

Brake Design & Safety --- Workshop # 1/2011
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1. The optimum braking forces of a vehicle for straight-line level braking are a function of which of the following parameters:
 - a. Vehicle weight
 - b. Wheel base
 - c. Front disc brake factor
 - d. Center-of-gravity height
 - e. Tire radius
 - f. Static rear axle load

2. For the braking forces diagram provided (see figure 1 below), read off the following data:
 - a. Critical deceleration
 - b. Installed brake force distribution.
 - c. For a tire-road friction coefficient of 0.4, at what deceleration does the front brake lock up.
 - d. For a tire-road friction coefficient of 0.7, what deceleration can the parking brake (rear axle) achieve?
 - e. What would the brake force distribution be for a critical deceleration of 0.3g?

3. Loss of directional stability due to pre-mature rear brake lockup is caused by which of the following factors?
 - a. Front brakes produce greater braking forces which cause the rear of the car to spin around.
 - b. Rear tires when locked have no side force, and hence, can not keep the car from spinning.
 - c. The front tires when rolling while braking produce a side force which causes the car to rotate.
 - d. The center-of-gravity is closer to the front axle than the rear.

4. Consider a single maximum effectiveness ABS stop on a dry road. For a rear drum brake, which of the following parameters has the most effect in reducing swept surface temperature?
 - a. Density of drum material
 - b. Convective heat transfer coefficient
 - c. Width of drum swept surface
 - d. Drum/lining friction coefficient

5. During continued slow speed down hill braking, which of the following parameters affect brake drum temperature the most?
 - a. Convective heat transfer coefficient
 - b. Drum cooling area
 - c. Braking time
 - d. Drum material

6. When designing a hydraulic braking system, the size of the master cylinder cross-sectional area is primarily a function of which of the following?
 - a. Single circuit failure
 - b. Disc versus drum design
 - c. Booster failure
 - d. Pedal travel available
 - e. Ratio of tire radius versus effective rotor radius

7. Consider the following vehicle data: Weight 3000 lb (13,350 N), static rear axle load 1800 lb (8,010 N), wheelbase 100 in (245 cm), center-of-gravity height 23 in. (58.4 cm), and dual hydraulic split front-to-rear.
 - a. Compute the optimum braking forces for a deceleration of 0.7g.
 - b. For a critical deceleration of 0.9g, determine the fixed brake force distribution.
 - c. Calculate the braking efficiency for a tire road friction coefficient of 0.6.
 - d. Calculate the maximum wheels-unlocked deceleration for a road friction coefficient of 0.6.
 - e. Calculate the maximum deceleration with the rear brakes locked due to parking brake application.
 - f. You are asked to design a proportioning valve (or brake line pressure reducing valve) for this vehicle. What base line brake force distribution should you use?
 - g. The actually produced normalized rear brake force must always below what value?

8. Using the data of #7, use MARC 1 Module V to design a braking system. Choose reasonable brake system data to accomplish a critical deceleration of 0.9g and a pedal force of less than 100 lb for a deceleration of 1g.

Figure 1 (use this data to answer question #2 above)

