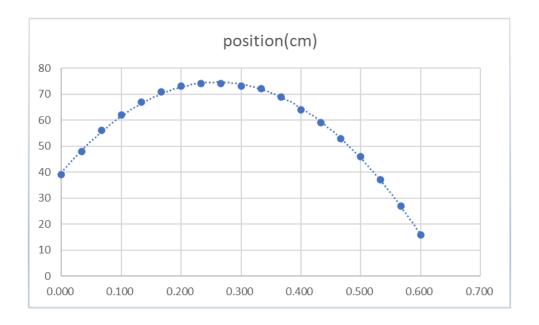
Science Activity Video

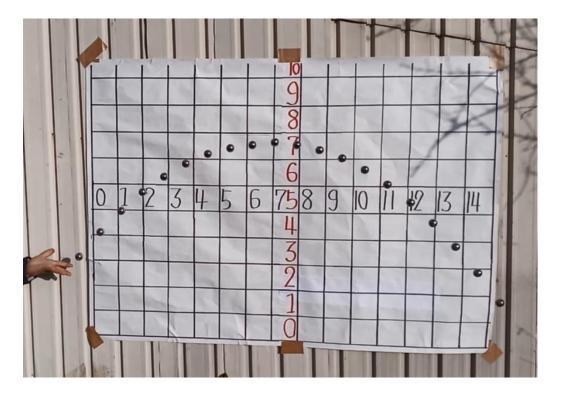


Hiroshi Onishi

RECSAM Training Programme Division JICA Senior Volunteer

Measurement of Projectile motion by Smartphone Video





Objectives

- •Measurement of projectile motion by smartphone video
- Independent analysis of vertical and horizontal movement

Experimental procedure

- 1. Take a video of projectile motion.
- 2. Read and record the ball position from each frame of the video.
- 3. Calculate periodical velocity and make a graph.

Materials

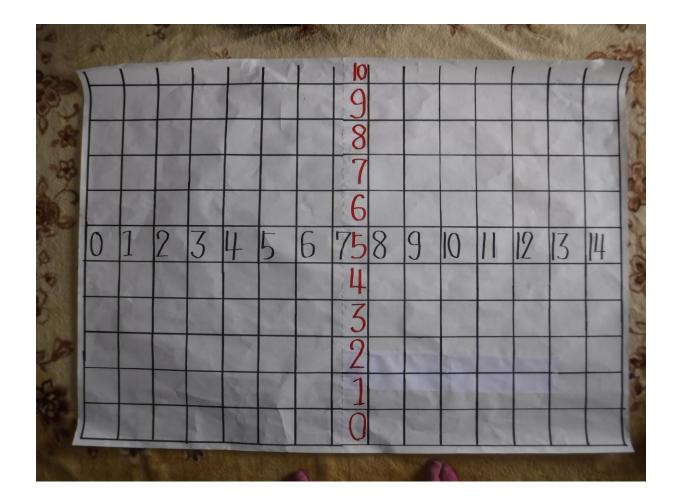


Ball

Smartphone Large Scale



Preparation



Draw a line every 10 cm in the vertical and horizontal directions on the paper.

Preparation



Use a weight to check the vertical direction and put this scale on the wall of the measurement place.

Video shooting



One person throws the ball diagonally near a scale. Another person takes video by smartphone.

excel sheet for record, calculation and graph

1				F	Record Sheet			
23								
3					No. of frame=	30	fr./s	
4	n	0.	time(s)	position(cm)				
5		1	0.000	-	difference(cm)	middle of time (s)	velocity(cm/s)	
6		1	0.000		0	0.017	0	
7		2	0.033			0.017	0	
8		4	0.055		0	0.050	0	
9		3	0.067		0	0.050	U	
10		5	0.007		0	0.083	0	
11		4	0.100	8	0	0.005	0	
12		4	0.100		0	0.117	0	
13		5	0.133			0.117	0	
14		0	0.155		0	0.150	0	
15		6	0.167			0.150	0	
16		0	0.167		0	0.102	0	
17		7	0.200		0	0.183	0	
18		7	0.200			0.017	0	
19			0.000		0	0.217	0	
20		8	0.233		0	0.050	0	
21			0.007		0	0.250	0	
22		9	0.267	ŝ.		0.000	0	
23	2.	0	0.200		0	0.283	0	
24	1	.0	0.300	8		0.017		

