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AN INVESTIGATION OF PROJECTILE MOTION   Designing a Projectile Launcher: An Investigation Of Projectile Motion Mark Clubine KitchenerWaterloo Collegiate Institute and Vocational School   1   AN INVESTIGATION OF PROJECTILE MOTION   2   Introduction Projectile motion is a form of motion where an object (called a projectile) is thrown near the earth's surface, following a parabolic path being influenced only by gravity (Science Clarified Premium Force Drag Drag equation TITLE To investigate the trajectory of a small ball as it rolls off a surface which is inclined to the horizontal. OBJECTIVE To investigate the trajectory of a two dimensional motion APPARATUS & MATERIALS Ramp Wooden block Pendulum bob Plumb line Steel ball Wooden board Carbon paper Meter rule Plasticine SETUP 1. A ramp has been set up at the edge of a bench as shown in the Figure 4-1. 3. Mount Premium Range of a projectile Force Curve Projectile motion into physics Objective: Our purpose for this lab was to observe projectile motion and use the equations of motion to predict the objects location in different instances of time. We used a projectile launcher and a ball to observe these properties of motion. The main equation used in this lab was d=Vit+1/2at^2 where Vit will produce the distance due to constant motion and 1/2at^2 will produce distance traveled due to accelerated motion or gravity in this case. Introduction: Premium Velocity Classical mechanics Acceleration Projectile Motion Purpose: Apply the concepts of two-dimensional kinematics (projectile motion) to predict the impact point of an object as its velocity increases. Introduction: The most common example of an object that is moving in two dimensions is a projectile. A projectile is an object upon which the only force acting is gravity. That is to say a projectile is any object that once projected or dropped continues in motion by its own, and is influenced only by the downward force Premium Force Velocity focus was projectile motion. A projectile is an object flying through the air that is only under the force of gravity (neglecting air resistance). A projectile moves both horizontally and vertically, which creates a parabolic flight path. In vertical projectile motion there is a constant velocity since there are no forces in the horizontal direction (neglecting drag due to air resistance). Consequently, there is no acceleration in horizontal. There is acceleration in vertical projectile motion gravity Premium Drag equation Force A projectile is any object that is given an initial velocity and follows a path determined by the effects of gravitational acceleration and air resistance. Projectile motion is the act of projecting an object into the air at an angle when a curved path is an object follows when thrown or propelled near the surface of the earth.For example: a thrown football, an object dropped from an airplane, or a bullet shot from a gun.Projectile motion may only be used to solve mechanics problems Premium Acceleration Force Classical mechanics Investigating Projectile Motion Introduction Projectile motion is a type of motion that consists of horizontal and vertical motions which are independent from each other, known as vector components. For an object to be considered a projectile, it must not be self-propelled. Projectiles move horizontally at a constant velocity. However, they undergo uniform acceleration in the vertical direction, which is caused by gravity. An important aspect of projectile motion is that the time it takes Premium Classical mechanics Acceleration Velocity hill. Determine the initial horizontal velocity of the soccer ball.   Problem Type 2: A projectile is launched at an angle to the horizontal and rises upwards to a peak while moving horizontally. Upon reaching the peak, the projectile falls with a motion that is symmetrical to its path upwards to the peak. Predictable unknowns include the time of flight, the horizontal range, and the height of the projectile when it is at its peak. Examples of this type of problem are a. A football is kicked Premium Problem solving PROJECTILE MOTION AND BASKET BALL By: Fieda Rizkiana 09/X11 SENIOR HIGH SCHOOL 2 KEDIRI 2013 ACKNOWLEDGEMENT The writer expresses her gratitude to Allah SWT for blessing, love, opportunity, health and mercy to complete this assignment entitled "PROJECTILE MOTION AND BASKET BALL" to complete final task of Physics in 2nd semester. To complete this assignment, the writer knows that without other people's help and support she will never be able to finish it. Therefore, writer would like Premium Basketball Velocity Force Projectile Motion Objectives: The purpose of this experiment is to examine the projectile motion of a ball launched horizontally. The initial velocity will be calculated. The range of the ball will be measured. Theory: Horizontal launch of the ball allows computing the initial velocity v0 by measuring the height of the launch and the distance traveled by the ball: h=, s=v0 • t Solving these parametric equations for v0 gives us: 0=s Where h and s are defined from the Premium Velocity Range of a projectile This is the equation of trajectory in projectile motion, and it proves that the projectile motion is always parabolic in nature. We know that projectile motion is a type of two-dimensional motion or motion in a plane. It is assumed that the only force acting on a projectile (the object experiencing projectile motion) is the force due to gravity. But how can we define projectile motion in the real world? How are the concepts of projectile motion applicable to daily life? Let us see some real-life examples of projectile motion in two dimensions. All of us know about basketball. The player jumps a little to score a basket and throws the ball in the basket. The motion of the ball is in the form of a projectile. Hence, it is referred to as projectile motion. What advantage does jumping give to their chances of scoring a basket? Now, apart from basketballs, if we throw a cricket ball, a stone in a river, a javelin throw, an angry bird, a football or a bullet, all these motions have one thing in common. They all show a projectile motion. And that is, the moment they are released, there is only one force acting on them- gravity. It pulls them