Journal of Physics Special Topics
An undergraduate physics journal

P2_4 Sky High

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December 5, 2018

Abstract

During a scene in the film "Sky High", a character called Speed runs around another character named Warren Peace at a very high speed in order to remove his access to air and put out Warren's fire abilities. We have found that the energy required to create a vacuum in that space would be 1.26 MJ, and so Speed would have to run at a velocity of about 400 mph.

Introduction

In a scene of the film "Sky High", a character called Speed (Will Harris) runs in circular motion at a high velocity around a character called Warren Peace (Steven Strait) who has the ability of pyrokinesis. He does so in order to remove Warren's access to air and thus stop the fire. This is shown in figure 1.

Figure 1: A diagram portraying the the scene from the movie.

In tornadoes, the updraft which powers the tornado, creates a low pressure zone at the core of the tornado [1], for the purpose of our calculations we assume a similar effect can be observed and creates a cylindrical barrier in which a vacuum is created. We assume all air is removed from the cylinder, air is at atmospheric pressure, no air re-enters the cylinder, Speed is travelling at a constant tangential velocity and that all the energy produced is used to produce a vacuum.

Method

To start with, we calculated the energy required to create a vacuum within the approximated cylinder created by the character Speed,

$$E = \Delta P V \tag{1}$$

Where P is the change in pressure (1 atm) and V is the volume of the cylinder [2]. We then found the volume of the cylinder to be 12.4 m^3 with the following equation,

$$V = \pi h r^2 \tag{2}$$

Where r is the radius of the cylinder (we approximate the radius to be 1.5 m from watching the film) and h is the height of the average male (1.76 m) [3]. We found that the energy required in this scenario would be 1.26 MJ.

Next, we equated this energy to the kinetic energy created from the man running in a circular

motion using the equation,

$$KE = 1/2(I\omega^2) \tag{3}$$

Where I is the moment of inertia, and ω is the angular velocity [4]. First, to calculate the moment of inertia, we modelled the cylinder to be hollow and it to be 175.5 kgm^2 with the following equation,

$$I = Mr^2 \tag{4}$$

Where M is the mass of an average male (78 kg) [5] [6]. Rearranging Eq. (3) for ω, we calculated the angular velocity of the man to be around 120 $rads^{-1}$.

From this, we were finally able to calculate the linear velocity of the man with the following equation,

$$v = \omega r \tag{5}$$

[7] This gave us an answer of 180 ms^{-1} (approximately 400 mph).

Conclusion

In this report, we investigated how fast the character Speed from the film "Sky High" would have to run in a circular motion around Warren Peace in order to remove all of the air from a cylindrical volume of space, and create a vacuum.

From our results, we found that Speed would have to run at a constant tangential velocity of 180 ms^{-1} (400 mph) in order to create enough energy to remove all of the air in the cylinder and thus create a vacuum.

To compare this to a real world scenario, Speed is travelling faster than a Fujita F6 tornado, which have wind speeds of between 319 and 379 mph. [8].

References

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