Grade Level/Course: Algebra I

Lesson/Unit Plan Name: Making Motion Problems Easy

Rationale/Lesson Abstract: This lesson provides the scaffolding necessary for students to have a deep understanding of motion problems, and provides them with a variety of methods to solve the problems.

Timeframe: 120 mins.

Common Core Standard(s): 8.EE.8.C – Solve real-world and mathematical problems leading to two linear equations in two variables.

Instructional Resources/Materials: Copies of pages 3 - 6, pages 9 and 10, and pages 13 – 16.

Warm-up Solutions: Quadrant I is 2 hours; Quadrant II is B; Quadrant III is $t = 8$; Quadrant IV is $120 = 60t$

Grabber: Have you ever asked the driver, "Are we there yet!" If so, their answer should be, "Do the math!" For example, if you are traveling 60 miles per hour and you have 120 miles to go, how long should it take? How did you find the answer? Can you write an equation to solve?

Lesson: **Day 1**: **Pages 3 – 6 and 9 -10**. Have a student read the problems aloud, have them read to themselves, and have them discuss with a partner what the question is asking. For each problem, have a student come up and model the different speeds and directions with you.

For each problem, guide students through the problems (see Motion Solutions Pages 7 and 8). Show them the corresponding graph and explain the problem graphically. Have them do the "You Trys." Option - Have them graph the "You Trys" using the graphing template (Page 11).

Students share their answers to the "You Trys " with a partner and discuss any patterns that they see. Call on a pair of students to share how they arrived at their answer. Ask the class if they notice any patterns and how those patterns were formed.

Day 2: **Pages 12 – 16**. After reviewing the homework, introduce the simplified table using side by side comparison (see page 12). Guide them through problems from the math textbook using the "$d = r \bullet t$" Table. Have them do a "You Try" after each example.

Assessment: **Pages 13 – 17.** In the last 15 mins. of class, give partners a bag of cut-up pieces of pages 13 and 14 (minus the questions). Give them the complete pages 15 and 16 and have them match the pieces to the problems. When they finish the matching correctly, they earn a ticket out the door.

Warm-Up

CST: Solving Equations

Elizabeth's average driving speed for a 4-hour trip was 45 miles per hour. During the first 3 hours she drove 40 miles per hour. What was her average speed for the last hour of her trip?

