APPENDICES

A - Table of Equations

Eq	US Units Speed	US Units Velocity	Metric Units Speed	Metric Units Velocity
	Speed Equations			
1	$S = \sqrt{30Df}$	$V = \sqrt{64.4Df}$	$S = 15.9\sqrt{Df}$	$V = 4.42\sqrt{Df}$
2	$S = \frac{D}{1.467t}$	$V = \frac{D}{t}$	$S = \frac{D}{0.278t}$	$V = \frac{D}{t}$
3	$S = 21.95f \times t$	$V = 32.2f \times t$	$S = 35.3f \times t$	$V = 9.81f \times t$
4	$S_f = S_o + 21.95f \times t$	$V_f = V_o + 32.2f \times t$	$S_f = S_o + 35.3f \times t$	$V_f = V_o + 9.81f \times t$
5	$S_f = \sqrt{S_o^2 + 30Df}$	$V_f = \sqrt{V_o^2 + 64.4f \times D}$	$S_f = \sqrt{S_o^2 + 254Df}$	$V_f = \sqrt{V_o^2 + 19.62f \times D}$
6	$S_o = S_f - 21.95f \times t$	$V_o = V_f - 32.2f \times t$	$S_o = S_f - 35.3f \times t$	$V_o = V_f - 9.81f \times t$
7	$S_o = \sqrt{S_f^2 - 30Df}$	$V_o = \sqrt{V_f^2 - 64.4Df}$	$S_o = \sqrt{S_f^2 - 254Df}$	$V_o = \sqrt{V_f^2 - 19.62Df}$
	Time Equations			
10	$t = \frac{D}{1.4667S}$	$t = \frac{D}{V}$	$t = \frac{D}{0.278S}$	$t = \frac{D}{V}$
11	$t = \frac{S}{21.95f}$	$t = \frac{V}{32.2f}$	$t = \frac{S}{35.3f}$	$t = \frac{V}{9.81f}$
12	$t = \frac{S_f - S_o}{21.95f}$	$t = \frac{V_f - V_o}{32.2f}$	$t = \frac{S_f - S_o}{35.3f}$	$t = \frac{V_f - V_o}{9.81f}$
13	$t = 0.249\sqrt{\frac{D}{f}}$	$t = 0.249\sqrt{\frac{D}{f}}$	$t = 0.45\sqrt{\frac{D}{f}}$	$t = 0.45\sqrt{\frac{D}{f}}$

	Distance Equations			
20	$D = \frac{S^2}{30f}$	$D = \frac{V^2}{64.4f}$	$D = \frac{S^2}{254f}$	$D = \frac{V^2}{19.62f}$
21	$D = 1.4667S \times t$	$D = V \times t$	$D = 0.278S \times t$	$D = V \times t$
22	$D = \frac{S_f^2 - S_o^2}{30f}$	$D = \frac{V_f^2 - V_o^2}{64.4f}$	$D = \frac{S_f^2 - S_o^2}{254f}$	$D = \frac{V_f^2 - V_o^2}{19.62f}$
23	$D = 1.4667S_o t + 16.1f \times t^2$	$D = V_o t + 16.1f \times t^2$	$D = 0.278S_o t + 4.9f \times t^2$	$D = V_o t + 4.9f \times t^2$