downwards, thus giving all of them an equal, impartial acceleration. It implies that if something is being thrown in the air, it can easily be predicted how long the projectile will be in the air and at what distance it will hit the ground from the initial point. If the air resistance is neglected, there would be no acceleration in the horizontal direction. This implies that as long as a body is thrown near the surface, the body's motion can be considered a two-dimensional motion, with acceleration only in one direction. But how can it be concluded that a body thrown in the air follows a two-dimensional path? To understand this, let us assume a ball that is rolling as shown below: Figure 1 Motion in one dimensionNow, if the ball is rolled along the path shown, what can we say about the dimension of motion? The most common answer would be that it has an x-component and a y-component, it is moving on a plane, so it must be an example of motion in two dimensions. But it is not correct, as it can be noticed that there exists a line that can completely define the basketball's motion. Thus, it is an example of motion in one dimension. Therefore, the choice of axis does not alter the nature of the motion itself. Figure 2 Motion in PlaneNow, if the ball is thrown at some angle, as shown, the velocity of the ball has an x-component and a y-component and also a z-component. So, does it mean that it is a three-dimensional motion? It can be seen here that a line cannot define such a motion, but a plane can. Therefore, for a body thrown at any angle, there exists a plane that entirely contains the motion of the body. Thus, it can be concluded that as long as a body is near the surface of the Earth and the air resistance can be neglected, then the irrespective of the angle of projection, it will not tells us how far the axes are chosen. If the axes are rotated in such a way that, then and can completely define the motion of the ball as shown below: Thus, it can be concluded that the minimum number of coordinates required to define the motion of a body completely determines the dimension of its motion. Projectile motion is a type of motion experienced by an object that is projected into the air and that is affected by gravity. It is an important topic in physics that incorporates the concepts of both kinematics and dynamics, and it provides essential information about the motion of objects.When we talk about projectile motion, we are considering objects that are initially pushed into the air, and which move along a curved trajectory under the force of gravity only. No other forces act on these objects, assuming we neglect air resistance and other forces. Classical examples include a ball thrown into the air, a cannonball fired from a cannon, or a stone thrown from a cliff.Core beliefsTo simplify the study of projectile motion, we usually make some assumptions:The only significant force acting on a projectile is gravity.Air resistance is negligible.The projectile travels a relatively short distance so the curvature of the Earth can be neglected.The acceleration due to gravity g is constant and acts downward with a magnitude of about 9.81 m/s².Components of projectile motionProjectile motion can be analyzed by dividing it into two components: horizontal and vertical. The key to understanding projectile motion is to understand that these two components are independent of each other except for the time of flight. Here, we will describe these components.Horizontal speedThe horizontal component of the projectile's motion is controlled by the initial velocity and time. In the absence of air resistance, the horizontal velocity v_x remains constant. It is described by the formula: v_x = v_i * cos(θ) Where v_i is the initial velocity and θ is the projection angle. Thus the horizontal displacement x can be determined using: x = v_x * t Vertical speedThe vertical motion is subject to gravitational acceleration, and the initial vertical velocity v_y is given by: v_y = v_i * sin(θ) However, the vertical speed changes continuously because of the acceleration due to gravity. The equations for vertical velocity and vertical displacement height y are: v_y = v_i * sin(θ) - g * t y = v_i * sin(θ) * t - (1/2) * g * t² Flight timeThe time the projectile is in the air, or "time of flight", is determined by the vertical component of the speed. For a projectile launched and landed at the same vertical level, the total time of flight is given by: T = (2 * v_i * sin(θ)) / g Maximum heightThe maximum height H reached by the projectile is also determined by the vertical component of the initial velocity: h = (v_i² * sin²(θ)) / (2 * g) Range of the projectileThe horizontal distance traveled by the projectile, known as its range R, is given by: r = (v_i² * sin(2θ)) / g This formula assumes that the projectile will fall at the same vertical level from which it was released.Illustration of projectile motionLet's visualize projectile motion with a simple illustration, showing the trajectory and key points: Peak (maximum height) launch EffectReal-world examples and problemsLet's take a look at some common examples of projectile motion and see how we can apply the formulas we've derived:Example 1: Kicking a footballImagine that a football is kicked at an angle of 30° with an initial velocity of 20 m/s. Let's find the time, maximum height and distance of the football's flight.Flight time: Given, v_i = 20 m/s, θ = 30°, g = 9.81 m/s² t = (2 * 20 * sin(30)) / 9.81 = 2.04 sec Therefore, the football remains in the air for approximately 2.04 seconds.Maximum height: H = (20² * sin²(30)) / (2 * 9.81) = 5.10 m The maximum height of the football is approximately 5.10 meters.Category: r = (20² * sin(60)) / 9.81 = 34.64 m Therefore, the football covers a horizontal distance of approximately 34.64 meters.Example 2: Basketball throwSuppose a player is throwing a basketball at an initial speed of 15 m/s and at an angle of 45°. Find the range of this basketball throw. Range, R = (v_i² * sin(2θ)) / g r = (15² * sin(90)) / 9.81 = 22.94 m If we assume there is no air resistance the basketball will fall approximately 22.94 meters from the point where it was thrown.Complex ideas for advanced studyIn real-world scenarios, factors such as air resistance, wind, spin, and the shape and mass of the object can