A) 50 miles per hour

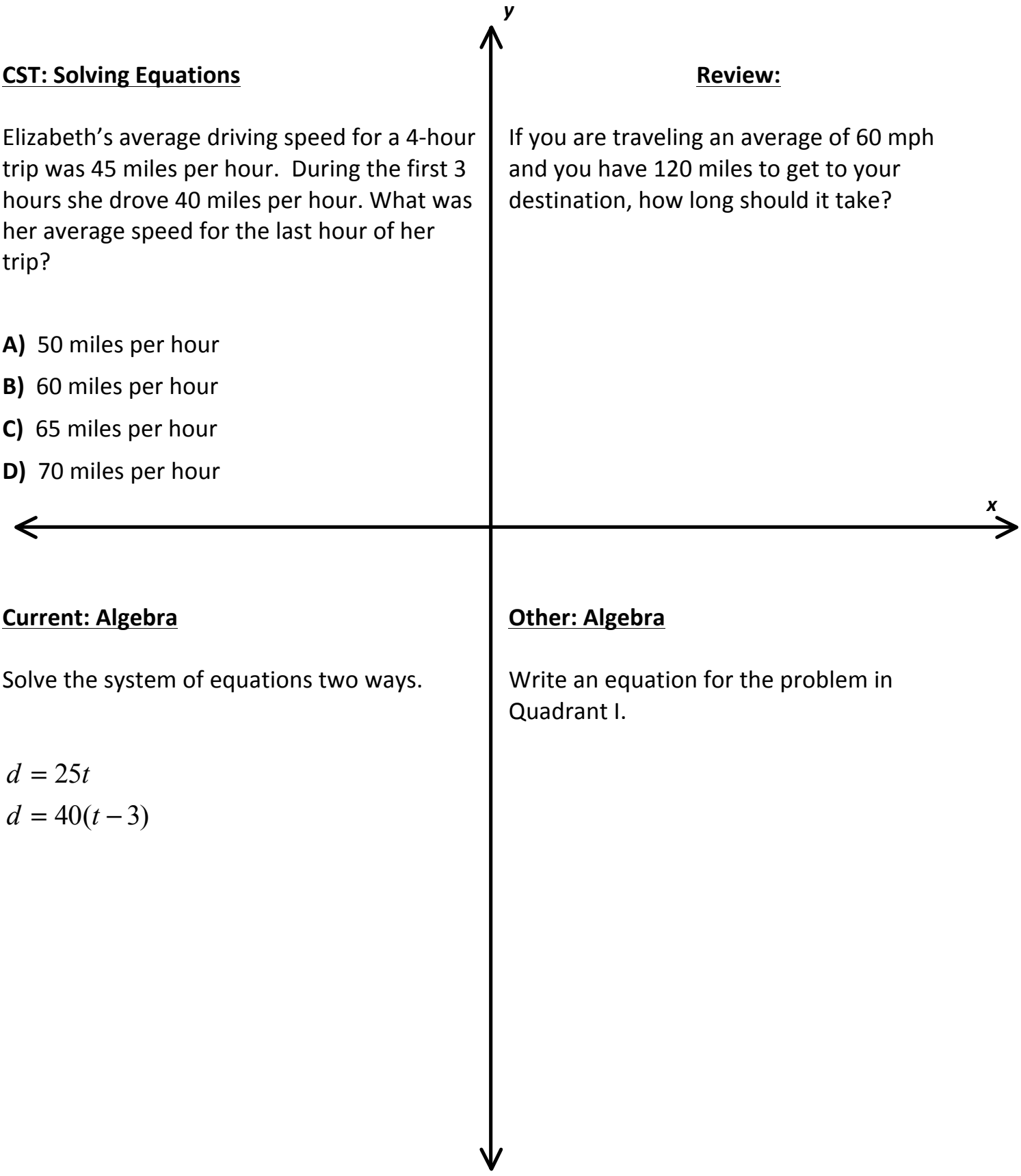
B) 60 miles per hour

C) 65 miles per hour

D) 70 miles per hour

Review:

If you are traveling an average of 60 mph and you have 120 miles to get to your destination, how long should it take?



Current: Algebra

Solve the system of equations two ways.

$d = 25t$

$d = 40(t - 3)$

Other: Algebra

Write an equation for the problem in Quadrant I.

Motion Problems Name:_____ Date:_____Per._____

1) Two cars leave LAX Airport at the same time headed towards Sacramento. The vintage car is traveling at 50 mph to Sacramento on I-5. The sports car is traveling at 70 mph. When will they be 160 miles apart?


Slower Motion

Time									
Rate									
Distance Traveled									
Difference in Distance									
Distance Traveled									
Rate									
Time									

Faster Motion 

You Try: Two cars leave the San Diego Zoo at the same time in the same direction. One car is traveling 60 mph and the other is traveling 75 mph. When will they be 75 miles apart?


Slower Motion

Time									
Rate									
Distance Traveled									
Difference in Distance									
Distance Traveled									
Rate									
Time									

Faster Motion 

2) One train leaves the station traveling at 80 km/h at 6 am. Another train leaves an hour later traveling on a parallel track going 120 km/h. What time will it be when the faster train is next to the slower train?


Slower Motion

Time									
Rate									
Distance Traveled									
Difference in Distance									
Distance Traveled									
Rate									
Time									

Faster Motion 

You Try: The slow train leaves the station traveling at 80 km/h at 1 pm. 2 hours later the bullet train leaves the same station going 160 km/h. What time does the bullet train meet the slow train?


Slower Motion

Time									
Rate									
Distance Traveled									
Difference in Distance									
Distance Traveled									
Rate									
Time									

Faster Motion 

3) Two cars leave Elk Grove traveling on I-5. One heads down south to Baja going 30 mph. The other heads up to Ashland, Oregon at 60 mph. When will they be 450 miles apart?

Slower Motion

Time									
Rate									
Distance Traveled									
Difference in Distance									
Distance Traveled									
Rate									
Time									

Faster Motion 

You Try: Two cars leave Redding, CA traveling on I-5. One heads south towards San Jose at a rate of 75 mph. The other heads up north towards Mt. Shasta going 60 mph. When will they be 540 miles apart?

Slower Motion

Time									
Rate									
Distance Traveled									
Difference in Distance									
Distance Traveled									
Rate									
Time									

Faster Motion 

4) Two friends are 600 miles apart in their cars. One is in Chico, CA and traveling south towards their friend at 70 mph. The other person is in Indio, CA and is traveling north at 50 mph towards Chico. How many hours will it take for them to meet?


Slower Motion

Time									
Rate									
Distance Traveled									
Difference in Distance									
Distance Traveled									
Rate									
Time									

Faster Motion 

You Try: Two friends start 39 miles apart. The marathoner is jogging at 10 mph. Her friend heads towards her walking an average of 3 mph. When will they meet?