	Acceleration Factor Equations			
30	$f = \frac{S^2}{30D}$	$f = \frac{V^2}{64.4D}$	$f = \frac{S^2}{254D}$	$f = \frac{V^2}{19.62D}$
31	$f = \frac{S}{21.95t}$	$f = \frac{V}{32.2t}$	$f = \frac{S}{35.3t}$	$f = \frac{V}{9.81t}$
32	$f = \frac{S_f - S_o}{21.95t}$	$f = \frac{V_f - V_o}{32.2t}$	$f = \frac{S_f - S_o}{35.3t}$	$f = \frac{V_f - V_o}{9.81t}$
33	$f = \frac{S_f^2 - S_o^2}{30D}$	$f = \frac{V_f^2 - V_o^2}{64.4D}$	$f = \frac{S_f^2 - S_o^2}{254D}$	$f = \frac{V_f^2 - V_o^2}{19.62D}$
34	$f = \frac{D}{16.1t^2}$	$f = \frac{D}{16.1t^2}$	$f = \frac{D}{4.9t^2}$	$f = \frac{D}{4.9t^2}$
35	$f = \frac{D - 1.467S_o t}{16.1t^2}$	$f = \frac{D - V_o t}{16.1t^2}$	$f = \frac{D - 0.278S_o t}{4.9t^2}$	$f = \frac{D - V_o t}{4.9t^2}$
36	$f = \mu \times n + m$	$f = \mu \times n + m$	$f = \mu \times n + m$	$f = \mu \times n + m$
37	$f = \frac{F}{W}$	$f = \frac{F}{W}$	$f = \frac{F}{W}$	$f = \frac{F}{W}$

	Linear Momentum Equations	
40	$S_2 = \frac{W_1}{W_2}\frac{S_3 \sin\theta}{\sin\psi} + \frac{S_4 \sin\phi}{\sin\psi}$	$V_2 = \frac{W_1}{W_2}\frac{V_3 \sin\theta}{\sin\psi} + \frac{V_4 \sin\phi}{\sin\psi}$
	$S_1 = S_3 \cos\theta + \frac{W_2}{W_1}\left[S_4 \cos\phi - S_2 \cos\psi\right]$	$V_1 = V_3 \cos\theta + \frac{W_2}{W_1}\left[V_4 \cos\phi - V_2 \cos\psi\right]$
41	$S_1 = S_3 + \frac{W_2}{W_1}\left(S_4 - S_2\right)$	$V_1 = V_3 + \frac{W_2}{W_1}\left(V_4 - V_2\right)$
42	$S_1 = \frac{S_4\left(1 + \frac{W_2}{W_1}\right) + S_2\left(e - \frac{W_2}{W_1}\right)}{(1+e)}$	$V_1 = \frac{V_4\left(1 + \frac{W_2}{W_1}\right) + V_2\left(e - \frac{W_2}{W_1}\right)}{(1+e)}$
	$S_3 = S_1 - \frac{W_2}{W_1}\left(S_4 - S_2\right)$	$V_3 = V_1 - \frac{W_2}{W_1}\left(V_4 - V_2\right)$
43	$S_1 = S_4\left(1 + \frac{W_2}{W_1}\right) - S_2$	$V_1 = V_4\left(1 + \frac{W_2}{W_1}\right) - V_2$
44	$S_1 = \frac{S_4\left(1 + \frac{W_2}{W_1}\right) + S_2\left(1 - \frac{W_2}{W_1}\right)}{2}$	$V_1 = \frac{V_4\left(1 + \frac{W_2}{W_1}\right) + V_2\left(1 - \frac{W_2}{W_1}\right)}{2}$
	$S_3 = S_1 - \frac{W_2}{W_1}\left(S_4 - S_2\right)$	$V_3 = V_1 - \frac{W_2}{W_1}\left(V_4 - V_2\right)$