	A	В	С	D	E	F	G	н	1							
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8			.)/\$F\$3		- 0	0.050	0									
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10			chock.		0	0.083	0									
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16			_		- 0	0.183	0									
17		7	0.200													
18		528 			- o	0.217	0									
19		8	0.233	, ,	243	1929-1979-199 5	5.2855									
20			and the second s	0	0	0.250	0									

Each frame time is calculated by the number of frames per second.

23	10	0.300	v	0.203	V	
24	10	0.500		0.007	1.2251	

	A	В	С	D	E	F	G	н	1
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		no.	time(s)	position(cm)					61
		1	0.000		difference(cm)	middle of time (s)	velocity(cm/s)		
		-			8	0.017	0		
		2	0.033		=D7-D5				
3			-		0	0.050	0		
D		3	0.067						
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2		4	0.100						
3					0	0.117	0		
4		5	0.133		0	0.150	0		2.
5		6	0.167		0	0.150	0		
5		0	0.107		0	0.183	0		
7		7	0.200		0	0.103	0		
8		3	0.200		0	0.217	0		
9		8	0.233		37.0 1				
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2					0	0.283	0		
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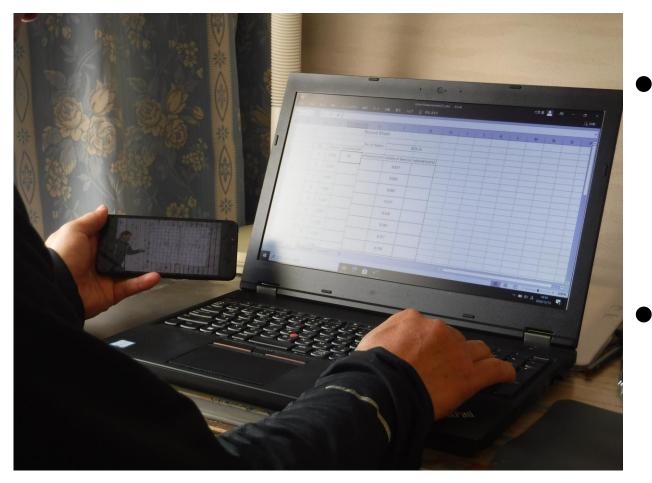
	A	В	С	D	E	F	G	н	
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1 2 3									
3					No. of frame=	30	fr./s		
4		no.	time(s)	position(cm)					
5		1	0.000		difference(cm)	middle of time (s)	velocity(cm/s)		
6		1	0.000		0		0		
7		2	0.033		0	=(C5+C7)/2	0		
8			0.000		- 0	0.050	0		
9		3	0.067	3		0.000	, e		
10		3	0	Q	- 0	0.083	0		
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12		22	22		0	0.117	0		
13		5	0.133						
14		-	-		0	0.150	0		
15		6	0.167						
16 17			12	<u>.</u>	0	0.183	0		
18		7	0.200	1			2 <u>8</u> 1		
CONTRACT.		Q	Q.	Q	0	0.217	0		
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e v	elocity	v and	l time	e graph					
		yanc		2 Drahu	- 0	0.283	0		

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4		no.	time(s)	position(cm)					
5		1	0.000		difference(cm)	middle of time (s)	velocity(cm/s)		
6		1	0.000		0	0.017			
7		2	0.033		Ŭ		=E6*\$F\$3		
8		2	0.055		0	0.050	0		
9		3	0.007		1 0	0.050	0		
10		3	0.067		0	0.000	0		
11			0.100		0	0.083	U		
12		4	0.100			0.117			
12 13		-	0.100		0	0.117	0		
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17		10.00%			0	0.183	0		1
18		7	0.200			and a second second	in a start		-
		-			0	0.217	0		

