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Calculation Analysis the Concept of Object Acceleration on a Simple Machine with an Inclined Plane Pulley System

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Abstract: Natural science is a branch of knowledge related to how to systematically find out about nature. Science has components consisting of products, processes and attitudes. This experimental study aims to determine the factors that affect the magnitude of the acceleration of objects on a simple plane with an inclined plane pulley system. The type of research used is experimental research using an inclined plane pulley system as an aid. Based on the six experiments of the inclined plane pulley system that have been carried out, the results of the study show that there are several factors that influence the magnitude of the acceleration of objects on simple planes of the inclined plane pulley system, including: the mass of the object, the pulling/pushing force, the slope of the plane (angle size), and the friction coefficient for rough/slippery surfaces. In addition, the value of the acceleration due to gravity somewhere can also affect the magnitude of the object's acceleration. However, because the value of the acceleration due to gravity in various places is the same, the value does not really affect it. The magnitude of the acceleration due to gravity is a constant g 9.8 m/s^2 or is often rounded up in calculations to g 10 m/s^2.

Keywords: Acceleration of objects; Inclined plane pulley system; Props; Simple plane

Introduction

Indonesia regulates the National Education System in Law Number 20 of 2003. National education has a vision of creating a system as a strong and authoritative social institution that enables all Indonesian people to grow into quality human beings and actively respond to the challenges of an ever-changing era. In addition, the Education System also has several visions that are expected to assist in the delivery of education in an active and effective manner. National education functions to develop capabilities and form dignified national character and civilization in the framework of educating the nation's life (Sakdiah et al., 2022; Suparlan, 2022; Wardani et al., 2019). While the aim is to develop the potential of students to become human beings who believe and fear, have noble character, are healthy, knowledgeable, capable, creative, independent (Abidin, 2019; Adventyana et al., 2023; Resya et al., 2022).

Natural science is a branch of knowledge related to how to systematically find out about nature (Azizi, 2022). Science can also be defined as the study of the causes and effects of events that occur in nature (Gunawan, 2015; Izzuddin, 2019; Musyadad et al., 2019). According to Pistanty et al. (2015), science has components consisting of products, processes and attitudes. The product includes all facts, concepts, principles, laws, theories and knowledge. Processes include thought processes and scientific processes for discovering and developing concepts and knowledge. While attitudes include scientific attitudes such as curiosity, objective and honest. These three components must be fulfilled as a whole, so that it can be said as a science as a whole. Science learning is not only limited to learning facts, concepts, principles, laws.

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The results of observations at SMPN 4 Narmada show that the low ability of teachers to make teaching materials or learning media that can support students' abilities. The availability of learning media, especially in the world of education, is needed, considering the use of media can facilitate the learning process. Learning media according to Rohman (2013) is a physical vehicle that contains subject matter. In general, learning media are all teaching tools used by teachers in conveying material. In certain matters the need for learning media can represent the teacher in presenting learning information to students. One of the learning media that can be used in science learning is the existence of visual aids in practicum. In the learning process.

One of the visual aids that can be sought to help the learning process is the inclined plane pulley system props. The inclined plane pulley system is a system in which there are pulleys and an inclined plane. The discussion on the inclined plane pulley system is to see the force acting on the object. By knowing the force acting on the object, later the acceleration of the object's motion can be determined/calculated. An inclined plane pulley system involves an object/object located on an inclined plane, a pulley, and an object suspended from a rope that is connected to other objects via the pulley.

Method

The type of research used is experimental method research (experimental research) by using an inclined plane pulley system props. According to Hamdayana (2017) the experimental method is a method of providing opportunities for individual or group students to be trained to carry out a process or experiment. The tools and materials used in this experiment were: props for an inclined plane pulley system, nylon thread, protractor, transparent paper, and wooden blocks as weights (0.1 gram, 0.2 gram, 0.6 gram and 1 gram in size).

