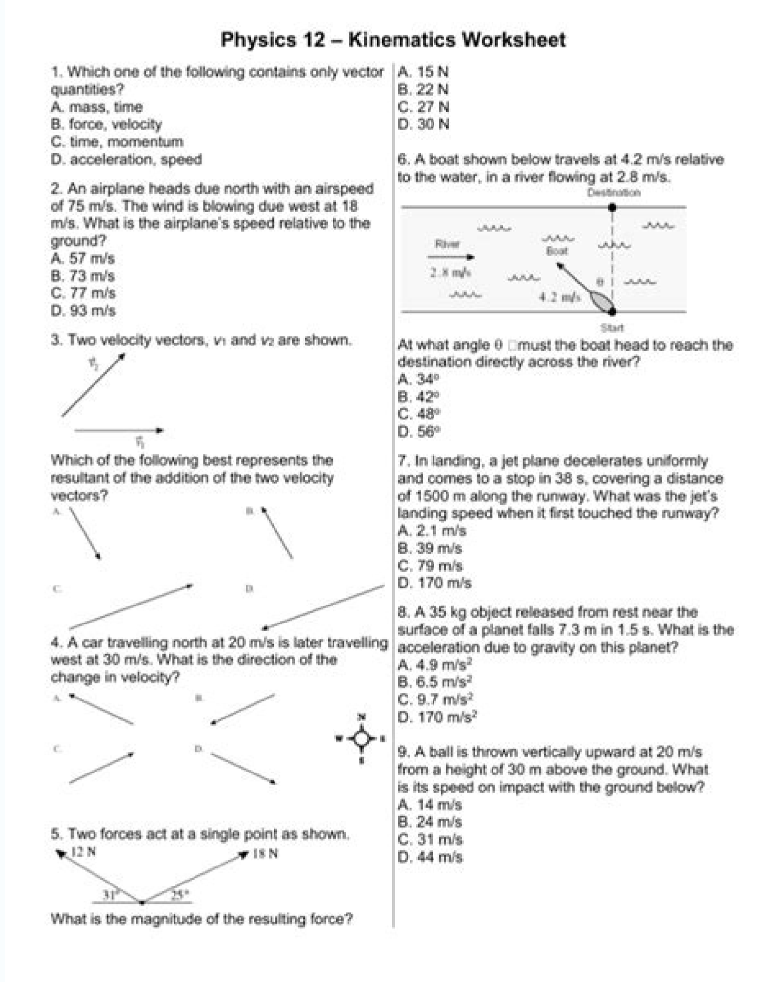
Physics kinematics problems and solutions pdf

Simple physics problems. Physics kinematics problems and solutions pdf class 11. Physics 1d kinematics problems and solutions pdf.


Physics 12 – Kinematics Worksheet

1. Which one of the following contains only vector quantities?
A. mass, time
B. force, velocity
C. time, momentum
D. acceleration, speed

2. An airplane heads due north with an airspeed of 75 m/s. The wind is blowing due west at 18 m/s. What is the airplane's speed relative to the ground?
A. 57 m/s
B. 73 m/s
C. 77 m/s
D. 93 m/s

3. Two velocity vectors, v_1 and v_2 are shown.

Which of the following best represents the resultant of the addition of the two velocity vectors?

4. A car travelling north at 20 m/s is later travelling west at 30 m/s. What is the direction of the change in velocity?

5. Two forces act at a single point as shown.

What is the magnitude of the resulting force?
A. 15 N
B. 22 N
C. 27 N
D. 30 N

6. A boat shown below travels at 4.2 m/s relative to the water, in a river flowing at 2.8 m/s.

At what angle θ must the boat head to reach the destination directly across the river?
A. 34°
B. 42°
C. 48°
D. 56°

7. In landing, a jet plane decelerates uniformly and comes to a stop in 38 s, covering a distance of 1500 m along the runway. What was the jet's landing speed when it first touched the runway?
A. 2.1 m/s
B. 39 m/s
C. 79 m/s
D. 170 m/s

8. A 35 kg object released from rest near the surface of a planet falls 7.3 m in 1.5 s. What is the acceleration due to gravity on this planet?
A. 4.9 m/s²
B. 6.5 m/s²
C. 9.7 m/s²
D. 170 m/s²

