0,3048 m/ft	0,4536 kg/lb	0,0254 m/in	0,9144 yd/m	1,60934 km/mi
3,2808 ft/m	2,2046 lb/kg	39,3702 in/m	1,0936 m/yd	

ρair = 1,225 kg/m³ air density at sea level 1,057 kg/m³ at 5000 ft - 1524 m 0,653 kg/m³ at 20000

cw = shape coefficient of skydiver body m = **80** kg overall jumper weight A = **1,54** m² jumper

cw = 0,28 frog position cw = 0,22 tracking position cw = 0,18

cw = **0,28**

g = 9,8 m/s² $k = 0.5 \cdot \rho_{air} \cdot cw \cdot A$ [kg/m] k = 0,2641 [kg/m] fficient gravity acceleration

VL = sqrt(g· m / k) [m/s] terminal velocity VL = 54,5 m/s q =

a(t) = $4 \cdot g \cdot (q / ((q + 1)^2))$ [m/s²] acceleration $v(t) = VL \cdot ((q - 1)/(q + 1))$ [m/s] v(t) =

s(t) = $(VL^2/(2\ g)) \cdot \ln(((q+1)^2)/(4\ q))$ [m] distance $P = \frac{1}{2}\ \rho_{air}\ v^2$ [N/m²] air pressure

FD = 1,5 dimishing factor

In C5 there is air density, in C12 there is the "shape coefficient", in T8 there is body surface and in J8 the overall suspended weight
Changing numerical values in these cells, automatically in P14 you get resistance coefficient and in P17 you get terminal velocity
Tip: stick with overall jumper weight in J8 to actual suspended weight , try to stick in C12 with proper "shape coefficient" relevant to freefall positior
and in T8 do repeated attempts to find which number for body area gives you (automatically) in P17 your experimental terminal velocity (from freef

Use the cells with yellow background to find the vale of body area A that yields the correct k and vL value
You read then in the columns: A - t delay time; C - s(t) distance fallen in m; E - v(t) velocity in m/s; G - a(t) acceleration in m/s²,
D - s(t) distance fallen in ft; F - v(t) velocity in ft/s
In H there is the corresponding air pressure in N/m² and finally in the columnms under F[kg] there is the corresponding pulling force of pilot chute in
In C24 there is the "dimishing factor" that, if set to a value greater than 1 (1.2, 1.5, 1.75, 2, ecc.) keeps into account factors as: manufacturing techn
PC not being an infinitely rigid disk but a piece of cloth and so its section under stress is less large than its section at rest, pilot chute esitations, et
Tip: In C24 a reasonable and sound value could be 1.5

