Kinematic Equations

1. Write down the 3 kinematic equations on the top of the page. If you don’t remember, look back in your notes or look online.

$$v\_{f}=at+v\_{o}$$

$$∆x=\frac{1}{2}at^{2}+v\_{o}t$$

$$v\_{f}^{2}-v\_{o}^{2}=2a∆x$$

1. What is the acceleration due to gravity? (Look back at your exhibition.)

ag = – 9.81m/s2

1. What is the equation to find acceleration?

$a= \frac{∆v}{∆t}$

vo = 0m/s

vf = 27m/s

t = 9s

a = ?

1. A sports car accelerates from rest to 27m/s in 9s. What is its acceleration?

$$a= \frac{∆v}{∆t}$$

$$a= \frac{27\frac{m}{s}-0\frac{m}{s}}{9s}$$

$$a=\frac{27\frac{m}{s}}{9s}$$

$$a=3\frac{m}{s^{2}}$$

1. The velocity of a train is 26.4m/s. It accelerates at -1.50m/s2. How much time is required for the train to decrease its velocity to 9.72m/s.

$$a= \frac{∆v}{∆t}$$

$$-1.5\frac{m}{s^{2}}= \frac{9.72\frac{m}{s}-26.4\frac{m}{s}}{t}$$

$$-1.5\frac{m}{s^{2}}=\frac{-16.68\frac{m}{s}}{t}$$

$$ t \left(-1.5\frac{m}{s^{2}}\right)= -16.68\frac{m}{s}$$

$$t= \frac{-16.68\frac{m}{s}}{-1.5\frac{m}{s^{2}}}$$

$$t=11.1s$$

vo = 26.4m/s

a = -1.5m/s2

vf = 9.72m/s

t = ?

1. Starting from rest, a speedboat reaches a velocity of 3.2m/s in 2s. What is the velocity of the boat after 3 more seconds? Assume acceleration is constant.

$$a= \frac{∆v}{∆t}$$

$$1.6\frac{m}{s^{2}}= \frac{v\_{f}-0\frac{m}{s}}{5s}$$

$$v\_{f}=8\frac{m}{s}$$

$$a= \frac{∆v}{∆t}$$

$$a= \frac{3.2\frac{m}{s}-0\frac{m}{s}}{2s}$$

$$a=1.6\frac{m}{s^{2}}$$

vo = 0m/s

vf = 3.2m/s if t = 2s

a = ?

vf = ? if t = 5s

1. A runner accelerates to a velocity of 5.36m/s in 3s. His acceleration is 0.64m/s2. What was his initial velocity?

$$v\_{f}=3.44\frac{m}{s}$$

1. A basketball player is about to slam-dunk the ball. Starting from rest, she sprints to a velocity of 6m/s in 1.5s. What is her acceleration? How far did she run?

$$∆x=\frac{1}{2}at^{2}+v\_{o}t$$

$∆x=\frac{1}{2}\left(4\frac{m}{s^{2}}\right)\left(1.5s\right)^{2}+(0\frac{m}{s})$(1.5s)

$$∆x=\frac{1}{2}\left(4\frac{m}{s^{2}}\right)\left(2.25s^{2}\right)+ 0m$$

$$∆x=4.5m$$

$$a=4\frac{m}{s^{2}}$$

vo = 0m/s

vf = 6m/s

t = 1.5s

a = 4m/s2

Δx = ?

1. A jetliner lands with a velocity of 69m/s. Once it touches down, it has 750m of runway to reduce its speed to 6.1m/s. Find the acceleration of the plane once it touches the ground.

vo = 69m/s

vf = 6.1m/s

Δx = 750m

a = ?

$$v\_{f}^{2}-v\_{o}^{2}=2a∆x$$

$$\left(6.1\frac{m}{s}\right)^{2}-\left(69\frac{m}{s}\right)^{2}=2a\left(750m\right)$$

$$37.21 \frac{m^{2}}{s^{2}}-4761\frac{m^{2}}{s^{2}}=(1500m)(a)$$

$$-4723.79\frac{m^{2}}{s^{2}}=\left(1500m\right)a$$

$$a=-3149\frac{m}{s^{2}}$$

1. A skier accelerates down a slope at 1.6m/s2 starting from rest. How far has she gone after 5s?

$$∆x=\frac{1}{2}at^{2}+v\_{o}t$$

$∆x=\frac{1}{2}\left(1.6\frac{m}{s^{2}}\right)\left(5s\right)^{2}+(0\frac{m}{s})$(5s)

$$∆x=\frac{1}{2}\left(1.6\frac{m}{s^{2}}\right)\left(25s^{2}\right)+ 0m$$

$$∆x=20m$$

vo = 0m/s

a = 1.6m/s2

t = 5s

Δx = ?

1. A soccer player, running at a velocity of 2.6m/s, accelerates at 0.45m/s2 for the next 18m. What is her velocity at the end of the run?

vo = 2.6m/s

a = 0.45m/s2

Δx = 18m

vf = ?

$$v\_{f}^{2}-v\_{o}^{2}=2a∆x$$

$$\left(v\_{f}\right)^{2}-\left(2.6\frac{m}{s}\right)^{2}=2(0.45\frac{m}{s^{2}})\left(18m\right)$$

$$\left(v\_{f}\right)^{2}-6.76 \frac{m^{2}}{s^{2}}=4.05\frac{m^{2}}{s^{2}}$$

$$\left(v\_{f}\right)^{2}=10.81\frac{m^{2}}{s^{2}}$$

$$v\_{f}=3.29\frac{m}{s}$$

1. A truck traveling at 33m/s comes to a halt by accelerating at -11m/s2. How far does the truck travel in the process of stopping?

$$v\_{f}^{2}-v\_{o}^{2}=2a∆x$$

$$\left(0\frac{m}{s}\right)^{2}-\left(33\frac{m}{s}\right)^{2}=2(-11\frac{m}{s^{2}})(∆x)$$

$$-1089 \frac{m^{2}}{s^{2}}=-(22\frac{m}{s^{2}})(∆x)$$

$$∆x=49.5\frac{m}{s}$$

vo = 33m/s

vf = 0m/s

a = -11m/s2

Δx = ?

1. A baseball is thrown upward with an initial velocity of 35m/s. What is its speed after 2s? (Recall: what is the acceleration due to gravity?)

$$v\_{f}=at+v\_{o}$$

$$v\_{f}=\left(-9.81\frac{m}{s^{2}}\right)\left(2s\right)+ (35\frac{m}{s})$$

$$v\_{f}=-19.62\frac{m}{s}+35\frac{m}{s}$$

$$v\_{f}=15.38\frac{m}{s}$$

vo = 35m/s

ag = -9.81m/s2

t = 2s

vf = ?

1. From her bedroom window, a girl drops a water-filled balloon to the ground, 6m below. If the balloon is released from rest, how long is it in the air?

$$∆x=\frac{1}{2}at^{2}+v\_{o}t$$

$$-6m=\frac{1}{2}\left(-9.81\frac{m}{s^{2}}\right)t^{2}+\left(0\frac{m}{s}\right)t$$

$$-6m=\left(-4.905\frac{m}{s^{2}}\right)t^{2}+0$$

$$\frac{-6m}{-4.905\frac{m}{s^{2}}}=t^{2}$$

$$t=1.1s$$

Δx = –6m

vo = 0m/s

ag = -9.81m/s2

t = ?

vf = ?