Unity Student Worksheet

| Lesson 1: Force

Parameter check:

What parameters did you use in Lesson 1?: Cannonball Mass: 5
Spring Force: 500
Velocity 6.17 m/s
Weight 49 N

The formula to calculate **force** is: F= MA

The formula that calculates **velocity** is: Velocity = Change in distance/Change in time.

The formula that calculates **acceleration** is: A= change in velocity/ change in time.

There are a set of parameters that don't allow the ball to launch:

What are they? Weight and no Tension.

Why don't they work? With higher weight and no tension the ball wont move.

Find the acceleration in the launch direction of your ball right after it was released, use the parameters you entered in the forces lesson. Write out the variables that you know first, then document your calculations.

Knowns:

F = 500

m = 5

a = ? 100m/s2

Calculate the average velocity of the ball in the horizontal axis using the distance and time displayed in the unity editor.

Knowns:

d = 7.7m

t = 1.25

v_x = ? 6.16 m/s

Will the velocity profile in the x-axis change at different points along the trajectory of the projectile?

Why or why not? Velocity will decrease as the ball loses force, eventually reaching 0 when it hits the ground.

Lesson 2: Energy

Parameter check:

What parameters did you use in Lesson 2?
Cannonball Mass: 3.5
Spring Force: 450

What are the four kinematic equations?

$$V_f = V_i + at$$

$$d = \left(\frac{V_i + V_f}{2}\right) \times t$$

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

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

Explain how the law of conservation of energy applies to the catapult and cannonball:

Energy is being transfered from the catapult at rest, into the cannonball as it is flung using the force and mass. the energy that was transferred gives its velocity.

Use the kinematic equation to calculate the vertical velocity of the cannonball at the top of it's arc; use the parameters from lesson 2. The calculation for the initial vertical velocity components has already been started for you. Round the velocities to a whole number in your calculations.

Knowns:

V_i = 6.85m/s2

t = 0

a = 9.81 m/s²

V_{fy} = ? 6.85m/s2

$$V_{iy} = V_i \sin(45)$$

$$V_{iy} = V_i \times 0.707$$

$$V_{iy} = 4.84$$

Use the same formula to find thevertical acceleration of your cannonball from the top of its arc to the bottom of the parabola. The final velocity you calculated above is now your initial velocity. Round your final answer to the nearest tenth.

Knowns:

V_{iy} = 6.85m/s2

V_{fy} = 6.85m/s2

t_i = 0

t_f = 0

a = ? 9.81m/s2

$$V_{fy} = V_f \sin(45)$$

$$V_{fy} = V_f \times 0.707$$

$$V_{fy} = 4.84$$

Was the vertical velocity at the midpoint you calculated close to zero m/s? What does your answer for the velocity reveal about the energy state of the ball? Will this always be the case?

It was not close to 0, it seems the energy state stayed the same. I believe it will

stay the same.

Is your answer for the vertical acceleration close to any significant value? What does your answer reveal about the movement of the ball in the vertical plane?

The vertical acceleration was the same as the vertical velocity. it travels at the

same rate while velocity is increasing.

What is the minimum mass of the ball needed to knock over all the blocks? _____20_____

What is the minimum spring force value needed to knock over all the blocks? _____11673_____