affect projectile motion. Such considerations make projectile motion much more complex and require more sophisticated mathematical models beyond the basics we've touched on here.For example, when air resistance is not negligible, it can be modeled as a force proportional to the velocity or the square of the velocity, depending on the speed and characteristics of the projectile. This will lead to differential equations that will require numerical methods or approximations to solve.ConclusionAn understanding of simple projectile motion is foundational to more complex physics topics. Engineers, scientists, and professionals in fields as diverse as sports, space exploration, and defense often use the principles of projectile motion. By understanding the fundamentals of how objects move in space under the influence of gravity, we can more accurately predict and model real-world phenomena. Page 2 Kinematics is a branch of classical mechanics that describes the motion of points, bodies, and systems of bodies without considering the forces that cause them to move. In simple terms, it is the study of how objects move. There are often two types of motion we consider: motion on a straight path (linear motion) and motion on a circular path (rotational motion). Kinematics focuses on different aspects such as displacement, velocity, and acceleration. Basic concepts of dynamics Dynamics can be understood effectively by breaking it down into some basic concepts and parameters. Displacement Displacement is a vector that represents the change in the position of an object. It has both magnitude and direction. Displacement is different from distance, which only measures how much ground an object has traveled, regardless of its starting or ending point. Example: If a car travels from point A to point B and returns to point A, the total distance traveled is the sum of AB and BA. However, the displacement is zero because the final position is the same as the initial position. A B A Velocity Velocity is a vector quantity that refers to the "rate of change of position of an object." It is an important aspect of dynamics because it not only tells us how fast an object is moving but also in which direction it is moving. The formula for velocity is: velocity = displacement / time Example: If a person walks 5 meters east in 5 seconds, then his velocity towards east will be 1 meter per second. Start 5 minutes V Acceleration Acceleration is a vector quantity defined as the rate of change of an object's velocity. It can be positive (speeding up) or negative (slowing down), and is described by the formula: acceleration = change in velocity / time Example: If a car increases its velocity from 10 m/s to 20 m/s in 5 seconds, the acceleration will be 2 m/s². 0s / 10m/s 5s / 20m/s Equations of motion In dynamics, there are three main equations of motion that relate displacement, velocity, acceleration, and time. These equations assume constant acceleration. First equation of motion This equation relates velocity, acceleration, and time: v = u + at Where: v = final velocity u = initial velocity a = acceleration t = time Example: If a car accelerates from rest (0 m/s) at a rate of 3 m/s² for 4 seconds, then the final velocity will be: v = 0 + (3 * 4) = 12 m/s Second equation of motion This equation takes into account the initial velocity, time, and acceleration to calculate displacement: s = ut + 0.5 * a * t² Example: For an object with an initial velocity of 2 m/s that accelerates at 2 m/s² for 3 seconds, the displacement is: s = 2 * 3 + 0.5 * 2 * (3)² = 12 meters Third equation of motion This equation relates initial and final motion, displacement, and acceleration: v² = u² + 2as Example: An object with an initial velocity of 5 m/s is accelerated to 15 m/s over a displacement of 50 m. Calculate the acceleration. 15² = 5² + 2 * a * 50 225 = 25 + 100a 200 = 100a a = 2 m/s² Graphical representation of motion Graphs are a valuable tool in studying kinetic motion because they provide a visual representation of the equations we are discussing. Common graphs include: Displacement- time graph These graphs show displacement on the y-axis and time on the x-axis. The straight line represents constant velocity, while the curved line represents acceleration. constant velocity Acceleration Velocity-time graphs These graphs show how velocity changes over time. A horizontal line represents constant velocity, while a sloping line represents acceleration, with the slope indicating the acceleration value. steady Acceleration Acceleration-time graphs These graphs measure how acceleration changes over time. A horizontal line represents constant acceleration, which often coincides with the graphs discussed above. Constant Acceleration Practical applications of dynamics Understanding dynamics is important for predicting the motion of objects in various fields such as engineering, robotics, astronomy, and sports. For example, in sports, analyzing an athlete's motion can help improve performance techniques and reduce the risk of injuries. Engineers designing vehicles such as cars or airplanes use the principles of kinematics to predict how changes in speed and velocity can affect safety and efficiency. In the field of robotics, kinematics aids in programming robots for specific tasks that involve motion. Conclusion Kinematics is a fundamental aspect of physics that plays a vital role in understanding the motion of objects. Using simple equations and representations such as graphs, it provides information about displacement, velocity, and acceleration without involving the forces that come into play. With a strong grasp on these concepts, predicting and analyzing motion becomes accessible, aiding many disciplines that rely on these principles. Page 3 Classical mechanics is a branch of physics that deals with the motion of objects and the forces that act upon them. It forms the foundation of many advanced studies in physics and engineering. Initially developed by Isaac Newton and later refined by other physicists, classical mechanics describes how macroscopic objects behave under various forces. It includes several key concepts such as Newton's laws of momentum, energy, momentum, and angular momentum. Newton's laws of motion First law: Law of inertia Newton's first law states that an object