

## Electric Vehicle Design Exercise Question

I received the following advertisement from Tesla Motors on 9<sup>th</sup> of June 2016. Answer the following questions according to the information given in this advertisement.



Today we're excited to reintroduce the Model S 60. Starting at \$58,500 (after incentives) or \$667 a month (details [here](#)), the Model S 60 delivers 210 miles (EPA est.) of range, a top speed of 130 mph and zero-to-60 acceleration in 5.5 seconds.

With all-wheel drive, the Model S 60D provides more range (218 miles EPA est.) and faster acceleration (zero-to-60 in 5.2 seconds).

Like all Tesla vehicles, the 60 and 60D come standard with active safety features and Autopilot hardware. And both versions can later be upgraded through a software update to 75 kWh for about 20% extra range.

### Drive



Anyone who buys a 60 or any other new Model S or Model X between now and July 15 through the Tesla Referral Program gets a \$1,000 credit towards the purchase. Just get the special personal code of any Tesla owner and enter it at the time of purchase.

60	75	90D	P90D
60 kWh Battery Rear Wheel Drive	75 kWh Battery Rear Wheel Drive	90 kWh Battery All-Wheel Drive	90 kWh Performance All-Wheel Drive
210 miles range (EPA est.)	249 miles range (EPA)	294 miles range (EPA)	270 miles range (EPA)
130 mph top speed	140 mph top speed	155 mph top speed	155 mph top speed
5.5 sec. 0-60 mph	5.5 sec. 0-60 mph	4.2 sec. 0-60 mph	3.1 sec. 0-60 mph 2.8 sec. with Ludicrous Speed Upgrade

1. It was necessary to give an explanation in parentheses after range information 210 miles and 218 miles. What does this information mean? Are there other similar definitions? Give one more example.

2. Are the given range values realistic for our daily trips? Explain your reasoning considering daily driving cycles and extra loads.
  
3. Assume that the same electric machine and inverter as well as same battery cells are implemented in all Tesla Model S versions. However, the maximum speed of the car increases with the battery energy capacity, such as 130mph with 60 kWh and 140 mph with 75 kWh. Which battery characteristic influences the maximum speed? Write the power equation at the maximum speed limit on a flat road.
  
4. Why can all-wheel drive have a faster acceleration? Explain in one sentence. Calculate the average acceleration from 0 to 60 mph (96.56 km/h) for all-wheel drive version that is Model S 60D.
  
5. State the most important reason of getting a longer range with all-wheel drive for a given battery energy capacity.
  
6. The email indicates that 75 kWh of battery result in about 20% more range than 60 kWh battery. The battery energy capacity is increased by 25 %, but range increases only be 20 %. Why does range not increase with the same ratio with the battery energy capacity? Explain in one sentence