

## #1 Automobile Problems (answer key at end)

1. A car is traveling at 60 mph and is tailgating another car at distance of only 30 ft. If the reaction time of the tailgater is 0.5 seconds (time between seeing the brake lights of the car ahead flash and hitting the brake), how far will his car travel during his reaction time?

2. Suppose a 2009 Mustang can accelerate from a stop to 100 mph in 15 seconds. Let us assume that the acceleration was at a constant rate (This would mean that the average speed during the time traveled was 50 mph.) Would the Mustang have traveled the quarter mile in this time? (1 mile = 5280 ft.)

3. The new VW Jetta TDI diesel has an EPA highway rating of 41 mpg. You plan to make a summer trip from Green Bay, Wisconsin to Los Angeles, a distance of 2172 miles.

a) Since this will be mostly highway driving, how many gallons of diesel will you need for the whole trip, there and back?

b) If diesel costs an average of \$2.25 a gallon, what will be the total fuel cost of the whole trip?

c) Instead of taking the VW, you think it might be cheaper to drive a Honda Civic to LA since gasoline is cheaper and costs only \$2.10 a gallon. However the Honda gets lower gas mileage at 34 mpg. How much would it cost for fuel for the whole trip if you took the Honda?

d) Which car is more economical? What is the savings in fuel costs using this car?

4. You take a 1200 mile trip to Saskatoon, Saskatchewan, Canada for the big annual powwow.

- a) How much time will you save on the 1200 mile trip if and you average 60 mph compared to averaging 50 mph.
- b) If your car gets 25 mpg at 60 mph but increases to 30 mpg at 50 mph, how many gallons of gas would you save on the 1200 mile trip at the lower speed? If gas costs \$2.10 a gallon, how much money do you save?
- c) Is the saving in time at 60 mph worth the extra cost?

5. Your friend leaves for the powwow 2 hours earlier than you do.

- a) If your friend is averaging 50 mph and you are trying to catch him by averaging 60 mph, how many hours will it take for you to catch him?
- b) How far will you each have traveled when you catch up to your friend?

6. After leaving for the powwow in Saskatoon, 1200 miles away, you discover that another friend of yours who lives in Saskatoon is coming to visit you in Wisconsin on his way to Florida. It is too late to turn back so you phone your friend and you agree to meet along the way. You and your friend from Saskatoon have both left home at the same time. Your friend is only averaging 40 mph while you are cruising along at an average speed of 60 mph.

- a) How many hours after leaving home will you meet?
- b) How far from home will each of you be?

### **#1 Automobile Problems Answer Key**

1. A car is traveling at 60 mph and is tailgating another car at distance of only 30 ft. If the reaction time of the tailgater is 0.5 seconds (time between seeing the brake lights of the car ahead flash and hitting the brake), how far will his car travel during his reaction time?

We will need to convert the 60 miles per hour to feet per second.

Since there are 5280 ft. in 1 mile, 60 miles would be  $60 \times 5280 \text{ ft.} = 316800 \text{ ft.}$

So the car travels 316800 ft in 1 hour.

There are 60 minutes in one hour and 60 seconds in 1 minute.

So 1 hour = 60 minutes, and 60 minutes =  $60 \times 60 \text{ seconds} = 3600 \text{ seconds.}$

So the car is traveling 316800 ft in 3600 seconds.

To find the number of ft per sec, we can divide 316800 ft by 3600 sec.

$316800 \text{ ft} \div 3600 \text{ sec} = 88 \text{ ft. per sec.}$

So at 60 mph he is traveling 88 ft. per second.

Since the reaction time of the tailgater is .5 sec or half a second, he will travel  $88 \text{ ft.} \times \frac{1}{2} = 44 \text{ ft.}$  between the time he first sees the brake lights come on and when he applies the brake.

Since he is following at a distance of only 30 ft., he will hit the car ahead of him before he can start to brake.

2. Suppose a 2009 Mustang can accelerate from a stop to 100 mph in 15 seconds. Let us assume that the acceleration was at a constant rate (This would mean that the average speed during the time traveled was 50 mph.) Would the Mustang have traveled the quarter mile in this time? (1 mile = 5280 ft.)

In the previous question, we determined that 60 mph is the same as 88 ft per second.

So, 50 mph would be  $\frac{50}{60}$  of 88 ft. per sec.

$\frac{50}{60}$  of 88 can be found by multiplying  $\frac{50}{60}$  or  $\frac{5}{6} \times 88$ .

$$\frac{5}{6} \times 88 = 73 \frac{1}{3} \text{ or } 73.33$$

So the car is traveling an average speed of  $73 \frac{1}{3}$  ft per sec for 15 second.

So the total distance covered in 15 seconds would be

$$73 \frac{1}{3} \times 15 = (73 \times 15) + (\frac{1}{3} \times 15) = 1095 + 5 = 1100 \text{ ft}$$

A quarter mile is

$$5280 \text{ ft} \div 4 = 1320 \text{ ft}$$

So the Mustang did not travel the quarter mile in 15 seconds.

