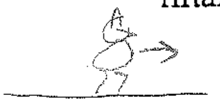
Kinematics Equations Worksheet

1. Starting from rest, the Road Runner accelerates at 3 m/s^2 for ten seconds. What is the final velocity of the Road Runner?

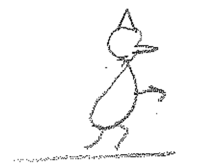


$a = 3\ m/s^2$
$t = 10\ s$
$V_i = 0\ m/s$

$V_f = ?$

$V_f = V_i + at$
$V_f = 0 + (3\ m/s^2)(10\ s)$
$\boxed{V_f = 30\ m/s}$

2. Starting from rest, the Road Runner accelerates at 3 m/s^2 for ten seconds. How far does the Road Runner travel during the ten second time interval?

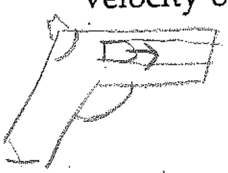


$a = 3\ m/s^2$
$t = 10\ s$
$V_i = 0\ m/s$

$\Delta x = ?$

$\Delta x = \frac{1}{2}at^2 + V_i t$
$\Delta x = \frac{1}{2}(3\ m/s^2)(10\ s)^2 + 0$
$\boxed{\Delta x = 1500\ m}$

3. A bullet starting from rest accelerates at 40,000 m/s^2 down a 0.5 m long barrel. What is the velocity of the bullet as it leaves the barrel of the gun?

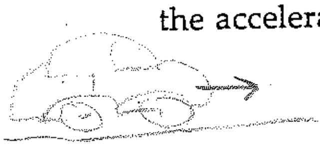


$a = 40000\ m/s^2$
$V_i = 0\ m/s$
$\Delta x = .5\ m$

$V_f = ?$

$V_f^2 = V_i^2 + 2a\Delta x$
$V_f^2 = (0\ m/s)^2 + 2(40000\ m/s^2)(.5\ m)$
$V_f^2 = 40000\ m/s$
$\boxed{V_f = 200\ m/s}$

4. A car traveling at 20 m/s applies its brakes and comes to a stop in four seconds. What is the acceleration of the car?



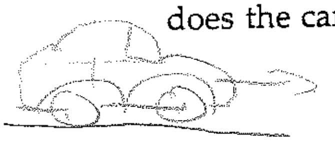
$V_i = 20\ m/s$
$t = 4\ s$
$V_f = 0\ m/s$

$a = ?$

$V_f = at + V_i$
$0\ m/s = a(4\ s) + 20\ m/s$
$-20\ m/s = a(4\ s)$
$\boxed{a = -5\ m/s^2}$

V_i is (+) but a is (−) so car slowed down

5. A car traveling at 20 m/s applies its brakes and comes to a stop in four seconds. How far does the car travel before coming to a stop?

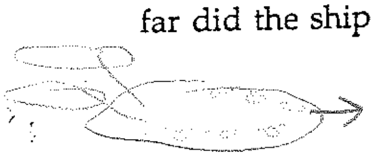


$V_i = 20\ m/s$
$V_f = 0\ m/s$
$t = 4\ s$

$\Delta x = ?$

$\Delta x = \frac{1}{2}(V_f + V_i)t$
$\Delta x = \frac{1}{2}(0 + 20\ m/s)(4\ s)$
$\boxed{\Delta x = 40\ m}$

6. The *USS Enterprise* accelerates from rest at 100,000 m/s^2 for a time of four seconds. How far did the ship travel in that time?



$V_i = 0\ m/s$
$a = 100000\ m/s^2$
$t = 4\ s$

$\Delta x = ?$

$\Delta x = \frac{1}{2}at^2 + V_i t$
$\Delta x = \frac{1}{2}(1 \times 10^5\ m/s^2)(4\ s)^2 + 0$
$\boxed{\Delta x = 800,000\ m}$

7. At the scene of an accident, a police officer notices that the skid marks of a car are 10 m long. The officer knows that the typical deceleration of this car when skidding is -45 m/s^2. What can the officer estimate for the original speed of the car?

$\Delta x = 10\ m$ $\quad v_i = ?$ $\quad v_f^2 = v_i^2 + 2a\Delta x$

$a = -45\ m/s^2$

$v_f = 0\ m/s$ $\quad (0\ m/s)^2 = v_i^2 + 2(-45\ m/s^2)(10\ m)$

$v_i = 30\ m/s$

8. A skier traveling at 5 m/s accelerates down a hill at 1 m/s^2 for three seconds. What is the final velocity of the skier, and how far down the hill has the skier traveled in this time?

$v_i = 5\ m/s$ $\quad v_f = ?$ $\quad v_f = at + v_i$ $\quad \Delta x = \frac{1}{2}(v_f + v_i)t$

$a = 1\ m/s^2$ $\quad \Delta x = ?$ $\quad v_f = (1\ m/s^2)(3\ s) + 5\ m/s$ $\quad \Delta x = \frac{1}{2}(8\ m/s + 5\ m/s)(3\ s)$

$t = 3\ s$ $\quad v_f = 8\ m/s$ $\quad \Delta x = 19.5$

9. A train decreases speed from 30 m/s to 20 m/s while traveling a distance of 250 m. What is the acceleration of the train?

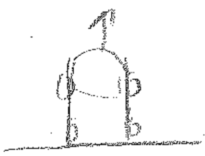
$a = ?$ $\quad v_f^2 = v_i^2 + 2a\Delta x$

$v_i = 30\ m/s$ $\quad (20\ m/s)^2 = (30\ m/s)^2 + 2(a)(250\ m)$

$v_f = 20\ m/s$

$\Delta x = 250\ m$ $\quad a = -1\ m/s^2$

10. A car travels at 25 m/s to the north. It has an acceleration of 2 m/s^2 to the south for a duration of twenty seconds. What is the final velocity of the car?



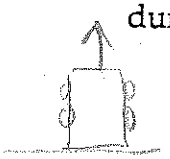
$v_i = 25\ m/s$ $\quad v_f = ?$ $\quad v_f = at + v_i$

$a = -2\ m/s^2$ $\quad v_f = (-2\ m/s^2)(20\ s) + 25\ m/s$

$t = 20\ s$

$v_f = -15\ m/s$

11. A car travels at 25 m/s to the north. It has an acceleration of 2 m/s^2 to the south for a duration of twenty seconds. What is the displacement of the car?



$v_i = 25\ m/s$ $\quad \Delta x = ?$ $\quad \Delta x = \frac{1}{2}at^2 + v_i t$

$a = -2\ m/s^2$ $\quad = \frac{1}{2}(-2\ m/s^2)(20\ s)^2 + (25\ m/s)(20\ s)$

$t = 20\ s$ $\quad \Delta x = 100\ m$

12. Calvin tosses a water balloon to Hobbes. As Hobbes is about to catch it the balloon has a speed of 1 m/s. Hobbes catches the balloon, and the balloon experiences an acceleration of -0.5 m/s^2 as it comes to rest. How far did Hobbes' hands move back while catching the balloon?

$v_i = 1\ m/s$ $\quad \Delta x = ?$ $\quad v_f^2 = v_i^2 + 2a\Delta x$

$a = -.5\ m/s^2$ $\quad (0\ m/s)^2 = (1\ m/s)^2 + 2(-.5\ m/s^2)\Delta x$

$v_f = 0\ m/s$ $\quad \Delta x = 1\ m$