In gravitational potential energy problems the quantity (mg) is involved. this represents the

 Remember that work is the amount of energy transferred to objects when it experiences displacement and acts by external power. It is given a symbol of W and measured in joules (J). We can use this formula to determine the work done by very specific forces, generating certain types of energy. We will examine three types of energy in this activity: potential gravity, kinetic, and heat. Before we begin to gain similarities to the potential energy of gravity and kinetic energy, we should note that because work is a transfer and/or energy transformation, we can also write symbols as . In general, the potential energy of gravity is an energy stored between any two masses, but in this course we consider the energy stored between the Earth and the objects raised or lowered near the surface of the Earth. This simplifies things significantly and we can think of potential energy of gravity as energy stored in objects because of its height on the ground. If you hold the ball at shoulder height, it remains lifeless. However, if you release it, even without pushing or throwing it, it begins to accelerate, transforming the potential energy of the gravity stored in the ball into kinetic energy in the form of ball movement as it falls. Just as it hits the ground, it has no more potential energy of gravity, but it has reached a maximum downward velope. Our course won't explore how the ball stops after it hits the ground. The work done on the ball because it falls is due solely to the force of gravity, so we can rewrite the equation of our work to reflect this. This work is a change in potential energy of gravity, . Remember that the magnitude of the force of gravity is , where [down]. Let's replace this for : But what is the disbursement () of the falling object? In the case of the ball, it is a change of height of the ball on the ground. We label this as , for height changes. We can issue vector notations because the force and displacement are in the same direction, causing positive work that counts as the product of these two quantities. Remember that we can write changes in variables as the final value minus the initial value. We saw this with a velined change into the final velince of minus the initial veer. We can write the same for height changes: and energy changes. Let's put this into our equation: we don't know the certain initial height for the object (which will depend on the context of the question), but if we set the final height is to be the same stage as the soil, then hf becomes equal to 0 m. Remember that objects in contact with does not have the potential energy of relative gravity to the ground, so being equal to 0 J. So, the potential energy of the gravity of the object at the initial height is arbitrary relative to the ground is similar to the object's mass product (m), gravity marketer (g) and the height of the object relative to the ground. We can remove the subscription i and be left with our final equation for potential energy gravity: Notice that we remove the Δ from energy - we now calculate the amount of energy the object has kept by being on the ground, and not an energy change because it falls (which will, when calculated, actually give the same amount , but still important to note). Looking at the equation, we know that the energy of the potential gravity of any object depends on three things: The mass of objects, measured in kg; Acceleration of the planet's gravity, in our case, ; The height of the object, measured in m. Let's practice with this equation. Try each question, and then check your answers to the solutions provided. Practice That has more potential energy of gravity: a 5.0 kg bowling ball suspended 2.0 m on the floor, or a block of 2.0 kg of cinder suspended 5.0 m on the floor? How do you know? Given Solution: Case B m = 5.0 kg m = 2.0 kg h = 2.0 m h = 5.0 kg Needed: In both cases, we are asked to determine the potential energy of gravity, so that we can compare both values. Analysis: Potential energy procided gravity with object mass, object height, and acceleration of object gravity. Assuming that the ball is on Earth, we also know the acceleration of gravity. Solution: Since instructions are not important for energy calculations, we will ignore vector notations. Case A Case B Paraphrase: Both balls bowling 5.0 kg hung 2.0 m on the floor, and the 2.0 kg block of cinder suspended 5.0 m on the floor, has the same potential amount of gravity energy: At the top of its run, the roller coaster car (mass of 535 kg) had a potential energy gravity of 393 225 J. What was the height of the car at that point? Given Solution: Required: We are asked to determine the height of the roller coaster car, based on potentially mass energy and gravity. h=? Analysis: Potential energy procided gravity with object mass, object height, and acceleration of object gravity. Assuming that the roller coaster is on Earth, we also know the acceleration of gravity. Because direction is not important for energy calculations, we will ignore the vector notation. Solution: Paraphrase: A roller coaster car that has a mass of 535 kg and potentially gravity energy of 393 225 J must be 75 m above ground. If you double the mass do you double the potential energy of gravity? Shows