Slower Motion

Time									
Rate									
Distance Traveled									
Difference in Distance									
Distance Traveled									
Rate									
Time									

Faster Motion 

Motion Solutions

1) Two cars leave LAX Airport at the same time headed towards Sacramento. The vintage car is traveling at 50 mph to Sacramento on I-5. The sports car is traveling at 70 mph. When will they be 160 miles apart? **8 hours**

Slower Motion

Time	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours	7 hours	8 hours	9 hours
Rate	50 mph	50 mph	50 mph	50 mph	50 mph	50 mph	50 mph	50 mph	50 mph
Distance Traveled	50 miles	100 miles	150 miles	200 miles	250 miles	300 miles	350 miles	400 miles	450 miles
Difference in Distance	20 miles	40 miles	60 miles	80 miles	100 miles	120 miles	140 miles	160 miles	180 miles
Distance Traveled	70 miles	140 miles	210 miles	280 miles	350 miles	420 miles	490 miles	560 miles	630 miles
Rate	70 mph	70 mph	70 mph	70 mph	70 mph	70 mph	70 mph	70 mph	70 mph
Time	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours	7 hours	8 hours	9 hours

Faster Motion 

You Try Answer: 5 hours

2) One train leaves the station traveling at 80 km/h at 6 am. Another train leaves an hour later traveling on a parallel track going 120 km/h. What time will it be when the faster train is next to the slower train? **9 am**

Slower Motion

Time	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours	7 hours	8 hours	9 hours
Rate	80 km/h	80 km/h	80 km/h	80 km/h	80 km/h	80 km/h	80 km/h	80 km/h	80 km/h
Distance Traveled	80 km	160 km	240 km	320 km	400 km	480 km	560 km	640 km	720 km
Difference in Distance	80 km	40 km	0 km	40 km	80 km	120 km	160 km	200 km	240 km
Distance Traveled	0 km	120 km	240 km	360 km	480 km	600 km	720 km	840 km	960 km
Rate	0 km/h	120 km/h	120 km/h	120 km/h	120 km/h	120 km/h	120 km/h	120 km/h	120 km/h
Time	0 hour	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours	7 hours	8 hours

Faster Motion 

You Try Answer: 5 pm

3) Two cars leave Elk Grove traveling on I-5. One heads down south to Baja going 30 mph. The other heads up to Ashland, Oregon at 60 mph. When will they be 450 miles apart? **5 hours**

Slower Motion

Time	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours	7 hours	8 hours	9 hours
Rate	30 mph	30 mph	30 mph	30 mph	30 mph	30 mph	30 mph	30 mph	30 mph
Distance Traveled	30 miles	60 miles	90 miles	120 miles	150 miles	180 miles	210 miles	240 miles	270 miles
Difference in Distance	90 miles	180 miles	270 miles	360 miles	450 miles	540 miles	630 miles	720 miles	810 miles
Distance Traveled	60 miles	120 miles	180 miles	240 miles	300 miles	360 miles	420 miles	480 miles	540 miles
Rate	60 mph	60 mph	60 mph	60 mph	60 mph	60 mph	60 mph	60 mph	60 mph
Time	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours	7 hours	8 hours	9 hours

Faster Motion 

You Try Answer: 4 hours

4) Two friends are 600 miles apart in their cars. One is in Chico, CA and traveling south towards their friend at 70 mph. The other person is in Indio, CA and is traveling north at 50 mph towards Chico. How many hours will it take for them to meet? **5 hours**

Slower Motion

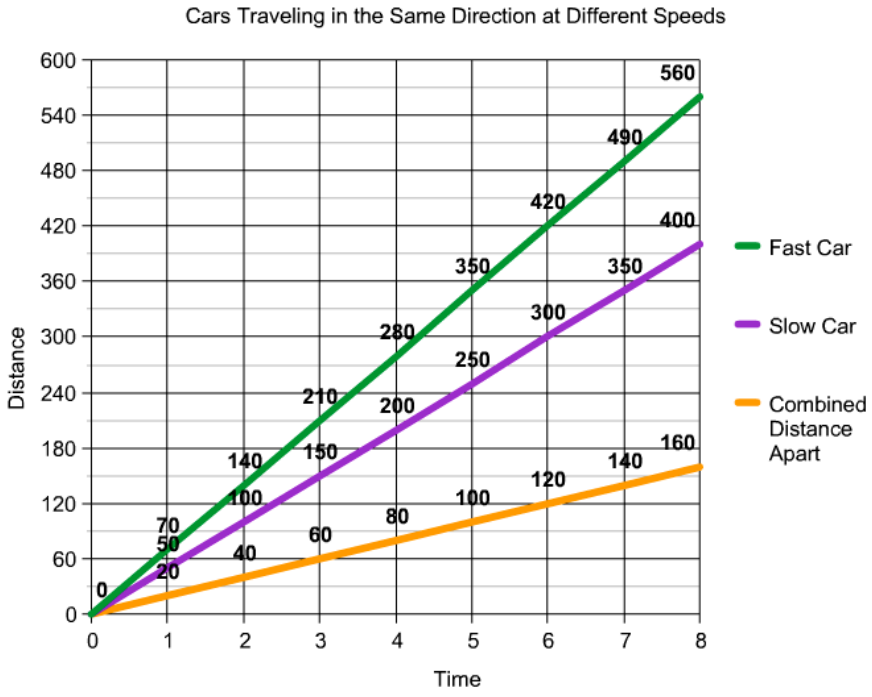
Time	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours	7 hours	8 hours	9 hours
Rate	50 mph	50 mph	50 mph	50 mph	50 mph	50 mph	50 mph	50 mph	50 mph
Distance Traveled	50 miles	100 miles	150 miles	200 miles	250 miles	300 miles	350 miles	400 miles	450 miles
Difference in Distance	480 miles	360 miles	240 miles	120 miles	0 miles	Hey	You	Passed	Me!
Distance Traveled	70 miles	140 miles	210 miles	280 miles	350 miles	420 miles	490 miles	560 miles	630 miles
Rate	70 mph	70 mph	70 mph	70 mph	70 mph	70 mph	70 mph	70 mph	70 mph
Time	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours	7 hours	8 hours	9 hours