	Special Equations			
45	$h = R - \sqrt{R^2 - D^2}$	$h = R - \sqrt{R^2 - D^2}$	$h = R - \sqrt{R^2 - D^2}$	$h = R - \sqrt{R^2 - D^2}$
46	$R = \frac{C^2}{8m} + \frac{m}{2}$	$R = \frac{C^2}{8m} + \frac{m}{2}$	$R = \frac{C^2}{8m} + \frac{m}{2}$	$R = \frac{C^2}{8m} + \frac{m}{2}$
47	$S = \frac{3.86\sqrt{R(f+e)}}{\sqrt{1-f\times e}}$	$V = \frac{5.67\sqrt{R(f+e)}}{\sqrt{1-f\times e}}$	$S = \frac{11.27\sqrt{R(f+e)}}{\sqrt{1-f\times e}}$	$V = \frac{3.13\sqrt{R(f+e)}}{\sqrt{1-f\times e}}$
48	$S = \sqrt{S_o^2 + 30(D_1f_1 + D_2f_2 + D_3f_3)}$		$S = \sqrt{S_o^2 + 254.3(D_1f_1 + D_2f_2 + D_3f_3)}$	
		$V = \sqrt{V_o^2 + 64.4(D_1f_1 + D_2f_2 + D_3f_3)}$		$V = \sqrt{V_o^2 + 19.62(D_1f_1 + D_2f_2 + D_3f_3)}$
49	$S_f = \sqrt{S_0^2+S_1^2+S_2^2+S_3^2+S_4^2}$		$S_f = \sqrt{S_0^2+S_1^2+S_2^2+S_3^2+S_4^2}$	
		$V_f = \sqrt{V_0^2+V_1^2+V_2^2+V_3^2+V_4^2}$		$V_f = \sqrt{V_0^2+V_1^2+V_2^2+V_3^2+V_4^2}$

	Airborne Equations			
50	$S = \frac{2.73D}{\sqrt{-h}}$	$V = \frac{4.01D}{\sqrt{-h}}$	$S = \frac{7.97D}{\sqrt{-h}}$	$V = \frac{2.215D}{\sqrt{-h}}$
51	$S = \frac{2.73D}{\sqrt{Dm-h}}$	$V = \frac{4.01D}{\sqrt{Dm-h}}$	$S = \frac{7.97D}{\sqrt{Dm-h}}$	$V = \frac{2.215D}{\sqrt{Dm-h}}$
52	$S = \frac{2.73D}{\cos\theta\sqrt{D\tan\theta-h}}$	$V = \frac{4.01D}{\cos\theta\sqrt{D\tan\theta-h}}$	$S = \frac{7.97D}{\cos\theta\sqrt{D\tan\theta-h}}$	$V = \frac{2.215D}{\cos\theta\sqrt{D\tan\theta-h}}$

	Energy Equations			
60	$S = \sqrt{\frac{30KE}{W}}$	$V = \sqrt{\frac{64.4KE}{W}}$	$S = \sqrt{\frac{25.92KE}{W}}$	$V = \sqrt{\frac{2KE}{W}}$
61	$KE = \frac{WS^2}{30}$	$KE = \frac{WV^2}{64.4}$	$KE = \frac{WS^2}{25.92}$	$KE = \frac{WV^2}{2}$
62	$F = \frac{WS^2}{30D}$	$F = \frac{WV^2}{64.4D}$	$F = \frac{WS^2}{254D}$	$F = \frac{WV^2}{19.62D}$
63	$D = \frac{WS^2}{30F}$	$D = \frac{WV^2}{64.4F}$	$D = \frac{WS^2}{254F}$	$D = \frac{WV^2}{19.62F}$

	Motorcycle Equations			
70	$f_s = \frac{S^2}{15R}$	$f_s = \frac{V^2}{32.2R}$	$f_s = \frac{S^2}{127R}$	$f_s = \frac{V^2}{9.81R}$
71	$L_\phi = \tan^{-1}\frac{S^2}{15R}$	$L_\phi = \tan^{-1}\frac{V^2}{32.2R}$	$L_\phi = \tan^{-1}\frac{S^2}{127R}$	$L_\phi = \tan^{-1}\frac{V^2}{9.81R}$
72	$R = \frac{S^2}{15f_s}$	$R = \frac{V^2}{32.2f_s}$	$R = \frac{S^2}{127f_s}$	$R = \frac{S^2}{9.81f_s}$

	Animation Assist Equations			
80	$S_f = S_o + 21.95f(t-t_o)$	$V_f = V_o + 32.2f(t-t_o)$	$S_f = S_o + 35.3f(t-t_o)$	$V_f = V_o + 9.81f(t-t_o)$
81	$D = D_o + 1.467S_o(t-t_o) + 16.1f(t-t_o)^2$		$D = D_o + 0.278S_o(t-t_o) + 4.9f(t-t_o)^2$	
		$D = D_o + V_o(t-t_o) + 16.1f(t-t_o)^2$		$D = D_o + V_o(t-t_o) + 4.9f(t-t_o)^2$

