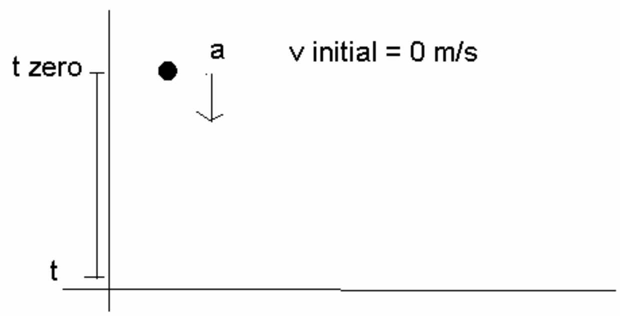
$(0\ m/s)^2 = -5402.25\ m^2/s^2 + (-19.6\ m/s^2)d$

$5402.25\ m^2/s^2 = (-19.6\ m/s^2)d$

$\frac{5402.25\ m^2/s^2}{(-19.6\ m/s^2)} = d$

$-275.625\ m = d$ → **d = -2.76 x 10^2 m**

c) $v_f = v_i + at$



-73.5 m/s = 0 m/s + (-9.8m/s^2)t

-73.5 m/s = (-9.8m/s^2)t

$$\frac{-73.5 \text{ m/s}}{-9.8 \text{m/s}^2} = t$$

7.5 s = t →

t = 7.50 x 10^0 s