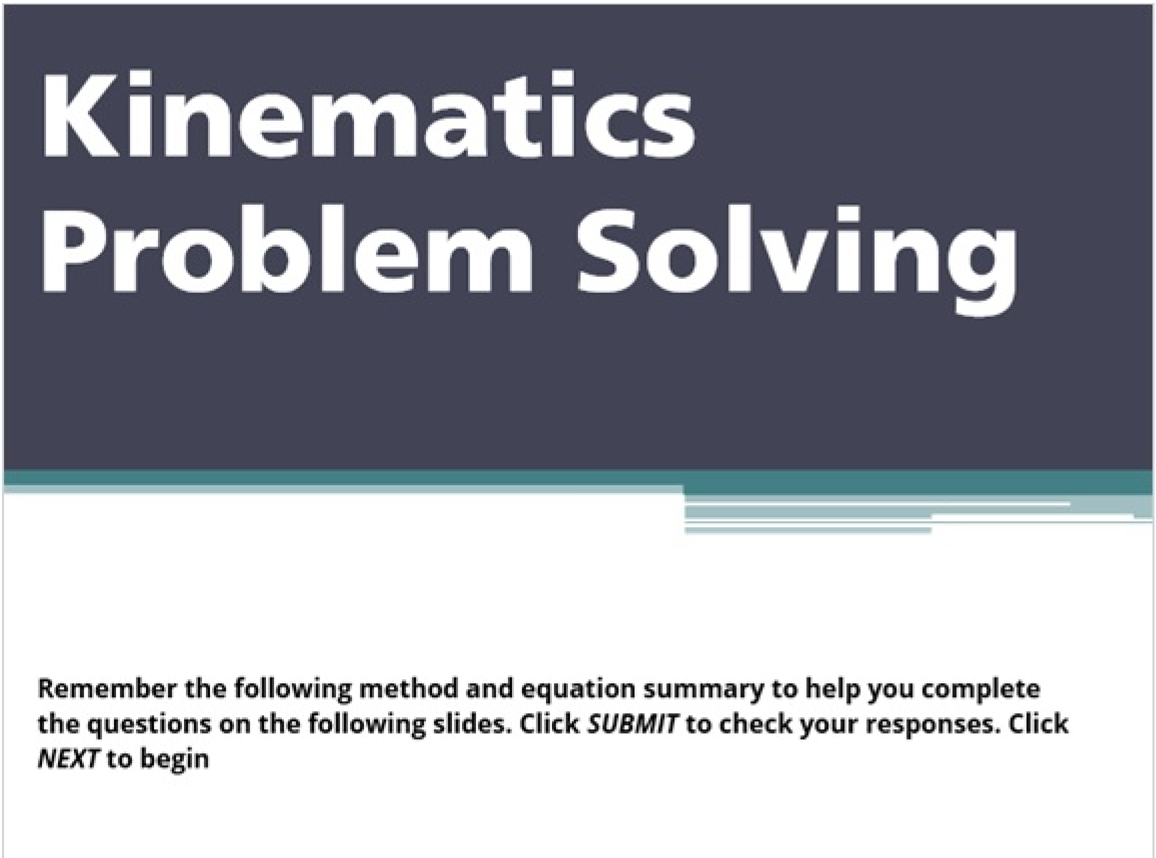
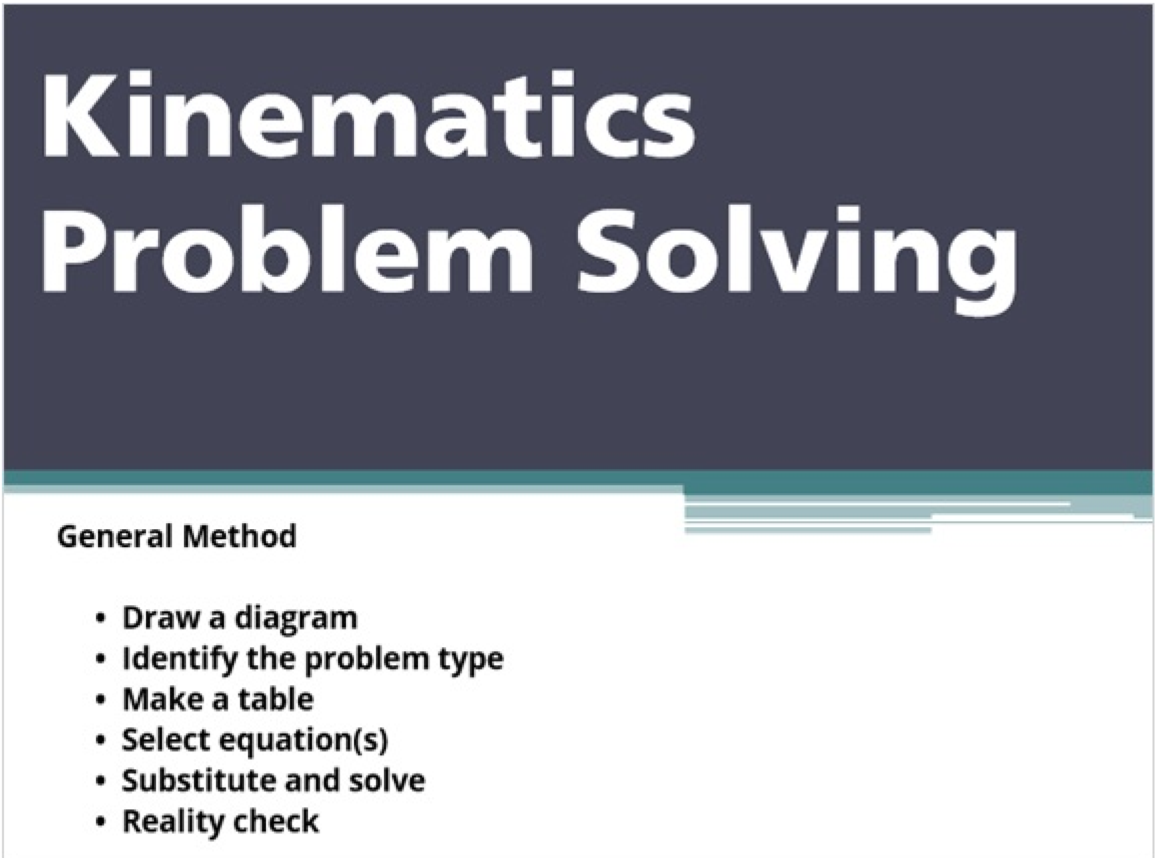
Module 1: Describing Motion
Topic 4 Content: Kinematics Problem Solving Practice Solutions



Remember the following method and equation summary to help you complete the questions on the following slides. Click ***SUBMIT*** to check your responses. Click ***NEXT*** to begin.



