Linear Motion written

Name Key
Date
Period

$d = v_{average}t$ $d = v_{constant}t$ $d = v_i t + \frac{1}{2}at^2$ $\Delta v = at$ $V_f^2 = V_i^2 + 2ad$

Draw a frame of reference, rearrange the equation for the missing variable, show all math (10 pts each)

1. A shopping cart given an initial velocity of 3.0 m/s undergoes a constant acceleration of 2.0 m/s^2. What is the cart's displacement after 4.0s?

$d = v_i t + \frac{1}{2}at^2$

$= 3.0 m/s \cdot 4.0 s + \frac{1}{2} 2.0 \frac{m}{s^2} \cdot (4.0 s)^2$

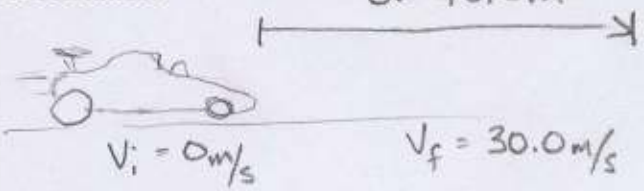
$= 28 m$

2. A sports car accelerates at a constant rate from rest to a speed of 30 m/s in 8.00 s. What is the displacement of the sports car in this time interval?

$d = \frac{V_i + V_f}{2} t = \frac{0 + 30 m/s}{2} (8.00 s)$

$= 120 m$

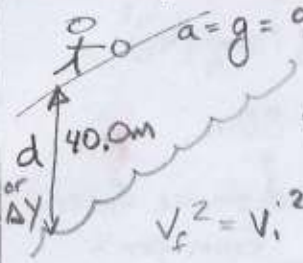
3. A race car accelerates from 0 m/s to 30.0 m/s with a displacement of 45.0 m. What is the vehicle's acceleration?



$a = \frac{V_f^2 - V_i^2}{2d} = \frac{(30.0 m/s)^2 - (0 m/s)^2}{2 \cdot 45.0 m}$

$= 10 m/s/s$

4. A tourist accidentally drops a camera from a 40.0 m high bridge. If $g = 9.81$ m/s^2 and air resistance is disregarded, what is the speed of the camera as it hits the water?

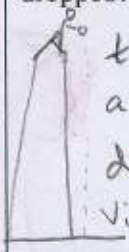


$V_f^2 = V_i^2 + 2ad$

$V_f^2 = 0 + 2 \cdot 9.81 m/s^2 \cdot 40.0 m$

$V_f = \sqrt{784 m^2/s^2} = 28.0 m/s$

5. A baseball is released at rest from the top of the Washington Monument. It hits the ground after falling for 6.00 s. What was the height from which the ball was dropped? (Disregard air resistance. $g = 9.81$ m/s^2.)

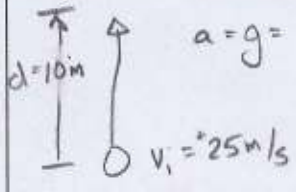


$d = v_i t + \frac{1}{2}at^2$

$= 0 \cdot 6.00 s + \frac{1}{2} -9.81 m/s^2 \cdot (6.00 s)^2$

$= 176.6 m = 177 m$

6. A water balloon is launched with an initial velocity of 25 m/s, how fast will the balloon be going when it reaches a height of 10 meters above its launch height?