The research procedure is described as follows: (1) Prepare an inclined plane pulley system props and other tools/materials. (2) Conduct six experiments to calculate the acceleration of objects on an inclined plane pulley system, including: (a) experiment with a rough inclined plane, 60 degree angle, object mass 1 0.2 gram, and object mass 2 0.1 gram; (b) experiment with a smooth inclined plane, 60 degree angle, object mass 1 0.2 gram, and object mass 2 0.1 gram; (c) experiment with a rough inclined plane, 45 degree angle, object mass 1 0.2 gram, and object mass 2 0.6 gram; (d) experiment with a smooth inclined plane, 45 degree angle, object mass 1 0.2 gram, and object mass 2 0.6 gram; (e) experiment with a rough inclined plane, 30 degree angle, object mass 1 0.2 gram, and object mass 2 1 gram; (f) experiment with a smooth inclined plane, 30 degree angle, object mass 1 0.2 gram, and object mass 2 1 gram. (3) Retrieving data from each trial.

Figure 1. Inclined plane pulley system trainer

Result and Discussion

The results of this study are data analysis of the calculation of the concept of acceleration on a simple plane with an inclined plane pulley system. To countthe acceleration of an object on an inclined plane pulley system with a rough plane type uses the formula:

$$a = \frac{w2 - fg - w1\ x\ \ \sin\theta}{m1 + m2} \quad (1)$$

Meanwhile to calculate the acceleration of an object on an inclined plane pulley system with a smooth plane type uses the formula:

$$a = \frac{w2 - w1\ \ \sin\theta}{m1 + m2} \quad (2)$$

After carrying out six experiments to calculate the acceleration of objects on an inclined plane pulley system, the data is obtained as shown in the following table.

Table 1. Experiment Results

Field Type	Angle	Mass 1 (g)	Mass 1 (g)	Acceleration of the Inclined Pulley System (m/s²)
Rough	60	0.2	0.1	-3
Slippery	60	0.2	0.1	-2.4
Rough	45	0.2	0.6	4.75
Slippery	45	0.2	0.6	5.75
Rough	30	0.2	1	2.73
Slippery	30	0.2	1	4.2

Based on the experiments that have been carried out, the magnitude of the acceleration of the object on the inclined plane pulley system depends on several factors, namely: the mass of the object, the pulling/pushing force, the slope of the plane (angle size), and the friction coefficient for rough/slippery surfaces. In addition, the value of the acceleration due to gravity somewhere can also affect the magnitude of the object's acceleration. However, because the value of the acceleration due to gravity in various places is the same, the value does not really affect it. The magnitude of the acceleration due to gravity is a constant g 9.8 m/s^2 or is often rounded up in calculations to g 10 m/s^2.

The first analysis concerns the effect of the mass of the object and the force of attraction/push on the acceleration of the object on the inclined plane pulley system.According to Newton's second law, the acceleration produced by the resultant force acting on an object is proportional to the magnitude of the resultant force, in the direction of the resultant force, and inversely proportional to the object's mass. The acceleration of an object is inversely proportional to its mass.The effect is that if the mass of an object is large then the acceleration is small.

The second analysis concerns the influence of the slope of the plane (angle size) onacceleration of an object on an inclined plane pulley system. Based on the experiments that have been carried out, the greater the angle of elevation of the inclined plane to the flat plane, the shorter the time it takes for the object to reach the end point so that the acceleration of the object is greater.

The third analysis is about the influence of the friction coefficient for rough/smooth surface types on the acceleration of objects on an inclined plane pulley system. Based on the experiments that have been carried out, the magnitude of the acceleration of objects passing through a rough surface is smaller than the acceleration of objects passing through a smooth surface. This happens because the frictional force reduces the speed of the object.Frictional forces provide negative acceleration or deceleration, making the object's speed decrease.

In this experiment, there are several obstacles found, namely: general errors and systematic errors. Common errors are errors that occur due to human error. The common error found in this experiment is the lack of accuracy in measuring angles on an inclined plane. Meanwhile, systematic errors are errors caused by the instruments/tools used and the influence of the surrounding environment when conducting experiments. The systematic error that occurs is that the tool shows an erratic pull on each object because the angle on the inclined plane is not fixed due to accidental vibrations.

Conclusion

Based on the discussion that has been described, the results of the study indicate that there are several factors that affect the magnitude of the acceleration of objects on a simple plane with an inclined plane pulley system, including: the mass of the object, the pulling/pushing force, the slope of the plane (angle size), and the coefficient of friction for rough plane types. /slippery. In addition, the value of the acceleration due to gravity somewhere can also affect the magnitude of the object's acceleration. However, because the value of the acceleration due to gravity in various places is the same, the value does not really affect it. The magnitude of the acceleration due to gravity is a constant g 9.8 m/s^2 or is often rounded up in calculations to g 10 m/s^2

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