ZP PILOT CHUTES

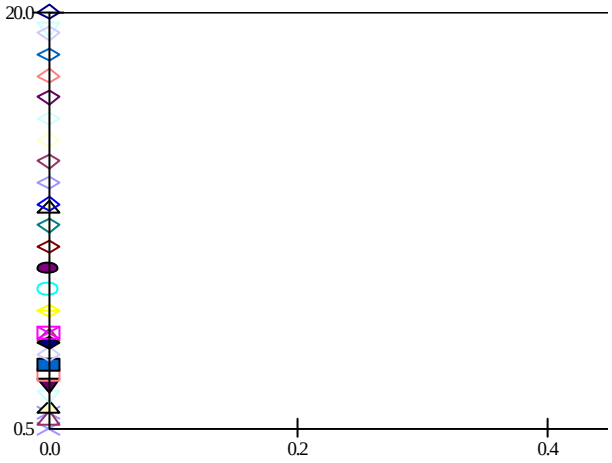
t [s]	q	s(t) [m]	s(t) [ft]	v(t) [m/s]	v(t) [ft/s]	a(t) [m/s²]	P [N/m²]	**48 "** 1,22 m 1,17 m² F [N]	F [kg]	**46 "** 1,17 m 1,07 m² F [N]	F [kg]	**45 "** 1,14 m 1,03 m² F [N]	F [kg]	**42 "** 1,07 m 0,89 m² F [N]	F [kg]	**40 "** 1,02 m 0,81 m² F [N]	F [kg]	**38 "** 0,97 m 0,73 m² F [N]	F [kg]
0	1	0	0	0	0	9,8	0	0	0	0	0	0	0	0	0	0	0	0	0
0,5	1	1	4	5	16	9,7	15	11	1,2	10	1,1	10	1,0	9	0,9	8	0,8	7	0,7
1	1	5	16	10	32	9,5	58	45	4,6	41	4,2	39	4,0	34	3,5	31	3,2	28	2,9
1,5	2	11	36	14	47	9,1	126	98	10	90	9	86	8,8	75	8	68	7	62	6
2	2	19	63	19	62	8,6	216	168	17	155	16	148	15	129	13	117	12	106	11
2,5	2	30	97	23	75	8,1	323	252	26	231	24	221	22,6	193	20	175	18	158	16
3	3	42	138	27	88	7,4	441	344	35	315	32	302	31	263	27	239	24	215	22
3,5	4	56	185	30	100	6,8	566	440	45	404	41	387	39,5	337	34	306	31	276	28
4	4	72	238	34	110	6,1	691	538	55	494	50	473	48	412	42	374	38	337	34
4,5	5	90	295	36	120	5,4	814	634	65	582	59	557	56,8	485	50	440	45	397	41
5	6	109	357	39	128	4,8	932	725	74	666	68	638	65	555	57	504	51	455	46
6	9	150	492	43	142	3,6	1143	890	91	817	83	782	80	681	70	618	63	558	57
7	12	195	639	46	152	2,7	1316	1024	105	941	96	900	92	784	80	711	73	642	66
8	18	242	796	49	160	2,0	1451	1130	115	1038	106	993	101	865	88	785	80	708	72
9	25	292	958	50	165	1,4	1554	1209	123	1111	113	1063	108	926	94	840	86	758	77
10	37	343	1126	52	169	1,0	1629	1268	129	1165	119	1115	114	971	99	881	90	795	81
11	52	395	1296	52	172	0,7	1684	1311	134	1204	123	1152	118	1004	102	910	93	822	84
12	75	448	1469	53	174	0,5	1724	1342	137	1232	126	1179	120	1027	105	932	95	841	86
13	107	501	1644	53	175	0,4	1752	1363	139	1252	128	1198	122	1044	107	947	97	854	87
14	154	555	1820	54	176	0,3	1772	1379	141	1266	129	1212	124	1056	108	957	98	864	88

15	221	609	1997	54	177	0,2	1786	1390	142	1276	130	1221	125	1064	109	965	98	871	89
16	316	663	2174	54	178	0,1	1795	1397	143	1283	131	1228	125	1070	109	970	99	876	89
17	453	717	2352	54	178	0,1	1802	1403	143	1288	131	1233	126	1074	110	974	99	879	90
18	649	771	2530	54	178	0,06	1807	1406	144	1292	132	1236	126	1077	110	977	100	881	90
19	930	826	2709	54	178	0,04	1810	1409	144	1294	132	1238	126	1079	110	978	100	883	90
20	1333	880	2887	54	178	0,03	1813	1411	144	1296	132	1240	127	1080	110	980	100	884	90
44	7486584	2187	7176	54		0,00	050 m/s	velocità media											
		ea level	0,974	0,9814				terminale dopo 12 s											
		·000 m	0,994	0,9789	53,47		67,739	terminale dopo 16 s											