9. A ball is thrown vertically upward at 20 m/s from a height of 30 m above the ground. What is its speed on impact with the ground below?
A. 14 m/s
B. 24 m/s
C. 31 m/s
D. 44 m/s

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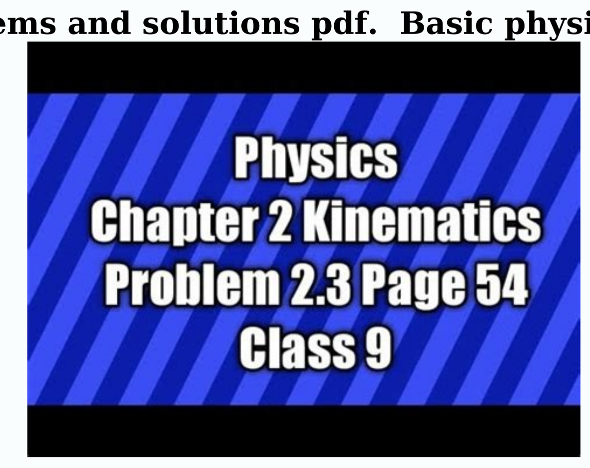
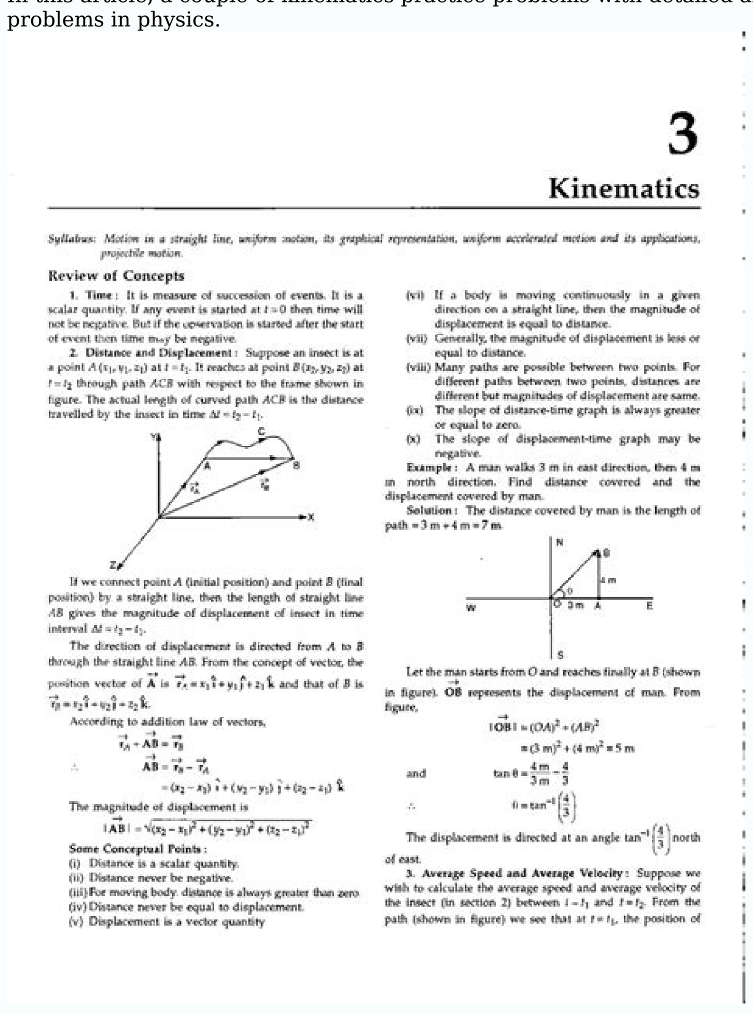


In this article, a couple of kinematics practice problems with detailed answers are presented. 42068424930.pdf The solution of each problem is itself a complete guide to applying the kinematics equations. All these kinematics problems are easy and helpful for high school students. You can also download a pdf version with other solved kinematics problems in physics.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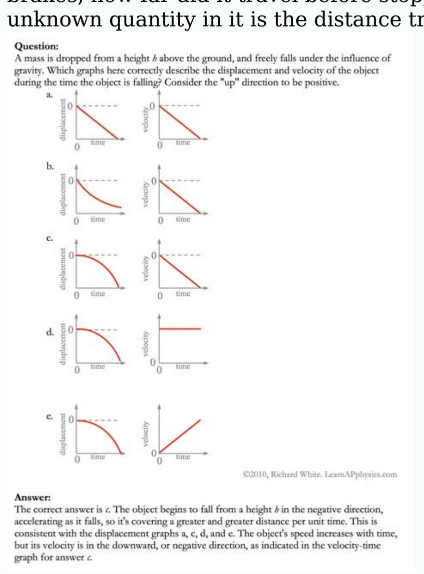
Kinematics