Faster Motion 

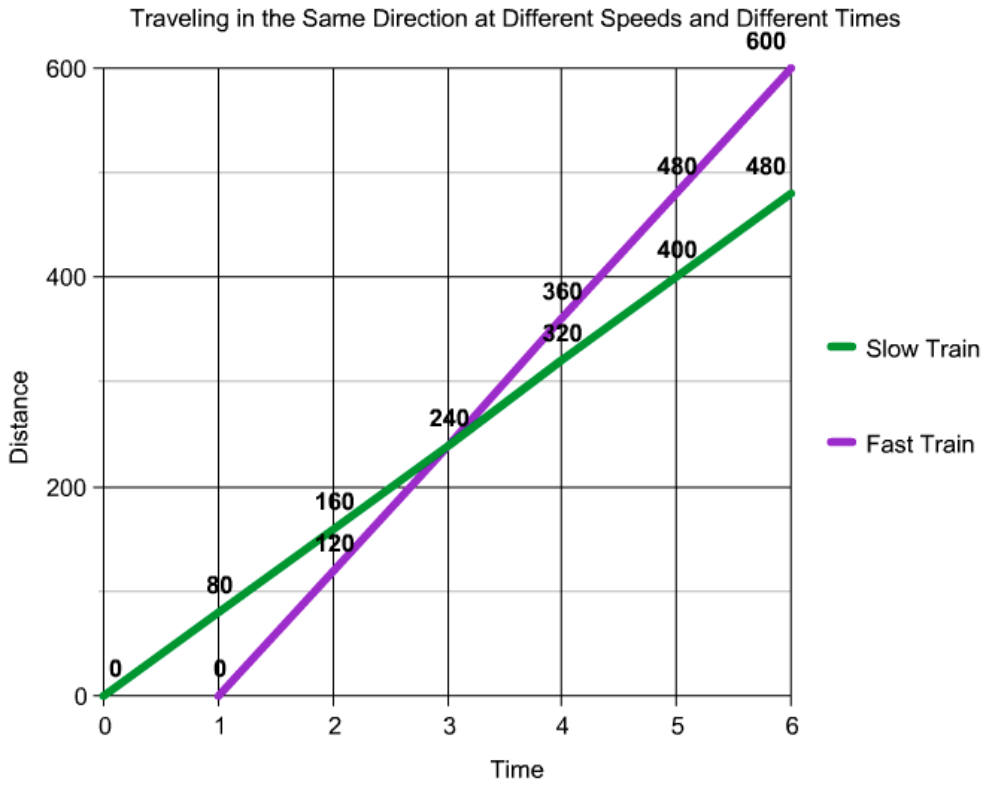
You Try Answer: 3 hours

Graphs for Examples 1 – 4

Ex. 1