at rest stays at rest, and an object in motion continues to move in a straight line at a constant speed unless an external force is applied. This is called the law of inertia. Second law: Law of acceleration The second law states the relationship between the force applied to an object and its acceleration. It is expressed mathematically as follows: F = ma Where F is the force applied to the object, m is the mass of the object, and a is the acceleration. Weight The force applied to an object is a force or thrown, it is set in motion along a forward horizontal pathway. In outer space, a projectile will keep following that pathway indefinitely (at least until the influence of some other object's gravitational field causes to gravity. Third law: Action and reaction Newton's third law states that for every action there is an equal and opposite reaction. This means that forces always come in pairs. If an object A exerts a force on an object B, then object B exerts an equal and opposite force on object A. Example: When a swimmer pushes off from a pool wall, according to Newton's third law, the wall pushes the swimmer in the opposite direction with an equal force, causing the swimmer to move forward. Concepts of force Force is any interaction that changes the motion of an object without opposition. Forces can make objects speed up, slow down, stay in place, or change shape. The unit of force in the International System (SI) is the newton (N). Work and energy Work Work is the energy transferred by a force moving an object over a distance. It is calculated as follows: W = Fd cos theta Where W is the work done, F is the force applied, d is the distance moved by the object, and theta is the angle between the direction of force and the direction of motion. Kinetic energy Kinetic energy is the energy that an object has due to its motion. It is given by the formula: KE = frac{1}{2}mv^2 Where KE is the kinetic energy, m is the mass of the object, and v is its velocity. Potential energy Potential energy is the energy that is stored in an object due to its position in a force field, usually gravity. Gravitational potential energy is calculated as follows: PE = mgh Where PE is the gravitational potential energy, m is the mass of the object, g is the acceleration due to gravity, and h is the height above the reference point. Conservation laws Energy conservation The principle of conservation of energy asserts that energy cannot be created or destroyed, but can only be converted from one form to another. The total energy in an isolated system remains constant. Example: In a roller coaster, the total mechanical energy is conserved. At the highest point, the potential energy is maximum, and the kinetic energy is minimum. On descent, the potential energy is converted into kinetic energy. Conservation of momentum Momentum is the product of the mass and velocity of an object. The law of conservation of momentum states that if no external force acts on a closed system, then its total momentum remains constant. p = mv Where p is momentum, m is mass, and v is velocity. Example: In a collision, the momentum before collision is equal to the momentum after collision, provided there are no external forces interfering. Collision Elastic collision In an elastic collision, both momentum and kinetic energy are conserved. Objects collide with each other without any deformation or heat generation. Inelastic collision In an inelastic collision, momentum is conserved, but kinetic energy is not. The objects may stick together or deform, causing the kinetic energy to be converted into other forms such as heat or sound. Simple harmonic motion Simple harmonic motion (SHM) is periodic motion where the restoring force is directly proportional to the displacement. An example of this is a mass attached to a spring. F = -kx Where F is the restoring force, k is the spring constant, and x is the displacement from equilibrium. Mass The blue circle represents a mass in simple harmonic motion or a spring. Example: A pendulum swinging at small angles approximates simple harmonic motion because the forces involved satisfy the SHM criterion. Angular velocity Angular velocity and acceleration Angular velocity is the rate of change of angular displacement and is measured in radians per second. Angular acceleration is the rate of change of angular velocity. omega = frac{Delta theta}{Delta t}, alpha = frac{Delta omega}{Delta t} Where omega is the angular velocity, Delta theta is the change in angle, Delta t is the change in time, and alpha is the angular acceleration. Torque Torque is a measure of the force that can rotate an object about an axis. It is a vector quantity, having both magnitude and direction. tau = rF sin theta Where tau is the torque, r is the lever arm distance, F is the applied force, and theta is the angle between the force and the lever arm. Force The above figure shows a lever arm rotating about a point by applying a force at an angle. Conservation of angular momentum Angular momentum is preserved in a closed system with no external torque. The angular momentum of a rotating object is expressed as: L = Iomega Where L is the angular momentum, I is the moment of inertia, and omega is the angular velocity. Example: An ice skater spinning with her arms outstretched will spin faster if she pulls her arms in, because angular momentum is conserved. Applications in daily life Classical mechanics can be seen in everyday activities and objects. From the basic act of walking, where our body muscles apply force to the ground, to driving a vehicle, where various forces and motions come into play. Understanding classical mechanics helps design efficient machines, predict weather patterns, and even launch satellites into space by carefully calculating forces and motions. Projectile motion is concluded when a projectile stops moving. Assuming nothing gets in the way, that conclusion is reached when the projectile comes to rest on the ground.On Earth, the motion of any projectile has both a horizontal component and a vertical component. When a projectile is fired or thrown, it is set in motion along a forward horizontal pathway. In outer space, a projectile will keep following that pathway indefinitely (at least until the influence of some other object's gravitational field causes its