You can also check these AP Physics 1 kinematics multiple-choice questions. Kinematics Practice Problems: Problem (1): A car slows down its motion from 10 m/s to 6 m/s in 2 seconds under constant acceleration. (a) What is its acceleration? (b) How far did the car travel during this time interval? Solution: This is the simplest kinematics problem, so we put a bit more time to solve it in detail. Step 1: Because all these problems are in one dimension, draw a directed horizontal axis (like the positive x axis), and put the object on it, so that it moves in the correct direction. Step 2: Specify the known and wanted information. Here, in the elapsed time interval $2\,{\rm s}$, the initial and final velocities of the car are given as $v_i=10\,{\rm m/s}$ and $v_f=6\,{\rm m/s}$. The wanted quantity is the constant acceleration of the object (car), $a=?$. Step 3: Apply the kinematics equation that is appropriate for this situation. (a) In this problem, we want to find the acceleration, given the time, initial, and final velocities so the kinematics equation $v=v_0+at$ is perfect since the only unknown quantity is acceleration a. Thus, \begin{gather*} v=v_0+at\\\\ 6=10+a(2) \\\\ 6-10=2a \\\\\\Rightarrow \quad a=\frac{6-10}{2}=-2\quad {\rm \frac{m}{s^2}}\end{gather*} Note that because the problem says the acceleration of the motion is constant, we could use the constant acceleration kinematics equations. The negative indicates the direction of the acceleration, which is here toward the negative x axis. (b) "How far'' means the distance traveled by car is wanted, denoted by x in the kinematics equations. Here, the best equation that relates the known and unknown information is $x=\frac 12 at^2+v_0t$ or $v^2-v_0^2=2ax$. We choose the first, so \begin{align*} x&=\frac 12 at^2+v_0t \\\\&=\frac 12 (-2)(2)^2+(10)(2) \\\\&=16\quad {\rm m}\end{align*} On the following page you can find over 40+ questions related to applying kinematics equations in velocity and acceleration: Velocity and acceleration problems Problem (2): A moving object slows down its motion from $12\,{\rm m/s}$ to rest at a distance of 20 m. Find the acceleration of the object (assumed constant). Solution: In the diagram below, all known information along with the direction of the uniform motion is shown. As you can see, one of the common phrases in kinematics problems is "ending or coming to a rest'', which means the final velocity of the object in that time interval (in which we look at the object's motion) is zero, $v_f=0$. The perfect kinematics equation that solves this problem is $v^2-v_0^2=2a(x-x_0)$ as the only unknown quantity is acceleration a. Keep in mind that in all kinematics equation problems, we can set the initial position of the motion x_0 as zero for simplicity, $x_0=0$. \begin{gather*} v^2-v_0^2=2ax\\\\0^2-(12)^2 =2a(20) \\\\ \rightarrow a=\frac{-144}{2\times 20}\\\\\Rightarrow \boxed{a=-3.6\quad {\rm \frac{m}{s^2}}}\end{gather*} As before, the minus sign indicates the direction of the acceleration which is toward the left. Need help with your final exams? Get this 550 solved high school and college physics midterm and final exams ($8). Problem (3): A bullet leaves the muzzle of an 84-cm rifle with a speed of 521 m/s. Find the magnitude of the bullet's acceleration by assuming it is constant inside the barrel of the rifle. Solution: The bullet accelerates from rest to a speed of 521 m/s at a distance of 0.84 meters. These are our known quantities. The unknown is acceleration a. The perfect kinematics equation that relates all these together is $v^2-v_0^2=2a(x-x_0)$, so \begin{gather*}v^2-v_0^2=2a(x-x_0)\\\\ (521)^2-0=2(a)(0.84-0) \\\\ \Rightarrow \boxed{a=1.62\times 10^5\quad {\rm m/s^2}}\end{gather*} A very large acceleration. Problem (4): A car starts its motion from rest and uniformly accelerates at a rate of $4\,{\rm m/s^2}$ for 2 seconds in a straight line. (a) How far did the car travel during those 2 seconds? (b) What is the car's velocity at the end of that time interval? Solution: Another common phrase in the kinematics problems. speed master n4 choukai pdf full screen download pc "Start from rest'' means the initial object's velocity is zero, $v_0=0$. The known information are $a=4\,{\rm m/s^2}$, $t=2\,{\rm s}$ and wants the distance traveled $x=?$. (a) The kinematics equation that relates that information is $x=\frac 12 at^2+v_0 t+x_0$ since the only unknown quantity is x with the given known data above. \begin{align*} x&=\frac 12 at^2+v_0 t+x_0 \\\\&=\frac 12 (4)(2)^2+(0)(2) \\\\&=\boxed{8\quad {\rm m}}\end{align*} As previous, we set $x_0=0$. (b) Now that the distance traveled by car in that time interval is known, we can use the following kinematics equation to find the car's final velocity v. 80316834765.pdf \begin{align*} v^2-v_0^2 &=2a(x-x_0) \\\\v^2-(0)^2&=2(4)(8-0) \\\\v^2&=64\end{align*} Taking the square root, we get v: \[v=\sqrt{64}=\pm 8\quad {\rm \frac ms}\] We know that velocity is a vector quantity in physics and has both a direction and a magnitude. The magnitude of the velocity (speed) was obtained as 8 m/s, but in what direction? Or we must choose which signs? alto clef theory worksheets Because the car is uniformly accelerating without stopping in the positive x axis, the correct sign for velocity is positive. Therefore, the car's final velocity is $\boxed{v_f=+8\,{\rm m/s}}$. Problem (5): We want to design an airport runway with the following specifications. The lowest acceleration of a plane should be $4\,{\rm m/s^2}$ and its take-off speed is 75 m/s. How long would the runway have to be to allow the planes to accelerate through it? Solution: The known quantities are $a=4\,{\rm m/s^2}$, and final velocity $v=75\,{\rm m/s}$. The wanted quantity is runway length $\Delta x=x-x_0$. The perfect kinematics equation that relates those together is $v^2-v_0^2=2a(x-x_0)$.

