

### Rigid Body Trajectory During and Following a Vehicle Launch

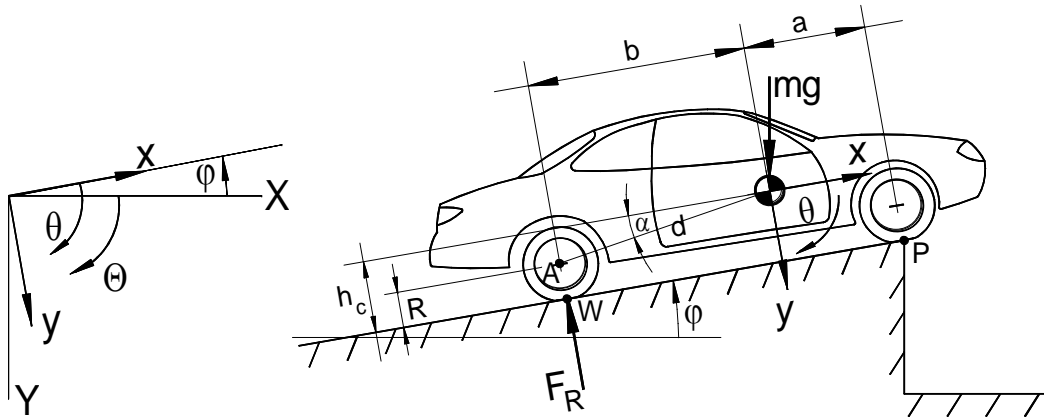
Wheelbase: $L = a + b$	8.83	ft
Weight	<b>3500.0</b>	lb
pitch $k_C$ (cg rad gyration)	<b>4.40</b>	ft
pitch $I$	2106.05	ft-lb-s <sup>2</sup>
$g$	32.17	ft/s <sup>2</sup>
grade, $\phi$	<b>10.00</b>	deg
grade, $\phi$	0.1745	rad
$V_{x_{init}}$	<b>62.14</b>	mph
$V_{x_{init}}$	91.13	ft/s
$V_{y_{init}}$	0.00	mph
$V_{y_{init}}$	0.00	ft/s
mass	108.78	lb-s <sup>2</sup> /ft

$V_{x_{init}}$	91.13	ft/s
$V_{y_{init}}$	0.00	ft/s
$V_{\theta_{init}}$	0.00	deg/s
$R$	<b>0.75</b>	ft
$h_c$	<b>1.75</b>	ft
$a$	<b>3.09</b>	ft
$b$	<b>5.74</b>	ft
$k_A$	7.30	ft
$C_1$	4.11	
$C_2$	4.11	
$C_3$	0.96	
$C_4$	0.96	

$y_{init}$	0.00	ft
$\theta_{init}$	0.00	deg
$d$	5.83	ft
$\alpha$	9.88	deg
$\eta_1$	1.09	
$\eta_2$	1.82	
$\beta_1$	1.38	
$\beta_2$	1.38	

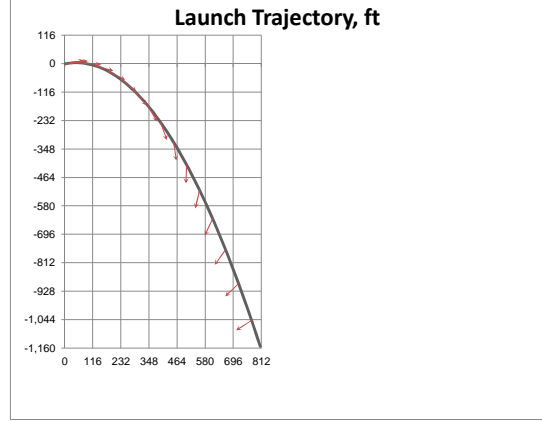
#### Calculation (output) Intervals

delt1 = $\Delta t_1$ , s	<b>0.010</b>	before launch
delt2 = $\Delta t_2$ , s	<b>0.100</b>	after launch



Rigid Body Trajectory

Launch Conditions						
Time	x - Vel	y - Vel	x	y	$\theta$	$\theta$ - Vel
[s]	[ft/s]	[ft/s]	[ft]	[ft]	[rad]	[rad/s]
0.097	90.59	1.85	8.83	0.09	0.02	0.32