course to change). Near the Earth's surface, though, the motion of any projectile is being immediately and affects the entire course of the projectile's flight. A projectile's horizontal velocity remains constant (ignoring factors such as air resistance and wind). It does not accelerate. But the force of gravity causes a projectile to accelerate in a vertical direction down toward the surface of the Earth (technically toward the center of the Earth). The influence of gravity pulls the projectile away from its straight-line original path into a curved, parabolic path. Downward acceleration continues until the projectile hits the ground and comes to rest. This state of rest where the projectile's velocity is zero in all directions is the conclusion of a projectile's motion. MORE FROM REFERENCE.COM Write an essay about conclusion of projectile motionAsked on 2/27/2025, 2 pageviews### Conclusion Of Projectile Motion Projectile motion is a fascinating and essential aspect of classical mechanics that describes the trajectory of an object launched into the air under the influence of gravity, while subject to its initial velocity and angle of projection. Understanding the principles of projectile motion not only allows for comprehension of physical phenomena encountered in various engineering, sports, and everyday contexts. At its core, projectile motion can be dissected into two primary components: horizontal and vertical. These components operate independently yet simultaneously, as per Galileo's principle of independence of motion. The horizontal motion occurs at a uniform velocity, assuming negligible air resistance, while the vertical motion is accelerated, influenced by the force of gravity. This segmented analysis facilitates the prediction of projectile characteristics, such as range, maximum height, and time of flight, using fundamental kinematic equations. 1. **Range**: The range of a projectile—the horizontal distance traveled before it returns to its original vertical position—is maximized at a launch angle of 45 degrees, assuming level ground. This observation has profound implications for various applications, such as sports, where athletes aim to optimize their launches for improved performance. In practical scenarios, factors like air resistance and initial velocity play pivotal roles in determining the effective range. 2. **Maximum Height**: The apex of a projectile's trajectory occurs when its vertical velocity component reaches zero, after which it descends back to the earth. The height attained depends on the initial velocity and launch angle. Understanding this aspect is crucial in fields like aerospace engineering, where predicting the altitude of projectiles (rockets, missiles) is vital for mission success and safety. 3. **Time of Flight**: The total time a projectile is in the air resonates not just with the height and range aspects but also holds significance in sports and engineering applications. The time of flight is influenced by the initial vertical component of the launch velocity and can drastically alter the effectiveness of a projectile based on planned trajectories. The analysis of projectile motion extends beyond mere academic exercise; it serves as a foundation for advanced studies in physics, engineering, and applied mathematics. Real-world implications can be observed in diverse fields such as sports (e.g., basketball, football), entertainment (e.g., fireworks display), and engineering (e.g., ballistic trajectories in military applications). Moreover, advancements in technology, particularly simulations and computer modeling, have enriched our understanding and ability to predict projectile paths with greater accuracy, taking into account factors such as air resistance and varying gravitational forces (in extraterrestrial contexts). Courses in physics often leverage these principles to instill critical thinking and problem-solving skills, essential for budding scientists and engineers. In conclusion, the study of projectile motion encapsulates fundamental principles of kinematics and dynamics, offering vital insights into the behavior of objects in motion. Its principles and applications reiterate the interconnectedness of various scientific disciplines and illustrate how foundational concepts can lead to monumental advancements across fields. Whether in calculating the perfect angle for a jump shot or designing propulsion systems for space exploration, the essence of projectile motion remains a pivotal consideration, framing our understanding of motion in the universe. Thus, mastering this subject not only enriches knowledge of physical laws but also hones practical skills applicable in numerous real-world scenarios.Request an EssayLoading... To improve projectile motion, you can adjust the initial velocity, launch angle, or launch height of the projectile. By optimizing these parameters, you can achieve greater distance, height, or accuracy in the motion of the projectile. Additionally, reducing air resistance and wind can also help improve the overall projectile motion. In conclusion, projectiles travel with a parabolic trajectory due to the fact that the downward force of gravity accelerates them downward from their otherwise straight-line, gravity-free trajectory. What are the possible sources of error in projectile motion experiment? The main source of error is likely to be the effect of air resistance, which is very difficult to account for theoretically at this level and is systematic in that it should decrease the range of all projectiles launched. Another source of error is likely to be the precision with which the projectile is aimed. See also What is Hooke's Law of elasticity? The purpose of this experiment is to predict and verify the range and the time-of-flight of a projectile launched at an angle. To predict the range of the projectile when it is shot off a table at some angle above the horizontal, it is necessary first to determine the initial speed (muzzle velocity) of the ball. What is a projectile motion in physics? Trajectory: The curved path taken by a projectile. Horizontal distance: the distance a projectile moves while falling; also called range. Oblique projectile motion. Horizontal projectile motion. Projectile motion on an inclined plane. Common sources of error include