

Conversion Factors and Unique Formulae Associated With the Transportation Professional Certification Board's Certification Examinations

Soft Conversion Factors

Metric	English	English	Metric
1 meter (m)	3.28 feet (ft)	1 foot (ft)	0.305 meters (m)
1 kilometer (km)	0.62 miles	1 mile (5,280 ft)	1.609 kilometers (km)
1 km/hour	0.62 mph	1 mph	1.609 km/hour
1 kilogram (kg)	2.20 pounds (lb)	1 pound (lb)	0.454 kilograms(kg)

Hard Conversion Factors

Lane Width		Shoulder Width/Clearance	
Metric (m)	English (ft)	Metric (m)	English (ft)
3.6 meters (m)	12 feet (ft)	3.0 meters (m)	10 feet (ft)
3.3 meters (m)	11 feet (ft)	2.4 meters (m)	8 feet (ft)
3.0 meters (m)	10 feet (ft)	1.8 meters (m)	6 feet (ft)
2.7 meters (m)	9 feet (ft)	1.2 meters (m)	4 feet (ft)

English	Metric
$E_m = \lambda^2 / \mu(\mu - \lambda)$ <p>Where: E_m = average queue length (veh) λ = arrival rate (veh/min) μ = service rate (veh/min)</p>	
<p>If $S < L$, then $L = AS^2/2158$ If $S > L$, then $L = 2S - (2158/A)$</p> <p>Where: L = length of vertical curve (ft) A = algebraic difference in grades (%) $G_1 - G_2$ (absolute of $G_1 - G_2$ in %) S = sight distance (ft)</p>	<p>If $S < L$, then $L = AS^2/658$ If $S > L$, then $L = 2S - (658/A)$</p> <p>Where: L = length of vertical curve (m) A = algebraic difference in grades (%) $G_1 - G_2$ (absolute of $G_1 - G_2$ in %) S = sight distance (m)</p>
$d = 1.47 Vt + 1.075 V^2/a$ <p>Where: d = stopping distance (ft) V = initial speed (mph) t = brake reaction time, 2.5 s (s) a = deceleration rate (ft/s²)</p>	$d = 0.278 Vt + 0.039 V^2/a$ <p>Where: d = stopping distance (m) V = initial speed (km/h) t = brake reaction time, 2.5 s (s) a = deceleration rate (m/s²)</p>

English	Metric
<p>$P = F [1/(1 + i)^n]$</p> <p>Where: P = present worth of a future amount F = future amount i = interest rate n = service life</p>	
<p>$P = A [(1 + i)^n - 1] / [i(1 + i)^n]$</p> <p>Where: P = present worth of a series of future amounts A = annual amount i = interest rate n = service life</p>	
<p>Incremental benefit/cost ratio of project <i>j</i> over project <i>k</i> = $\frac{(\text{Benefits}_j - \text{Benefits}_k)}{(\text{Costs}_j - \text{Costs}_k)}$</p>	
<p>$Y \geq t + \frac{1.47(V_{85} - V_E)}{a + 32.2g} + \frac{1.47V_E}{2a + 64.4g}$</p> <p>Where: Y = minimum yellow change interval (sec.) t = perception-reaction time (sec.) V₈₅ = 85th percentile approach speed (mph) V_E = intersection entry speed (mph) a = deceleration (ft./sec./sec.) g = grade of approach (percent/100, downhill is negative grade)</p>	<p>$Y \geq t + \frac{0.28(V_{85} - V_E)}{a + 9.8g} + \frac{0.28V_E}{2a + 19.6g}$</p> <p>Where: Y = minimum yellow change interval (sec.) t = perception-reaction time (sec.) V₈₅ = 85th percentile approach speed (km/h) V_E = intersection entry speed (km/h) a = deceleration (m/sec./sec.) g = grade of approach (percent/100, downhill is negative grade)</p>
<p>$R = \left[\frac{W + L}{1.47V_E} \right] - t_s$</p> <p>Where: R = red clearance interval (sec.) W = distance to traverse the intersection (width) (ft.) V_E = intersection entry speed (mph) L = length of vehicle (ft.) t_s = conflicting vehicular movement start up delay (sec.)</p>	<p>$R = \left[\frac{W + L}{0.28V_E} \right] - t_s$</p> <p>Where: R = red clearance interval (sec.) W = distance to traverse the intersection (width), (m) V_E = intersection entry speed (km/h) L = length of vehicle (m) t_s = conflicting vehicular movement start up delay (sec.)</p>

English	Metric
$PF = f_p(1 - P)/(1 - (g/C))$ <p>Where: PF = progression factor f_p = supplemental adjustment factor P = proportion of vehicles arriving on green g = green time of phase(s) C = cycle length</p>	
$f = (V^2/15R) - e/100$ <p>Where: f = side friction factor V = speed (mph) R = curve radius (ft) e = rate of superelevation (%)</p>	$f = (V^2/127R) - e/100$ <p>Where: f = side friction factor V = speed (km/h) R = curve radius (m) e = rate of superelevation (%)</p>
$d = 1.47V(J + t_a)$ <p>Where: d = sight distance required (ft) V = approaching train velocity (mph) J = driver perception/reaction time (s) t_a = time to accelerate and clear (s)</p>	$d = 0.28V(J + t_a)$ <p>Where: d = sight distance required (m) V = approaching train velocity (km/h) J = driver perception/reaction time (s) t_a = time to accelerate and clear (s)</p>
$C_o = (1.5L + 5)/(1 - Y_1 - Y_2 - Y_3 - \dots Y_n)$ <p>Where: C_o = optimum cycle length(s) L = lost time/cycle(s) Y_n = critical volume/saturation flow rate by phase</p>	
$K = L/A$ <p>Where: K = a factor L = length of curve (ft) A = algebraic difference in grades (%) $G_1 - G_2$ (absolute of $G_1 - G_2$ in %)</p>	$K = L/A$ <p>Where: K = a factor L = length of curve (m) A = algebraic difference in grades (%) $G_1 - G_2$ (absolute of $G_1 - G_2$ in %)</p>

English	Metric
$U_s = dn/\Sigma t$ $U_t = \Sigma u/n$ $U_t = U_s + \sigma_s^2 / U_s$ <p>Where: U_s = average space-mean speed U_t = average time-mean speed σ_s^2 = variance of space-mean speeds d = distance traversed n = number of travel times observed t_i = travel time for the ith vehicle u_i = speed of the ith vehicle</p>	
$R_{sec} = A \times 10^8 / (365TVL)$ <p>Where: R_{sec} = crash rate for the road section per hundred million vehicle miles A = number of reported crashes T = time period of the crashes (years) V = annual average daily traffic volume L = length of the segment (miles)</p>	$R_{sec} = A \times 10^8 / (365TVL)$ <p>Where: R_{sec} = crash rate for the road section per hundred million vehicle kilometers A = number of reported crashes T = time period of the crashes (years) V = annual average daily traffic volume L = length of the segment (kilometers)</p>
$R_{spot} = A \times 10^6 / (365 TV)$ <p>Where: R_{spot} = crash rate for the spot per million vehicles A = number of reported crashes T = time period of the analysis (years) V = annual average daily traffic volume entering the spot (vehicles per day)</p>	
$d = \frac{v_i^2 - v_f^2}{2a}$ <p>Where: d = distance v_i = initial velocity (fps) v_f = final velocity (fps) a = acceleration rate (ft/sec²)</p>	$d = \frac{v_i^2 - v_f^2}{2a}$ <p>Where: d = distance v_i = initial velocity (mps) v_f = final velocity (mps) a = acceleration rate (m/sec²)</p>