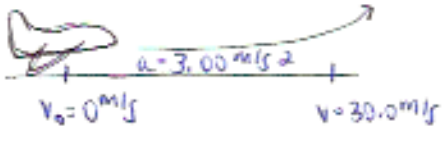
**Kinematics**

**Example 5:**
A plane is moving down a runway, trying to take off. It begins from rest and must reach a velocity of 30.0 m/s to lift off the ground. The acceleration of the plane is a constant 3.00 m/s². How long must the runway be for the plane to take off?

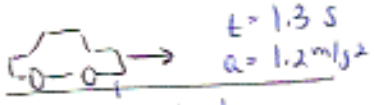



$V_0 = 0\ m/s$
$V = 30.0\ m/s$
$a = 3.00\ m/s^2$
$X = ?$

$V^2 = V_0^2 + 2aX$
$(30.0)^2 = (0)^2 + 2(3.00)x$
$900 = 0 + 6 \cdot x$
$900 = 6x$
$x = \frac{900}{6}$
$\boxed{x = 150\ m}$

**Example 6:**
A car has an initial velocity of 31.4 km/h. It accelerates at a uniform rate of 1.2 m/s² for 1.3 seconds. Please express your answers in SI units.

A. What is the final velocity of the car?
B. What is the displacement of the car during this time?




$V_0 = 31.4\ km/h$
$V_0 = 8.72\ m/s$

$\frac{31.4\ km}{1\ h} \left| \frac{1000\ m}{1\ km} \right| \left| \frac{1\ h}{3600\ s} \right| = 8.72\ m/s$

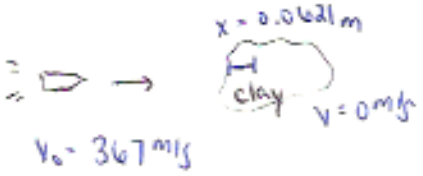
A.) $t = 1.3\ s$
$a = 1.2\ m/s^2$
$V_0 = 8.72\ m/s$
$V = ?$

$V = V_0 + at$
$V = 8.72 + (1.2)(1.3)$
$V = 8.72 + 1.56$
$\boxed{V = 10.3\ m/s}$

B.) $t = 1.3\ s$
$a = 1.2\ m/s^2$
$V_0 = 8.72\ m/s$
$x = ?$

$x = V_0 t + \frac{1}{2} a t^2$
$x = (8.72)(1.3) + \frac{1}{2}(1.2)(1.3)^2$
$x = 11.336 + 1.014$
$\boxed{x = 12.4\ m}$

**Example 7:**
A bullet is fired from a gun with an initial velocity of 367 m/s before embedding itself into a lump of clay. The bullet penetrates into the clay a distance of 0.0621 m before coming to a stop. Assuming a uniform acceleration, what is the value for the acceleration of the bullet as it moves into the clay?




$V_0 = 367\ m/s$
$V = 0\ m/s$
$x = 0.0621\ m$
$a = ?$

$V^2 = V_0^2 + 2ax$
$(0)^2 = (367)^2 + 2a(0.0621)$
$0 = 134,689 + 0.1242 \cdot a$
$-134,689 = 0.1242 \cdot a$
$\boxed{a = -1.08 \times 10^6\ m/s^2}$