\begin{align*} v^2-v_0^2&=2a\Delta x\\\\ (75)^2-0&=2(4) \Delta x\\\\ \Rightarrow \Delta x&=\boxed{703\quad {\rm m}}\end{align*} Thus, if the runway wants to be effective, its length must be at least about 703 meters. Problem (6): A stone is dropped vertically from a high cliff. After 3.55 seconds, it hits the ground. 72915349979.pdf How high is the cliff? Solution: There is another type of kinematics problem in one dimension but in the vertical direction. In such problems, the constant acceleration is that of free falling, $a=g=-10\,{\rm m/s^2}$. "Dropped'' or "released'' in free-falling problems means the initial velocity is zero, $v_0=0$. In addition, it is always better to consider the point of release as the origin of the coordinate, so $y_0=0$. The most relevant kinematics equation for these known and wanted quantities is $y=-\frac 12 gt^2+v_0t+y_0$ \begin{align*} y&=-\frac 12 gt^2+v_0t+y_0 \\\\&=-\frac 12 (9.8)(3.55)^2+0+0\\\\&=\boxed{-61.8\quad {\rm m}}\end{align*} The negative indicates that the impact point is below our chosen origin. Problem (7): A ball is thrown into the air vertically from the ground level with an initial speed of 20 m/s. (a) How long is the ball in the air? (b) At what height does the ball reach? Solution: The throwing point is considered to be the origin of our coordinate system, so $y_0=0$. Given the initial velocity $v_0=+20\,{\rm m/s}$ and the gravitational acceleration $a=g=-9.8\,{\rm m/s^2}$. The wanted time is how long it takes the ball to reach the ground again. To solve this free-fall problem, it is necessary to know some notes about free-falling objects. Note (1): Because the air resistance is neglected, the time the ball is going up is half the time it is going down. Note (2): At the highest point of the path, the velocity of the object is zero. (a) By applying the kinematics equation $v=v_0+at$ between the initial and the highest ($v=0$) points of the vertical path, we can find the going up time. farmacia de guardia pobra do caramiñal \begin{align*} v&=v_0+at \\0&=20+(-9.8)t\\\Rightarrow t&=2.04\quad {\rm s}\end{align*} The total flight time is twice this time \[t_{tot}=2t=2(2.04)=4.1\,{\rm s}\] Hence, the ball takes about 4 seconds to reach the ground. (b) The kinematics equation $v^2-v_0^2=2a(y-y_0)$ is best for this part. \begin{align*} v^2-v_0^2&=2a(y-y_0) \\0-20^2&=2(-9.8)(y-0) \\ \Rightarrow y&=\boxed{20\quad {\rm m}}\end{align*} Hence, the ball goes up to a height of about 20 meters. Problem (8): An object moving in a straight line with constant acceleration, has a velocity of $v=+10\,{\rm m/s}$ when it is at position $x=+6\,{\rm m}$ and of $v=+15\,{\rm m/s}$ when it is at $x=10\,{\rm m}$. Find the acceleration of the object. Solution: Draw a diagram, put all known data into it, and find a relevant kinematics equation that relates them together. We want to analyze the motion in a distance interval of $\Delta x=x_2-x_1=10-6=4\,{\rm m}$, thus, we can consider the velocity at position $x_1=6\,{\rm m}$ as the initial velocity and at $x_2=10\,{\rm m}$ as the final velocity. The most relevant kinematics equation that relates these known quantities to the wanted acceleration a is $v^2-v_0^2=2a(x-x_0)$, where $x-x_0$ is the same given distance interval. Thus, \begin{align*} v^2-v_0^2&=2a(x-x_0) \\\\ (15)^2-(10)^2&=2(a)(4) \\\\225-100&=8a\\\\\Rightarrow a&=\frac{125}{8}\\\\&=15.6\,{\rm m/s^2}\end{align*} Problem (9): A moving object accelerates uniformly from 75 m/s at time $t=0$ to 135 m/s at $t=10\,{\rm s}$. How far did it move at the time interval $t=2\,{\rm s}$ to $t=4\,{\rm s}$? Solution: Draw a diagram and implement all known data in it as below. Because the problem tells us that the object accelerates uniformly, its acceleration is constant along the entire path. Given the initial and final velocities of the moving object, its acceleration is determined using the definition of instantaneous acceleration as below \[a=\frac{v_2-v_1}{t_2-t_1}=\frac{135-75}{10}=6\,{\rm m/s^2}\] In this kinematics problem, to analyze the motion between the requested times (stage II in the figure), we must have a little bit of information for that time interval, their velocities, or the distance between them. As you can see in the figure, the initial velocity of stage II is the final velocity of stage I.