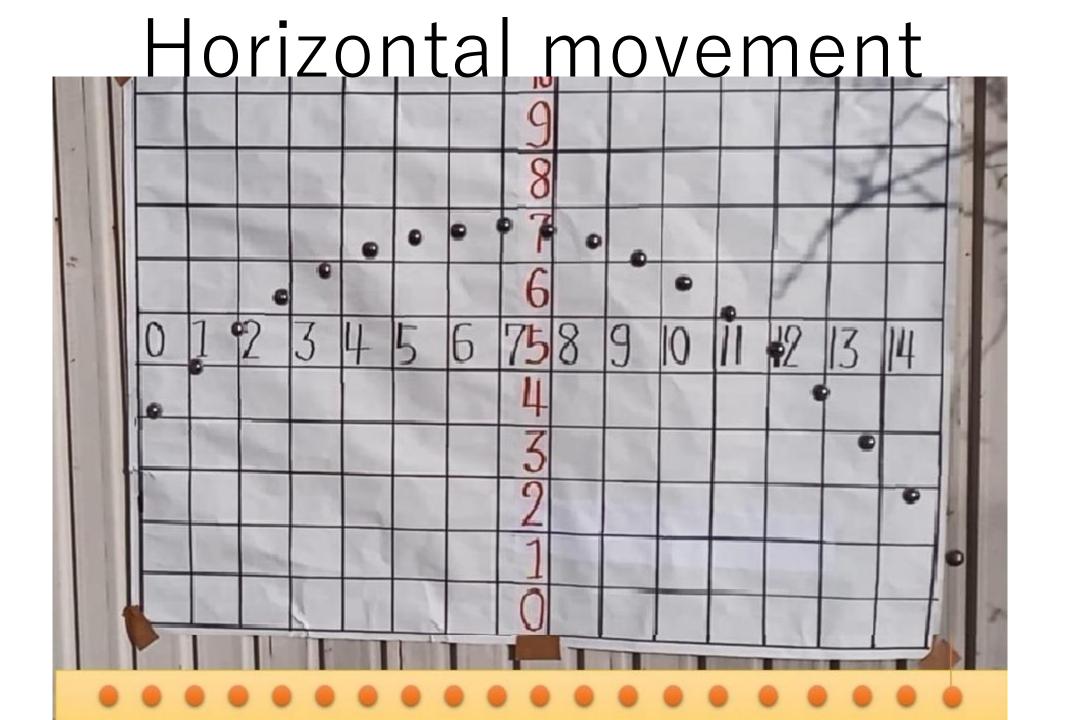
The velocity between each frame is calculated from the difference and the time of the frame.