your judgment with calculations. Let's create an example that will test whether or not double the mass of objects will double its potential gravity energy. Granted: A mass bird of 10 kg (randomly selected) Mass birds 20 kg (double the mass of birds 10 kg) Height 3 m on the ground (also randomly selected) Required: We want to determine the potential energy of bird gravity. Analysis: Potential energy procided gravity with object mass, object height, and acceleration of object gravity. Assuming that the birds on Earth, we also know the acceleration of gravity. Because direction is not important for energy calculations, we will ignore the vector notation. Solution: For the first bird: For the second bird: Comparing two potential energy gravity: Paraphrase: When the mass of objects is doubled (but its height remains the same), the potential energy of the object's gravity also doubles. This makes sense, because the energy of the potential gravity is directly propelable to the mass of objects. Another type of energy for which we can get the equation is kinetic energy: the energy that the object belongs to because of its movement. Although there are different types of kinetic energy based on what is moving (for example, thermal energy is the energy of the objects that are in place due to the movement of its particles), for now we will focus on the entire moving object, such as flying birds, or footballers running. Just like with the potential energy of gravity, we start with our similarities to work. Considering that work is a change in energy, we can replace W symbols with symbols that represent energy changes because of the movement of objects: . In this case, and unlike the potential energy of gravity, we do not know what force or force is used for our objects. There may be some sort of applied power, but there may be tension forces, or even friction force. The best we can do is replace the force in the equation with our similarities to clean force: Newton's second law. ... and because , we can write: Note that we only deal with the magnitude of these values, and with it has removed all the vector notations. Now, we need to think back to kinematics to come up with simplifications for this equation. If we restructure the equation for the average veracy, ... we can settle and write: Another way of writing the average velocity is This makes sense, because the way we find the average for any group of measurements is to add them all, and then divide the amount by the number of measurements. In kinematics, there are additional conditions that must be true for this simple relationship to hold: the object must suffer a uniform (constant) acceleration. It situations where the object's acceleration changes over time. Since this is an equation for the average velocity, we can set them equal to each other: Resolve to require multiplying both sides of the equation that leaves us with: let's take a look at the other similarities from kinematic. Remember that acceleration is a change in direction over time changes. Again, we only see the magnitude of these values, so we have issued vector notations. A change of direction can be written as ... and we can rearrange this to complete the change of time: We can then replace the value of this Δt into our equation above for the Δd: Multiplying the breakdown together gives us: When multiplying the breakdown, we multiply the figure together, and then multiply the denominator together. Using distributor property, we can expand the bracket in figures: Simplify the figures, we get: Multiply both sides by giving us: So, where does this make us? Look back at our original similarities for changes in kinetic energy. We have stopped at We now have similarities that we can replace. This leaves us with: Reordering just a little to move the marketer (1/2) forward the expression, we are left with: Just like with potentially gravity energy, this is the change of energy of the object available because it goes from a slower speed () faster speed (). Although we do not know what the final speed will be (which will depend on the question), we can set the initial speed to be when the object is resting: . Our similarities then become: Notice again that we remove the Δ from energy - we now calculate the amount of energy the objects have during the journey at a certain speed, and not a change of energy as an object profit or loss of speed. Looking at the equation, we know that the kinetic energy of any object depends on two things: The mass of objects, measured in kg; The speed of objects, measured in m/s. Let's practice with this equation a little. Try each question, and then check your answers to the solutions provided. Which has more kinetic energy: a 5.0 kg bowling ball hung rolling at a speed of 2.0 m/s, or a block of 2.0 kg of cinder dragged at a speed of 5.0 m/s? How do you know? Given Solution: Case B m = 5.0 kg v = 2.0 m /s m = 2.0 kg v = 5.0 m/s Required: In both cases, we are asked to determine kinetic energy, so that we can compare two values. Analysis: Kinetic energy is procided by the mass of objects and squares of object speed. Solution: Case B Paraphrase Case: A bowling ball of 5.0 kg moves at 2.0 m/s has less kinetic energy than a block of 2.0 kg of cinder moving at 5.0 m/s. kicking football 0.43 kg, giving kinetic power 38.6 J kinetic power. What