Time	x - Vel	y - Vel	$\theta$ - Vel	$\theta$ - Vel	x	y	$\theta$	$\theta$	X	Y	$\Theta$	$\Theta$	X - Vel	Y - Vel	Kinetic Energy	Potential Energy	Total Energy
[s]	[ft/s]	[ft/s]	[rad/sec]	[deg/sec]	[ft]	[ft]	[rad]	[deg]	[ft]	[ft]	[deg]	[rad]	[ft/s]	[ft/s]	[ft-lb]	[ft-lb]	[ft-lb]
0.000	91.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-10.00	0.17	89.75	-15.83	4.52E+05	0.00E+00	4.52E+05
0.010	91.08	0.00	0.00	0.00	0.91	0.00	0.00	0.00	0.90	0.16	-10.00	0.17	89.69	-15.82	4.51E+05	-5.54E+02	4.51E+05
0.020	91.02	0.19	0.03	1.89	1.82	0.00	0.00	0.01	1.79	0.32	-9.99	0.17	89.67	-15.82	4.51E+05	-1.10E+03	4.50E+05
0.030	90.97	0.38	0.07	3.79	2.73	0.00	0.00	0.04	2.69	0.47	-9.96	0.17	89.65	-15.42	4.50E+05	-1.65E+03	4.48E+05
0.040	90.91	0.57	0.10	5.69	3.64	0.01	0.00	0.09	3.59	0.62	-9.91	0.17	89.63	-15.23	4.50E+05	-2.18E+03	4.47E+05
0.050	90.86	0.76	0.13	7.58	4.55	0.02	0.00	0.15	4.48	0.78	-9.85	0.17	89.61	-15.03	4.49E+05	-2.71E+03	4.46E+05
0.060	90.80	0.95	0.17	9.48	5.46	0.02	0.00	0.24	5.38	0.92	-9.76	0.17	89.58	-14.83	4.49E+05	-3.24E+03	4.45E+05
0.070	90.74	1.14	0.20	11.38	6.37	0.03	0.01	0.34	6.27	1.07	-9.66	0.17	89.56	-14.63	4.48E+05	-3.75E+03	4.44E+05
0.080	90.69	1.33	0.23	13.28	7.27	0.05	0.01	0.46	7.17	1.22	-9.54	0.17	89.54	-14.44	4.47E+05	-4.26E+03	4.43E+05
0.090	90.63	1.52	0.26	15.18	8.18	0.06	0.01	0.61	8.07	1.36	-9.39	0.16	89.52	-14.24	4.47E+05	-4.76E+03	4.42E+05
0.100	90.58	1.94	0.32	18.45	9.09	0.10	0.02	0.95	8.96	1.48	-9.05	0.16	89.54	-13.82	4.47E+05	-5.19E+03	4.41E+05
0.110	90.52	2.26	0.32	18.45	9.99	0.12	0.02	1.13	9.86	1.62	-8.87	0.15	89.54	-13.49	4.46E+05	-5.67E+03	4.40E+05
0.120	89.96	5.43	0.32	18.45	19.02	0.50	0.05	2.98	18.81	2.81	-7.02	0.12	89.54	-10.28	4.42E+05	-9.83E+03	4.32E+05
0.210	89.40	8.60	0.32	18.45	27.98	1.20	0.08	4.82	27.77	3.68	-5.18	0.09	89.54	-7.06	4.39E+05	-1.29E+04	4.28E+05
0.410	88.84	11.76	0.32	18.45	36.90	2.22	0.12	6.67	36.72	4.22	-3.33	0.06	89.54	-3.84	4.37E+05	-1.48E+04	4.22E+05
0.510	88.29	14.93	0.32	18.45	45.75	3.55	0.15	8.51	45.67	4.44	-1.49	0.03	89.54	-0.62	4.36E+05	-1.56E+04	4.21E+05
0.610	87.73	18.10	0.32	18.45	54.55	5.21	0.18	10.36	54.63	4.35	0.36	-0.01	89.54	2.59	4.37E+05	-1.52E+04	4.21E+05
0.710	87.17	21.27	0.32	18.45	63.30	7.18	0.21	12.20	63.58	3.93	2.20	-0.04	89.54	5.81	4.38E+05	-1.37E+04	4.24E+05
0.810	86.61	24.44	0.32	18.45	71.99	9.46	0.25	14.05	72.54	3.18	4.05	-0.07	89.54	9.03	4.41E+05	-1.11E+04	4.29E+05
0.910	86.05	27.61	0.32	18.45	80.62	12.06	0.28	15.89	81.49	2.12	5.89	-0.10	89.54	12.25	4.44E+05	-7.42E+03	4.37E+05
1.010	85.49	30.78	0.32	18.45	89.20	14.98	0.31	17.74	90.44	0.73	7.74	-0.14	89.54	15.46	4.49E+05	-2.57E+03	4.47E+05
1.110	84.93	33.94	0.32	18.45	97.72	18.22	0.34	19.58	99.40	-0.97	9.58	-0.17	89.54	18.68	4.55E+05	3.41E+03	4.59E+05
1.210	84.37	37.11	0.32	18.45	106.18	21.77	0.37	21.42	108.35	-3.00	11.42	-0.20	89.54	21.90	4.62E+05	1.05E+04	4.73E+05
1.310	83.82	40.28	0.32	18.45	114.59	25.64	0.41	23.27	117.30	-5.35	13.27	-0.23	89.54	25.12	4.70E+05	1.87E+04	4.89E+05
1.410	83.26	43.45	0.32	18.45	122.95	29.83	0.44	25.11	126.26	-8.02	15.11	-0.26	89.54	28.33	4.80E+05	2.81E+04	5.08E+05