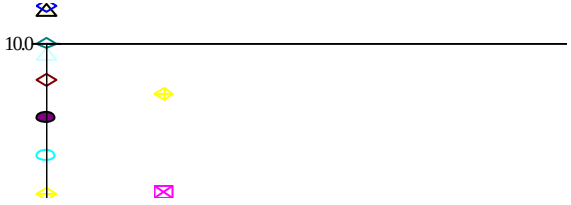
80 kg

t [s]	q	s(t) [m]	v(t) [m/s]	a(t) [m/s²]	tgh v(t) [m/s]	t [s]	q	s(t) [m]	v(t) [m/s]	a(t) [m/s²]
0	1	0	0	9,8	0	0,0	5,5	129	41	4,2
0,1	1	0,05	1,0	9,8	0,98	0,0	6	150	43	3,6
0,2	1	0,2	2,0	9,8	1,96	0,2	6,5	172	45	3,1
0,3	1	0,4	2,9	9,8	2,94	0,4	7	195	46	2,7
0,4	1	0,8	3,9	9,7	3,91	0,8	7,5	218	48	2,3
0,45	1	1,0	4,4	9,7	4,4	1,0	8	242	49	2,0
0,5	1	1,2	4,9	9,7	4,9	1,2	8,5	267	50	1,7
0,6	1	1,8	5,9	9,7	5,9	1,8	9	292	50	1,4
0,7	1	2,4	6,8	9,6	6,8	2,4	9,5	317	51	1,2
0,8	1	3,1	7,8	9,6	7,8	3,1	10	343	52	1,0
0,9	1	4,0	8,7	9,5	8,7	4,0	11	395	52	0,7
1	1	5	10	9,5	10	4,9	12	448	53	0,5
1,5	2	11	14	9,1	14	11,0	13	501	53	0,4
2	2	19	19	8,6	19	19,6	14	555	54	0,3
2,5	2	30	23	8,1	23	30,6	15	609	54	0,2
3	3	42	27	7,4	27	44,1	16	663	54	0,1
3,5	4	56	30	6,8	30	60,0	17	717	54	0,1
4	4	72	34	6,1	34	78,4	18	771	54	0,06
4,5	5	90	36	5,4	36	99,2	19	826	54	0,04
5	6	109	39	4,8	39	122,5	20	880	54	0,03

Distan



Velocit



100 m	328,1 ft
1,63 m	64 "
1,32 m	52 "
1,27 m	50 "
1,22 m	48 "
1,17 m	46 "
1,14 m	45 "
1,07 m	42 "
1,02 m	40 "
0,97 m	38 "
0,94 m	37 "
0,91 m	36 "
0,89 m	35 "
0,81 m	32 "
0,76 m	30 "
0,71 m	28 "

kg	lb
60	132
62,5	138

65	143
67,5	149
70	154
72,5	160
75	165
77,5	171
80	176
82,5	182
85	187
87,5	193
90	198
92,5	204
95	209
97,5	215
100	220

$\alpha 2$ $\beta 2$

$\alpha 1$ $\beta 1$

A **M** **d** **N**

h = d H = d

Span [ft]	Chord [ft]	A.R.	**Mojo** Pack volume [ft²]	volume [in³]	weight [lb]	weight [kg]	Ratio [in³/ft²]	Ratio [lb/ft²]
19,2	9,9	1,94	190	393	5,9	2,7	2,07	00,000
21,0	10,8	1,94	227	468	7,2	3,3	2,06	00,000
21,6	11,1	1,95	240	496	8,5	3,9	2,07	00,000
22,6	11,5	1,97	260	536	9,1	4,1	2,06	00,000
23,3	12,0	1,94	280	578	9,6	4,4	2,06	00,000
24,5	12,7	1,93	310	685	11,0	5,0	2,210	00,000
						AVG =	2,09	00,000
							2,0887	

Span [in]	Chord [in]	A.R.	**Fox** Estimated Pack volum [ft²]	volume [in³]	weight [lb]	weigh [kg]	Ratio [in³/ft²]	Ratio [lb/ft²]
231	118	1,96	185	386	6,75	3,1	2,089	0,0365
244,5	124	1,97	205	428	7,00	3,2	2,089	0,0341
252	128	1,97	225	470	7,75	3,5	2,089	0,0344
263	135	1,95	**245**	512	9,25	4,2	2,09	0,0378
274	142	1,93	265	554	10,50	4,8	2,089	0,0396
285	145	1,97	285	595	11,75	5,3	2,089	0,0412
							AVG =	0,0373

feet	**m**	**Sabre** Pack volume [ft²]	volume [in³]	weight [lb]	weight [kg]	Ratio [in³/ft²]	Ratio [lb/ft²]
7	2,13						
9	2,74						
164	50	97	240	4,5	2,0	2,47	#####
175	53	107	260	4,7	2,1	2,43	#####

PD 7 cell Pack [ft²]	volum [in³]	Ratio [in³/ft²]
143	286	2,00
160	312	1,95

ámics Pack **rafoil** [ft²]	volume [in³]	Ratio [in³/ft²]
232	720	3,10
252	740	2,94