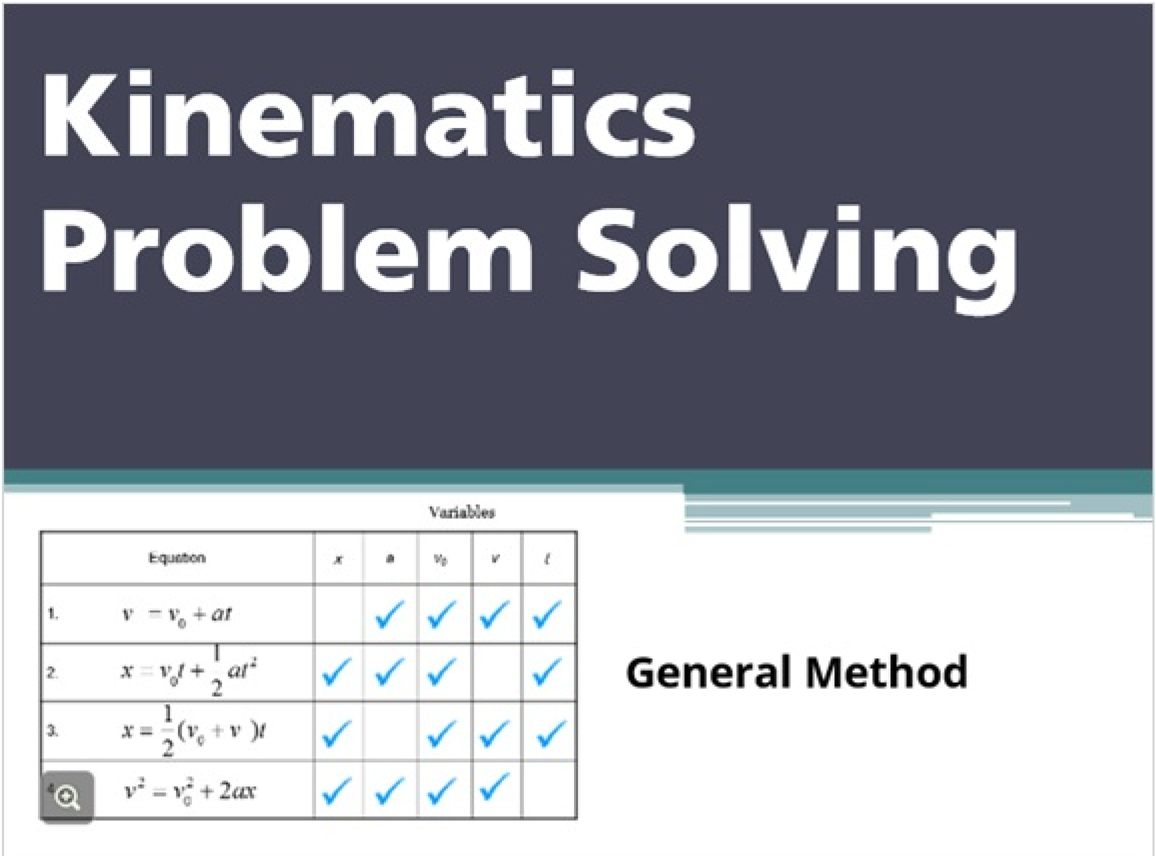
We will be solving problems throughout this course. In the beginning, the problems will be easier. As we progress through our studies of mechanics problems will become more complex. Here we will establish some basic problem solving procedures that will be used as a general method throughout the course.

Step one is to draw a diagram. We will label positions, velocities, times and other important information.

Step two will be to identify the problem type. We will do this by stating what physics concepts apply to this situation. Step three is to make a table of information.

Step four is to select appropriate equations.

Step five is the substitute values into the equation and solve. Step six is to check our answer to see if it makes sense.

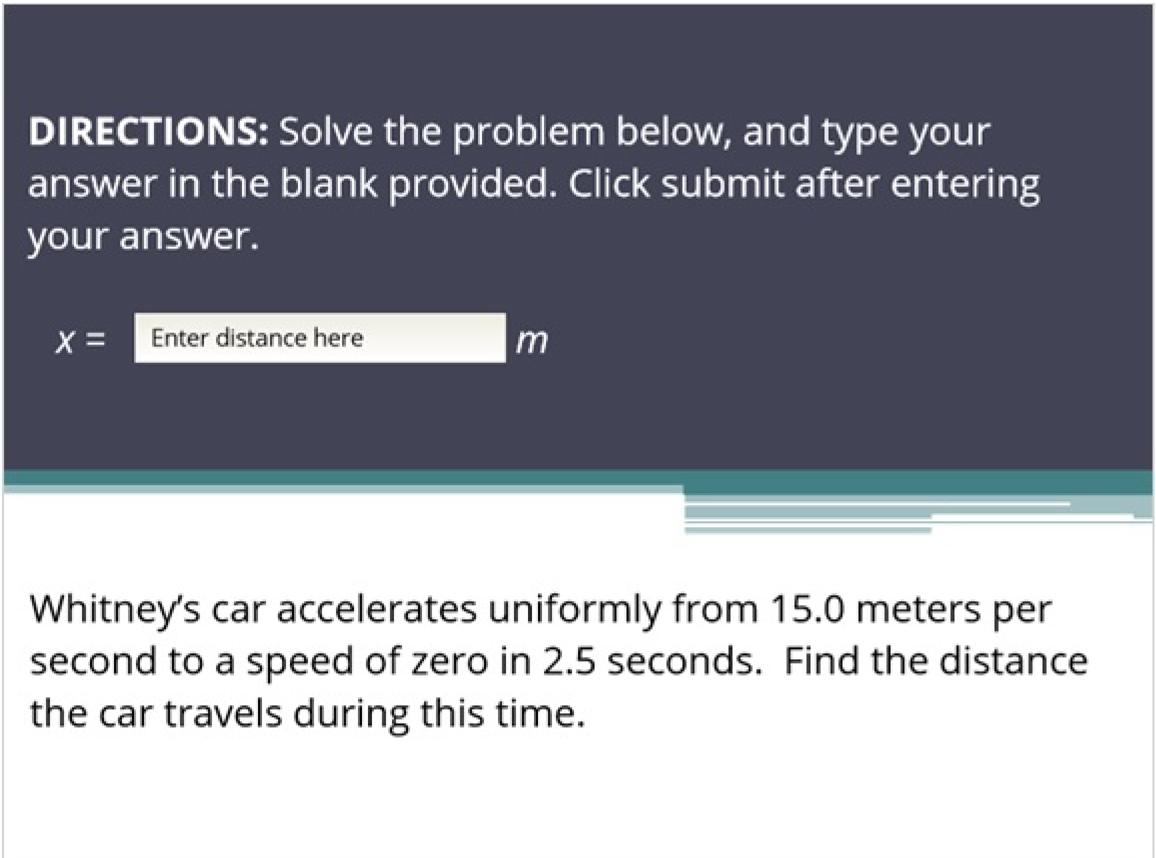


Equation	x	a	v_0	v	t
1. $v = v_0 + at$		✓	✓	✓	✓
2. $x = v_0 t + \frac{1}{2}at^2$	✓	✓	✓		✓
3. $x = \frac{1}{2}(v_0 + v)t$	✓		✓	✓	✓
4. $v^2 = v_0^2 + 2ax$	✓	✓	✓	✓	

Here is the list of four equations we developed in the last lesson. The four equations each have a unique subset of the five variables.

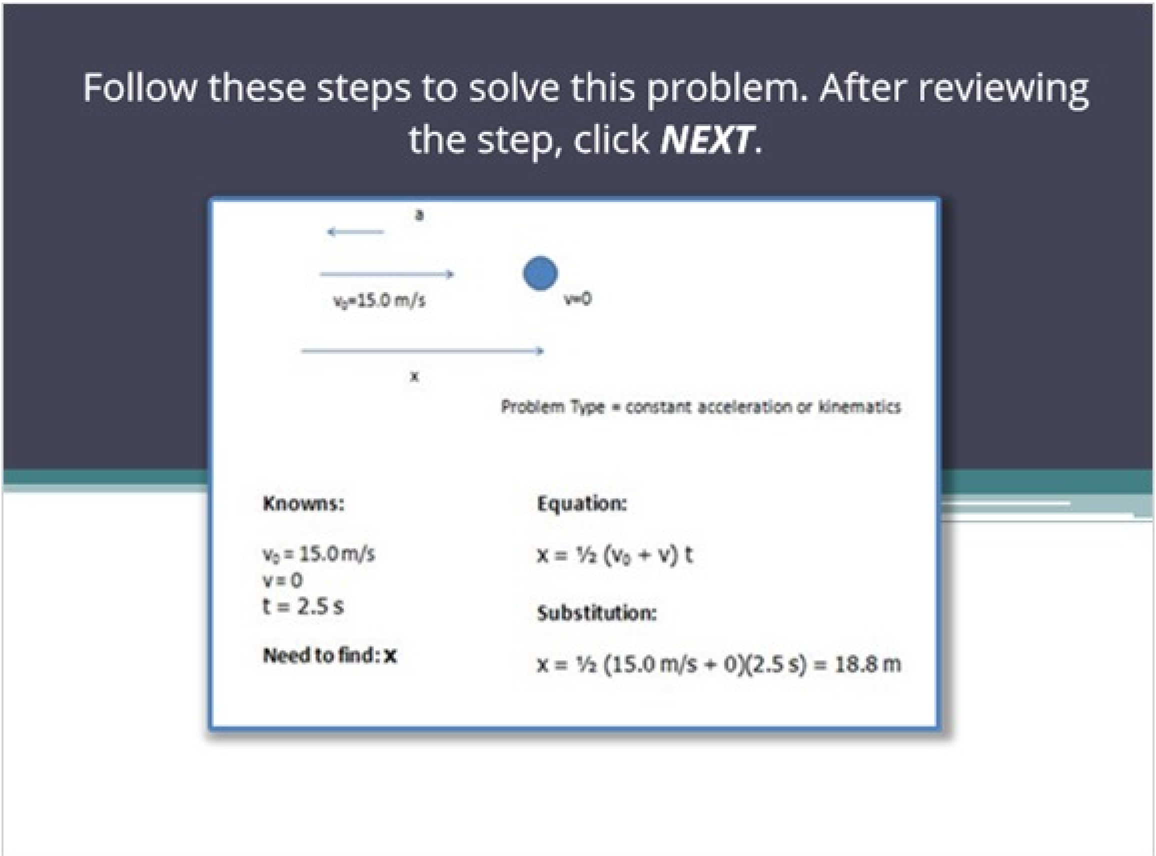
When we solve problems, we select the equation by identifying the variables that are given in the problem and what is being asked for.

