**Kinematics 3 :** $v\_{f}^{2}=v\_{0}^{2}+2a∆x$

**rearranging and solving for each variable from the 2nd kinematics equation**

Solving for final velocity $v\_{f}$

|  |  |
| --- | --- |
| **Equation** | **Reason** |
| $$v\_{f}^{2}=v\_{0}^{2}+2a∆x$$ | To solve for final velocity you need to get $v\_{f}$ by itself (get it to not be squared)  |
| $$\sqrt{v\_{f}^{2}}= \sqrt{v\_{0}^{2}+2a∆x}$$ | Before substituting values you need to square root each side to cancel out the square on $v\_{f}$. This will leave $v\_{f}$ by itself |
| $$v\_{f}= \sqrt{v\_{0}^{2}+2a∆x}$$ | You are done and have solved for final velocity. Substitute in your values for $v\_{0}, a, and ∆x$ to finish and solve |

Solving for initial velocity$v\_{0}$

|  |  |
| --- | --- |
| **Equation** | **Reason** |
| $$v\_{f}^{2}=v\_{0}^{2}+2a∆x$$ | Start with the kinematics equation. We are trying to get initial velocity by itself (alone on one side of the equation) |
| $$v\_{f}^{2}=v\_{0}^{2}+2a∆x$$$$-2a∆x -2a∆x$$ | The term “ $2a∆x$ “ is being added to the initial velocity term. Therefore we can subtract “ $2a∆x$ “ from both sides to move it to the other side. |
| $$v\_{f}^{2}-2a∆x=v\_{0}^{2}$$ | Re-write what you have. Now initial velocity is alone on one side, this is good but we’re not done yet. We need to get rid of the squared part still. |
| $$\sqrt{v\_{f}^{2}-2a∆x}=\sqrt{v\_{0}^{2}}$$ | Square root both sides to cancel out the squared on initial velocity |
| $$\sqrt{v\_{f}^{2}-2a∆x}=v\_{0}$$ | Re-write what you have.  |
|  | **You are done. The equation is solved for initial velocity and you just need to substitute in known values to solve.** |

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**rearranging and solving for each variable from the 2nd kinematics equation**

Solving for final velocity $v\_{f}$

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Solving for initial velocity$v\_{0}$

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| $$v\_{f}^{2}-2a∆x=v\_{0}^{2}$$ | Re-write what you have. Now initial velocity is alone on one side, this is good but we’re not done yet. We need to get rid of the squared part still. |
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|  | **You are done. The equation is solved for initial velocity and you just need to substitute in known values to solve.** |

Solving for acceleration $a$

|  |  |
| --- | --- |
| **Equation** | **reason** |
| $$v\_{f}^{2}=v\_{0}^{2}+2a∆x$$ | Start with the original equation. We are going to arrange it (algebra) so that it is solved for acceleration. |
| $$v\_{f}^{2}=v\_{0}^{2}+2a∆x$$$$-v\_{0}^{2} -v\_{0}^{2} $$ | we want acceleration by itself so let’s get the “ $v\_{0}^{2}$ “ term to the other side. It is being added so let’s subtract it from both sides |
| $$v\_{f}^{2}-v\_{0}^{2}=2a∆x$$ | Re-write the equation. The “$v\_{0}^{2}"$ is now on the other side. |
| $$\frac{v\_{f}^{2}-v\_{0}^{2} }{2}=\frac{2a∆x}{2}$$ | We still need to get acceleration by itself. Let’s move the 2 over by dividing both sides by 2. |
| $$\frac{v\_{f}^{2}-v\_{0}^{2}}{2}=a∆x$$ | Re-write what you have now. The 2 is canceled out because $\frac{2}{2}=1$ .  |
| $$\frac{v\_{f}^{2}-v\_{0}^{2}}{2∆x}=\frac{a∆x}{∆x}$$ | Almost done. Acceleration is being multiplied by displacement so we will divide both sides by displacement to get acceleration alone. |
| $$\frac{v\_{f}^{2}-v\_{0}^{2}}{2∆x}=a$$ | Re-write what you have. The displacement is cancelled out on the right hand side and leaves acceleration alone.  |
|  | **The work is done. You have solved for acceleration and just need to substitute values in to solve.** |