200	61	120	286	4,8	2,2		2,38	#####		176	338	1,92		262	760	2,90	
215	66	135	312	5,1	2,3		2,31	#####		193	390	2,02		272	794	2,92	
246	75	150	338	5,9	2,7		2,25	#####		218	416	1,91		282	830	2,94	
300	91	170	364	6,4	2,9		2,14	#####		235	445	1,89		302	890	2,95	
328	100	190	416	7,2	3,3		2,19	#####		253	468	1,85					
350	107	210	468	7,6	3,4		2,23	#####						cepts	Pack		
400	122	230	520	7,9	3,6		2,26	#####	NAA		Pack			**rtrac**	volume	Ratio	
492	150								**Eagle**	**7 ce**	volum	Ratio		[ft²]	[in³]	[in³/ft²]	
500	152		Pack						[ft²]		[in³]	[in³/ft²		245	442	1,80	
600	183	**Stiletto**	volume	weight	weight		Ratio	Ratio	140		330	2,36		265	580	2,19	
656	200	[ft²]	[in³]	[lb]	[kg]		[in³/ft²]	[lb/ft²]	160		365	2,28		290	608	2,10	
700	213	97	234	4	1,8		2,41	#####	180		400	2,22					
800	244	107	273	4,5	2,0		2,55	#####	200		450	2,25		signs	Pack		
820	250	120	312	5	2,3		2,60	#####	220		480	2,18		**Lightni**	volume	Ratio	
900	274	135	338	5,5	2,5		2,50	#####	240		500	2,08		[ft²]	[in³]	[in³/ft²]	
984	300	150	364	6	2,7		2,43	#####	260		535	2,06		126	312	2,48	
1000	305	170	385	6,5	2,9		2,26	#####	280		565	2,02		143	338	2,36	
1100	335	190	475	7	3,2		2,50	#####	300		595	1,98		160	390	2,44	
1148	350								320		625	1,95		176	416	2,36	
1200	366						Pack							193	468	2,42	
1300	396	Span	Chord	ATAIR	**Troll**		volume	weigh	weight		Ratio	Ratio		218	520	2,39	
1312	400	[ft]	[ft]	A.R.	[ft²]		[in³]	[lb]	[kg]		[in³/ft²]	[lb/ft²]		235	573	2,44	
1400	427	19,4	10,0	1,94	205		430	6,6	3,0		2,10	#####		253	627	2,48	
1476	450	20,0	10,3	1,94	225		480	8,4	3,8		2,13	#####					
1500	457	20,3	10,5	1,93	245		510	8,8	4,0		2,08	#####			Pack		
1640	500	21,1	10,9	1,94	265		551	9,6	4,4		2,08	#####		**Spectr**	volume	Ratio	
1804	550	22,4	11,3	1,98	290		630	10,6	4,8		2,17	#####		[ft²]	[in³]	[in³/ft²]	
1969	600									AVG =	2,11	#####		97	281	2,90	
2000	610													107	296	2,77	
2133	650													120	321	2,68	
2297	700													135	354	2,62	
2461	750													150	413	2,75	
2625	800													170	455	2,68	

2789	850		190	475	2,50
2953	900		210	515	2,45
3117	950		230	532	2,31
3281	1000				
102.800	#####				
485	148				

y

y

Trajectory for generic pitch ?

Trajectory for MAX trajectory ?

$V^2/(2 \cdot g) \cdot \sin^2 ?$ **V**

$\sqrt{}^2/(4 \cdot g)$ **V**

sin ?

/ 2) · V

?

x

/ 4

0 V · cos ?

0 (? 2 / 2) · V

$(V^2/g) \cdot \sin ? \cdot \cos ?$

$2 (V^2/g) \cdot \sin ? \cdot \cos ?$

$V^2/(2 \cdot g)$

$\frac{? 2}{2} = 0{,}001$

$? 2 = 0{,}001$

$\sin (? / 4) = \cos (? / 4) = \frac{? 2}{2} = 0{,}001$

$? / 4 = 45°$

Motion Equations for generic pitch ?