Then we select the equation that has those four variables in it. In this lesson we will practice problem solving skills.



Problem 1

Whitney's car accelerates uniformly from fifteen point zero meters per second to a speed of zero in two point five seconds. Find the distance the car travels during this time.



Problem 1 Solution

First, step one, draw a diagram. We will represent the car as a blue dot on our diagram for simplicity. Let's label what we know. The car starts from an initial velocity of fifteen meters per second and then slows down. The final velocity is zero. The acceleration and the initial velocity are in the opposite direction. The displacement is in the same direction as the velocity but in the opposite direction of the acceleration.

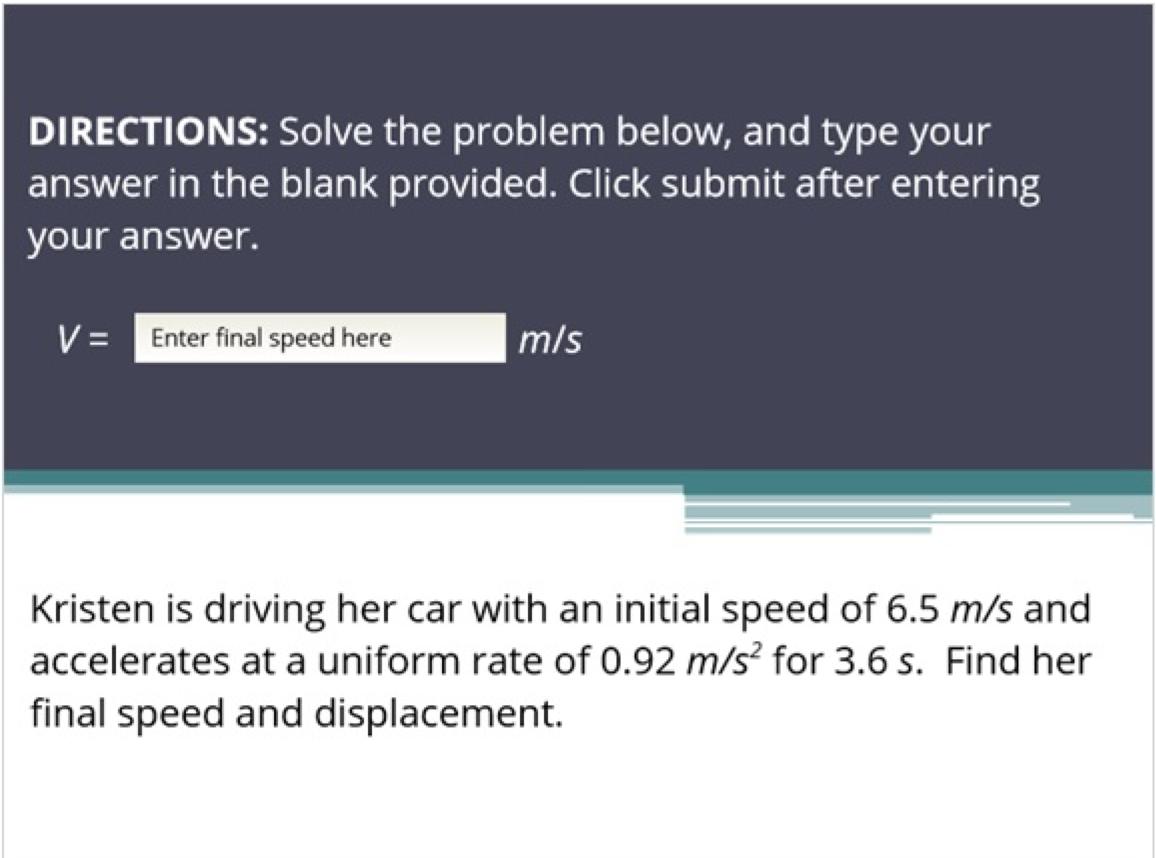
Next, step two, identify problem type. The key phrase in this problem is slows uniformly. This tell us the type of problem we are working on. This problem involves uniform acceleration and we can apply the four kinematics equations.

Step three is to make a table of values. Here we list all the knowns as well as what we are being asked to determine. In this problem, we know initial velocity, final velocity and time. We need to find displacement.

Step four is to select an equation. We already determined that this is a uniform acceleration problem and that we can use the four kinematics equations. Now we need to decide which one. We need the equation that has initial velocity, final velocity, time and displacement in it. We do not want the equation to have acceleration in it. If we look at the list of equations, we can see that only one of them meets these requirements. The equation we will use is displacement equals one half of the quantity initial velocity plus final velocity multiplied by time.

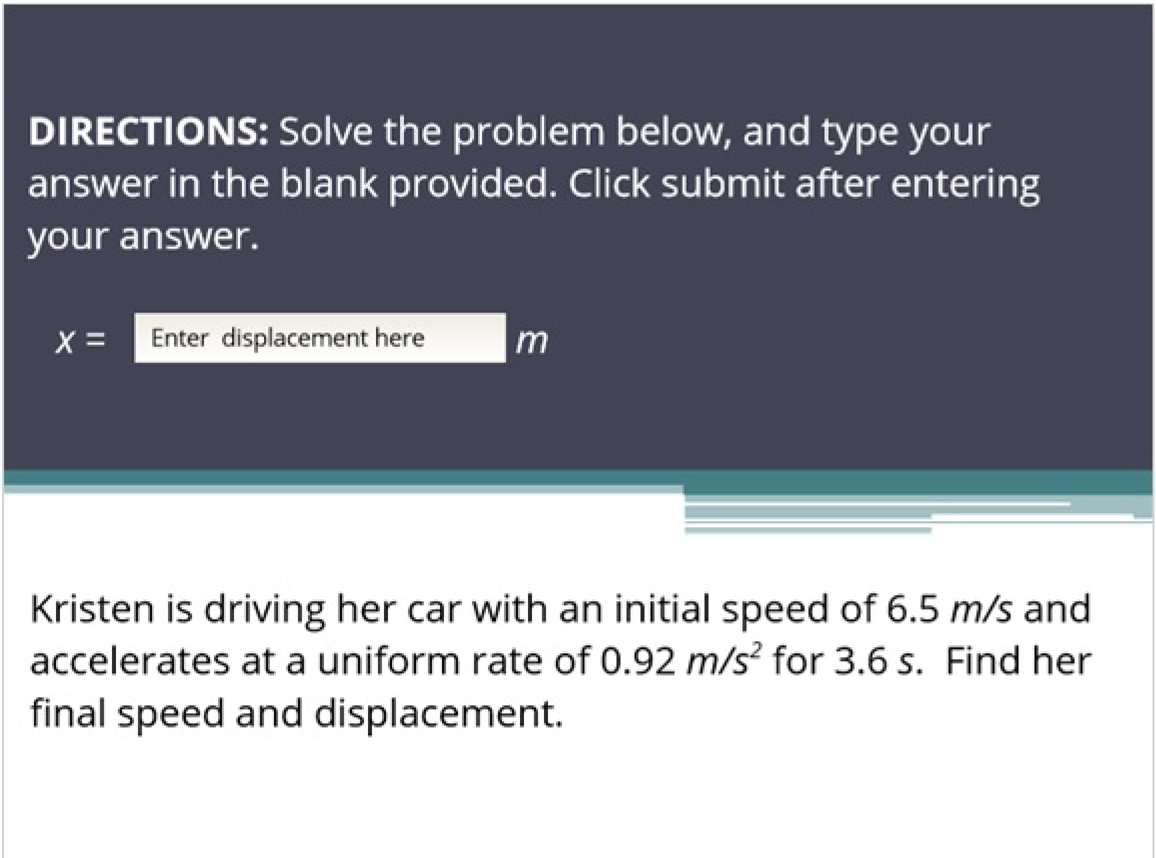
Step five is to substitute values into the equation and solve. Final velocity is zero, initial velocity is fifteen point zero meters per second and time is two point five seconds. We determine that the answer is 18.8 m.