Ex. 2



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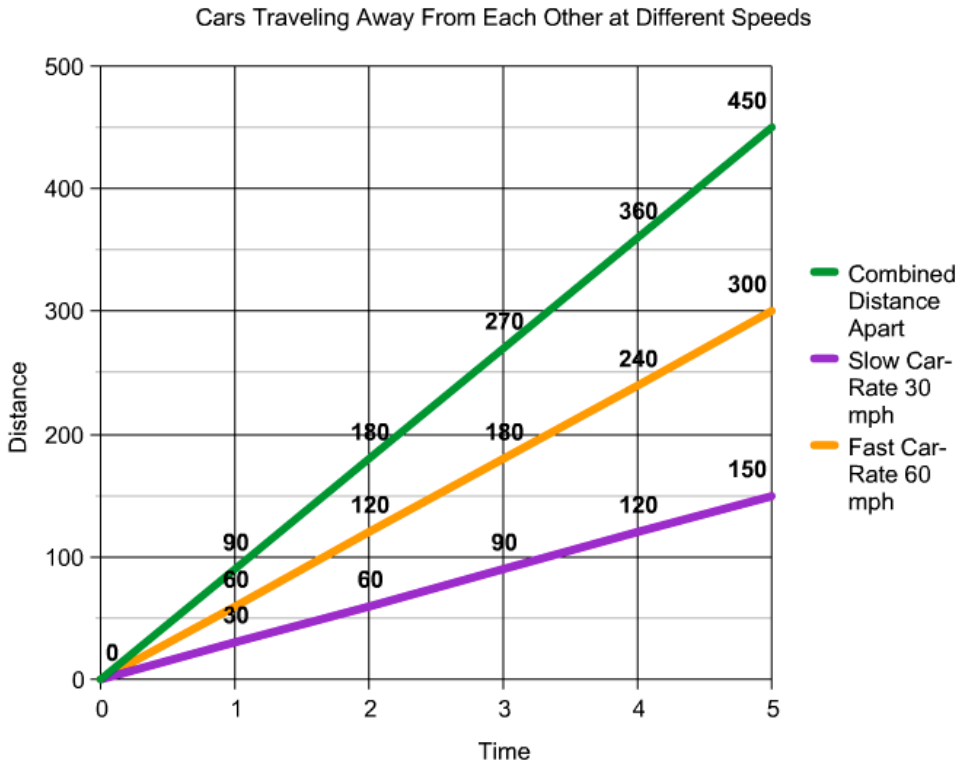