			0	0.283	0	
23	10	0.200	Ŭ	0.200		
24	10	0.500		0.017	0	

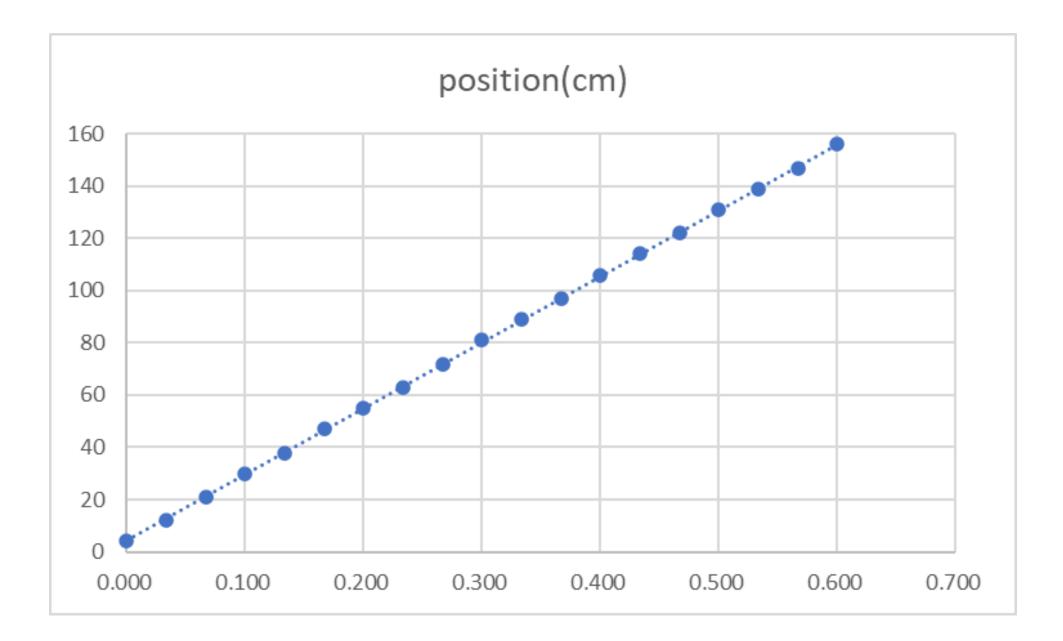
Reading and Recording

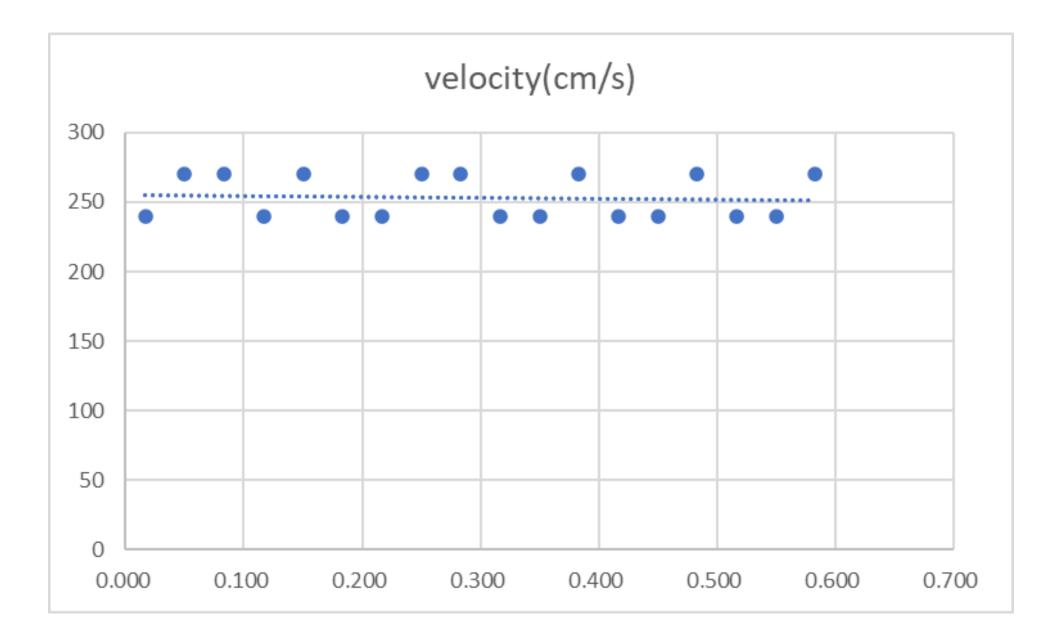


Read ball positions on each frame Record them in the sheet.



