The shot put track and field competition is an excellent example of basic projectile motion. The shot's large density, (relatively) slow launch speed, and lack of airfoil-like surfaces mean that air resistance plays a very small role in the trajectory followed. The analysis is complicated, however, by two important considerations. First, the shot will be "launched" from a nonzero height relative to its landing location. Second, the speed with which the shot is thrown will *not* be constant as the angle is varied. Thus, we cannot assume that a 45° throw is optimal. (Pictures SDN-064643 and SDN-064648 from the Chicago Daily News negatives collection courtesy of the Chicago Historical Society.)

a.) In 1995 A.V. Maheras studied five collegiate shot putters to examine the dependence of throwing speed on launch angle. Below are data from his Ph.D. dissertation (University of Kansas). Each row in the table represents the average of a group of five throws (each athlete threw the shot a total of 50 times). **Choose the results for ONE of the athletes** and determine which of the ten groups given in the table would give maximum horizontal range *for that particular athlete*. Explain how you arrived at your conclusion, and give a sample of any calculations used. Don't forget to specify which athlete you chose!

v = launch speed in m/s θ = launch angle in degrees (above horizontal) h = launch height in m.

	Athlete 1			**Athlete 2**			**Athlete 3**			**Athlete 4**			**Athlete 5**		
Throw Group	v (m/s)	θ (deg)	h (m)	v (m/s)	θ (deg)	h (m)	v (m/s)	θ (deg)	h (m)	v (m/s)	θ (deg)	h (m)	v (m/s)	θ (deg)	h (m)
1	10.7	28.5	2.06	11.7	17.6	1.89	12.0	22.3	2.00	11.2	23.4	1.95	12.9	18.8	1.97
2	10.6	32.4	2.10	11.4	21.9	1.93	11.8	24.8	1.99	11.2	25.5	2.00	12.9	24.3	2.04
3	10.6	33.7	2.07	11.4	24.7	1.95	11.7	27.8	2.01	11.5	27.4	2.00	12.6	30.0	2.19
4	10.9	35.2	2.14	11.5	27.0	2.01	11.4	31.2	2.14	11.4	29.5	2.08	12.2	32.5	2.09
5	10.4	35.9	2.09	11.8	29.9	2.05	11.9	34.1	2.14	11.4	31.0	2.08	11.9	33.9	2.14
6	10.8	36.8	2.15	12.1	31.2	2.12	11.2	36.5	2.20	10.8	32.2	2.10	12.1	35.1	2.17
7	10.7	38.4	2.22	11.7	32.5	2.13	10.2	39.6	2.24	10.5	33.6	2.11	12.4	36.3	2.23
8	10.3	40.3	2.20	11.9	33.5	2.10	10.4	44.3	2.31	10.1	37.0	2.17	12.2	38.7	2.21
9	9.9	46.1	2.27	10.4	47.2	2.32	10.3	46.6	2.30	9.4	45.9	2.33	10.6	48.9	2.38
10	9.8	48.1	2.29	9.9	50.6	2.35	10.3	48.8	2.33	9.1	48.5	2.35	10.5	52.9	2.36

b.) Using the average parameters given in the table, calculate the horizontal distance for the single maximum-range throw group that you chose in part (a.). Show your complete calculation.