Step six is to think about if our answer is reasonable. We calculated a positive displacement. Does this make sense? The car slowing down as it moves forwards, so the positive displacement is reasonable.



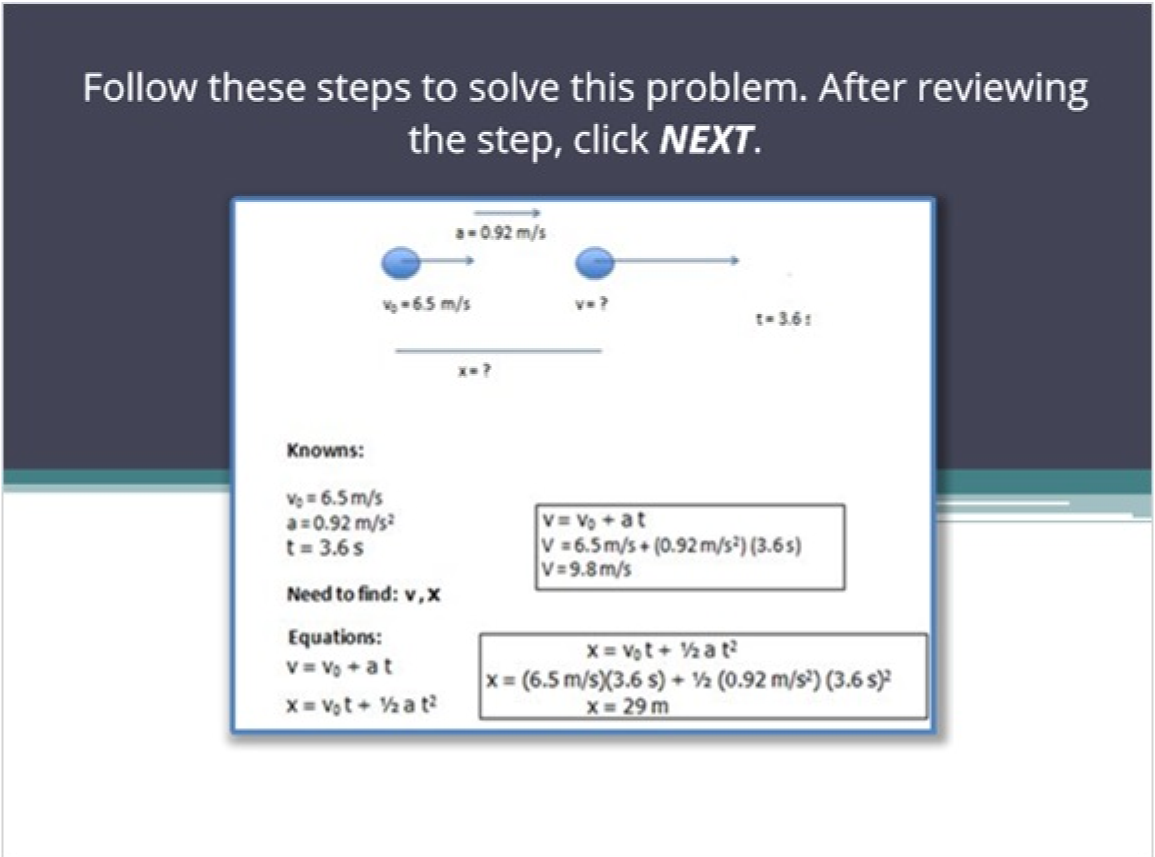
Problem 2 part 1

Kristen is driving her car with an initial speed of six point five meters per second and accelerates at a uniform rate of zero point nine two meters per second squared for three point six seconds. Find her final speed and displacement.



Problem 2 part 2

Kristen is driving her car with an initial speed of six point five meters per second and accelerates at a uniform rate of zero point nine two meters per second squared for three point six seconds. Find her final speed and displacement.



Problem 2 Solution

First, step one, draw a diagram. We will represent the car as a blue dot on our diagram for simplicity. Let's label what we know. The car starts from an initial velocity of six point five meters per second and then speeds up. The final velocity is unknown, but because her acceleration is in the same direction as the velocity she should be speeding up. The acceleration and the initial velocity are in the same direction. The displacement is in the same direction as the velocity and the acceleration.

Next, step two, identify problem type. The key phrase in this problem is slows uniformly. This tell us the type of problem we are working on. This problem involves uniform acceleration and we can apply the four kinematics equations.

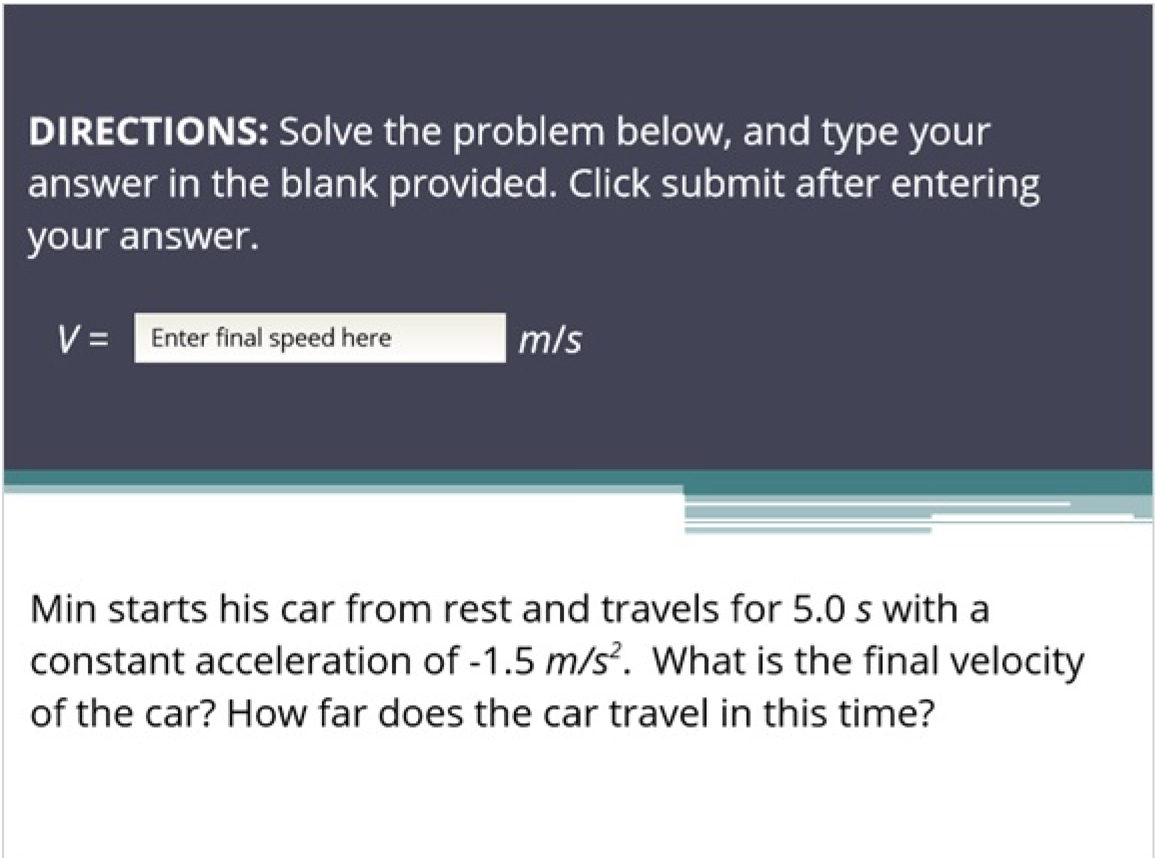
Step three is to make a table of values. Here we list all the knowns as well as what we are being asked to determine. In this problem, we know initial velocity, acceleration and time. We need to find final velocity and displacement.