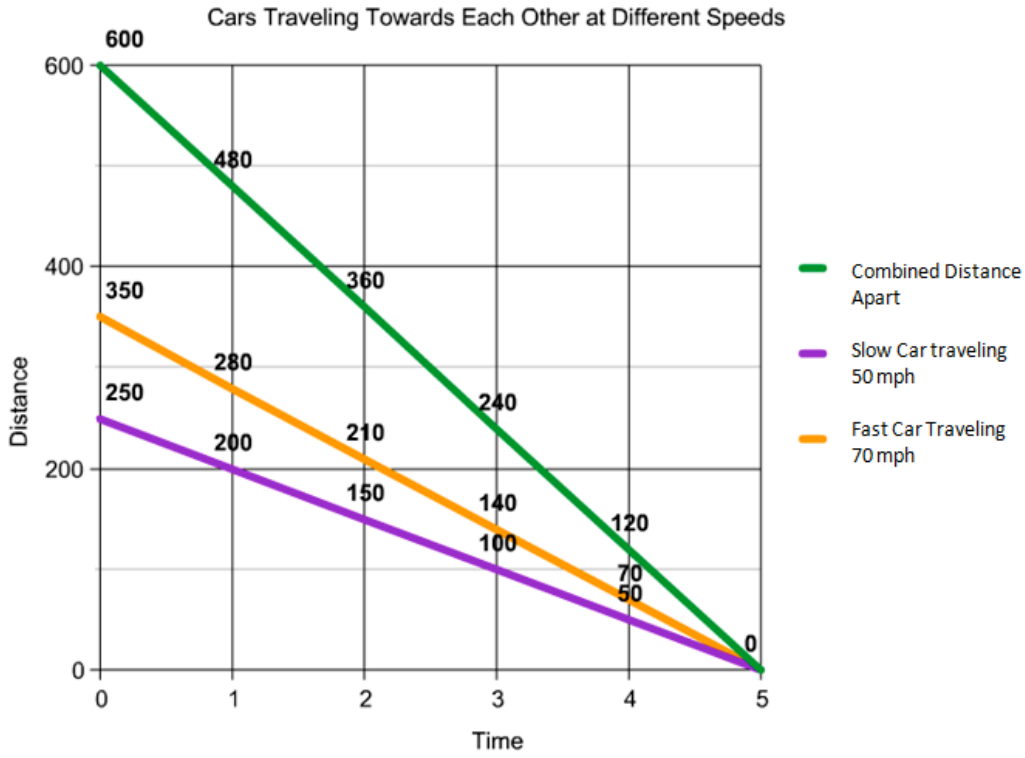
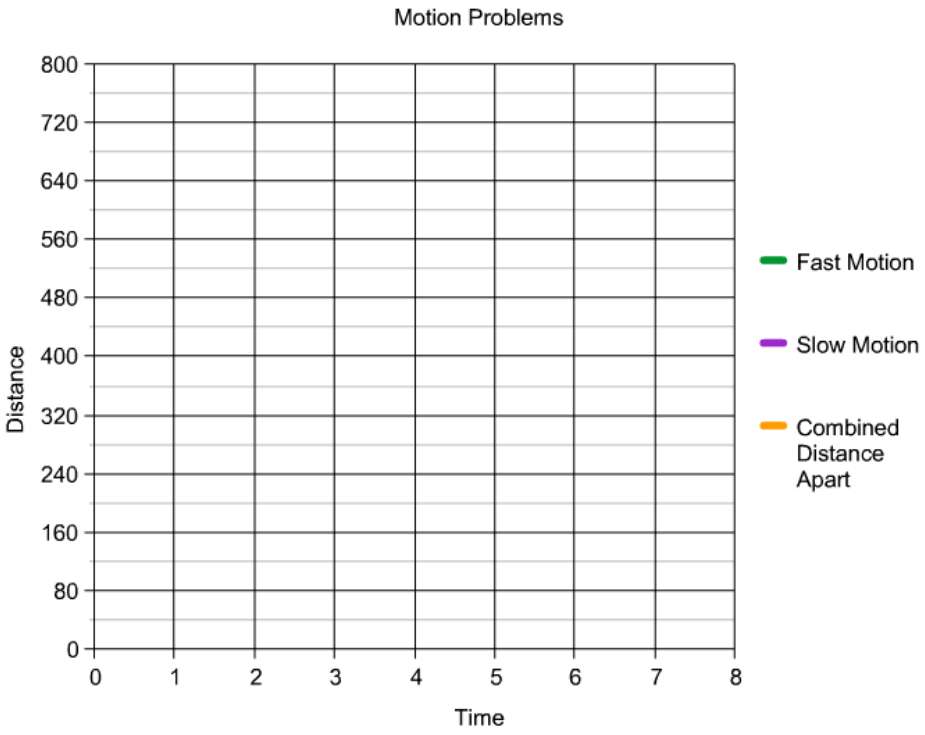
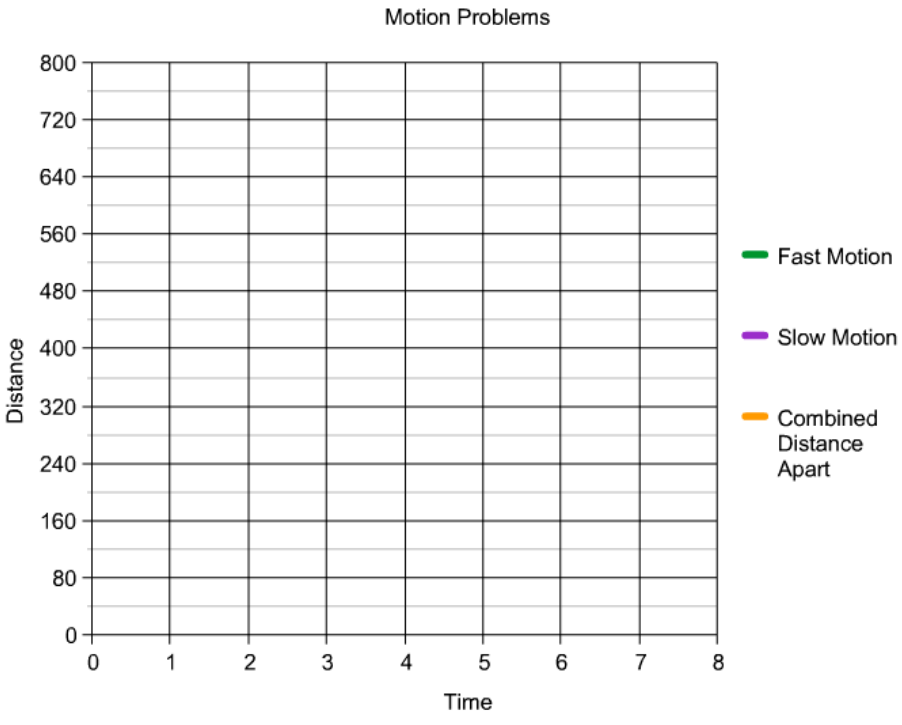

