MA153 Lesson 11

LESSON 11 - Block I Review and Launchers

10 September, 2008

Outline

Admin

1. Mid Term Exam 1 is on 11 September during normal class time - Bring a formula sheet - handwritten

Admin

2. Lesson 13 - Next Monday, will be on technical writing. You need to read all the documents under the Projects Section in preparation for Monday! This includes the Project Write-Up Guidance, and the Writing Guide. You should also look at the example MA 153 Project and Student Write-Up.

Admin

3. Dean's Hour, 12 September, This Friday
   The day of our drop
   Guest Speaker in Robinson Auditorium
   I highly encourage you to attend - You will enjoy it!

Admin

4. Only 2 days and a wake up or 2 days and a butt until

Admin

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5. Death Magnetic - Metallica comes out

Outline

Homework Help

Questions? - Homework Help

Outline

MA 153 WPR I Checklist

Start from the bottom work backwards

Outline

Block I Bowman Notes

Start at the end and work back

Projectile Launching Part I

- Start the launcher at the origin like we are firing from the ground.
- Force due to gravity acts downward so we have $F = m\mathbf{a} = -mg\mathbf{j}$
- $g = |\mathbf{a}| \approx 9.8m/s^2$. or $g = |\mathbf{a}| \approx 32ft/s^2$. So $\mathbf{a} = -g\mathbf{j}$
- Since $\mathbf{v}'(t) = \mathbf{a}$, we have $\mathbf{v}(t) = -gt\mathbf{j} + C$
- $\mathbf{C} = \mathbf{v}(0) = \mathbf{v}_0$ So we get $\mathbf{r}'(t) = \mathbf{v}(t) = -gt\mathbf{j} + \mathbf{v}_0$
- Integrating again we get $\mathbf{r}(t) = -\frac{1}{2}gt^2\mathbf{j} + t\mathbf{v}_0 + \mathbf{D}$
- We now substitute in for $\mathbf{D}$ our initial position which if we start at the origin is zero

Projectile Launching Part II

- If we find the speed at time zero $|\mathbf{v}_0| = v_0$
- Then we get $\mathbf{v}_0 = v_0 \cos(\alpha) t\mathbf{i} + v_0 \sin(\alpha) t\mathbf{j}$
- So now we have $\mathbf{r}(t) = (v_0 \cos\alpha) t\mathbf{i} + \left[(v_0 \sin\alpha)t - \frac{1}{2}gt^2\right]\mathbf{j}$
- Our parametric equations of the mortar are

$$x = (v_0 \cos\alpha)t, \quad y = (v_0 \sin\alpha)t - \frac{1}{2}gt^2$$

Finding Initial Velocity

- Our parametric equations of the mortar are

$$x = (v_0 \cos \alpha)t + x_0, \quad y = (v_0 \sin \alpha)t - \frac{1}{2}gt^2 + y_0$$

Finding Initial Velocity

- Our parametric equations of the mortar are

$$x = (v_0 \cos \alpha)t + x_0, \quad y = (v_0 \sin \alpha)t - \frac{1}{2}gt^2 + y_0$$

- If we set these equations up and fill in all the known values like our angle α, the angle our projectile is launched at, our initial positions, and our final positions, we get two equations and two unknowns.

Finding Initial Velocity

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$$x = (v_0 \cos\alpha)t + x_0, \quad y = (v_0 \sin\alpha)t - \frac{1}{2}gt^2 + y_0$$

- If we set these equations up and fill in all the known values like our angle α, the angle our projectile is launched at, our initial positions, and our final positions, we get two equations and two unknowns.
- We can now solve for one unknown like v_0, substitute it into the other equation and solve for t. Finally we substitute one last time and get a numerical answer for v_0.

Baseball Hit

- Simulate a hit of a baseball with your launcher
- Put a target out and measure the distance to it.
- Using the math and your known muzzle velocity adjust the angle to hit the target.
- BONUS POINTS FOR THE LEAST TRIES OR A FIRST TIME HIT

Outline

The Dreaded Thayer Board Work

- If a nine iron lofts a golf ball at an angle of 60°, how fast would you have to swing in order to hit the ball 30 feet?
- You are standing on a hilltop located at (10, 20, 300), all distances in meters. You want to launch mortars to the north. The gun tube is set at 70° and the mortars fire with a velocity of 200 meters per second. With no wind, where will the projectiles land?

Look Forward

WPR I

Questions?

Questions?