Step four is to select an equation. We will find final velocity first. We already determined that this is a uniform acceleration problem and that we can use the four kinematics equations. Now we need to decide which one. We need the equation that has initial velocity, acceleration, time and final velocity in it. We do not want the equation to have displacement in it. If we look at the list of equations, we can see that only one of them meets these requirements. The equation we will use is final velocity equals initial velocity plus acceleration times time. Then we will want to find displacement. We can use the equation displacement equals initial velocity times time plus one-half acceleration times time squared.

Module 1: Describing Motion
Topic 4 Content: Kinematics Problem Solving Practice Solutions

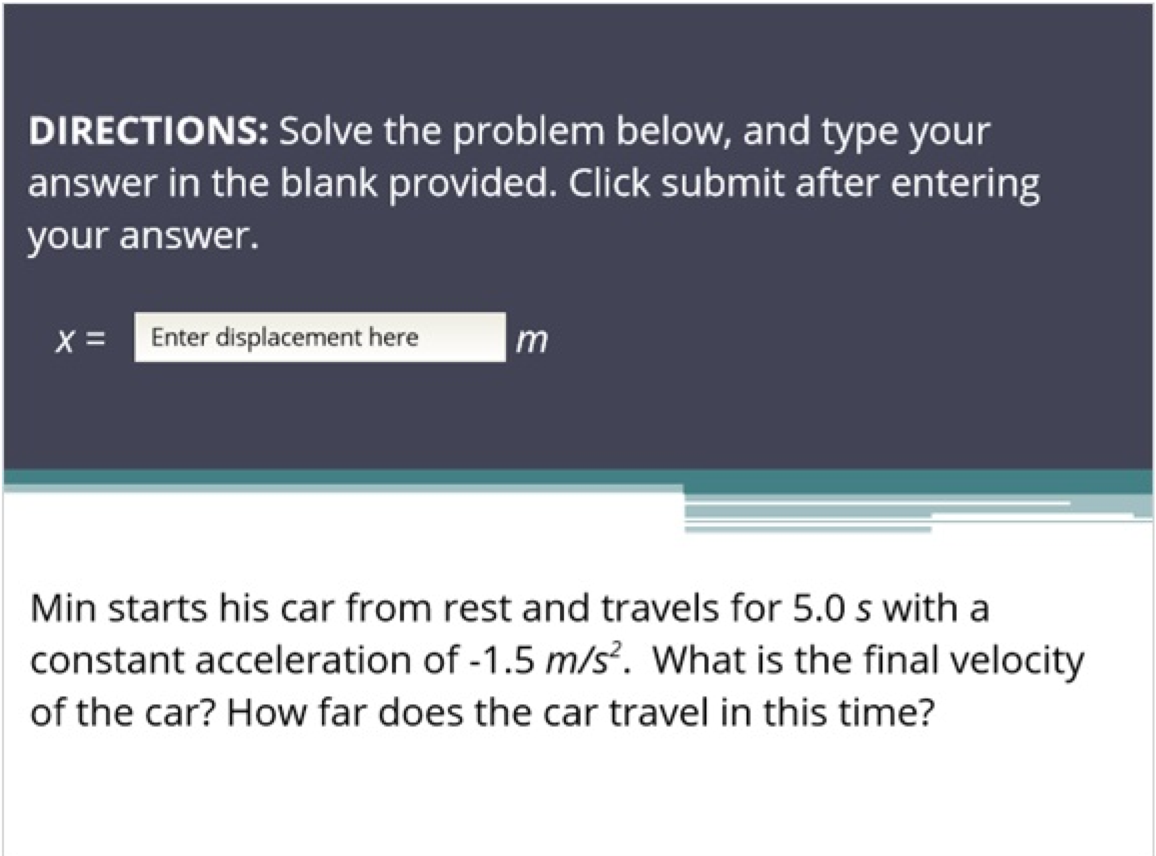
Step five is to substitute values into the equation and solve. To find velocity we substitute: initial velocity is six point five meters per second, acceleration is zero point nine two meters per second squared and time is three point six seconds. To find displacement we substitute the same values into the equation for displacement. We calculate a velocity of nine point eight meters per second and a displacement of twenty nine meters.

Step six is to think about if our answer is reasonable. Our final velocity is positive nine point eight, which is bigger than the initial velocity. This makes sense because Kristen is speeding up. The displacement is positive which makes sense because Kristen moves in the positive direction the entire time.



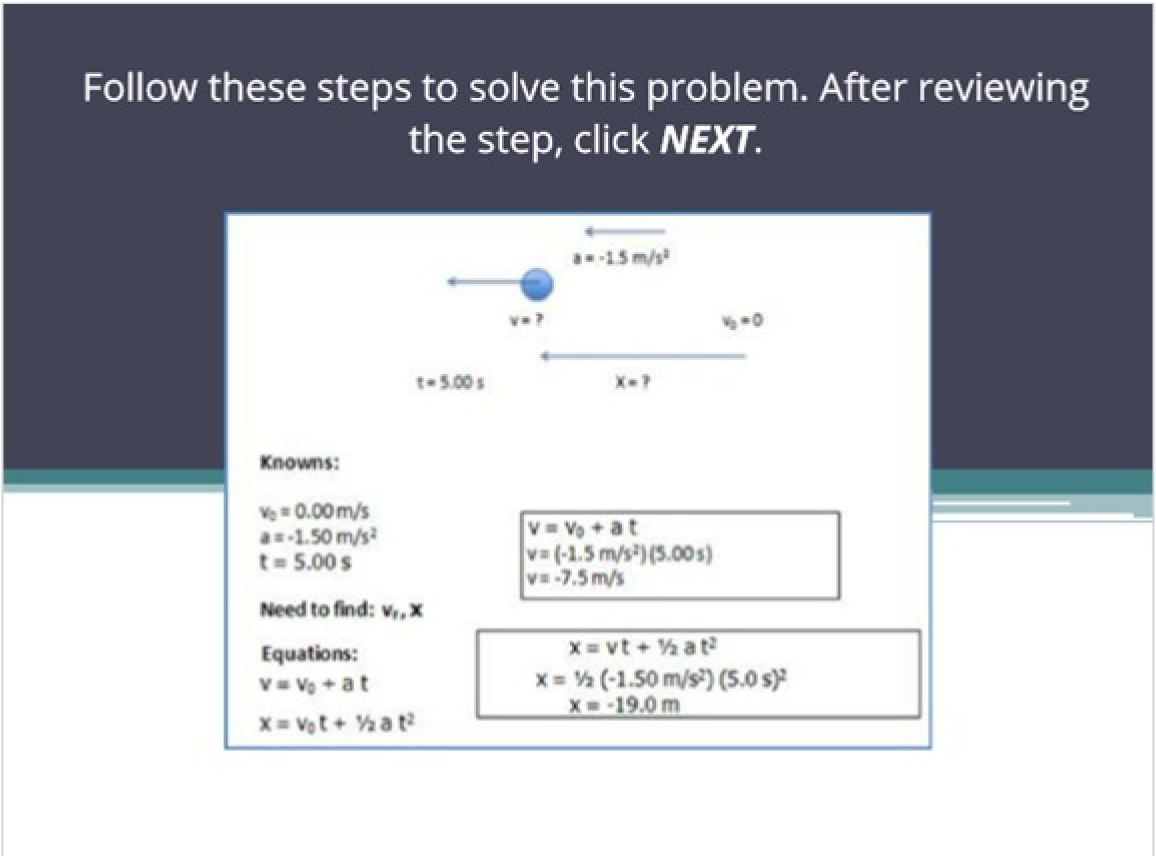
Problem 3 part 1

Min starts his car from rest and travels for five point zero seconds with a constant acceleration of negative one point five meters per second squared. What is the final velocity of the car? How far does the car travel in this time?



Problem 3 part 2

Min starts his car from rest and travels for five point zero seconds with a constant acceleration of negative one point five meters per second squared. What is the final velocity of the car? How far does the car travel in this time?



Problem 3 Solution

First, step one, draw a diagram. We will represent the car as a blue dot on our diagram for simplicity. Let's label what we know. The car starts from an initial velocity of zero and then speeds up in the negative direction. The final velocity is unknown, but it must be in the negative direction since he starts from rest and has a negative acceleration. The acceleration and the initial velocity are in the same direction. The displacement is in the same direction as the velocity and the acceleration so all of them must be negative. The time interval is five seconds.