Cars Traveling Away From Each Other at Different Speeds
Distance
Time
0
100
200
300
400
500
0
1
2
3
4
5
0
90
180
270
360
450
0
60
120
180
240
300
0
30
60
90
120
150
Combined Distance Apart
Slow Car- Rate 30 mph
Fast Car- Rate 60 mph

Ex. 4


Cars Traveling Towards Each Other at Different Speeds
Distance
Time
0
200
400
600
0
1
2
3
4
5
600
480
360
240
120
0
350
280
210
140
70
0
250
200
150
100
50
0
Combined Distance Apart
Slow Car traveling 50 mph
Fast Car Traveling 70 mph

Name:_____
Date:_____
Period:_____





Day 2: One train leaves the station traveling at 80 km/h. Another train leaves an hour later traveling on a parallel track going 120 km/h. How many hours have past when the faster train is next to the slower train?

Slower Motion

Time									
Rate									
Distance Traveled									
Difference in Distance									
Distance Traveled									
Rate									
Time									

Faster Motion 

Slower Motion

Time	1	2	3	4	5	6
Rate	80	80	80	80	80	80
Distance Traveled	80	160	240	320	400	480
Difference in Distance	80	40	0	40	80	120
Distance Traveled	0	120	240	360	480	600
Rate	120	120	120	120	120	120
Time	1	2	3	4	5	6

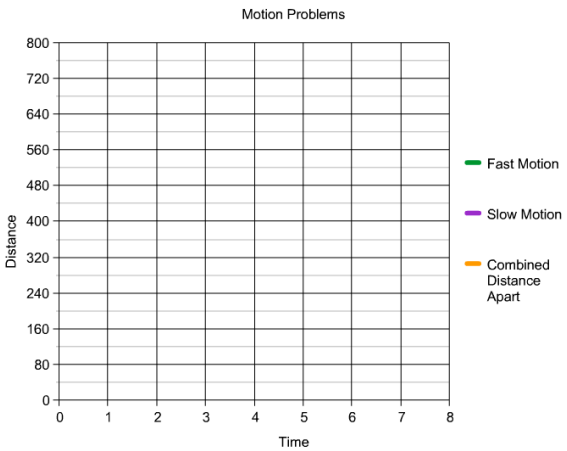
Faster Motion 

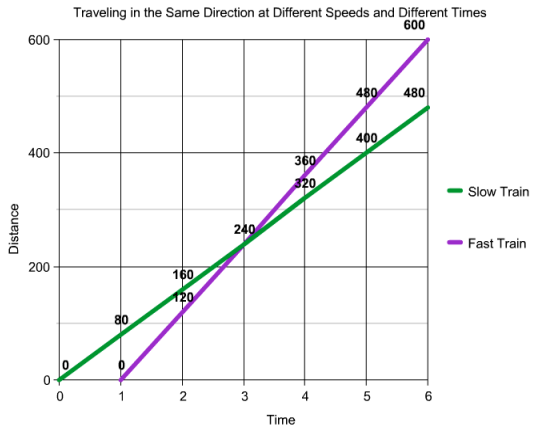
$d = r \bullet t$ Table	Distance	Rate	Time
Slow Motion 			
Fast Motion 			

d=r(t)	Distance	Rate	Time
Slow Motion 	d	80	t
Fast Motion 	d	120	t - 1

Slow: $d = 80t$ Fast: $d = 120(t - 1)$

$$120(t - 1) = 80t$$
$$120t - 120 = 80t$$
$$40t = 120$$
$$t = 3$$





Day 2: Motion Problems Assessment Sort

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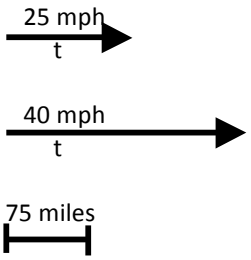
<td>Two cars leave town at the same time in the same direction. One travels 25 mph and the other 40 mph. How long until they are 75 miles apart?</td>
<td>Sketch:
 
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<tr><td></td><td>d</td><td>r</td><td>t</td></tr>
<tr><td>Slow</td><td>d</td><td>25</td><td>t</td></tr>
<tr><td>Fast</td><td>d+75</td><td>40</td><td>t</td></tr>
</table></td>
<td>System
$d = 25 \bullet t$
$d + 75 = 40 \bullet t$
$(25t) + 75 = 40t$</td>
<td>Answer:
$t = 5$ hours</td>
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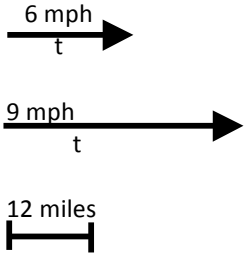
<tr>
<td>Two people leave on a trail at the same time in the same direction. One walks at 6 mph and the other at 9 mph. How long until they are 12 miles apart?</td>
<td>Sketch:
 
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<tr><td>Slow</td><td>d</td><td>6</td><td>t</td></tr>
<tr><td>Fast</td><td>d+12</td><td>9</td><td>t</td></tr>
</table></td>
<td>System
$d = 6 \bullet t$
$d + 12 = 9 \bullet t$
$(6t) + 12 = 9t$</td>
<td>Answer:
$t = 4$ hours</td>
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<td>Two cars leave town going in opposite directions at the same time. One travels at 25 mph and the other travels at 40 mph. When will they be 195 miles apart?</td>
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 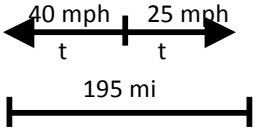
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<tr><td>Fast</td><td>d_f</td><td>40</td><td>t</td></tr>
</table></td>
<td>System
$d_s = 25 \bullet t$
$d_f = 40 \bullet t$
$d_s + d_f = 195$
$(25t) + (40t) = 195$</td>
<td>Answer:
$t = 3$ hours</td>
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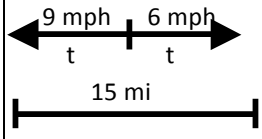
<td>Two people leave on a trail at the same time in opposite directions. One walks 6 mph and the other walks 9 mph. When will they be 15 miles apart?</td>
<td>Sketch:
 