$x(t) = V \cdot \cos ? \cdot t$

1 g 2 V^2

$$y = -\frac{1}{2}\cdot\frac{g}{V^2\cdot\cos^2\vartheta}\cdot x^2 + \tan\vartheta\cdot x \qquad x2 = \frac{V^2}{g}\sin\vartheta\cdot\cos\vartheta$$

ectory

$$y(t) = V\cdot\sin\vartheta\cdot t - \frac{1}{2}\,g\cdot t^2$$

Motion Equations for pitch to MAX trajectory ϑ = ϑ / 4 (ϑ = 45°)

and defining the horizontal velocity $Vo = \frac{\sqrt{2}}{2}V$ we can write:

$$x(t) = \frac{\sqrt{2}}{2}V\cdot t = Vo\cdot t$$

$$y = -\frac{g}{V^2}\cdot x^2 + x \qquad x2 = \frac{V^2}{g}$$

trajectory: ectory:

$$y(t) = \frac{\sqrt{2}}{2}V\cdot t - \frac{1}{2}\,g\cdot t^2 = Vo\cdot t - \frac{1}{2}\,g\cdot t^2$$

Motion Equations for pitch zero: ϑ = 0

y **Traiettoria con alz**
Trajectory with pit

$$x(t) = V\cdot t$$

V

oria: $y = -\frac{g}{2V^2}\cdot x^2$ 0
ectory:

$$y(t) = -\frac{1}{2}\,g\cdot t^2$$

$$x2 = \vartheta\sqrt{2}\cdot\frac{V^2}{g} \qquad = \vartheta\sqrt{2}\cdot\frac{V}{g}$$

pitch ? = ? / 4

$$t = ?2 \cdot \frac{V}{g}$$

$$x = \frac{V^2}{g}$$

Supposing a jump by a jumper with maximum trajectory
(? = ? / 4) of 2m, we have velocity on exit V and horizontal velocity Vo

$$\frac{V^2}{g} = 2\ m \qquad \mathbf{2 \cdot g} = 4{,}43\ m/s$$

$$\mathbf{? g =} \ 3{,}13\ m/s \qquad \mathbf{=} \ 0{,}64\ s$$

Distance travelled horizontally after 0.5 s, 0.64 s,
1 s, 1.5 s, 2 s, 2.5 s, 3 s, 3.5 s, 4 s, 4.5 s, 5 s, ecc.
x (0,5) = 1,6 m

pitch zero ? = 0

$$= ?2 \cdot \frac{V}{g}$$

$$x = ?2 \cdot \frac{V^2}{g} = 0{,}001 \cdot \frac{V^2}{g}$$

Supposing a jump by a jumper with body pitch zer
that if would apply his velocity on exit V to a maxim
we have the horizontal velocity Vo equal to the velo

$$\frac{V^2}{g} = 2\ m \qquad \mathbf{g =} \ 4{,}43$$

Distance travelled horizontally after 0.5 s, 0.64 s,
1 s, 1.5 s, 2 s, 2.5 s, 3 s, 3.5 s, 4 s, 4.5 s, 5 s, ecc.
‹ (0,5) = 2,2 m

x (0,64) =	2,0 m		‹ (0,64) =	2,8 m	
x (1) =	3,1 m		‹ (1) =	4,4 m	
x (1,5) =	4,7 m		‹ (1,5) =	6,6 m	
x (2) =	6,3 m		‹ (2) =	8,9 m	
x (2,5) =	7,8 m		‹ (2,5) =	11,1 m	
x (3) =	9,4 m		‹ (3) =	13,3 m	
x (3,5) =	11,0 m		‹ (3,5) =	15,5 m	
x (4) =	12,5 m		‹ (4) =	17,7 m	
x (4,5) =	14,1 m		‹ (4,5) =	19,9 m	
x (5) =	15,7 m		‹ (5) =	22,1 m	

0,0929 m²/ft²
10,7640 ft²/m²

ft - 6096 m 0,551 kg/m³ at 25000 ft - 7620 m

exposed surface

head down position

cw	A	m
0,22	1,8	80

k = 0,2426 VL = **56,85**

exp(VL · (2k/m) · t)