Total Braking with Perception/Reaction Time Equations

90 $D_t = 1.467S_o t_r + \frac{S_f^2 - S_o^2}{30f}$ $D_t = V_o t_r + \frac{V_f^2 - V_o^2}{64.4f}$ $D_t = 0.278S_o t_r + \frac{S_f^2 - S_o^2}{254f}$ $D_t = V_o t_r + \frac{V_f^2 - V_o^2}{19.62f}$

91 $D_t = 1.467S_o(t_r + t) + 16.1ft^2$ $D_t = V_o(t_r + t) + 16.1ft^2$ $D_t = 0.278S_o(t_r + t) + 4.9ft^2$ $D_t = V_o(t_r + t) + 4.9ft^2$

92 $t_R = \frac{1}{1.467S_o}\left(D_t - \frac{S_f^2 - S_o^2}{30f}\right)$ $t_R = \frac{1}{V_o}\left(D_t - \frac{V_f^2 - V_o^2}{64.4f}\right)$ $t_R = \frac{1}{0.278S_o}\left(D_t - \frac{S_f^2 - S_o^2}{254f}\right)$ $t_R = \frac{1}{V_o}\left(D_t - \frac{V_f^2 - V_o^2}{19.62f}\right)$

93 $t_r = \left(\frac{D_t - 16.1ft^2}{1.467S_o}\right) - t$ $t_r = \left(\frac{D_t - 16.1ft^2}{V_o}\right) - t$ $t_r = \left(\frac{D_t - 4.9ft^2}{0.278S_o}\right) - t$ $t_r = \left(\frac{D_t - 4.9ft^2}{V_o}\right) - t$

94 $S_o = \frac{D_t - 16.1f \times t^2}{1.467(t_r + t)}$ $V_o = \frac{D_t - 16.1f \times t^2}{(t_r + t)}$ $S_o = \frac{D_t - 4.9f \times t^2}{0.278(t_r + t)}$ $V_o = \frac{D_t - 4.9f \times t^2}{(t_r + t)}$

95 $S_o = 21.95ft_R + \sqrt{(21.95ft_R)^2 + S_f^2 - 30fD_t}$ $S_o = 35.3ft_r + \sqrt{(35.3ft_r)^2 + S_f^2 - 254fD_t}$

$V_o = 32.2ft_r + \sqrt{(32.2ft_r)^2 + V_f^2 - 64.4fD_t}$ $V_o = 9.81ft_r + \sqrt{(9.81ft_r)^2 + V_f^2 - 19.62f}$

96 $f = \frac{S_f^2 - S_o^2}{30(D_t - 1.467S_o t_R)}$ $f = \frac{V_f^2 - V_o^2}{64.4(D_t - V_o t_R)}$ $f = \frac{S_f^2 - S_o^2}{254(D_t - 0.278S_o t_R)}$ $f = \frac{V_f^2 - V_o^2}{19.62(D_t - V_o t_R)}$

97 $f = \frac{D_t - 1.467S_o(t_R + t)}{16.1t^2}$ $f = \frac{D_t - V_o(t_R + t)}{16.1t^2}$ $f = \frac{D_t - 0.278S_o(t_R + t)}{4.9t^2}$ $f = \frac{D_t - V_o(t_R + t)}{4.9t^2}$

98 $t_T = t_R + \frac{S_f - S_o}{21.95f}$ $t_T = t_R + \frac{V_f - V_o}{32.2f}$ $t_T = t_R + \frac{S_f - S_o}{35.3f}$ $t_T = t_R + \frac{V_f - V_o}{9.81f}$

99 $t_T = t_R + 0.249\sqrt{\frac{D}{f}}$ $t_T = t_R + 0.249\sqrt{\frac{D}{f}}$ $t_T = t_R + 0.45\sqrt{\frac{D}{f}}$ $t_T = t_R + 0.45\sqrt{\frac{D}{f}}$