

Question 1

Refer to the graph below. Explain (briefly) what is happening to the EV at Zone A, B, C, and D. (25 marks)

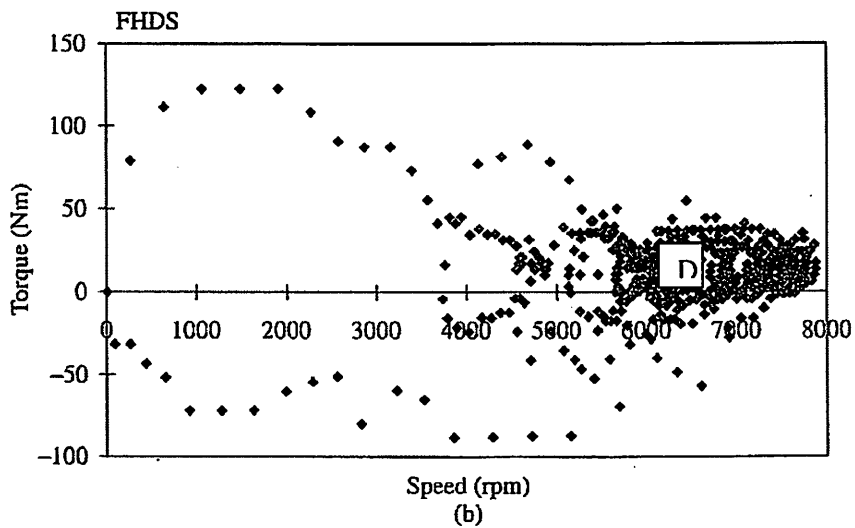
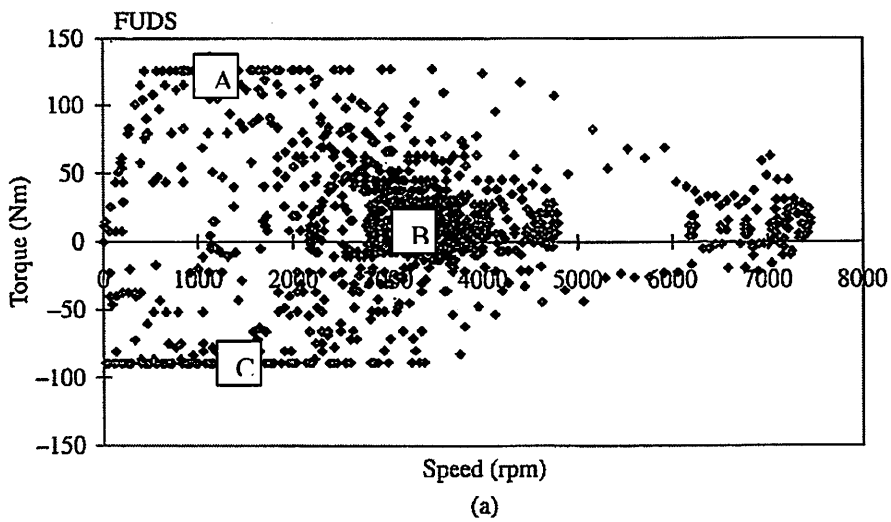
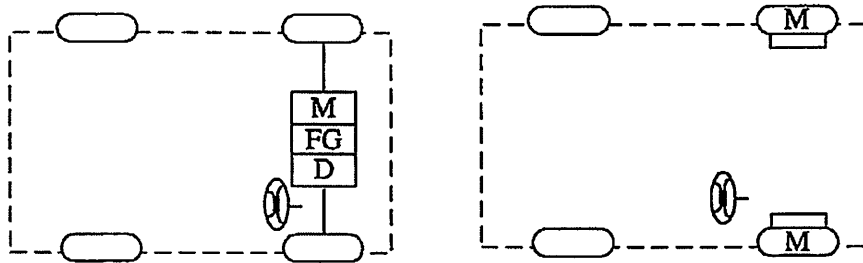


Fig. 1.7. Torque-speed requirements of typical driving cycles.

Question 2

Compare the two configurations, and give THREE major differences between these two configurations. For each difference, comment on the advantages and disadvantages comparison. (25 marks)



Question 3

Draw the structure block diagram of a parallel hybrid car and a serial hybrid car. Give THREE major differences between these two configurations. For each difference, comment on the advantages and disadvantages comparison. (25 marks)

Question 4

By referring to the characteristics of the following types of electric motor, give 2 advantages and 2 disadvantages for application in EV (for each type of motor). (25 marks)

- (i) Brushless DC motor
- (ii) Induction motor
- (iii) Switched reluctance motor

Question 1

- A: Accelerating or driving uphill at low speed, in urban condition
- B: Cruising at low speed, on level ground, in urban condition
- C: Braking to low speed, or to stop, in urban condition
- D: Cruising at high speed, in highway condition

Question 2

1. Difference #1: with or without the different gear

Without differential gear, the mechanics is simpler, and the drive is more efficient. However it is less safe, needs one more motor, and needs wheels synchronization.

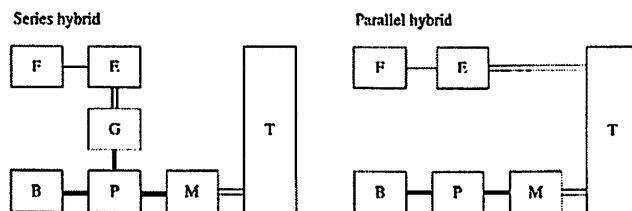
2. Difference #2: motor is “direct drive” or “with reduction gear”

For direct drive, the mechanics is simpler. However, the motor size needs to be much bigger for the same torque output.

3. Difference #3: motor is attached to the wheel or to the car chassis

When the motor is attached to the wheel, the suspension design and the mechanical linkage is simpler. The customer can change the wheel to change the power output of the car. However, the motor needs to be more reliable, as it is subject to dust, water, shock and vibration.

Question 3



Difference #1: Electric motor is fully responsible for the output drive in series hybrid, whereas both the ICE and the electric motor together drive the car in parallel hybrid.

Difference #2: The ICE engine of a series hybrid runs at one single speed high speed with no gear change, whereas the parallel hybrid's ICE needs to run at large speed range and need gear change.

Difference #3: With the Plug-in version: Series hybrid can work as full power pure electric vehicle, parallel hybrid cannot.\

Question 4

- (i) Advantages: high power to size ratio, high efficiency
Disadvantages: Costly permanent magnet, complicated drive with sensors
- (ii) Advantages: Low cost, No magnets
Disadvantages: Complicated drive, lower power to size ratio
- (iii) Advantages: Rugged and reliable, simple construction
Disadvantages: No standard driving technique, nonlinear characteristics