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Worksheet on horizontally launched projectiles answer key

Bullet motion questions are common in level A physics, as they combine the idea of solving vectors in their components and using motion equations (suvat equations) to calculate unknown amounts related to the movement of an object. There are 2 types of typical questions of the bullet movement: bullets launched horizontally (in which an object is launched horizontally from a high plane and follows a parabolic path to the ground) and bullets launched not horizontally (in which a beet is thrown into the ground air, rises to a peak height and then falls to the ground again). In this matter, we take care of the case that the bullet is launched horizontally. Before trying to answer bullet motion questions, it is important to understand what a bullet is. A bullet is an object that moves under its own inertia - in simpler terms, the only force acting on it is gravity. For this example, the following 'suvat' equations are used: Eqn 1) $v = u + a \cdot t$ Eqn 2) $s = ut + 0.5at^2$ Eqn 3) $s = 0.5 \cdot (u + v) \cdot t$ Eqn 4) $v^2 = u^2 + 2as$ Eqn 5) $s = vt - 0.5a \cdot t^2$ where s = shift, u = initial speed, v = final acceleration A ball is thrown from the top of a 10m high building with a horizontal speed of 5m Calculate the time necessary to fall to the floor and its horizontal shift to the point when it reaches the floor. The first step in all bullet motion questions should be to understand thatof the object that is thrown, in this case the ball, has 2 components, its vertical component and its horizontal component. As a result, when we write our 'suvat' equations, we must have separate equations for horizontal and vertical components. Then we start by writing suvat lists for each component: Horizontal: ? Note that since gravity is the only force acting on the bullet and this is a vertical force, there is no horizontal force and therefore no acceleration in the horizontal direction, so the internal and final speeds remain the same. So far we do not know other horizontal values. Vertical: $S = -10m$ $U = 0ms^{-1}$ $V = ?$ $A = -9.8ms^{-2}$ $T = ?$ In this case, the gravitational force creates an acceleration due to the gravity of -g, where $g = 9.8ms^{-2}$. The initial vertical component of speed is 0 as the object is thrown vertically (i.e. there is no vertical component when $t=0$, the vertical component occurs only because of acceleration due to gravity as the object falls). Remember that the shift is a carrier so that the vertical shift is the height with a minus sign in front of it to show that the ball has abandoned this height. The next step in this solution is to use vertical suvat equations to calculate the time that takes the ball to reach the ground. This is done by looking at the suvat list and comparing the equations above. In this case, we want to find t and we have u , a and s , so we use Eqn 2: $s = ut + 0.5at^2$ Rearranging for t gives: $t = \sqrt{\frac{2s}{a}}$ The bandage in $s = -10$ and $a = -9.8$ gives $t = 1.429$ seconds, this is the time that takes the ball to reach the floor. Now that we have calculated time, we can use this to determine the horizontal shift of the ball. Since time is the same in both suvat lists (the time needed for the ball to finish its path is the same if you are looking at its horizontal or vertical speed), we can add this t in the horizontal suvat list we wrote above: Oriztonal: $S = ?$ $U = 5ms^{-1}$ $V = 5ms^{-1}$ $A = 0ms^{-2}$ $T = 1.429$ s So now we want to calculate s , and we have u , v and t , so we use Eqn 3: $s = 0.5 \cdot (u + v) \cdot t$ because $u = v$ we can replace this to get: $s = 0.5 \cdot (2u) \cdot t$ $s = u \cdot 5m = 5m$ = This is the horizontal ball moving in time. ground.

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