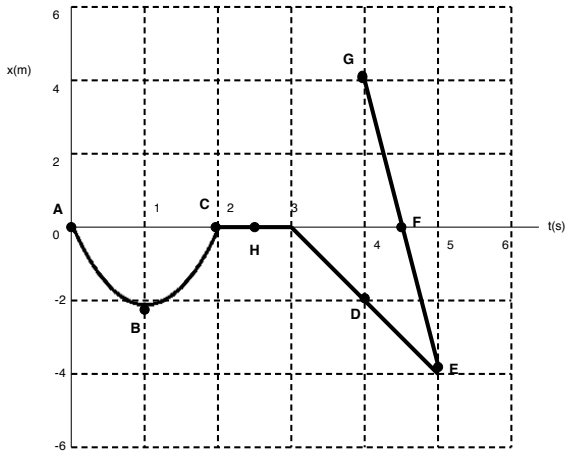
Your Name: _____

PHY203
Exam #1
Chapters 1-3
Fri., 9/26/14

Solutions



1. The plot above depicts the position vs. time for the one dimensional motion of a toy car:

a. Find the average velocity (magnitude and sign) from point A to point C.

$v_{iavg} = \Delta x/\Delta t = (0m - (0m))/(2s) = 0$ **5**

b. Find the instantaneous velocity (magnitude and sign) at point F.

.

v_{int} = slope = (-8m)/1s = -8.00 m/s **5**

c. Find the average speed (magnitude and sign) from point D to point G.

$speed_{iavg} = \Delta s/\Delta t = (10m))/(0s)$ = undefined **5**

other reasonable answers are also accepted

d. Find the average acceleration (magnitude and sign) from point H to point F.

$a_{iavg} = \Delta v/\Delta t = (-8.00m/s - 0)/(2s) = -4.00m/s^2$ **10**

2. Consider a rocket being launched from rest at ground level (height = 0) straight up into the atmosphere. In the first stage, the rocket accelerates at 17.5 m/s^2 for 12.0 s. Then the motor cuts off and the rocket continues to travel upwards for a while. (Ignore any effects due to air resistance.)

a. Find the height of the rocket when the motor cuts off.

$H_1 = 0 +) + 1/2(17.5\ m/s^2)(12.0)^2$ **5**
$= 1260\ m = 1.26x10^3\ m$

b. Find the speed of the rocket when the motor cuts off.

$v = 0 + (17.5\ m/s^2)(12.0\ s)$ **5**
$v = +210\ m/s$

c. Find the height of the rocket at its highest point.

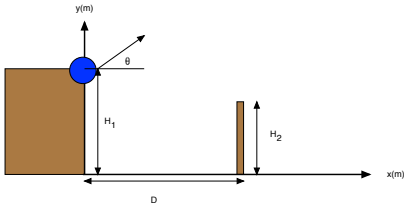
$0 = (210)^2 + 2(-9.81)(H_2)$
$H_2 = 2248m$
$H = 2248m + 1260m$ **15**
$= 3.51x10^3 m$

d. Find the time it takes the rocket to reach its highest point.

$0 = 210\ m/s + (-9.81\ m/s^2)(t_2)$ **10**
$t_2 = 21.4\ s$

$t = 21.4s + 12.0s = 33.4s$

3. A cannonball is launched with an angle , θ, from the top of a tall building with height H_1 at a nearby wall a distance D=50.0 m from the building that has height H_2.The initial velocity in the y-direction given to the ball is 27.5 m/s. It takes 4.50 s for the cannonball to hit the top of the wall (ignore the thickness of the wall).



a. Find the initial velocity of the ball in the x-direction (magnitude and sign).

$50.0\ m = 0 + (v_{ox})(4.50\ s)$ **10**

$v_{ox} = 11.1\ m/s$

b. Find the initial speed of the ball.

$$v_o = \sqrt{(11.1)^2 + (27.5)^2}$$
$$= 29.7 m/s$$ **5**

c. Find the angle the ball made initially with respect to the horizontal (x) direction.

