Linear Motion and Freefall

Physics Honors

Name _____

Period _____

Acceleration & Distance Problems Part 1

$$V_f = V_i + a \cdot t \qquad d = V_{average} \cdot t = \frac{V_i + V_f}{2} \cdot t$$

Note: For the next problems, assume the objects are traveling in a straight-line motion and are going the same direction.

1. What is the acceleration of each car?

a) A Ford mustang can go from zero 26.8 m/s to in 5.0 seconds. **(5.36 m/s²)**

$V_i = 0$, $V_f = 26.8$, d, $a = ?$, $t = 5$

$V_f = V_i + at$

$26.8 = 5a$

$a = \frac{26.8}{5} = 5.36 m/s^2$

b) A Ford Escort can go from zero to 35.8 m/s in 10 seconds. **(3.58 m/s²)**

$V_i = 0$, $V_f = 35.8$, $a = ?$, $t = 10$

$V_f = V_i + at$

$35.8 = 10a$

$a = \frac{35.8}{10} = 3.58 m/s^2$

2. In 3 seconds a car moving in a straight line increases its speed from 22.4 m/s to 29.1 m/s while a truck increases its speed from 0 mph to 6.7m/s in the same amount of time. What is the acceleration of each vehicle? **(2.23 m/s²)**

CAR

$V_i = 22.4$, $V_f = 29.1$, $a = ?$, $t = 3$

$V_f = V_i + at$

$29.1 = 22.4 + a(3)$

$3a = 29.1 - 22.4$

$3a = 6.7$

$a = \frac{6.7}{3} = 2.2 m/s^2$

TRUCK

$V_i = 0$, $V_f = 6.7$, $a = ?$, $t = 3$

$V_f = V_i + at$

$6.7 = 0 + 3a$

$a = \frac{6.7}{3}$

$a = 2.2 m/s^2$

3. Suppose a sprinter increases her speed each second, first from 0 to 5 meters/sec, then from 5 m/s to 10 m/s, then from 10 m/s to 15 m/s. What is her acceleration?

Since the car's velocity changes by 5 m/s every second it has an acceleration of 5 m/s per seconds or 5 m/s²

4. A car starting from rest increases its velocity to 24 m/s in 3.0 seconds.

a. What is the car's acceleration?

$V_i = 0$
$V_f = 24$
$t = 3$

$V_f = V_i + at$

$24 = 0 + 3a$

$a = \frac{24}{3} = 8\ m/s^2$

b. What is the car's average velocity?

$V_{avg} = \frac{0+24}{2} = 12\ m/s$

c. How far did the car go in the 3.0 seconds?

$d = V \cdot t = (12\ m/s)\ 3\ sec = 36\ m$

Acceleration & Distance Problems Part 2

5 A ball rolls down a hill, starting from rest and travels 30.0 m in 6.0 s.

$v_i = 0$
v_f
$d = 30$
a
$t = 6$

a. What was the ball's average velocity?

$d = (v_{avg}) \cdot t \qquad 30 = v_{avg}(6) \qquad v_{avg} = \frac{30}{6} = 5\ m/s$

b. What was the ball's final velocity?

$v_{avg} = \frac{v_i + v_f}{2} \qquad \frac{v_f}{2} = 5\ m/s \qquad v_f = 10\ m/s$

c. What was the ball's acceleration?

$v_f = v_i + at \qquad 10 = a(6) \qquad a = \frac{10}{6} = 1.67\ m/s^2$

$v_f = at$

6. A skateboarder going 24 m/s rolls to a stop in 4 s.

$v_i = 24$
$v_f = 0$
$d =$
$a =$
$t = 4$

a. What was the skateboarder's average velocity?

$v_{avg} = \frac{v_i + v_f}{2} = \frac{24+0}{2} = 12\ m/s$

b. What was the skateboarder's acceleration?

$v_f = v_i + at \qquad a = \frac{-24}{4} = -6\ m/s^2$

$0 = 24 + 4a$

c. How far did the skateboarder travel while stopping?

$d = v_{avg} \cdot t = 12(4) = 48\ m$

7. A pitcher throws a ball straight upward at 39.2 m/s. The balls maximum height is reached 4.0 s later.

$v_i = 39.2$
$v_f = 0$
d
$a = ?$
$t = 4$

a. What was the ball's acceleration? (think about the velocity at the top)

$v_f = v_i + at \qquad 4a = -39.3$

$0 = 39.3 + 4a \qquad a = \frac{-39.3}{4} = 9.8\ m/s^2$

b. How high did the ball go?

$d = \left(\frac{v_i + v_f}{2}\right) \cdot t = \frac{39.3+0}{2}(4) = 78.4\ m$