instrumental, environmental, procedural, and human. All of these errors can be either random or systematic depending on how they affect the results. Instrumental error happens when the instruments being used are inaccurate, such as a balance that does not work (SF Fig. 1.4). Is air resistance a source of error? For example, if your experiment is intended to determine the acceleration due to gravity of a freely falling object, the effect of air resistance will always cause the time of the ball's fall to increase. This is a systematic error since it will always add an error in the same direction. The numerator is a sum of the square root of the deviation from the mean for all data points, xi. See also Why does the armature of a buzzer vibrate? What are the characteristics of projectile motion? Objects experiencing projectile motion have a constant velocity in the horizontal direction, and a constantly changing velocity in the vertical direction. The trajectory resulting from this combination always has the shape of a parabola. How do you predict where a projectile will land? This can be determined by launching the ball horizontally off the table and measuring the vertical and horizontal distances through which the ball travels. Then the initial velocity can be used to calculate where the ball will land when the ball is shot at an angle. Air friction is assumed to be negligible. The key components that we need to remember in order to solve projectile motion problems are: Initial launch angle, θ Initial velocity, u. Time of flight, T. What is the formula for projectile? The angular momentum of projectile - mu cos Θ × h where the value of h denotes the height. The angular momentum of the body— and acceleration in the case of angular projectile varies from 0 < Θ < 180 degrees. How do you calculate projectile? Horizontal velocity component: Vx = V* cos(a) Vertical velocity component: Vy = V* sin(a) Time of flight: t = 2 * Vy / g. Range of the projectile: R = 2 * Vx * Vy / g. Maximum height: hmax = Vy² / (2 * g) What forces is acting on the projectile? The only force acting upon a projectile is gravity! Projectile motion is movement of an object in a curved path toward the ground because it has both a horizontal force and the downward force of gravity acting on it. See also Which chapters are included in thermal physics for NEET?What is range in projectile motion? Assuming a projectile is launched from the ground level, the range is defined as the distance between the launch point and the point where the projectile hits the ground. Why is horizontal velocity zero? Suppose the particle in projectile motion reaches its highest point along the horizontal path. In that case, the horizontal velocity will usually be zero because as soon as it reaches the peak point, it is made to fall vertically downwards by the influence of the force of gravity. T tof = 2 (v 0 sin θ 0) g . This is the time of flight for a projectile both launched and impacting on a flat horizontal surface. Does mass affect projectile motion? Explanation: Mass is not relevant in projectile motion. What is relevant is the initial speed and direction of the object. Thus we can say that even if the masses of two objects are different, if they are subjected to the same projectile motion, they will usually have the same experimental results. (3) Negligent errors. Zero error is defined as the condition where a measuring instrument records a reading when no reading is required. In case of Vernier calipers it occurs when a zero on the main scale does not coincide with a zero on Vernier scale it is called zero error for Vernier. See also How do you get an A* in physics A level?How can random error be reduced? If you reduce the number of a data set, you reduce the width (FULL WIDTH AT HALF MAXIMUM) of a distribution, or the counting noise (POISSON NOISE) of a measurement. Usually, you can reduce random error by simply taking more measurements. Page 2In conclusion, projectiles travel with a parabolic trajectory due to the fact that the downward force of gravity accelerates them downward from their otherwise straight-line, gravity-free trajectory. What are the possible sources of error in projectile motion experiment? The main source of error is likely to be the effect of air resistance, which is very difficult to account for theoretically at this level and is systematic in that it should decrease the range of all projectiles launched. Another source of error is likely to be the precision with which the projectile is aimed. See also What is the velocity ratio of an incline plane? The purpose of this experiment is to predict and verify the range and the time-of-flight of a projectile launched at an angle. To predict the range of the projectile when it is shot off a table at some angle above the horizontal, it is necessary first to determine the initial speed (muzzle velocity) of the ball. What is a projectile motion in physics? Trajectory: The curved path taken by a projectile. Horizontal distance: the distance a projectile moves while falling; also called range. Oblique projectile motion. Horizontal projectile motion. Projectile motion on an inclined plane. Common sources of error include instrumental, environmental, procedural, and human. All of these errors can be either random or systematic depending on how they affect the results. Instrumental error happens when the instruments being used are inaccurate, such as a balance that does not work (SF Fig. 1.4). Is air resistance a source of error? For example, if your experiment is intended to determine the acceleration due to gravity of a freely falling object, the effect of air resistance will always cause the time of the ball's fall to increase. This is a systematic error since it will always add an error in the same direction. The numerator is a sum of the square root of the deviation from the mean for all data points, xi. What are the characteristics of projectile motion? Objects experiencing projectile motion have a constant velocity in the horizontal direction, and a constantly changing velocity in the vertical direction. The trajectory resulting from this combination always has the shape of a parabola. How do you predict where a projectile will land? This can be determined by launching the ball horizontally off the table and