A3_7 The Trunchbull Olympics - Pigtail Hammer Throw

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Abstract

In the 1996 film *Matilda*, Amanda Thripp is thrown by her pigtails, in the style of a hammer throw, by Miss Trunchbull. Based on how long she is airborne for, we determined that she would have travelled 1089 m. To reach this distance she would also have to be spun around up to 535 Revolutions Per Minute (RPM) where her body would experience 5.89 G's of force.

Introduction

In the 1996 film *Matilda* Miss Trunchbull punishes one of her students, Amanda Thripp, for having pigtails. Miss Trunchbull uses her hammer throwing technique to throw Amanda over a fence. In this paper we determined how fast Amanda would have to be spun around, in revolutions per minute (RPM), to be airborne for the duration depicted in the film. In addition to this, we found how far Amanda would travel, by assuming a parabolic path. We then found the g-force she would experience.

Theory and Results

To find the velocity of Amanda in the y-direction after being released, equation (1) is used.

$$S_y = V_y t - \frac{1}{2} g t^2 \qquad (1)$$

In this equation, S_y is the distance travelled in the y direction, V_y is the velocity in the y direction, t is the time of flight and $g = 9.81$ ms^{-2}.

We timed how long Amanda was airborne for using a stopwatch and slowing the scene [1] by $\times 0.25$ before scaling the time back to full speed. We found her to be airborne for $t = 14.89$ s.
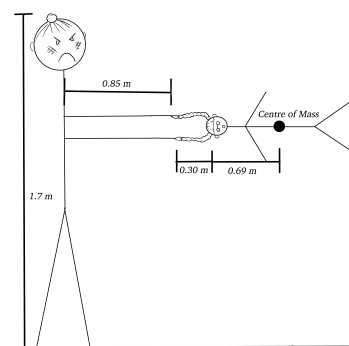

Figure 1: The measurements involved in Miss Trunchbull's hammer throw of Amanda.

From the scene, it was found that Miss Trunchbull releases Amanda at head-height. Miss Trunchbull was found to be 1.7 m tall [2]. This was used as the distance travelled in the y direction, so S_y = -1.7 m. Re-arranging equation (1) gives us a value of $V_y = 73.14$ m s^{-1}

For simplicity, we assumed that the angle Amanda was thrown at was 45°. The distance Amanda was thrown in the x-direction can therefore be found using equation (2).

$$S_x = V_x t \qquad (2)$$

Here, S_x is the distance travelled in the x

direction and V_x is the velocity in the x direction. Due to the angle being 45°, we know that V_x is the same value as V_y. Therefore, with equation (2), the distance Amanda was thrown in the x direction was found to be 1089 m.

We next found the RPM that Miss Trunchbull had to undergo in order to throw Amanda the distance of 1089 m. The number of revolutions per second is found by equation (3).

$$\frac{1}{t_r} = \frac{V_0}{C} \tag{3}$$

t_r is the time taken for 1 revolution, V_0 is the initial velocity of Amanda and C is the circumference of the circle Amanda is being spun in. C is found from Figure 1. We assumed that Miss Trunchbull's arm length is equal to half the height of her body, 0.85m. We then estimated the length of Amanda's pigtails to be 0.30m. The average height of a 10 year old child is 1.38 m [6]. Hence, 0.69 m was used as the distance from the centre of mass of Amanda to her head. Therefore, the total radius of the circle, r, is 0.85 + 0.30 + 0.69 = 1.84 m. C could then be calculated as 11.56 m.

To calculate V_0, equation (4) is used.

$$V_0 = \frac{V_y}{sin(45)} \tag{4}$$

V_0 was found to be 103.14 m s^{-1}.

These values are used in Equation (3) which is then multiplied by 60 seconds to find the RPM. Hence, Miss Trunchbull and Amanda spin at 535 RPM.

To find the G-Force Amanda would experience, equation (5) is used [3].

$$G_{Force} = RPM^2(1.118 \times 10^{-5})r \tag{5}$$

We found that Amanda would be subjected to a force of 5.89 G's.

Discussion

The distance she is thrown, 1089 m, is comparable to approximately the length of 10 football fields [4]. Her trajectory once she has been thrown is shown in Figure 2.
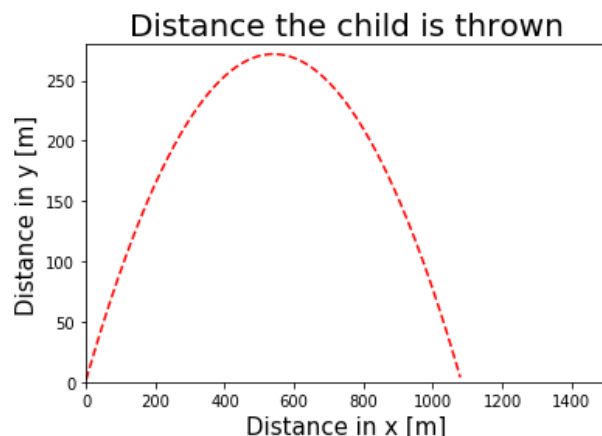

Figure 2: Amanda's trajectory

The G-force she experiences would be similar to a Soyuz landing where astronauts experience no more than 6 G's [5]. Therefore, it is unlikely Amanda would feel as fine afterwards as she did in the film.

Conclusion

We calculated that Miss Trunchbull threw Amanda 1089 m in the film Matilda. This means that Miss Trunchbull would have to spin at a rate of 535 RPM, meaning Amanda is subjected to a force of 5.89 G's. This is a huge force for a human to experience, comparable to the force astronauts endure during a Soyuz landing.

References

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