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<tr><td>Slow</td><td>d_s</td><td>6</td><td>t</td></tr>
<tr><td>Fast</td><td>d_f</td><td>9</td><td>t</td></tr>
</table></td>
<td>System
$d_s = 6 \bullet t$
$d_f = 9 \bullet t$
$d_s + d_f = 15$
$(6t) + (9t) = 15$</td>
<td>Answer:
$t = 1$ hour</td>
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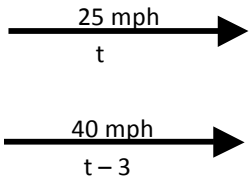
<tr>
<td>One car leaves town going 25 mph. Another car leaves in the same direction 3 hours later going 40 mph. How far from town will they meet?</td>
<td>Sketch:
 
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<tr><td>Fast</td><td>d</td><td>40</td><td>t-3</td></tr>
</table></td>
<td>System
$d = 25 \bullet t$
$d = 40(t - 3)$
$25t = 40t - 120$</td>
<td>Answer:
$d = 200$ miles</td>
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</table>

Motion Problems Assessment Sort

One person leaves on a trail walking 6 mph. Another person leaves 1 hour later in the same direction walking 9 mph. How long until they meet on the trail?	Sketch: 6 mph t 9 mph t – 1		System $d = 6 \bullet t$ $d = 9(t - 1)$ $6t = 9t - 9$	Answer: t = 3 hours
A boat travels for 4 hours with a 6 mph current to reach a campsite. The return trip takes 10 hours. Find the speed of the boat in still water.	Sketch: r + 6 4 hr r – 6 10 hr		System $d = (r - 6)10$ $d = (r + 6)4$ $10r - 60 = 4r + 24$	Answer: r = 14 mph
An airplane flies for 5 hours with a 25 mph tailwind. The return flight takes 10 hours. What is the distance of the trip one way?	Sketch: r + 25 5 hr r – 25 10 hr		System $d = (r + 25)5$ $d = (r - 25)\ 10$ $5r + 125 = 10r - 250$	Answer: d = 500 miles
It takes a bike 2 hours more than a car to go from home to school. The bike goes 10 mph, and the car goes 15 mph. How far is it from home to school?	Sketch: 10 mph t + 2 15 mph t		System $d = 10(t + 2)$ $d = 15 \bullet t$ $10t + 20 = 15t$	Answer: d = 60 miles
It takes a bike 4 more hours than a car to go from school to the park. The bike goes 12 mph and the car goes 24 mph. How far is it from school to the park?	Sketch: 12 mph t + 24 24 mph t		System $d = 12(t + 4)$ $d = 24 \bullet t$ $12t + 48 = 24t$	Answer: d = 96 miles

	d	r	t
Slow	d	6	t
Fast	d	9	t - 1

	d	r	t
With	d	r -6	10
Against	d	r +6	4

	d	r	t
With	d	r+25	5
Against	d	r - 25	10

	d	r	t
Slow	d	10	t + 2
Fast	d	15	t

	d	r	t
Slow	d	12	t + 4
Fast	d	24	t

Motion Sort	Sketch	Table	System	Answer
Two cars leave town at the same time in the same direction. One travels 25 mph and the other 40 mph. How long until they are 75 miles apart?				
Two people leave on a trail at the same time in the same direction. One walks at 6 mph and the other at 9 mph. How long until they are 12 miles apart?				
Two cars leave town going in opposite directions at the same time. One travels at 25 mph and the other travels at 40 mph. When will they be 195 miles apart?				
Two people leave on a trail at the same time in opposite directions. One walks 6 mph and the other walks 9 mph. When will they be 15 miles apart?				
One car leaves town going 25 mph. Another car leaves in the same direction 3 hours later going 40 mph. How far from town will they meet?				

Motion Sort	Sketch	Table	System	Answer
One person leaves on a trail walking 6 mph. Another person leaves 1 hour later in the same direction walking 9 mph. How long until they meet on the trail?				
A boat travels for 4 hours with a 6 mph current to reach a campsite. The return trip takes 10 hours. Find the speed of the boat in still water.				
An airplane flies for 5 hours with a 25 mph tailwind. The return flight takes 10 hours. What is the distance of the trip one way?				
It takes a bike 2 hours more than a car to go from home to school. The bike goes 10 mph, and the car goes 15 mph. How far is it from home to school?				
It takes a bike 4 more hours than a car to go from school to the park. The bike goes 12 mph and the car goes 24 mph. How far is it from school to the park?				