KEY

Kinematics Review

Solve the following problems using the principles and equations of kinematics.

1.) The average velocity of a min-bike is $+15.0\,\frac{km}{h}$, how long will it take to go $35.0\ m$?

$\vec{v}_{avg} = \frac{\Delta\vec{d}}{\Delta t}$ $\quad +4.16666 = \frac{35}{t}$ $\quad t = 8.4\ s$

2.) A sprinter starting from rest reaches a final velocity of $+28.8\,\frac{km}{h}$. What is her average velocity?

- The average is $\frac{+28.8+0}{2}$ $\quad = +14.4\,\frac{km}{h}$

3.) A coin is dropped and strikes the earth with a velocity of $15.15\,\frac{m}{s}$. For how long was it falling, and what from what height did it fall?

$\vec{v}_f = \vec{v}_o + \vec{a}t$ $\quad -15.15 = 0 + -9.81t$ $\quad t = 1.55\ s$

$\vec{d} = \vec{v}_o t + \frac{1}{2}\vec{a}t^2$ $\quad \vec{d} = 0 + (0.5)(-9.81)(1.564)^2$ $\quad \vec{d} = -11.71\ m$

4.) A rocket lifts off from Earth at $+13.3\,\frac{m}{s^2}$ from the launch pad, how high into the atmosphere does it rise during the first five seconds of its path?

$\vec{d} = \vec{v}_o t + \frac{1}{2}\vec{a}t^2$ $\quad \vec{d} = 0 + \frac{1}{2}(13.3)5^2$ $\quad \vec{d} = +166\ m$

5.) A truck accelerates from rest to a velocity of $+22.4\,\frac{m}{s}$ at a rate of $+0.60\,\frac{m}{s^2}$. How long was it accelerating and how far did it travel while accelerating?

$\vec{v}_f = \vec{v}_o + \vec{a}t$ $\quad 22.4 = 0 + (0.60)t$ $\quad t = 37.3\ s$

$\vec{v}_f^2 = \vec{v}_o^2 + 2\vec{a}\vec{d}$ $\quad 22.4^2 = 0 + 2(0.60)(\vec{d})$ $\quad \vec{d} = +418\ m$

6.) A car in a school zone accelerates from $+85\,\frac{km}{h}$ to $+120\,\frac{km}{h}$ in $9.2\ s$. What was its acceleration?

$\vec{v}_f = \vec{v}_o + \vec{a}t$ $\quad 33.3333 = 23.6111111 + \vec{a}(9.2)$ $\quad \vec{a} = +1.06\,\frac{m}{s^2}$

7.) How long will it take for a rock to fall to the ground if dropped from a height of $92.0\ m$?

$\vec{d} = \vec{v}_o t + \frac{1}{2}\vec{a}t^2$ $\quad -92.0 = 0 + \frac{1}{2}(-9.81)t^2$ $\quad t = 4.3\ s$

KEY

8.) A rock is thrown down from a rail trestle with height $13.0\ m$ at velocity $+18.8\frac{m}{s}$. With what velocity will it strike the ground?

$\vec{v}_f^2 = \vec{v}_o^2 + 2\vec{a}\vec{d}$ $\quad \vec{v}_f^2 = -18.8^2 + 2(-9.81)(-13)$ $\quad \vec{v}_f = +24.7\frac{m}{s}$

9.) A car travelling at $90.0\frac{km}{h}$ comes to a stop in 12.0 s, what was its acceleration?

$\vec{a} = \frac{\Delta\vec{v}}{\Delta t}$ $\quad \vec{a} = \frac{25}{12}$ $\quad \vec{a} = -2.1\frac{m}{s^2}$

10.) A car travelling at $60.0\frac{km}{h}$ accelerates to $90.0\frac{km}{h}$ at $+2.03\frac{m}{s^2}$. How long does this take and how far does the car travel in this time?

$\vec{v}_f = \vec{v}_o + \vec{a}t$ $\quad +25 = +16.666666 + 2.03t$ $\quad t = 4.11\ s$

$\vec{v}_f^2 = \vec{v}_o^2 + 2\vec{a}\vec{d}$ $\quad 25^2 = 16.6666^2 + 2(2.03)(\vec{d})$ $\quad \vec{d} = 85.5\ m$

11.) A rock is dropped from a bridge and strikes the water below $24.0\ s$ later. With what speed did it strike the water and from what height was it dropped?

$\vec{v}_f = \vec{v}_o + \vec{a}t$ $\quad \vec{v}_f = 0 + (-9.81)(24.0)$ $\quad \vec{v}_f = -235\frac{m}{s}$

$\vec{d} = \vec{v}_o t + \frac{1}{2}\vec{a}t^2$ $\quad \vec{d} = 0 + \frac{1}{2}(-9.81)(24.0)^2$ $\quad \vec{d} = -2.82 \times 10^3 m$

12.) A bullet is fired upward from a gun and reaches a maximum height of $2100\ m$. What is its velocity at the high point, what was its initial velocity, and how long was it **in the air**?

- high point velocity = 0

$\vec{v}_f^2 = \vec{v}_o^2 + 2\vec{a}\vec{d}$ $\quad 0^2 = \vec{v}_o^2 + 2(-9.81)(2100)$ $\quad \vec{v}_o = +203\frac{m}{s}$

$\vec{v}_f = \vec{v}_o + \vec{a}t$ $\quad 0 = 203 + -9.81t$ $\quad t = 20.7\ s$ $\quad t = 20.7 \times 2 = 41.4\ s$

13.) A cat is thrown upward from the edge of a building with velocity $+2.0\frac{m}{s}$. If the cat then falls the entire height of the building ($30.0\ m$) with what velocity will it strike the ground?

$\vec{v}_f^2 = \vec{v}_o^2 + 2\vec{a}\vec{d}$ $\quad 0 = 2^2 + 2(-9.81)(\vec{d})$ $\quad \vec{d} = 0.204\ m$

$\vec{v}_f^2 = \vec{v}_o^2 + 2\vec{a}\vec{d}$ $\quad \vec{v}_f^2 = 0 + 2(-9.81)(-30.204)$ $\quad \vec{v}_f = -24.3\frac{m}{s}$