By using a relevant kinematics equation that relates those data to each other, we would have \begin{align*} v&=v_0+at\\\\&=75+(6)(2) \\\\&=87\,{\rm m/s}\end{align*} This velocity would be the initial velocity for stage II of the motion. Now, all known information for stage II is initial velocity $v_0=87\,{\rm m/s}$, acceleration $a=6\,{\rm m/s^2}$, and time interval $\Delta t=2\,{\rm s}$. The wanted is the distance traveled $x=?$ The appropriate equation which relates all these together is $x=\frac 12 at^2+v_0t+x_0$. difference between normal and anomalous dispersion pdf \begin{align*}x&=\frac 12 at^2+v_0t+x_0\\\\&=\frac 12 (6)(2)^2+(87)(2)+0\\\\&=186\quad {\rm m}\end{align*} Hence, our moving object, travels a distance of 186 m between the instances 2 s and 4 s. Problem (10): From rest, a fast car accelerates with a uniform rate of $1.5\,{\rm m/s^2}$ in 4 seconds. After a while, the driver applies the brakes for 3 seconds, causing the car to uniformly slow down at a rate of $-2\,{\rm m/s^2}$. (a) How fast is the car at the end of the braking period? (b) How far has the car traveled after braking? Solution: This motion is divided into two parts. First, draw a diagram and specify each section's known kinematics quantities. (a) In the first part, given the acceleration, initial velocity, and time interval, we can find its final velocity at the end of 4 seconds. \begin{align*} v&=v_0+at\\&=0+(1.5)(4) \\&=6\quad {\rm m/s}\end{align*} This velocity is considered as the initial velocity for the second part whose final velocity is wanted. In the next part, the acceleration and braking time period is given, so its final velocity is found as below \begin{align*} v&=v_0+at\\&=6+(-2)(3) \\&=0\end{align*} The zero velocity, here, indicates that the car after the braking period comes to a stop. (b) Now, the distance traveled in the second part is found using the kinematics equation $x=\frac 12 at^2+v_0t+x_0$, because the only unknown quantity is distance x. \begin{align*} x&=\frac 12 at^2+v_0t+x_0\\\\&=\frac 12 (-2)(3)^2+(6)(3)+0\\\\&=+9\quad {\rm m}\end{align*} Therefore, after braking, the car has traveled a distance of 9 meters before getting stopped. Problem (11): A car moves at a speed of 20 m/s down a straight path. Suddenly, the driver sees an obstacle in front of him and applies the brakes. Before the car reaches a stop, it experiences an acceleration of $-10\,{\rm m/s^2}$. (a) After applying the brakes, how far did it travel before stopping? (b) How long does it take the car to reach a stop? Solution: As always, the first and most important step in solving a kinematics problem is drawing a diagram and putting all known values into it, as shown below. (a) The kinematics equation $v^2-v_0^2=2a(x-x_0)$ is the perfect equation as the only unknown quantity in it is the distance traveled x.