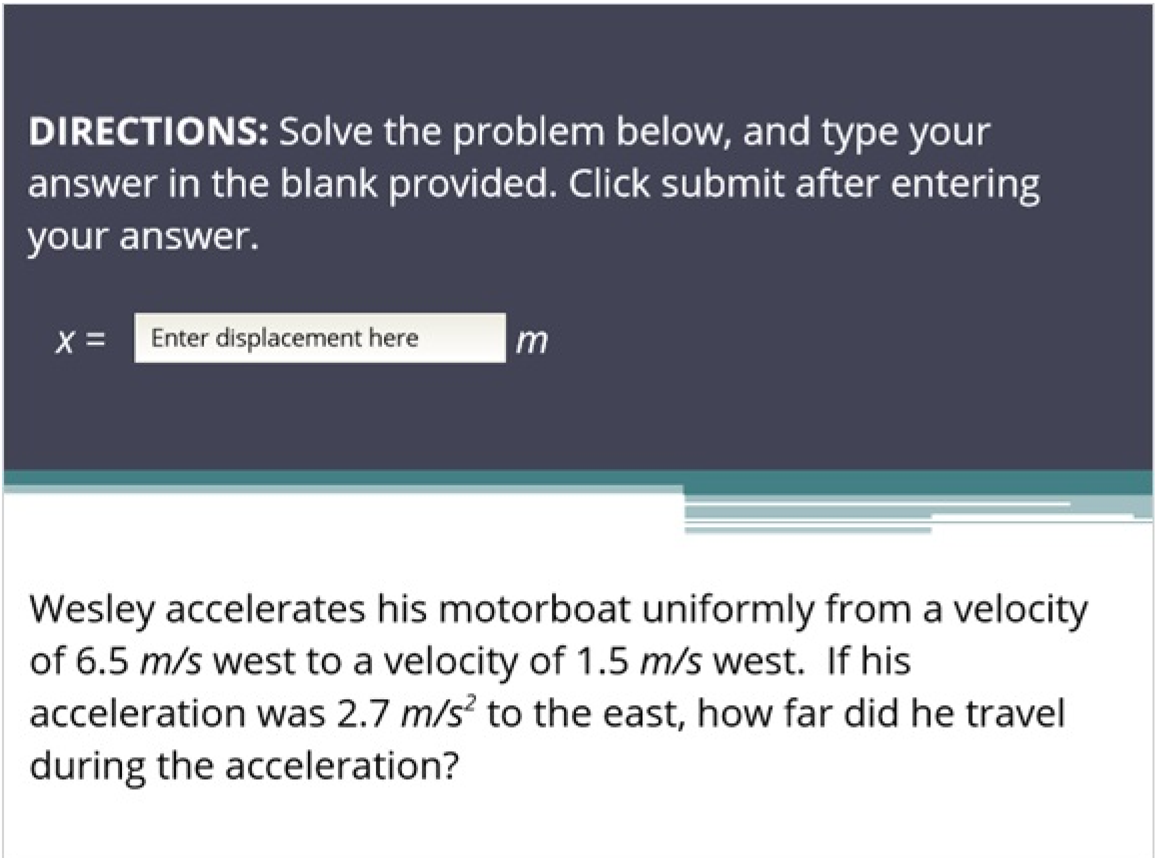
Next, step two, identify problem type. The key phrase in this problem is slows uniformly. This tell us the type of problem we are working on. This problem involves uniform acceleration and we can apply the four kinematics equations.

Step three is to make a table of values. Here we list all the knowns as well as what we are being asked to determine. In this problem, we know initial velocity, acceleration and time. We need to find final velocity and displacement.

Step four is to select an equation. We will find final velocity first. We already determined that this is a uniform acceleration problem and that we can use the four kinematics equations. Now we need to decide which one. We need the equation that has initial velocity, acceleration, time and final velocity in it. We do not want the equation to have displacement in it. If we look at the list of equations, we can see that only one of them meets these requirements. The equation we will use is final velocity equals initial velocity plus acceleration times time. Then we will want to find displacement. We can use the equation displacement equals initial velocity times time plus one-half acceleration times time squared.

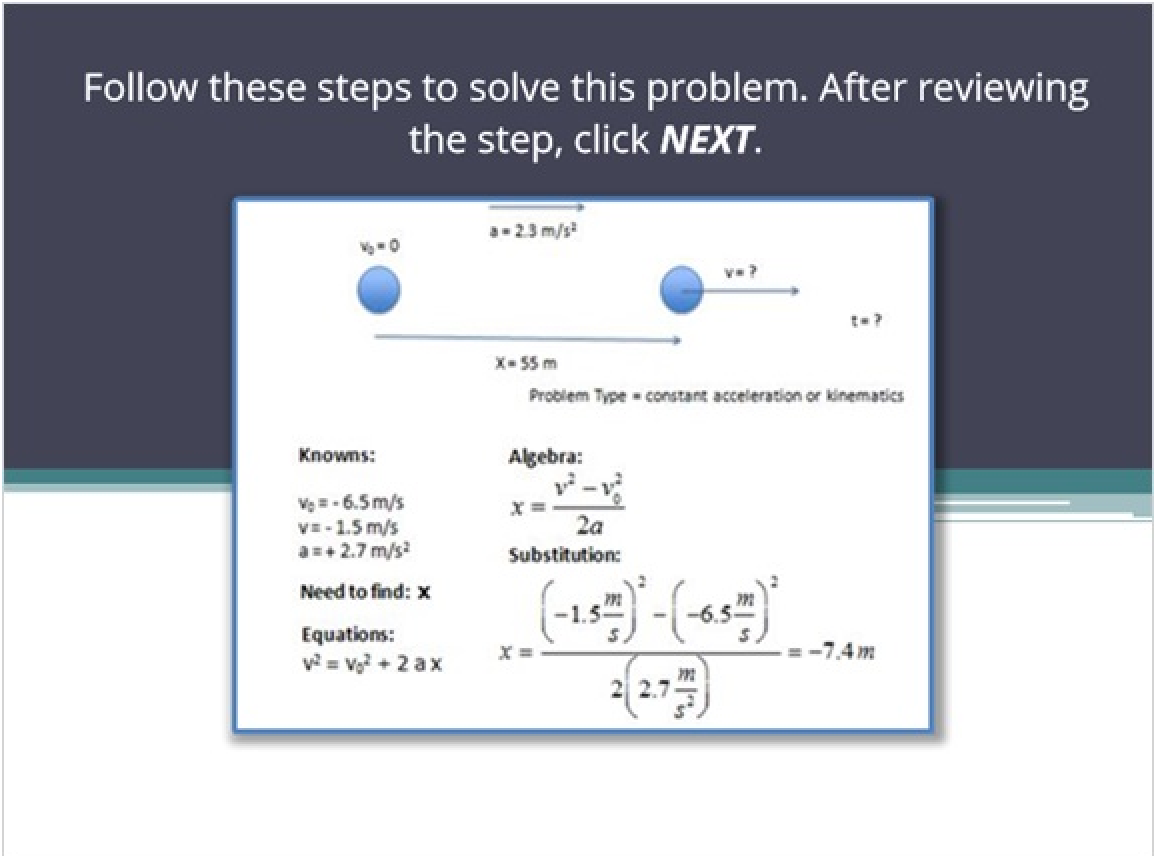
Step five is to substitute values into the equation and solve. To find velocity we substitute: initial velocity zero, acceleration is negative one point five meters per second squared and time is five point zero seconds. To find displacement we substitute the same values into the equation for displacement. We calculate a velocity negative seven point five meters per second and a displacement negative nineteen point zero meters.

Step six is to think about if our answer is reasonable. Our final velocity is negative seven point five, which is faster than the initial speed but in the negative direction. This makes sense because Min is speeding up in the negative direction. The displacement is negative which makes sense because Min moves in the negative direction the entire time.



Problem 4

Wesley accelerates his motorboat uniformly from a velocity of 6.5 m/s west to a velocity of 1.5 m/s west. If his acceleration was 2.7 m/s^2 to the east, how far did he travel during the acceleration?



