Kinematics Equations (The '~~Big 3~~') Big 4

$$\vec{v} = \frac{\Delta \vec{x}}{\Delta t} = \frac{\vec{d}_f - \vec{d}_i}{t_f - t_i} \qquad \vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_f - \vec{v}_i}{t_f - t_i}$$

Variables: $\vec{d}$, $\vec{v}_f$, $\vec{v}_i$, $\vec{a}$, t

$\vec{v}_f = \vec{v}_i + \vec{a}t$ no $\vec{d}$ $\qquad$ $\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$ no $\vec{v}_f$

$\vec{d} = \left(\frac{\vec{v}_f + \vec{v}_i}{2}\right)t$ no $\vec{a}$ $\qquad$ $\vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a}\vec{d}$ no t

(*) Problems vary in packets.

6. A motorcycle traveling at 12.6 m/s accelerates at a rate of 1.7 m/s² for 3.4 seconds. What is its final velocity?

(v_i, a, t, $v_f = ?$)

$\vec{v}_f = \vec{v}_i + at$

$12.6\frac{m}{s} + \left(1.7\frac{m}{s^2}\right)(3.4s) =$

$\vec{v}_f = 18\frac{m}{s}$ or $18.4\frac{m}{s}$

7. A bullet is accelerated from rest at a rate of 400 m/s² for 0.05 seconds. How far did it travel while it was accelerating?

($v_i = 0\frac{m}{s}$, a, t, $d = ?$)

$\vec{d} = \vec{v}_o t + \frac{1}{2}\vec{a}t^2$

$\vec{d} = 0.5m$

8. An elephant accelerates from 5.0 m/s to 10. m/s at a rate of 2.0 m/s². What is the elephant's final displacement?

(v_i, v_f, $\vec{a}$, d)

$\vec{v}_f^2 = \vec{v}_i^2 + 2ad$

$\vec{d} = 19m$

9. A driver brings a car traveling at 22 m/s to a full stop in 4.0 seconds.

(v_i, $v_f = 0 m/s$, t)

a) What is the car's acceleration?

$$\vec{a} = \frac{v_f - v_i}{t} = \frac{0\frac{m}{s} - 22\frac{m}{s}}{4.0s} = -5.5\frac{m}{s^2}$$

b) How far did the car travel before stopping? $\vec{d} = \left(\frac{v_f + v_i}{2}\right)t$ $\quad$ $\vec{d} = 44m$

$V_f = \emptyset \frac{m}{s}$ $\quad d$

10. Skid marks left from a stopped car are 27 meters long. If the car had a acceleration of magnitude 6.0 m/s² and stopped in 3.0 seconds, how fast was the car moving initially?

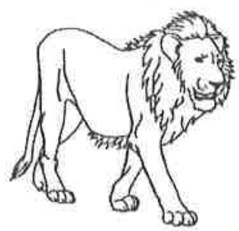
$t \qquad V_i = ? \qquad -6.0\frac{m}{s^2}$

$\vec{d} = \vec{V}_i t + \frac{1}{2}\vec{a}t^2 \qquad \vec{V}_i = \dfrac{\vec{d} - \frac{1}{2}at^2}{t}$

$V_i = 18\frac{m}{s}$

11. Starting from with a velocity of 2.0 m/s, a lion moves 110 m in 5.0 seconds. What was the lion's acceleration?

$V_i = 2.0\frac{m}{s} \qquad \vec{d} \qquad t \qquad \vec{a} = ?$



$\vec{d} = \vec{V}_i t + \frac{1}{2}at^2$

$\dfrac{(d - V_i t)2}{t^2} = \vec{a}$

$\vec{a} = 8.0\frac{m}{s^2}$

12. In a historical movie, two knights on horseback start from rest 88.0 m apart and ride directly toward each other to do battle. Sir George's acceleration has a magnitude of 0.300 m/s², while Sir Alfred's has a magnitude of 0.200 m/s². Relative to Sir George's starting point, where do the knights collide?

$d = 88.0\,m \qquad \ominus \longleftrightarrow \oplus$

G — 53 m → X ← −35 m — A

$V_i = \emptyset\frac{m}{s}$

$\vec{a} = 0.300\frac{m}{s^2} \qquad \vec{a} = -.200\frac{m}{s^2}$

$d = \cancel{V_i t} + \frac{1}{2}at^2 \qquad \vec{d}_G = \frac{1}{2}\left(0.300\frac{m}{s^2}\right)t^2 \qquad \vec{d}_A = \frac{1}{2}\left(-0.200\frac{m}{s^2}\right)t^2$

$\vec{d}_G + |\vec{d}_A| = 88.0\,m \qquad t = 18.8\,s$

$\vec{d}_G = \frac{1}{2}\left(+0.300\frac{m}{s^2}\right)(18.8\,s)^2 = 53\,m \qquad \vec{d}_A = \frac{1}{2}\left(-0.200\frac{m}{s^2}\right)(18.8\,s)^2 = -35\,m$

if used 18.76 s (52.8 m, −35.2 m)