is the speed of the ball? Settlement Given: m = 0.43 kg Required: We asked to determine the speed of the ball. v = ? Analysis: Kinetic energy is procided by the mass of objects and squares of object speed. Solution: Paraphrase: When Niamh kicked the ball, he made the ball ride at a speed of 13.4 m/s. If you double the speed of the object, do you double its kinetic energy? Shows your judgment with calculations. Let's create an example that will test whether or not doubling the speed of objects will double its kinetic energy. Granted: A mass of 60 kg (randomly selected) Speed of 5 m/s (also randomly selected) Speed of 10 m/s (double the initial speed Required: We are looking to determine the kinetic energy of the person travelling at different speeds. Analysis: Kinetic energy is procided by the mass of objects and squares of object speed. Solution: For people moving at a speed of 5 m/s: For the same person moving at a speed of 10 m/s: Comparing two kinetic energy: Paraphrase: When the speed of the object doubles (but its mass remains the same), the kinetic energy quadruples the object (not double). This makes sense, because kinetic energy is directly proancial to the square of object speed, which means that as speed doubles, kinetic energy increases by factors. Look around you. Lift an object that cannot be broken, and hold at the height of the shoulder on the ground. As you do, consider the potential for object gravity and kinetic energies. You may not have the numbers to do the calculations, but you should have an idea of whether the object currently has both of them energized (hint: the object has only one). Now drop the object. As it falls to the floor, observes and reflects what happens to the kinetic energy of objects and potential energy of gravity. Do they change when objects fall? If so, how? Ultimately, although you can't freeze objects in place before it hits the floor, giving some thoughts about what kinetic and gravity of potential objects to a second split before it bounces (or smashes). Create a reflection to answer the following question: What happens to the height of the object as it falls? Knowing what you know about height, when does the object you fall into having the GREATEST potential gravity energy? When does it have potential energy of gravity AT LEAST? What happens to the speed of objects as it falls? Knowing what you know about speed, when does the object have the BIGGEST kinetic energy? When does it have kinetic energy AT LEAST? Where do you think objects get energy from to moving faster as it falls? The last question was complicated. You may notice that the object appears as it falls if you are in a microgravity environment). As it travels at faster and faster speeds, it gets Energy. But where does that energy come from? For that matter, where does any energy come from? The answer turns out to be quite simple: the energy of the given type always comes from some other form of energy. This is a fundamental principle of physics known as energy conservation: energy cannot be created or destroyed, only changing from one type to another. (When learning this, one often asks where the first spirit in the universe comes from. That's the problem cosmologists are trying to solve!) As the object falls towards the ground, it loses the potential energy of gravity as its height decreases, and its kinetic energy gains as its speed increases. In reality, it doesn't gain or lose energy: because objects fall, its potential gravity energy turns into kinetic energy. At any time when an object falls, it has the so-called mechanical amount of energy (): the amount of kinetic energy AND the potential energy of gravity combined. We can write this as: Throughout the fall of the object, although its kinetic energy will change and its potential energy of gravity will change, its mechanical amount of energy will remain the same. Watch the following video and ponder the question below. In the video, you'll notice that the potential energy of gravity at the top of the hill is equal to kinetic energy at the bottom of the hill. If a roller coaster is stopped at any time along its path, what you notice about the potential amount of energy is gravity and kinetic energy. Whenever a roller coaster is stopped, is mechanical energy always the same? Where is the potential energy of gravity and kinetic energy exactly the same? Does this location make sense? Why? As we saw in the simulation, if we know the potential amount of energy the object's gravity at the top of its fall (by measuring the height and mass of objects), we automatically know the amount of kinetic energy at the bottom. Because we already know the mass, we can use the formula for kinetic energy to calculate the speed of objects. An example of a 150 kg mass piano is pushed out the fourth floor window (12 m high). What will its speed before it hits the ground? Granted: m = 150 kg h = 12 m Required: We are asked to determine the speed of the piano at the end of its fall. v = ? Analysis: The amount of mechanical energy is the amount of potential energy of gravity (which is procided by the mass of objects, the height of objects, and the acceleration of object gravity) and kinetic energy (which is protracted by the mass of objects and squares of object speed). At the top of the fall, the piano is stationery, so