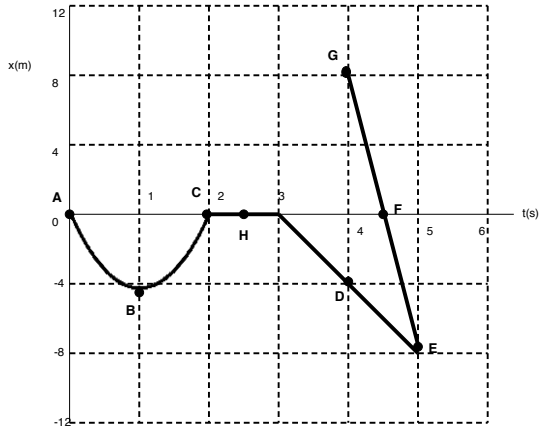
$$\theta = \tan^{-1}(\frac{27.5}{11.1}) = 68.0^o$$ **5**

d. Find and write the velocity in vector notation using the coordinate system shown above for when the ball just hits the top of the wall.

$v_y = 27.5\ m/s + (-9.81\ m/s^2)(4.50)$ **15**
$v_y = -16.6\ m/s$

v = (11.1**i** - 16.6 **j**)m/s **5**

Alt Version



1. The plot above depicts the position vs. time for the one dimensional motion of a toy car:

a. Find the average velocity (magnitude and sign) from point A to point C.

$v_{iavg} = \Delta x/\Delta t = (0m - (0m))/(2s) = 0$ **5**

c. Find the instantaneous velocity (magnitude and sign) at point F

.

v_{int} = slope = (-16m)/1s = -16.0 m/s **5**

c. Find the average speed (magnitude and sign) from point D to point G.

$speed_{iavg} = \Delta s/\Delta t = (20m))/(0s)$ = undefined **5**

other reasonable answers are also accepted

d. Find the average acceleration (magnitude and sign) from point H to point F.

$a_{iavg} = \Delta v/\Delta t = (-16.0m/s - 0)/(2s) = -8.00m/s^2$ **10**

2. Consider a rocket being launched from rest at ground level (height = 0) straight up into the atmosphere. In the first stage, the rocket accelerates at 19.5 m/s^2 for 14.0 s. Then the motor cuts off and the rocket continues to travel upwards for a while. (Ignore any effects due to air resistance.)

a. Find the height of the rocket when the motor cuts off.

$H_1 = 0 + 0 + 1/2(19.5\ m/s^2)(14.0)^2$ **5**
$= 1911\ m = 1.91x10^3\ m$

b. Find the speed of the rocket when the motor cuts off.

$v = 0 + (19.5\ m/s^2)(14.0\ s)$ **5**
$v = +273\ m/s$

c. Find the height of the rocket at its highest point.

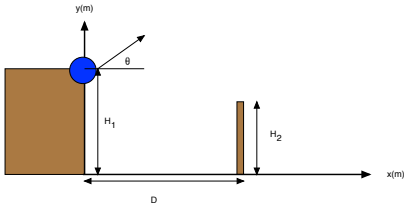
$0 = (273)^2 + 2(-9.81)(H_2)$
$H_2 = 3799m$
$H = 3799m + 1911m$ **15**
$= 5.71x10^3 m$

d. Find the time it takes the rocket to reach its highest point.

$0 = 273\ m/s + (-9.81\ m/s^2)(t_2)$ **10**
$t_2 = 27.8\ s$

$t = 27.8s + 14.0s = 41.8s$

3. A cannonball is launched with an angle , θ, from the top of a tall building with height H_1 at a nearby wall a distance D=60.0 m from the building that has height H_2). The initial velocity in the y-direction given to the ball is 25.5 m/s. It takes 4.50 s for the cannonball to hit the top of the wall (ignore the thickness of the wall.



a. Find the initial velocity of the ball in the x-direction (magnitude and sign).

$60.0\ m = 0 + (v_{ox})(4.50\ s)$ **10**

$v_{ox} = 13.3\ m/s$

b. Find the initial speed of the ball.

$$v_o = \sqrt{(13.3)^2 + (25.5)^2}$$
$$= 28.8 m/s$$ **5**

c. Find the angle the ball made initially with respect to the horizontal (x) direction.

$$\theta = \tan^{-1}(\frac{25.5}{13.3}) = 62.5^o$$ **5**

d. Find and write the velocity in vector notation using the coordinate system shown above for when the ball just hits the top of the wall.

$v_y = 25.5\ m/s + (-9.81\ m/s^2)(4.50)$ **15**
$v_y = -18.6\ m/s$

v = (13.3**i** - 18.6 **j**)m/s **5**