measuring the vertical and horizontal distances through which the ball travels. Then the initial velocity can be used to calculate where the ball will land when the ball is shot at an angle. Air friction is assumed to be negligible. The key components that we need to remember in order to solve projectile motion problems are: Initial launch angle, θ Initial velocity, u. Time of flight, T. What is the formula for projectile? The angular momentum of projectile = mu cos Θ × h where the value of h denotes the height. The angular momentum of the body—and acceleration in the case of angular projection varies from 0 < Θ < 180 degrees. How do you calculate projectile? Horizontal velocity component: Vx = V* cos(a) Vertical velocity component: Vy = V* sin(a) Time of flight: t = 2 * Vy / g. Range of the projectile: R = 2 * Vx * Vy / g. Maximum height: hmax = Vy² / (2 * g) What forces is acting on the projectile? The only force acting upon a projectile is gravity! Projectile motion is movement of an object in a curved path toward the ground because it has both a horizontal force and the downward force of gravity acting on it. See also What are conceptual questions examples?What is range in projectile motion? Assuming a projectile is launched from the ground level, the range is defined as the distance between the launch point and the point where the projectile hits the ground. Why is horizontal velocity zero? Suppose the particle in projectile motion reaches its highest point along the horizontal path. In that case, the horizontal velocity will usually be zero because as soon as it reaches the peak point, it is made to fall vertically downwards by the influence of the force of gravity. T tof = 2 (v 0 sin θ 0) g . This is the time of flight for a projectile both launched and impacting on a flat horizontal surface. Does mass affect projectile motion? Explanation: Mass is not relevant in projectile motion. What is relevant is the initial speed and direction of the object. What are the 3 types of experimental errors? Three general types of errors occur in lab measurements: random error, systematic error, and gross errors. Random (or indeterminate) errors are caused by uncontrollable fluctuations in variables that affect experimental results. (1) Systematic errors. With this type of error, the measured value is biased due to a specific cause. (2) Random errors. This type of error is caused by random circumstances during the measurement process. (3) Negligent errors. Zero error is defined as the condition where a measuring instrument records a reading when no reading is required. In case of Vernier calipers it occurs when a zero on the main scale does not coincide with a zero on Vernier scale it is called zero error for Vernier. How can random error be reduced? If you reduce the number of a data set, you reduce the width (FULL WIDTH AT HALF MAXIMUM) of a distribution, or the counting noise (POISSON NOISE) of a measurement. Usually, you can reduce random error by simply taking more measurements.

Two-dimensional motion is the motion of a body along a plane. If the motion of the plane is considered along the XY plane, then the x coordinate and y coordinate of the position of the particle changes with time. In two-dimensional motion are projectile motion and circular motion. Here, we will discuss projectile motion in Physics, which is a two-dimensional motion. Projectile Motion of a Body Under GravityIn Physics, projectile motion is defined as the motion of an object under the influence of gravity. A body thrown vertically upwards is an example of projectile motion. For projectile motion, the air resistance acting on the body only force acting on the body is the gravitational force. A body thrown with an initial velocity at an angle with the horizontal is a projectile motion. In this projectile, the body moves along the vertical plane, and the path followed by the body is called a trajectory. A ball that is thrown horizontally from the top of a cliff is also a projectile motion. These are examples of projectile motion. For a projectile motion, the gravitational force acting on the body is in the downward direction. Therefore, the body in a projectile motion has acceleration due to gravity 9.8 m/s2. Since the acceleration due to gravity is constant and acts in the downward direction, the motion is an accelerated motion. Here, let us discuss the two types of projectile motion. The projectile motion is uniformly accelerated motion. Therefore, we can apply the equations of the vertical and horizontal directions. There are three equations of motion for uniformly accelerated motion as follows:1Image of equation 1:\[\Rightarrow v = at \]\[\Rightarrow S = at \]Where:S- Displacement of the body- Initial velocity of the body- Final velocity of the body- Time taken for the motion- Acceleration of the motionTypes of Projectile MotionThere are different types of projectile motion based on the direction of the initial velocity of the projectile. The three main types are vertical projectile motion, horizontal projectile motion and oblique projectile. Let us learn them in detail.Vertical projectile MotionIn the vertical projectile motion, the angle between the initial velocity and the horizontal direction is 90°. The body moves in a vertical direction under the action of gravity.The horizontal initial velocity (ux) of the projectile is zero and the initial velocity is only along the vertical direction. (Image will be uploaded soon)For a horizontal projectile motion,\[\Rightarrow u_{x} = 0 \]\[\Rightarrow a_{x} = 0 \]\[\Rightarrow a_{y} = -g \]Where,\[u\] - Initial velocity of the body\[u_{x}\] - Horizontal component initial velocity\[u_{y}\] - Vertical component initial velocity\[a_{x}\] - Horizontal component acceleration of the body\[\Rightarrow a_{y} = -g \]The projectile motion derivation for the maximum vertical displacement is given as follows.Image of equation 2:\[\Rightarrow a_{x} = 0 \]\[\Rightarrow a_{y} = -g \]The projectile motion derivation for each term in the above equation to calculate the maximum vertical displacement.