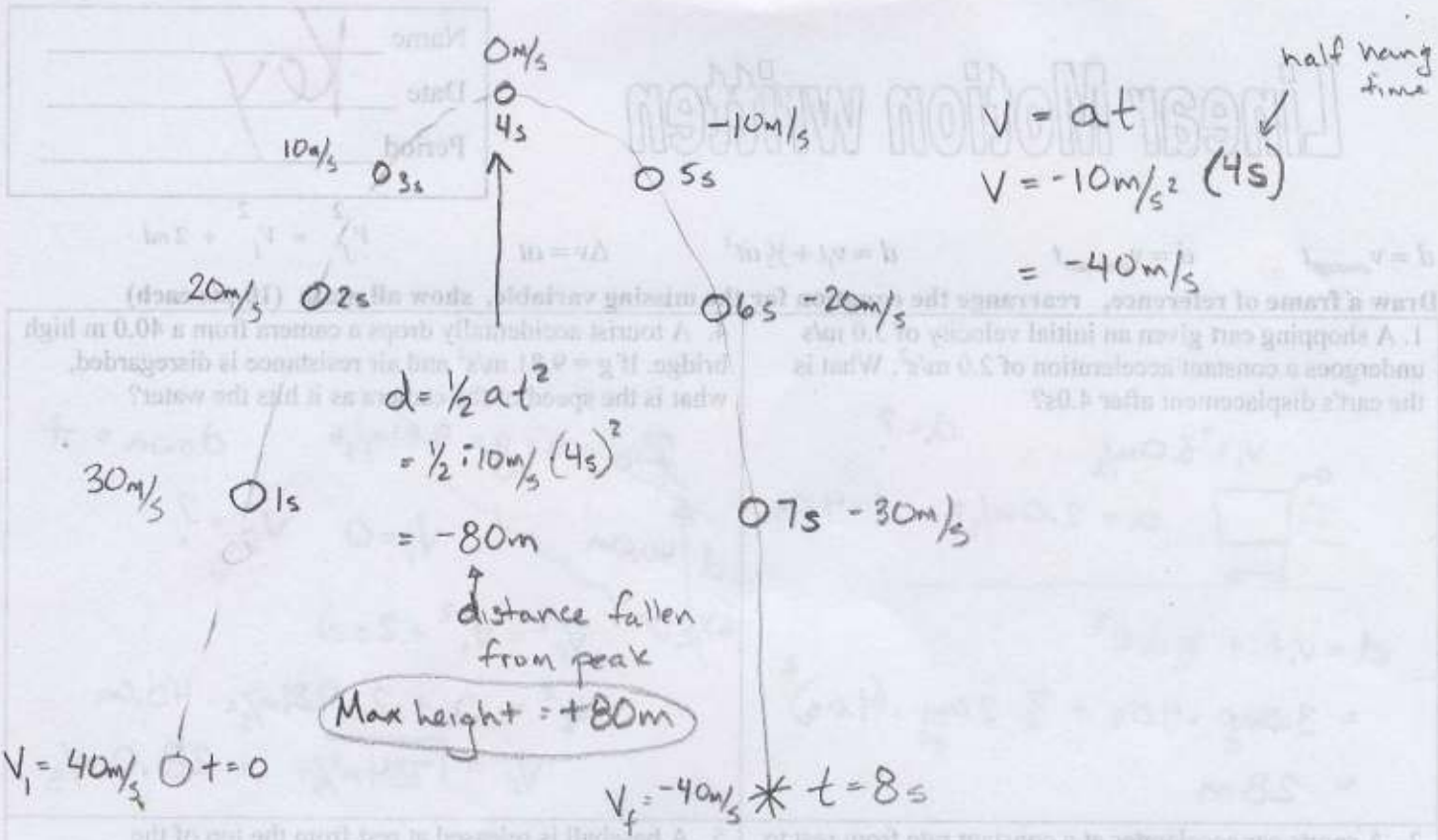
$V_f^2 = V_i^2 + 2ad$

$V_f^2 = (25 m/s)^2 + 2(-9.81 \frac{m}{s^2})(10 m)$

$V_f = \sqrt{428.8 \frac{m^2}{s^2}} = 20.7 m/s$

21 m/s

7. On the back of this paper (rounding gravity to -10m/s/s) draw the trajectory of a water balloon that has a hang time of 8 seconds. Label the velocity at each second (starting from zero) and label the maximum height. (show all math) 20 points


0m/s
4s
-10m/s
10m/s
3s
5s
20m/s
2s
6s -20m/s
1s
30m/s
7s -30m/s
$d = \frac{1}{2} a t^2$
$= \frac{1}{2} \cdot 10 m/s (4s)^2$
$= -80m$
distance fallen from peak
Max height = +80m
$V_i = 40 m/s$
t = 0
$V_f = -40 m/s$
t = 8s
half way time
$V = at$
$V = -10 m/s^2 (4s)$
$= -40 m/s$