3. The new VW Jetta TDI diesel has an EPA highway rating of 41 mpg. You plan to make a summer trip from Green Bay, Wisconsin to Los Angeles, a distance of 2172 miles.

a) Since this will be mostly highway driving, how many gallons of diesel will you need for the whole trip, there and back?

The total distance there and back will be  $2 \times 2172$  miles which is 4344 miles.

At 41 mpg, the VW will need  $(4344 \div 41)$  gallons of diesel.

$4344 \div 41 = 105.95$  gallons approximately.

b) If diesel costs an average of \$2.25 a gallon, what will be the total fuel cost of the whole trip?

Rounding the answer in a) to 106 gallons, the cost would be

$106 \times \$2.25 = \$238.50$

c) Instead of taking the VW, you think it might be cheaper to drive a Honda Civic to LA since gasoline is cheaper and costs only \$2.10 a gallon. However the Honda gets lower gas mileage at 34 mpg. How much would it cost for fuel for the whole trip if you took the Honda?

$4344 \text{ miles} \div 34 \text{ mpg} = 127.76$  gallons approximately.

Round this to 128 gallons.

So the cost would be  $128 \times \$2.10 = \$268.80$

d) Which car is more economical? What is the savings in fuel costs using this car?

The VW is more economical.

You save  $(\$268.80 - 238.50) = \$30.30$  with the VW.

4. You take a 1200 mile trip to Saskatoon, Saskatchewan, Canada for the big annual powwow.

a) How much time will you save on the 1200 mile trip if and you average 60 mph compared to averaging 50 mph.

At 60 mph the trip will take  $(1200 \div 60)$  hours.

$$1200 \div 60 = 20 \text{ hours.}$$

At 50 mph the trip will take  $(1200 \div 50)$  hours.

$$1200 \div 50 = 24 \text{ hours.}$$

So the time saved at 60 mph is  $(24 - 20)$  hours.

$$24 - 20 = 4 \text{ hours. So at 60 mph you saved 4 hours compared to traveling at 50 mph.}$$

b) If your car gets 25 mpg at 60 mph but increases to 30 mpg at 50 mph, how many gallons of gas would you save on the 1200 mile trip at the lower speed? If gas costs \$2.10 a gallon, how much money do you save?

At 25 mpg you would need  $(1200 \div 25)$  gallons of gas.

$$1200 \div 25 = 48 \text{ gallons.}$$

At 30 mpg you would need  $(1200 \div 30)$  gallons of gas.

$$1200 \div 30 = 40 \text{ gallons.}$$

So you would save  $(48 - 40)$  gallons = 8 gallons.

$$\text{If gas costs } \$2.10 \text{ a gallons, you would save } (8 \times \$2.10) = \$16.80$$

c) Is the saving in time at 60 mph worth the extra cost?

It depends how you look at it. You are saving \$16.80 at the slower speed but it is taking you 4 hours longer to make the trip. Any reasonable answer is acceptable.

5. Your friend leaves for the powwow 2 hours earlier than you do.

a) If your friend is averaging 50 mph and you are trying to catch him by averaging 60 mph, how many hours will it take for you to catch him?

There are many ways to do this but a table or diagram would be useful. Here is a table that shows when they have traveled the same distance hence when they meet.

Time (hours) after friend leaves	1	2	3	4	5	6	7	8	9	10	11	12
Distance (miles) traveled by friend	50	100	150	200	250	300	350	400	450	500	550	600
Distance (miles) you traveled	0	0	60	120	180	240	300	360	420	480	540	600

After 12 hours you have both traveled 600 miles and this is when you catch up with your friend.

b) How far will you each have traveled when you catch up to your friend?

As already stated, you will both have traveled 600 miles.

\* Note: This problem could be done with an equation but it is better for students to first work it with a table or diagram to ensure they understand the problem and its solution.

With an equation, if you let  $x$  = the time your friend traveled, then  $x - 2$  would be the time you traveled and the equation would be

$$50x = 60(x - 2)$$

6. After leaving for the powwow in Saskatoon, 1200 miles away, you discover that another friend of yours who lives in Saskatoon is coming to visit you in Wisconsin on his way to Florida. It is too late to turn back so you phone your friend and you agree to meet along the way. You and your friend from Saskatoon have both left home at the same time. Your friend is only averaging 40 mph while you are cruising along at an average speed of 60 mph.

a) How many hours after leaving home will you meet?

This time the cars are traveling towards each other. They are starting out 1200 miles apart. A diagram showing the cars approaching each other would be helpful.

After 1 hour.



After 2 hours



Continuing like this, they would meet after their combined distance is 1200 miles.

We can see that their combined distance per hour is 100 miles.

So to cover a combined distance of 1200 miles would take  $(1200 \div 100)$  hours.

$$1200 \div 100 = 12$$

So they meet after 12 hours

b) How far from home will each of you be?

Since your friend traveled at 40 mph, he will be  $(40 \times 12)$  miles from home.

$$40 \times 12 = 480 \text{ miles.}$$

Since you traveled at 60 mph, you will be  $60 \times 12$  miles from home.

$$60 \times 12 = 720 \text{ miles.}$$

$480 + 720 = 1200$  miles, which is the combined distance so this checks out.