\[\Rightarrow S_{y} = ut + frac{1}{2} gt^{2}\]Oblique Projectile MotionIn oblique projectile motion, the angle between the initial velocity and the horizontal direction displacement of the horizontal projectile motion is given by,\[\Rightarrow H = \frac{1}{2} gt^{2}\]Oblique projectile Motionln oblique projectile motion, the body is making an angle with the horizontal. The angle made by the initial velocity with the horizontal is greater than 00 and greater than 900. Oblique projectile motion is also called angular projectile motion. The trajectory of angular projectile motion is a parabolic path. The horizontal of the initial velocity and the vertical component of the initial velocity is not equal to zero.(Image will be uploaded soon)For angular projectile motion,\[\Rightarrow u_{x} = u cos(\theta) \]\[\Rightarrow u_{y} = u sin(\theta) \]\[\Rightarrow a_{x} = 0 \]\[\Rightarrow a_{y} = -g \]Where,\[u \] - Initial velocity of the body\[u_{x}\] - Horizontal component initial velocity\[u_{y}\] - Vertical component initial velocity\[a_{x}\] - Horizontal component acceleration of the body\[theta\] - The angle between initial velocity and the horizontal. Find the maximum height of the ball. Take acceleration due to gravity as 10 m/s2 and neglect the air resistance.Ans:The initial velocity of the ball = u = 20 m/s. The angle between the initial velocity and the horizontal = \[\theta = 30°\]\[The formula to calculate the maximum height of the projectile motion is given by, \[\Rightarrow H = \frac{u^{2} \sin^{2}\theta}{2g} \]H- Maximum height of the body\[\Rightarrow H = \frac{(20 m/s)^{2} sin^{2} (30^{0})}{2g} \]\[\Rightarrow H = 5 m \]Therefore, the maximum height of the projectile motion is 5 m.Therefore, the maximum height of the projectile motion is given by, \[\Rightarrow H = \frac{u^{2} \sin^{2}\theta}{2g} \]H- Maximum height of the projectile motion is \[= \frac{(20 m/s)^{2} sin^{2} (30°)}{(2 * g)}\] \[\Rightarrow H = 5 m \]Solved Examples:1. A ball is thrown with an initial velocity of 20 m/s at an angle of 300 with the horizontal. Find the maximum height of the ball. Take acceleration due to gravity as 10 m/s2 and neglect the air resistance.Ans:The initial velocity of the ball = u = 20 m/s. The angle between the initial velocity and the horizontal = \[\theta = 30°\] \[The formula to calculate the maximum height of the projectile motion is given by, \[\Rightarrow H = \frac{u^{2} \sin^{2}\theta}{2g} \]H- Maximum height of the body\[\Rightarrow H = \frac{(20 m/s)^{2} sin^{2} (30^{0})}{2g} \]\[\Rightarrow H = 5 m \]Therefore, the maximum height of the projectile motion is 5 m. It is the horizontal distance covered by the projectile motionConclusionProjectile motion is a two-dimensional motion. There are mainly three types of projectile motion based on the angle between initial velocity and horizontal. The projectile is a uniformly accelerated motion having acceleration equal to the acceleration due to gravity in the downward direction. The displacement and time taken during the projectile motion can be calculated by applying its equation in the horizontal and vertical directions. Title: Projectile Motion Author: Cheyenne DanielsPartner: Kyle FreemanDate: April

11, 2014 We will investigate projectile motion by determining the initial velocity given to a ball. We will also predict the range of a projectile. In order to determine projectile motion, I first needed to to find initial velocity of the ball. Initial velocity was found using the apparatus pictured in Figure 1 as well as photogate brackets. Next, I recorded the initial velocity of the ball ten times to get an average velocity. From there, I used the initial velocity and my given/known information to solve for time and ultimately range, or, how far the ball traveled when fired. The given/available data I was able to conclude was the angle of the mini launcher and the height from the bottom of the steel ball in the launcher to the ground. From there, I was able to manipulate the fourth kinematic equation for vertical motion to solve for time (t) as pictured in Figure 2. In order to find the range, time was then used to find the range or total distance the ball went by the equation pictured in Figure 3. Figure 1. Figure 3. Figure 2. In order to find Delta y, I had to measure the distance from the bottom of the steel ball in the launcher to the ground using a tape measure. In addition, I also measured the angle the mini launcher was set at, or theta. Below is a picture of the launcher set up at it's desired angle. A piece of carbon paper was placed over a paper to mark where the ball landed after ten trials. Next, the distance from the starting position of the marks made were measured so that an average of the marks could be made. The average was then compared to the predicted range and a percent difference was calculated. Predicted range = .85mDelta y = .845mTheta = 45 degreesInitial velocity = 3.02m/sActual range = 1.6m Already knowing initial velocity, Vo, delta y, and theta, I was able to plug them into the fourth kinematic equation to solve for time, t. In order to do this, the equation had to be solved using the quadratic formula. Then, from the arrived time answer, we could find the range. Predicted Range Average actual range Average actual velocity Percent Difference Uncertainty = 1.6m + or - 1.00 In conclusion, this lab allowed us to investigate projectile motion by determining the initial velocity given to the ball and ultimately predict the range of a projectile. Projectile Motion equations were used to predict the range in this projectile motion lab. The measured initial velocity and height were used in a kinematic equation that was converted into the predicted range equation to calculate a predicted range of .85m. After testing the predicted range the calculated average of the 10 launches came to equal 1.6m. The percent difference between the predicted range and the calculated average range was 61%. The amount of uncertainty came to be +/- .05. This could have been due to slight misplacement of the plumb bomb or slight shifting in the tape measure during measurement. Also, the contact from the ball hitting the page on the ground could have shifted the paper minimally even though it was taped. There could have been resistance within the launcher itself during various launches to cause the slight differences found. Even though my percent difference was very high, this experiment still served its purpose to allow investigation of projectile motion.

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