1.510	82.70	46.62	0.32	18.45	131.24	34.33	0.47	26.96	135.21	-11.02	16.96	-0.30	89.54	31.55	4.90E+05	3.86E+04	5.29E+05
1.610	82.14	49.79	0.32	18.45	139.49	39.15	0.50	28.80	144.16	-14.34	18.80	-0.33	89.54	34.77	5.02E+05	5.02E+04	5.52E+05
1.710	81.58	52.96	0.32	18.45	147.67	44.29	0.53	30.65	153.12	-17.97	20.65	-0.36	89.54	37.98	5.15E+05	6.29E+04	5.78E+05
1.810	81.02	56.12	0.32	18.45	155.80	49.74	0.57	32.49	162.07	-21.93	22.49	-0.39	89.54	41.20	5.28E+05	7.68E+04	6.05E+05
1.910	80.46	59.29	0.32	18.45	163.88	55.51	0.60	34.34	171.03	-26.21	24.34	-0.42	89.54	44.42	5.43E+05	9.17E+04	6.35E+05
2.010	79.90	62.46	0.32	18.45	171.89	61.60	0.63	36.18	179.98	-30.82	26.18	-0.46	89.54	47.64	5.60E+05	1.08E+05	6.67E+05
2.110	79.35	65.63	0.32	18.45	179.86	68.01	0.66	38.03	188.93	-35.74	28.03	-0.49	89.54	50.85	5.77E+05	1.25E+05	7.02E+05
2.210	78.79	68.80	0.32	18.45	187.76	74.73	0.70	39.87	197.89	-40.99	29.87	-0.52	89.54	54.07	5.95E+05	1.43E+05	7.39E+05
2.310	78.23	71.97	0.32	18.45	195.61	81.77	0.73	41.72	206.84	-46.55	31.72	-0.55	89.54	57.29	6.15E+05	1.63E+05	7.78E+05
2.410	77.67	75.14	0.32	18.45	203.41	89.12	0.76	43.56	215.79	-52.44	33.56	-0.59	89.54	60.51	6.35E+05	1.84E+05	8.18E+05
2.510	77.11	78.30	0.32	18.45	211.15	96.79	0.79	45.41	224.75	-58.66	35.41	-0.62	89.54	63.72	6.57E+05	2.05E+05	8.62E+05
2.610	76.55	81.47	0.32	18.45	218.83	104.78	0.82	47.25	233.70	-65.19	37.25	-0.65	89.54	66.94	6.80E+05	2.28E+05	9.08E+05
2.710	75.99	84.64	0.32	18.45	226.46	113.09	0.86	49.10	242.66	-72.04	39.10	-0.68	89.54	70.16	7.04E+05	2.52E+05	9.56E+05
2.810	75.44	87.81	0.32	18.45	234.03	121.71	0.89	50.94	251.61	-79.22	40.94	-0.71	89.54	73.38	7.29E+05	2.77E+05	1.01E+06
2.910	74.88	90.98	0.32	18.45	241.55	130.65	0.92	52.79	260.56	-86.72	42.79	-0.75	89.54	76.59	7.55E+05	3.04E+05	1.06E+06
3.010	74.32	94.15	0.32	18.45	249.01	139.90	0.95	54.63	269.52	-94.54	44.63	-0.78	89.54	79.81	7.83E+05	3.31E+05	1.11E+06
3.110	73.76	97.32	0.32	18.45	256.41	149.48	0.99	56.48	278.47	-102.68	46.48	-0.81	89.54	83.03	8.11E+05	3.59E+05	1.17E+06
3.210	73.20	100.48	0.32	18.45	263.76	159.37	1.02	58.32	287.42	-111.15	48.32	-0.84	89.54	86.25	8.41E+05	3.89E+05	1.23E+06
3.310	72.64	103.65	0.32	18.45	271.05	169.57	1.05	60.16	296.38	-119.93	50.16	-0.88	89.54	89.46	8.71E+05	4.20E+05	1.29E+06
3.410	72.08	106.82	0.32	18.45	278.29	180.10	1.08	62.01	305.33	-129.04	52.01	-0.91	89.54	92.68	9.03E+05	4.52E+05	1.36E+06
3.510	71.52	109.99	0.32	18.45	285.47	190.94	1.11	63.85	314.29	-138.47	53.85	-0.94	89.54	95.90	9.36E+05	4.85E+05	1.42E+06
3.610	70.97	113.16	0.32	18.45	292.59	202.10	1.15	65.70	323.24	-148.22	55.70	-0.97	89.54	99.12	9.70E+05	5.19E+05	1.49E+06
3.710	70.41	116.33	0.32	18.45	299.66	213.57	1.18	67.54	332.19	-158.29	57.54	-1.00	89.54	102.33	1.01E+06	5.54E+05	1.56E+06
3.810	69.85	119.49	0.32	18.45	306.67	225.36	1.21	69.39	341.15	-168.68	59.39	-1.04	89.54	105.55	1.04E+06	5.90E+05	1.63E+06
3.910	69.29	122.66	0.32	18.45	313.63	237.47	1.24	71.23	350.10	-179.40	61.23	-1.07	89.54	108.77	1.08E+06	6.28E+05	1.71E+06
4.010	68.73	125.83	0.32	18.45	320.53	249.89	1.28	73.08	359.05	-190.44	63.08	-1.10	89.54	111.99	1.12E+06	6.67E+05	1.78E+06