v = 0 m/s. At the bottom of the fall, the height of the piano is 0 m. Assuming that the piano is on Earth, we also know the gravity Because direction is not important for energy calculations, we will ignore the vector notation. Settlement: At the top of the piano fall: So at the top: Since at the top of the piano fall is similar to at the bottom of its fall, so at the bottom, we can write: Paraphrase: The piano of 150 kg falls from a height of 12 meters will travel at a speed of 15 m/s before it hits the ground. In this task, we will verify the conservation of energy principles. You'll do this by rolling the object down the rampage, and comparing its energy at the top of the rampage to its energy at the bottom of the rampage. It's up to you to choose the objects you use (make sure they can roll, like balls, soups can, or toy cars), heights from where you start rolling down the rampage, and how you will measure the time it takes for objects to roll the entire length of the rampage. For this investigation, you will be prompted for most parts, and also given a few words. In this task, anything in italics must be answered or completed; any type of common can be copied directly. Check with your teacher if you have any questions. Read through the laboratory instructions below, and develop the procedure. Once your teacher has approved your procedure, complete the investigation, and submit the required section below. Purpose: The purpose of this laboratory is to ... What is the purpose of this investigation? What are we trying to prove? Hypothesis: How do you think the energy at the top of the ramp will compare with the energy at the bottom of the rampage? Why do you think this? Materials: Read through observations and analytics sections to determine what materials you might need. Make a complete list of all the materials you use to collect your data. Procedures: Read through observations and analytics sections to determine the information you need to collect, and then write procedures for investigation. Do not forget to include how time is reached, and how certain variables (such as height, start time, etc.) are controlled. If someone is to reproduce this exact experiment, what should they know? Make sure your procedure is in the past tense (use a passive voice). Make sure the procedures you create are secure. Observation: Record the following information while you perform an experiment: Vertical distance from above raging to the floor (in meters); The mass of your object (in kilograms); Raging length (in meters); The time it takes for objects to roll the entire length of the rampage (within seconds); You may want to collect this piece of data several times to then determine the average time. Analysis: Calculate the potential energy of object gravity when it is in the section Rampage. Specify the average time of object needed to roll the rampage. Determine the average speed of the object as it is launched ramp (HINT: you know both the distance of the object rolling, as well as how long it takes, on average). Double your average speed to determine the final speed of the object at the bottom of the rampage. This can be done because: ... and zero (assent you start an object from a break). Determine the kinetic energy of the object at the bottom of the rampage. Compare the kinetic energy of the object at the bottom raging to the potential energy of the object gravity at the top of the rampage. This is known as efficiency: Is conservation of energy principles screened? Otherwise, why do you think this? Conclusion: In one or two of the most sentences, summarize your findings. Check out the rubrics to make sure you have everything you need, and then submit your work to your teacher. In an ideal world, one hundred percent of the potential energy of the object's gravity at the top of its fall will turn into kinetic energy shortly before it hits the ground. In reality, some energy turns into other types. In the investigation you just did, can you hear the object as it winds up raging? If so, some energy the potential of early gravity has turned into solid energy rather than kinetic energy. If not all potential energy of gravity turns into kinetic energy, there is a decrease in efficiency. One of the most common energy transformations that leads to decreased efficiency is the work done by the force of kinetic friction that transforms mechanical energy into heat energy. Heat energy is measured by temperature (which is actually the average kinetic energy measurement of the particles of the material). Heat energy transfer occurs in the form of heat. If there is a increase in temperature as two objects rub each other, energy is being altered (usually in a useless way). In our original roller coaster example, not all energy gained by starting at the top of the first hill turned into kinetic energy at the bottom (although mostly not). Some energy strays as sound (wheel noise against tracks), yet more energy gets as heat due to the friction between the wheel and the track, or between the wheel and the axe. Another example is close: if you rub your hands together in earnest, some of the energy you put into moving your hands is lost as sound (you can hear your hands as they rub together), but also as heat - you can feel the increase in temperature between the palms of your hands. Hand.