Thus,
$$\begin{align*} v^2-v_0^2&=2a(x-x_0) \\ 0^2-(20)^2&=2(-10)(x-0) \\ \Rightarrow \quad x&=\frac {-400}{-20}\\&=20\quad {\rm m}\end{align*}$$
(b) "how long does it take'' asks us to find the time interval. The initial and final velocities, as well as acceleration, are known, so the only relevant kinematics equation is $v=v_0+at$. Thus,
$$\begin{align*} v&=v_0+at\\0&=20+(-10)t\\ \Rightarrow t&=\frac{-20}{-10}\\&=2\quad {\rm s}\end{align*}$$
Therefore, after braking, the car has moved 2 seconds before reaching a stop.

Problem (12): A sports car moves a distance of 100 m in 5 seconds with a uniform speed. Then, the driver brakes, and the car, come to a stop after 4 seconds. Find the magnitude and direction of its acceleration (assumed constant).

Solution: uniform speed means constant speed or zero acceleration for the motion before braking.

Thus, we can use the definition of average velocity to find its speed just before braking as below
$$\begin{align*} \bar{v}&=\frac{\Delta x}{\Delta t}\\&=\frac{100}{5}\\&=20\quad {\rm m/s}\end{align*}$$
Now, we know the initial and final velocities of the car in the braking stage. Since the acceleration is assumed to be constant, so by applying the definition of average acceleration, we would have
$$\begin{align*} \bar{a}&=\frac{v_2-v_1}{\Delta t}\\&=\frac{0-20}{4}\\&=-5\quad {\rm m/s^2}\end{align*}$$
The negative shows the direction of the acceleration that is toward the negative x-axis. Hence, the car's acceleration has a magnitude of $5\,{\rm m/s^2}$ in the negative x direction.

Problem (13): A race car accelerates from rest at a constant rate of $2\,{\rm m/s^2}$ in 15 seconds. It then travels at a constant speed for 20 seconds, and after that, it comes to a stop with an acceleration of $2\,{\rm m/s^2}$. (a) What is the total distance traveled by car? (b) What is its average velocity over the entire path?

Solution: To solve this kinematics question, we divided the entire path into three parts.

Part I: "From rest'' means the initial velocity is zero. Thus, for the first part of the path, given the acceleration and time interval, we can use the kinetic equation $v=v_0+at$ to find the distance traveled by car at the end of 15 seconds
$$\begin{align*} x&=\frac{1}{2}at^2 +v_0 t+x_0\\&=\frac 12 (2)(15)^2 +(0)(15)+0\\&=\boxed{125\quad{\rm m}}\end{align*}$$
As a side calculation, we find the final velocity for this part as below
$$\begin{align*}v&=v_0+at\\&=0+(2) (15) \\&=30\quad {\rm m/s}\end{align*}$$
Part II: the speed in this part is the final speed in the first part because the car continues moving at this constant speed after that moment.

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Problem Set 1 contains the following problems: Car and Bicycle Rider Elevator Trip Rocket Launch Throw and Catch Vertical Collision « Previous | Next »