Problem 4 Solution

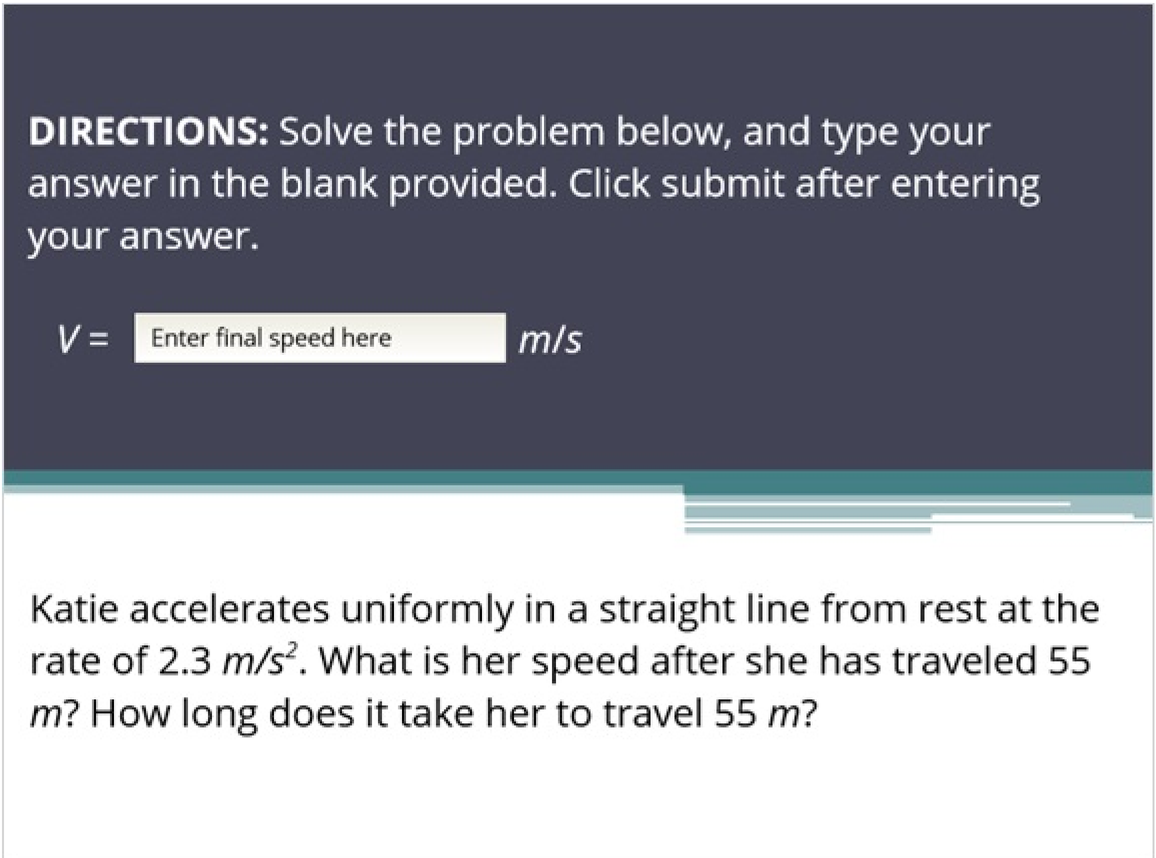
First, step one, draw a diagram. We will represent the boat as a blue dot on our diagram for simplicity. Let's label what we know. The car starts from an initial velocity of negative six point five meters per second and then slows down in the negative direction. The final velocity is negative one point five meters per second. The acceleration and the initial velocity are in the opposite directions. The displacement is in the same direction as the velocity but opposes the acceleration. The time interval is not known.

Step three is to make a table of values. Here we list all the knowns as well as what we are being asked to determine. In this problem, we know initial velocity, final velocity and acceleration. We need to find displacement.

Step four is to select an equation. We already determined that this is a uniform acceleration problem and that we can use the four kinematics equations. Now we need to decide which one. We need the equation that has initial velocity, final velocity, acceleration and displacement in it. We do not want the equation to have time in it. If we look at the list of equations, we can see that only one of them meets these requirements. The equation we will use final velocity squared equals initial velocity squared plus two times acceleration times displacement.

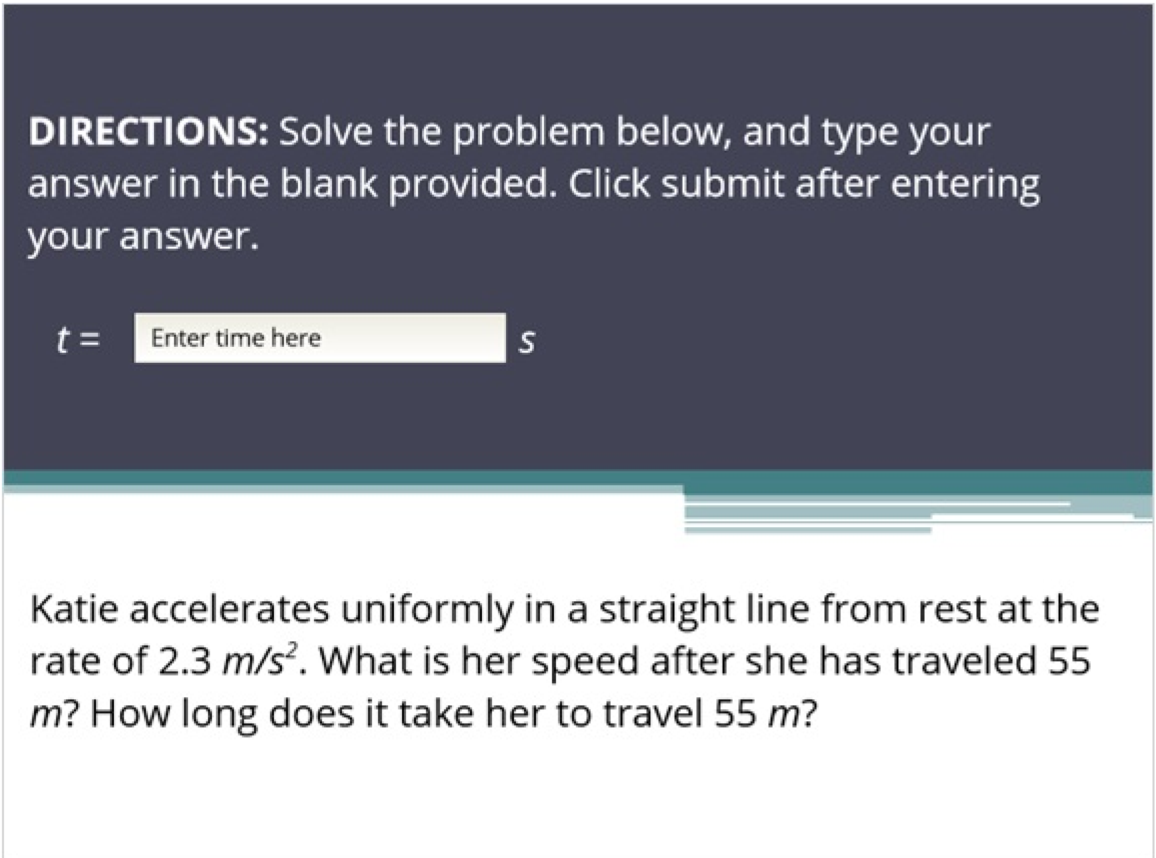
Step five is to substitute values into the equation and solve. To find velocity we substitute: initial velocity negative six point five meters per second, final velocity is negative one point five meters per second and acceleration is two point seven meters per second squared. We calculate a displacement of negative seven point four meters.

Step six is to think about if our answer is reasonable. Our displacement is negative seven point four. This makes sense because Wesley is traveling in the negative direction.