VL· tanh(VL· (k/m)· t) [m/s] velocity - velocità

79 ft²	7,34 m²	1 m²	10,76 ft²
87 ft²	8,08 m²	2 m²	21,53 ft²
97 ft²	9,01 m²	3 m²	32,29 ft²
100 ft²	9,29 m²	4 m²	43,06 ft²
107 ft²	9,94 m²	5 m²	53,82 ft²
120 ft²	11,15 m²	6 m²	64,58 ft²
135 ft²	12,54 m²	7 m²	75,35 ft²
150 ft²	13,94 m²	8 m²	86,11 ft²
170 ft²	15,79 m²	9 m²	96,88 ft²
190 ft²	17,65 m²	10 m²	107,64 ft²
210 ft²	19,51 m²	12 m²	129,17 ft²
220 ft²	20,44 m²	15 m²	161,46 ft²
230 ft²	21,37 m²	20 m²	215,28 ft²
245 ft²	22,76 m²	25 m²	269,10 ft²
260 ft²	24,15 m²	30 m²	322,92 ft²
300 ft²	27,87 m²	35 m²	376,74 ft²

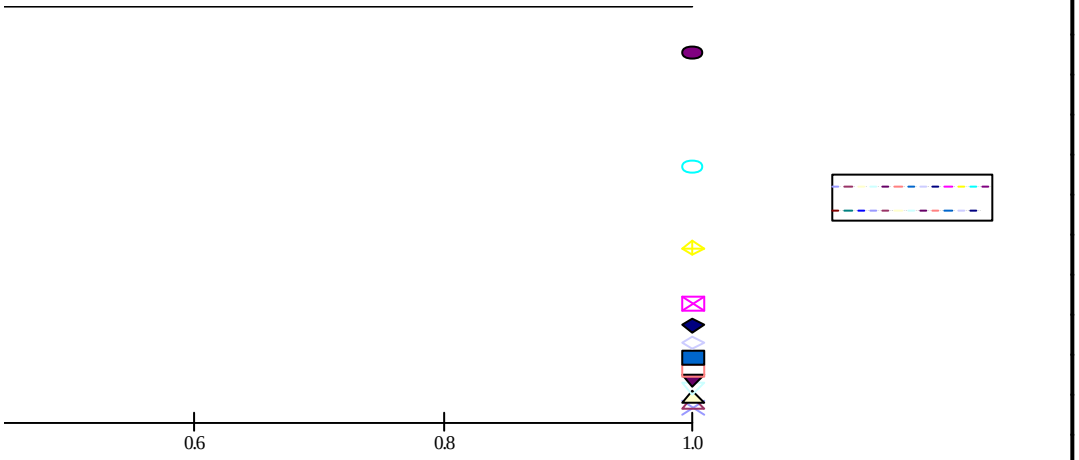
ı,
all computer)

kg
nique of PC,
c. etc.

m = 80 kg		VL = 54 m/s						
36 "		**35 "**		**32 "**		**28 "**		
0,91 m		0,89 m		0,81 m		0,71 m		
0,66 m²		0,62 m²		0,52 m²		0,40 m²		t
F [N]	F [kg]	F [N]	F [kg]	F [N]	F [kg]	F [N]	F [kg]	[s]
0	0	0	0	0	0	0	0	0
6	1	6	0,6	5	0,5	4	0,4	0,5
25	2,6	24	2,4	20	2,0	15	1,6	1
55	6	52	5	44	4	33	3	1,5
95	10	90	9	75	8	57	6	2
142	14	134	14	112	11	86	9	2,5
193	20	183	19	153	16	117	12	3
248	25	234	24	196	20	150	15	3,5
303	31	286	29	239	24	183	19	4
357	36	337	34	282	29	216	22	4,5
408	42	386	39	322	33	247	25	5
500	51	473	48	395	40	303	31	6
576	59	545	56	455	46	349	36	7
635	65	601	61	502	51	384	39	8
680	69	643	66	537	55	412	42	9
713	73	674	69	564	58	432	44	10
737	75	697	71	583	59	446	46	11
755	77	713	73	596	61	456	47	12
767	78	725	74	606	62	464	47	13
776	79	733	75	613	63	469	48	14

