1. _____F____ The mass factor used to determine acceleration is assumed to be 1.04.

2. _____T_____ If the normal weight of the centripetal force is taken into consideration in highway design, curve radii will always be shorter than the current design practices which ignore this component of centripetal force.

3. _____T_____ If the lane width is equal to 12ft., the correction factor for lane width is zero.

4. _____T_____ The assumption of Poisson distribution of arrivals and departures is not correct under heavy congested traffic.

5. _____T____ On a two lane undivided highway, with 12 ft lanes, R will be 6ft longer than Rv.

6. _____F____ A curve with $G_1 = -3.7\%$ and $G_2 = +3.7\%$ will have its highest point at exactly L/2 from the curve’s PVC.

7. _____T_____ In D/D/1, the horizontal distance on the classic cumulative vehicle-time diagram, gives the delay (wait time) of the vehicle.

8. _____F____ In basic traffic-flow models, the speed flow relationship is assumed to be linear.

9. _____T_____ The speed at jam density is zero.

10. _____T____ In calculating stopping sight distance, Braking Reaction distance is sometimes less than the distance traveled during perception/reaction time.
**Problem 1**

An eight lane urban freeway (four lanes in each direction) is on rolling terrain and has 11-ft lanes with a 4-ft right-side shoulder. The interchange density is 1.25 per mile. The base free-flow speed is 70 mi/hr. The directional peak-hour traffic volume is 5400 vehicles with 6% large trucks and 5% buses (no recreational vehicles). The traffic stream consists of regular users and the peak hour factor is 0.95. It has been decided that large trucks will be banned from the freeway during the peak hour. What will the freeway’s density and level of service be before and after the ban? (Assume that the trucks are removed and all other traffic attributes are unchanged)

**Problem 2**

A freeway with two northbound lanes is shut down because of an accident. At the time of the accident, the flow rate is 1200 vehicles per hour per lane and the flow remain at this level. The capacity of this freeway is 2200 vehicles per hour per lane when not impacted by an accident. The freeway is completely shut down for 20 minutes after the accident and then one lane is open for 20 minutes and finally both the lanes are opened (40 minutes after the accident). What is the average delay per vehicle resulting from the accident (assuming D/D/1 queuing)? Draw a sketch to of vehicles with time to show the traffic flow analysis.

**Problem 3**

A horizontal curve on a two lane highway (10 ft lanes) is designed for 50 mi/hr with a 6% superelevation. The central angle of the curve is 35 degrees and the PI at the station is 482+72. What is the station of the PT and how many feet have to be cleared from the lane’s shoulder edge to provide adequate sight distance?
Problem 1.

\[ P_T = 0.06 \quad P_B = 0.05 \quad \text{(given)} \]

\[ P_{TB} = P_T + P_B \quad P_{TB} = 0.11 \]

\[ E_{TB} = 2.5 \quad \text{(Table 6.7)} \]

\[ f_{HVTB} = \frac{1}{1 + P_{TB}(E_{TB} - 1)} \quad f_{HVTB} = 0.858 \quad \text{(Eq. 6.5)} \]

\[ PHF = 0.95 \quad f_p = 1.0 \quad N_{AV} = 4 \quad V_{AV} = 5400 \quad \text{(given)} \]

\[ V_p = \frac{V}{PHF f_{HVTB} f_p N} \quad V_p = 1655.526 \quad \text{(Eq. 6.3)} \]

\[ BFFS = 70 \quad \text{(given)} \]

\[ f_{LW} = 1.9 \quad \text{(Table 6.3)} \]

\[ f_{LC} = 0.4 \quad \text{(Table 6.4)} \]

\[ f_L = 1.5 \quad \text{(Table 6.5)} \]

\[ f_D = 3.7 \quad \text{(Table 6.6)} \]

\[ FFS = BFFS - f_{LW} - f_{LC} - f_L - f_D \quad FFS = 62.5 \quad \text{(Eq. 6.2)} \]

\[ S_{AV} = 62.5 \quad \text{(Figure 6.2)} \]

\[ D = \frac{V_p}{S} \quad D = 26.5 \quad \text{pc/mi/ln} \quad \text{LOS D} \quad \text{(Eq. 6.6)} \]

After:

\[ V_{new} = V(1 - P_T) \quad V_{new} = 5076 \]

\[ \text{NumBuses} = V \cdot P_B \quad \text{NumBuses} = 270 \]
Problem 2.

\[
\begin{align*}
\lambda &= \frac{2400}{60} = 40 \text{ vpm} \quad \text{MaxLine} = \frac{2200}{60} = 36.67 \text{ vpm} \\
\mu_{\text{two lane}} &= \frac{4400}{60} = 73.33 \text{ vpm} \\
\text{After 20 min} \quad 40 \times 20 = 800 \text{ veh in queue} \\
\text{After 40 min} \quad 40 \times 40 = 1600 \text{ arrived} \\
&36.67 \times 20 = 733.4 \text{ departed} \quad \frac{866.6}{866.6} \text{ in queue} \\
\text{queue clears} \quad 866.6 + 40 \times t = 73.33 \times t \Rightarrow t = 26 \text{ min} \\
\text{Total vehs} \quad 66 \times 40 = 2640 \\
\text{Total delay} \quad \frac{20(800)}{2} + \frac{20(800+1600)}{2} - \frac{733.4(20)}{2} + \frac{866.6(26)}{2} \\
= 35936.71 \text{ veh-min /2640 veh} \\
= 13.61 \text{ min}
\end{align*}
\]
Problem 3

\[ R_v = 835 \quad \text{from Table 3.5} \quad \text{so} \quad R = 835 + \frac{10}{2} = 840 \]

\[ T = R \tan \frac{A}{2} = 840 \tan 17.5 = 264.85 \]

\[ \text{STA } PC = 480 + 72 - 2 + 64.85 = 480 + 07.15 \]

\[ L = \frac{\pi}{180} R \Delta = \frac{\pi}{180} (840)(35) = 512.87 \]

\[ \text{STA } PT = 480 + 07.15 + 5 + 12.87 = 485 + 20.02 \]

\[ \text{SSD} = 425' \quad \text{at} \quad 50 \text{m.p.h. \quad Table 3.1} \]

\[ \text{Eq } 3.42 \quad M_s = R_v \left( 1 - \cos \frac{90(\text{SSD})}{11R_v} \right) = 835 \left( 1 - \cos \frac{90(425)}{11(835)} \right) = 26.92 \]

**MUST CLEAR FROM INSIDE LANE \# 26.92 - 5 = 21.92'**