Solving for displacement $∆x$

|  |  |
| --- | --- |
| **Equation** | **Reason** |
| $$v\_{f}^{2}=v\_{0}^{2}+2a∆x$$ | Start with the original kinematics equation. We are trying to solve for $∆x$ by getting it by itself. |
| $$v\_{f}^{2}=v\_{0}^{2}+2a∆x$$$$-v\_{0}^{2} -v\_{0}^{2}$$ | we want displacement by itself so let’s get the “ $v\_{0}^{2}$ “ term to the other side. It is being added so let’s subtract it from both sides |
| $$v\_{f}^{2}-v\_{0}^{2}=2a∆x$$ | Re-write the equation. The “$v\_{0}^{2}"$ is now on the other side. |
| $$\frac{v\_{f}^{2}-v\_{0}^{2} }{2}=\frac{2a∆x}{2}$$ | Re-write the equation. The “$v\_{0}^{2}"$ is now on the other side. We still need to get acceleration by itself. Let’s move the 2 over by dividing both sides by 2. |
| $$\frac{v\_{f}^{2}-v\_{0}^{2}}{2}=a∆x$$ | Re-write what you have now. The 2 is canceled out because $\frac{2}{2}=1$ .  |
| $$\frac{v\_{f}^{2}-v\_{0}^{2}}{2a}=\frac{a∆x}{a}$$ | Almost done. Acceleration is being multiplied by displacement so we will divide both sides by acceleration to get $∆x$ alone. |
| $$\frac{v\_{f}^{2}-v\_{0}^{2}}{2a}=∆x$$ | Re-write what you have. Acceleration cancels out because $\frac{a}{a}=1 $ and $∆x$ is left alone. |
|  | **You are done. The equation is solved for displacement and you just need to substitute in your known values and solve.** |

Solving for acceleration $a$

|  |  |
| --- | --- |
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| $$\frac{v\_{f}^{2}-v\_{0}^{2}}{2∆x}=\frac{a∆x}{∆x}$$ | Almost done. Acceleration is being multiplied by displacement so we will divide both sides by displacement to get acceleration alone. |
| $$\frac{v\_{f}^{2}-v\_{0}^{2}}{2∆x}=a$$ | Re-write what you have. The displacement is cancelled out on the right hand side and leaves acceleration alone.  |
|  | **The work is done. You have solved for acceleration and just need to substitute values in to solve.** |

Solving for displacement $∆x$

|  |  |
| --- | --- |
| **Equation** | **Reason** |
| $$v\_{f}^{2}=v\_{0}^{2}+2a∆x$$ | Start with the original kinematics equation. We are trying to solve for $∆x$ by getting it by itself. |
| $$v\_{f}^{2}=v\_{0}^{2}+2a∆x$$$$-v\_{0}^{2} -v\_{0}^{2}$$ | we want displacement by itself so let’s get the “ $v\_{0}^{2}$ “ term to the other side. It is being added so let’s subtract it from both sides |
| $$v\_{f}^{2}-v\_{0}^{2}=2a∆x$$ | Re-write the equation. The “$v\_{0}^{2}"$ is now on the other side. |
| $$\frac{v\_{f}^{2}-v\_{0}^{2} }{2}=\frac{2a∆x}{2}$$ | Re-write the equation. The “$v\_{0}^{2}"$ is now on the other side. We still need to get acceleration by itself. Let’s move the 2 over by dividing both sides by 2. |
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|  | **You are done. The equation is solved for displacement and you just need to substitute in your known values and solve.** |