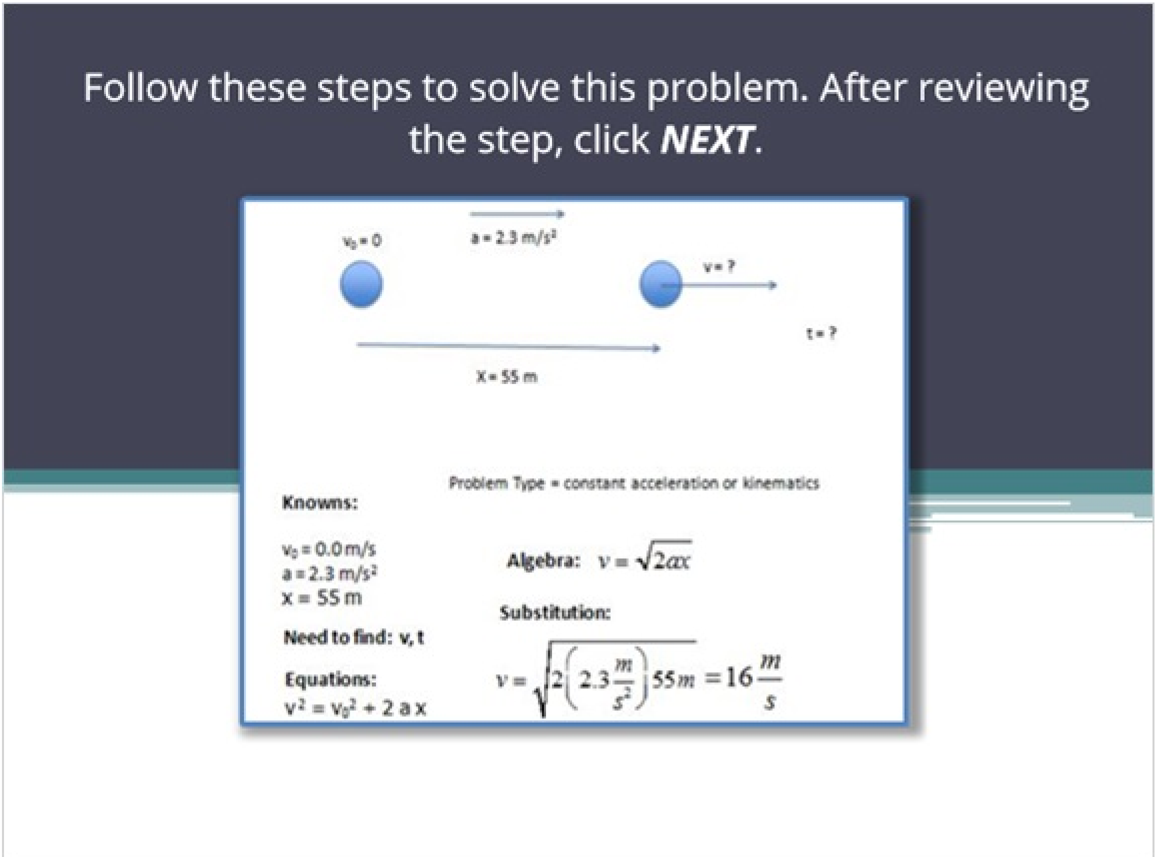
Problem 5 part 1

Katie accelerates uniformly in a straight line from rest at the rate of 2.3 m/s^2. What is her speed after she has traveled 55 m? How long does it take her to travel 55 m?



Problem 5 part 2

Katie accelerates uniformly in a straight line from rest at the rate of 2.3 m/s^2. What is her speed after she has traveled 55 m? How long does it take her to travel 55 m?



Problem 5 Solution

First, step one, draw a diagram. We will represent the car as a blue dot on our diagram for simplicity. Let's label what we know. The car starts from an initial velocity of zero and then speed up. The acceleration is two point three meters per second squared. The final velocity, the displacement and the initial velocity are in the same direction. The time interval and final velocity are not known.

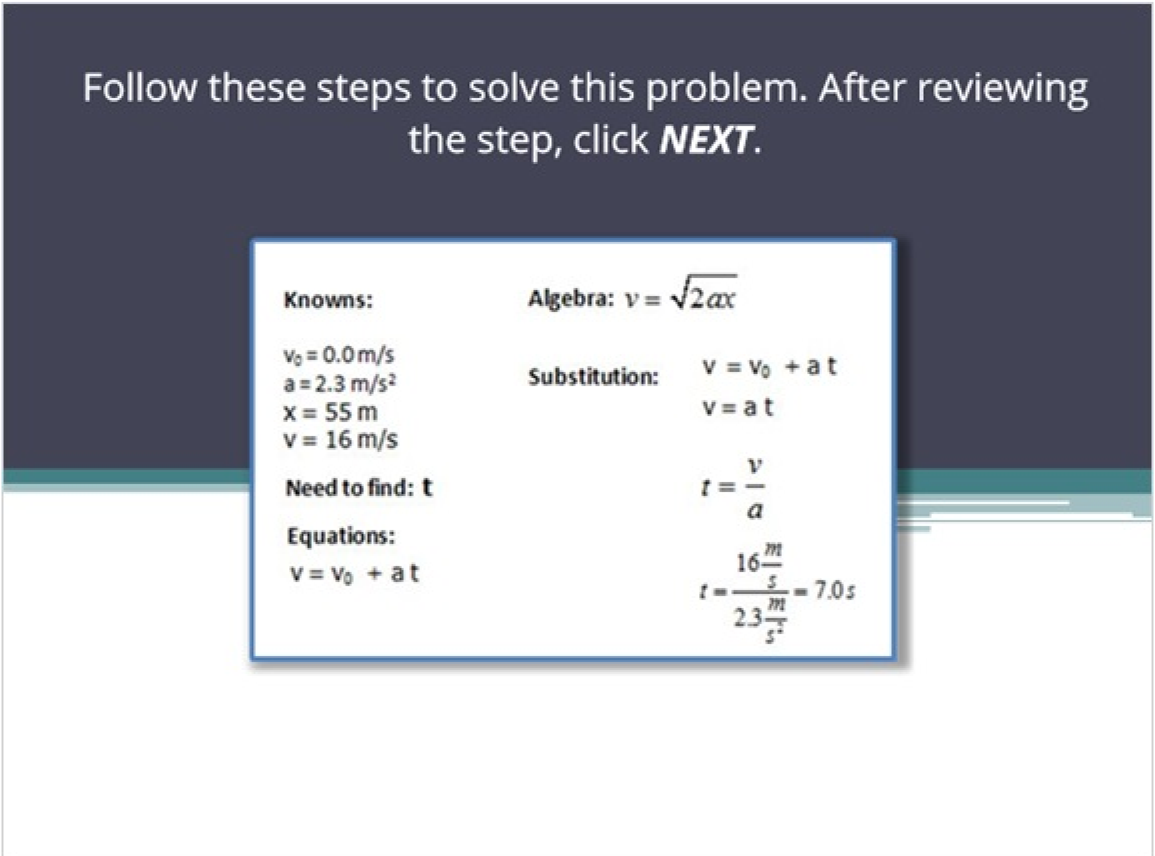
Next, step two, identify problem type. The key phrase in this problem is accelerates uniformly. This tell us the type of problem we are working on. This problem involves uniform acceleration and we can apply the four kinematics equations.

Step three is to make a table of values. Here we list all the knowns as well as what we are being asked to determine. In this problem, we know initial velocity, acceleration and displacement. We need to find final velocity and time.

Step four is to select an equation. We already determined that this is a uniform acceleration problem and that we can use the four kinematics equations. Now we need to decide which one. We need the equation that has initial velocity, acceleration, displacement and final velocity in it. We do not want the equation to have time in it. If we look at the list of equations, we can see that only one of them meets these requirements. The equation we will use is final velocity squared equals initial velocity squared plus two times acceleration times displacement.

Step five is to substitute values into the equation and solve. To find velocity we substitute: initial velocity zero, acceleration is two point three meters per second squared, and displacement fifty five meters. We calculate a final velocity of sixteen meters per second. This means Katie's speed is sixteen meters per second since speed is the magnitude of the velocity.

Step six is to check if the answer is reasonable. The final velocity is positive and larger than the initial velocity. This makes sense because Katie is speeding up in the positive direction.



Problem 5 Solution

Now we repeat steps four through six for finding time.

Step four is to select an equation. The equation we will use is final velocity equals initial velocity plus acceleration times time.

Step five is to substitute values into the equation and solve. To find velocity we substitute: initial velocity zero, final velocity sixteen meters per second, and acceleration is two point three meters per second squared. We calculate the time required to be seven point zero seconds.

Step six is to check if the values are reasonable. Seven seconds seems like a reasonable time for accelerating a car.