Questions to a Traffic Engineer – ITE Yellow Change Interval Formula

A driver is approaching the intersection at the speed limit and the light turns yellow . . .

Regarding the ITE formula that sets the duration of yellow lights:

$$Y = t_p + \frac{1}{2}\left[\frac{v}{a + Gg}\right]$$

Question 1.

Using the ITE formula, how long is the yellow light?

A. 50% of the time it takes a driver to stop
B. 100% of the time it takes a driver to stop
C. 150% of the time it takes a driver to stop

Question 2.

What kinds of traffic movement does the ITE formula apply thereby giving sufficient yellow time? (For other movements, the ITE formula computes too short of a yellow time.)

A. Turning traffic
B. Traffic moving toward and straight through the intersection
C. Unimpeded traffic approaching straight toward and going through an intersection at the constant speed of the speed limit, where the driver knows the exact location of the critical distance (The critical distance is the closest point upstream from the intersection where the driver can still react and stop comfortably.)
D. Traffic performing avoidance maneuvers
E. Commercial vehicle movements

Question 3.

The moment the driver no longer has the distance to comfortably stop, at what speed must he maintain in order to reach the stop bar (limit line) before the light turns red?

A. He must continue at the speed limit.
B. He can go faster than the speed limit (beat the light).
C. He can be cautious and go less than the speed limit.
D. He can decelerate (for example—to prepare to turn) into the intersection.

Question 4. To give the legally moving driver the distance to stop, what must be the minimum value for "v" for any traffic lane?

A. The speed limit
B. Half the speed limit
C. The approach speed
D. It does not matter. The yellow only needs to be the MUTCD 3.0 second minimum.

Question 5. Where is "v" supposed to be measured?

A. At the stop bar
B. At the critical distance upstream from the intersection. The critical distance is also known as the safe and comfortably stopping distance, or the point of no return.
C. 600 feet upstream from the intersection
D. Depends on the traffic lane

Question 6. Where is "G", the grade of the road, supposed to be measured?

A. At the stop bar
B. At the critical distance
C. At the midpoint between the stop bar and the critical distance
D. It is the average grade of road through the critical distance.
E. 600 feet upstream from the intersection

Question 7. There is a "2" in the ITE formula. Where does the "2" come from?

The "2" comes from physics' stopping distance equation (eq. 3-16): distance = $v^2/\mathbf{2}a$. Where v is the velocity of the car at this distance where it starts decelerating at rate "a".

The critical distance is the comfortable stopping distance + the distance a driver travels during the perception/reaction time.

Question 8. A driver approaches the intersection. The light turns yellow. What does the physics of the ITE formula require the driver to do?

If the driver is farther from the intersection than the critical distance, then the driver has the distance to stop. He must stop. If the driver is closer to the intersection than the critical distance, he must proceed at the speed limit "v" or more toward and into the intersection.

Time = distance/velocity. Dividing the critical distance by the constant speed "v" renders the ITE formula.

Question 9. True or False? "If we increase the length of the yellow light, drivers will treat the yellow as a green light, drivers will disrespect the yellow and/or drivers will crash more."

False. This is a rumor. None of these things have been shown to be true in 100 years. Not even once. While the engineer proclaims this to justify keeping a short yellow, there is no study, no paper, nothing ever supporting him. The rumor was officially discarded in 1959 (p. 131) in the same paper from which ITE drew its yellow light formula. The rumor was bunked again in 1961 by Olsen and Rothery's paper, *Driver Response to the Amber Phase of Traffic Signals*. The opposite of what the traffic engineer claims is true: There are dozens of studies containing millions of examples showing that when the yellow is lengthened, drivers are now able to obey the yellow resulting in permanent drastic reductions in red light running.

Question 10. Because perception/reaction time, deceleration and road grade have known statistical errors and ranges, so does the resulting computation of the yellow change interval. The error in the yellow change interval can be computed by the mathematic technique of error propagation—standard practice by engineers and physicists. What is the approximate *known engineering error* of the yellow change interval when properly using the ITE formula?

A. 0.0 seconds
B. 0.3 seconds
C. 3.0 seconds
D. 6.0 seconds

Ask the police what amount of seconds they use for the red light camera *grace period*. (The grace period is also called the *delay*.) If you run the red light within the grace period, the camera will not trigger. You will not get a ticket.

But the police usually set the time to 0.3 second or less. The police unknowingly punish drivers for engineering error. You will find that traffic engineers, unlike other engineers, do not understand the principle of error propagation and tolerances. Traffic engineers believe drivers should be punished with 0 tolerance--an oxymoron in any branch of engineering.

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The answers to these questions are explained primarily in two papers:

The Derivation of the Yellow Change Interval Formula
The Uncertainty in the Yellow Change Interval

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