GRADING CONGESTION WORKSHEET

Part 1 – Data Collection

1. Form your track using the ropes, cones, or other materials so 2 to 3 individuals can walk beside one another.

2. Measure the length of your track from the middle of the lane

   Length = __________

3. Have a person walk leisurely through the track and time how long it takes him/her to complete 8 laps

   Time = ______________

4. Have the same person walk leisurely through the track again, but with an additional 7 people on the track walking in the same direction. Now time how long it takes him/her to complete 8 laps

   Time = ______________

Part 2 – Calculations based on 1 person on the track

5. Calculate the individual’s speed in feet per second and mph

   Distance Traveled = (# laps)*(Length)

   Length = ______________ (From step 2)

   # of Laps = 8 laps

   Distance Traveled = ______________

   Time = ______________ (From step 3)

   Speed = Distance / Time

   Speed = __________________

   Convert to mph:

   Speed = __________________
6. Calculate how fast that would be if you were a car.
   Speed = _________________________

7. Calculate density of the roadway assuming only 1 lane
   # of Persons on the Track = ______________
   Density = (# of Persons) / [(Distance)*(# of lanes)]
   Density = _____________________________

8. Let us see the density if you were a car
   Density = _____________________________

9. Use the density from step 8 and the Table 1 to find level of service (LOS)
   Density = ____________________________
   Which range does the density fall within? ______________
   LOS = _________________________

<table>
<thead>
<tr>
<th>Finding LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>F</td>
</tr>
</tbody>
</table>

10. Let us try finding LOS through flow and speed
    Flow = Density*Speed
    Density = _______________ (Find from step 8)
    Speed = ________________ (Find from step 6)
    Flow = _____________________________
11. Using the Figure 1, determine LOS

Flow = ___________________ (Find from step 10)
Speed = ___________________ (Find from step 6)

LOS = ___________________

12. Are the LOSs from steps 9 and 11 the same? ___________

LOS = ________ (From step 9)
LOS = ________ (From step 11)

Part 3 – Calculations based on 8 people on the track
13. Calculate the individual’s speed in feet per second and mph

\[ \text{Distance Traveled} = (# \text{ laps}) \times (\text{Length}) \]

\[ \text{Distance Traveled} = \] ________________________________

\[ \text{Time} = \] ___________ (From Step 4)

\[ \text{Speed} = \text{Distance} / \text{Time} \]

\[ \text{Speed} = \] ________________________________

Convert to mph

\[ \text{Speed} = \] ________________________________

14. Calculate how fast that would be if you were a car

\[ \text{Speed} = \] ________________________________

15. Calculate density of the roadway assuming only 1 lane

\[ \# \text{ of Persons on the Track} = \] ___________

\[ \text{Density} = (\# \text{ of Persons}) / \left[ (\text{Distance}) \times (\# \text{ of lanes}) \right] \]

\[ \text{Density} = \] ________________________________

16. Calculate density if you were a car

\[ \text{Density} = \] ________________________________

17. Use the density from step 16 and the Table 2 to find level of service (LOS)
Density = ________________

Which range does the density fall within? ________________

LOS = ________________

### Table 2: LOS Density Levels

<table>
<thead>
<tr>
<th>LOS</th>
<th>Max Density</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>11</td>
<td>0 - 11</td>
</tr>
<tr>
<td>B</td>
<td>18</td>
<td>11 - 18</td>
</tr>
<tr>
<td>C</td>
<td>26</td>
<td>18 - 26</td>
</tr>
<tr>
<td>D</td>
<td>35</td>
<td>26 - 35</td>
</tr>
<tr>
<td>E</td>
<td>45</td>
<td>35 - 45</td>
</tr>
<tr>
<td>F</td>
<td>&gt;45</td>
<td>&gt;45</td>
</tr>
</tbody>
</table>

18. Let us try finding LOS through flow and speed

Flow = Density*Speed

Density = ________________  (Find from step 16)
Speed = ________________   (Find from step 14)

Flow = __________________________

19. Using the Figure 2, determine LOS

Flow = ________________  (Find from step 18)
Speed = ________________ (Find from step 14)

LOS = ________________
20. Are the LOSs from steps 17 and 19 the same? 

LOS = ________  (From step 17)
LOS = ________  (From step 19)

21. Are the LOSs from Part 2 and Part 3 Different? 

LOS = ________  (From part 2)
LOS = ________  (From part 3)

22. If they are different, why? Incorporate discussion on times, speeds, and densities.
23. What have you learned from this activity and how can it be useful?

24. Draw a picture of your congested roadway (track and students on the track).

25. Engineering Design Problem: Currently there is a 2 mile segment of a 6 lane divided highway (3 lanes in each direction) where the posted speed limit is 55 mph. Local residents are complaining about a proposed new residential development off the highway will increase congestion. They have asked you, the county engineer, to stop the project by analyzing the situation and recommend the development not to be constructed. You have performed a site visit and recorded the number of vehicles in the busiest direction during a 60 minute period, 66 vehicles, and you noted the vehicles were traveling at the speed limit, 55 mph. Through analysis, the combined existing and new traffic levels will produce a flow of 800 pc/h/ln with an average speed of 50 mph. Use the knowledge you obtained through this activity and lesson to solve the problem. (Hint: Determine the current LOS and how it will change with the new development.)
Existing Conditions:

\[ Speed = \] 
\[ Density = \frac{\text{# of vehicles}}{(\text{lane})(\text{mile})} = \] 
\[ LOS = \]

Proposed Conditions:

\[ Speed = \] 
\[ Flow = \] 
\[ Density = \frac{\text{Flow}}{\text{Speed}} = \] 
\[ LOS = \]

From your calculations, the current level of service of the roadway is _________.

The proposed development would drop that to a _____________.

Would you recommend allowing the development to proceed? Why or why not?