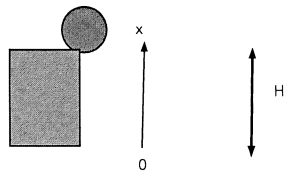
Your Name: _____

PHY203
Exam #1
Chapters 1-4
~~?????~~?
Fri., Feb. 14, 2025

Solutions

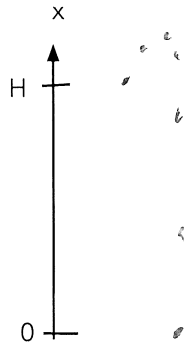
S25

Exam1 F24 Makeup



1. On Planet x, a ball is thrown straight up from the top of a cliff of height, H = 155 m, with an initial speed of 17.5 m/s. It takes 5.00 s for the ball to hit the ground. We want to find the acceleration due to gravity on Planet X. (Ignore air resistance.)

a. Produce a motion diagram of the ball: **5**



b. Fill out the table of known quantities for the ball: **5**

Parameter	Known Value
x_0	155 m
x_f	0
v_0	17.5 m/s
v_f	
a	
t	5.00 s

c. Find the magnitude of the acceleration of gravity. ~~15~~ 10

A: $0 = 155 + 17.5(5.00) + \frac{1}{2} a_x (5.00)^2$

$a_x = -19.4\ m/s^2$ $|a| = 19.4\ m/s^2$

d. Find the ~~speed~~ velocity of the ball just before it hits the ground **10**

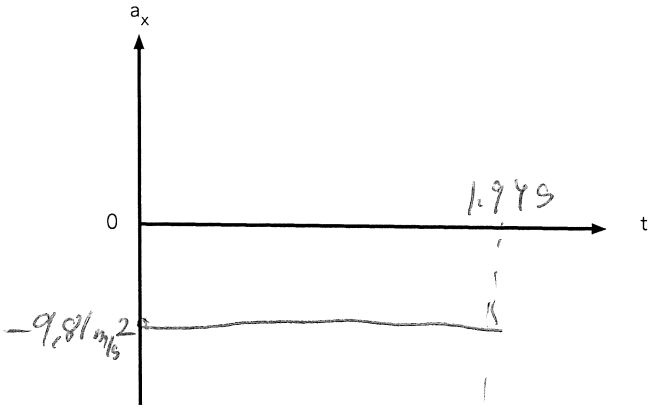
$v = v_0 + at$

$= 17.5 - 19.4(5.00)$

$= -79.5\ m/s$

2. A ball is thrown straight up from a cliff of height 250 m at t=0 with an initial speed of 19.0 m/s. Plot the following from t=0 until the ball reaches its highest point, <u>including appropriate values including units on **both** axes</u>. Take "up" as the positive x-direction with x=0 at ground level.

a. Acceleration vs. time. **10**

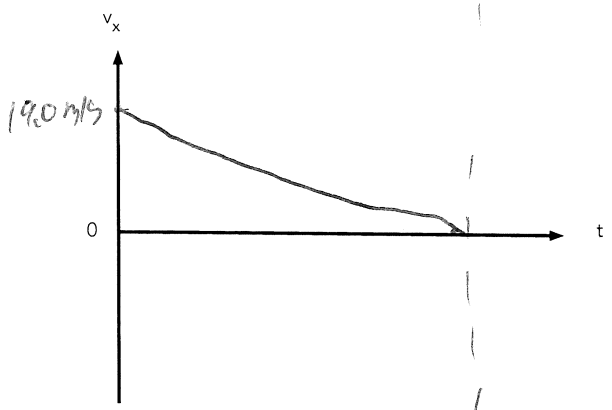


$v = v_0 + at$

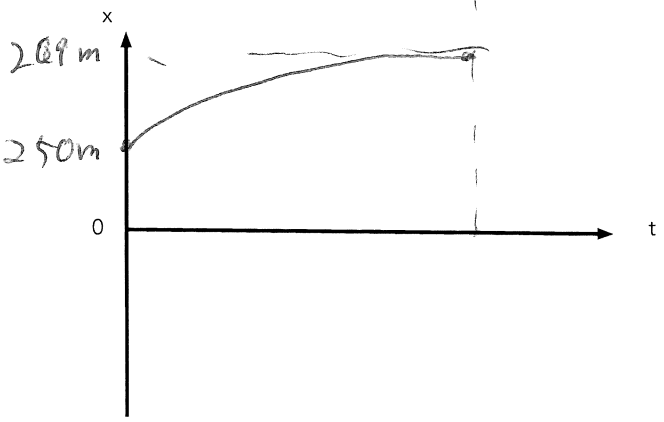
$0 = 19.0 - gt$

$t = 1.99s$

b. Velocity vs. time. **10**



c. Position vs. time. **10**

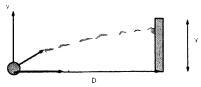


$x = 250 + 19.0(1.99) - \frac{1}{2}g(1.99)^2$

$= 269 m$

Or

$0 = 19^2 - 2g\Delta x$



3. A cannonball is shot from ground level at a castle wall. The castle wall has a height of 350 m and is a horizontal distance D = 175 m from the cannon. The initial horizontal component of velocity of the ball is 85.0 m/s in magnitude. Take y = 0 at ground level. Assume the ball hits the wall at a height of 250 m on the way up.

a. On the figure above, plot the trajectory of the cannonball. **5**

b. Fill out the tables of known values. Take the final position as when the cannonball grazes the castle wall. **5**

Parameter	Known Value
x_0	0
x_f	175 m
v_{x0}	85.0 m/s
v_{xf}	85.0 m/s
a_x	0

Parameter	Known Value
y_0	0
y_f	250 m
v_{y0}	
v_{yf}	
a_y	$-9.81\ m/s^2$

c. Find the time it takes the cannonball to hit the wall. **5**

x: A: $175 = 85.0t$, $t = 2.06\ s$

c. Find the initial velocity of the cannonball and write it in vector notation using the coordinate system above. **15**

y: A: $250 = 0 + v_{y0}(2.06) - \frac{1}{2}g(2.06)^2$

$v_{y0} = 13.1\ m/s$

$\vec{v}_0 = (85.0\hat{i} + 13.1\hat{j})\ m/s$

d. If instead the wall was shorter and the cannonball missed the wall, find the velocity, acceleration, and position of the cannonball at its highest point and write them in vector notation. **15**

$\vec{a} = -9.81\hat{j}\ m/s^2$

y: $0 = 13.1 - gt$, $t = 13.3\ s$

x: $x = 0 + 85(13.3) = 1.14 \times 10^3\ m$

y: $0 = 13.1^2 - 2gy$, $y = 8.75\ m$

$\vec{v} = 85.0\hat{i}\ m/s$

$\vec{r} = (1.14 \times 10^3\hat{i} + 8.75\hat{j})\ m$