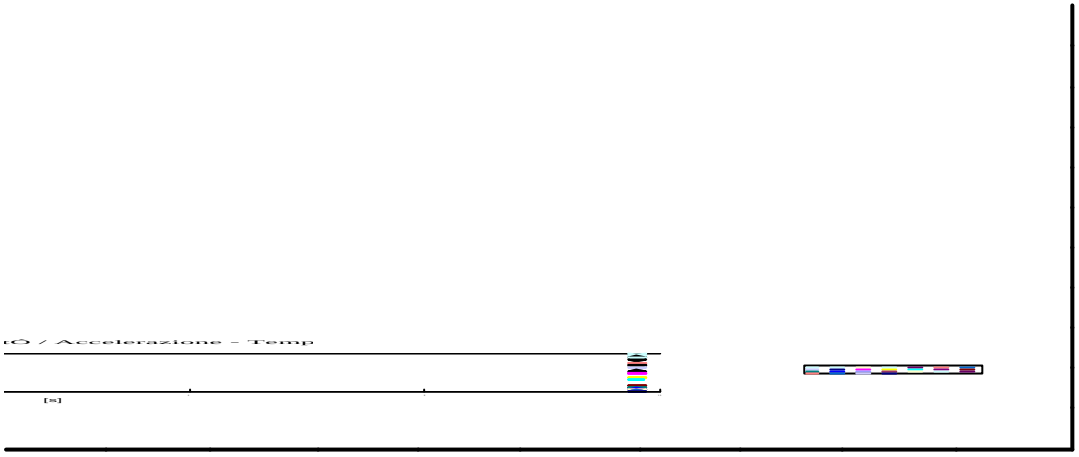
782	80	739	75	618	63	473	48	15
786	80	743	76	621	63	475	49	16
789	81	746	76	623	64	477	49	17
791	81	748	76	625	64	479	49	18
793	81	749	76	626	64	479	49	19
794	81	750	77	627	64	480	49	20

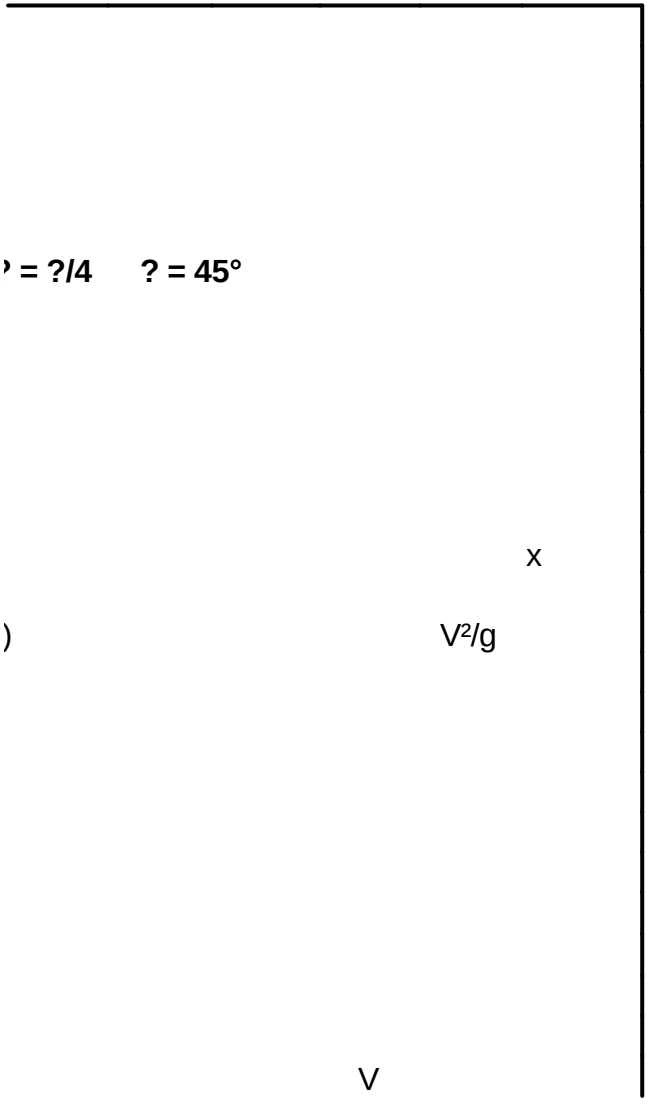
za caduta libera - Tempo



[s]

Ó / Accelerazione - Tempo


[s]


' = ?/4 ? = 45°
x
)
V²/g
V

$$t = 2 \cdot \frac{}{g} \sin ?$$

after

$$= ? \, 2 \cdot \frac{V}{g}$$

after

o zero ? = 0
ch zero ? = 0

x

o (? = 0), and considering
um trajectory jump he would jump 2 m,
ocity on exit V

m/s **t =** 0,64 s