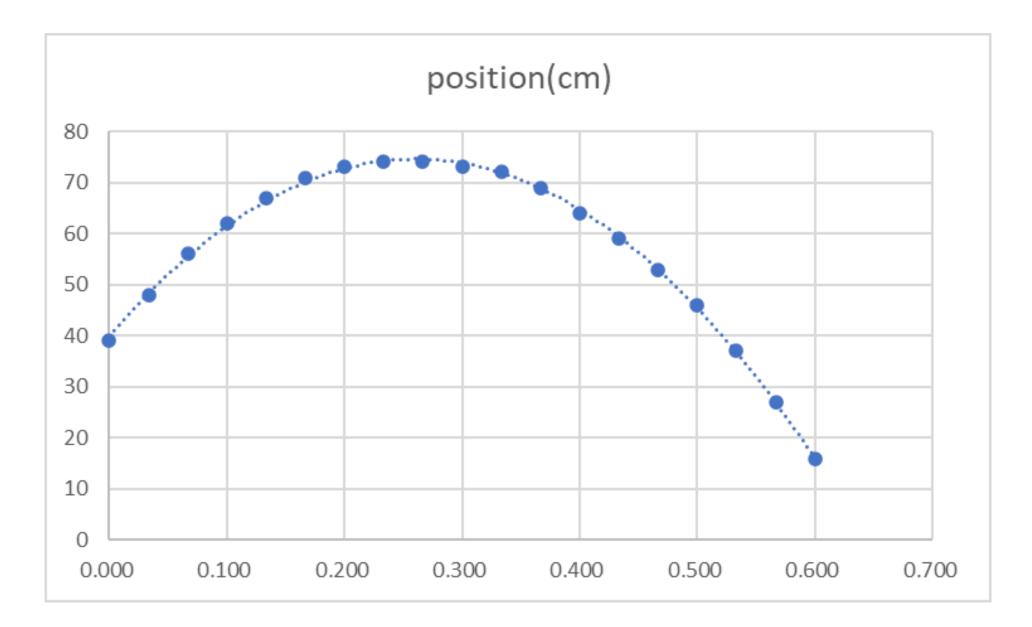
			F	Record Sheet	t		
				No. of frame=	30	fr./s	The position of the ball for each frame is
	no.	time(s)	position(cm)				
ſ	1	0.000		difference(cm)	middle of time (s)		
				0	0.017	0	Calculations and graphs can be done at
	2	0.033					the same time.
ľ	3	0.067		0	0.050	0	
	3	0.007		0	0.083	0	
	4	0.100					
				0	0.117		
	5	0.133		0	0.150		
	6	0.167			0.150		
				0	0.183		
	7	0.200	8				0 1 2 3 4 5 6 75 8 9 10 11 12 13 14
	8	0.233		0	0.217		
	0	0.235		0	0.250	. /	
	9	0.267				-	
ł				0	0.283		
	10	0.300		0	0.317		
	11	0.333			0.317		

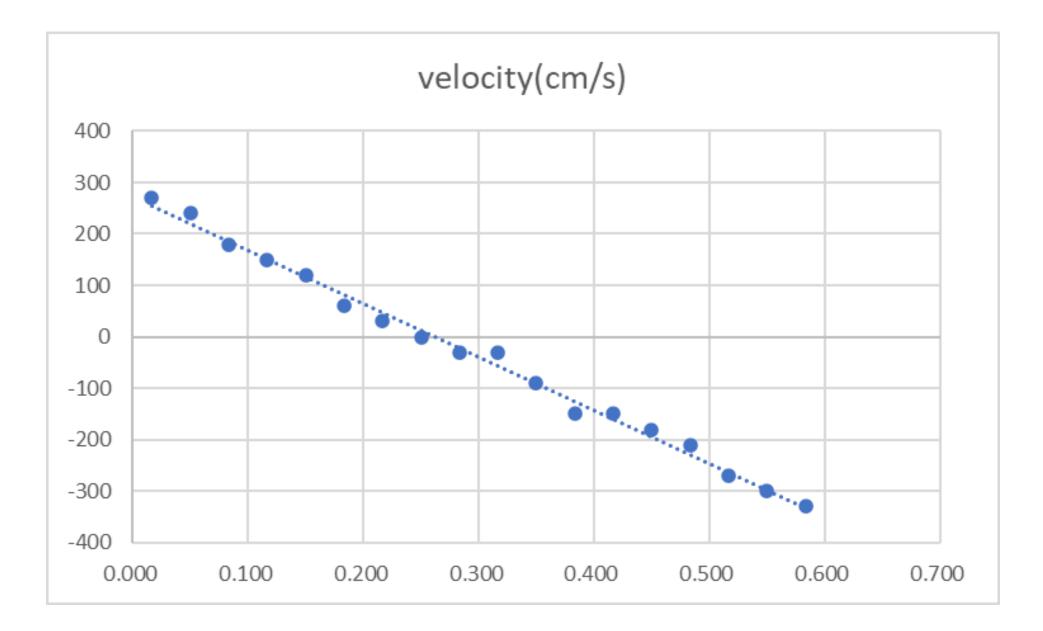


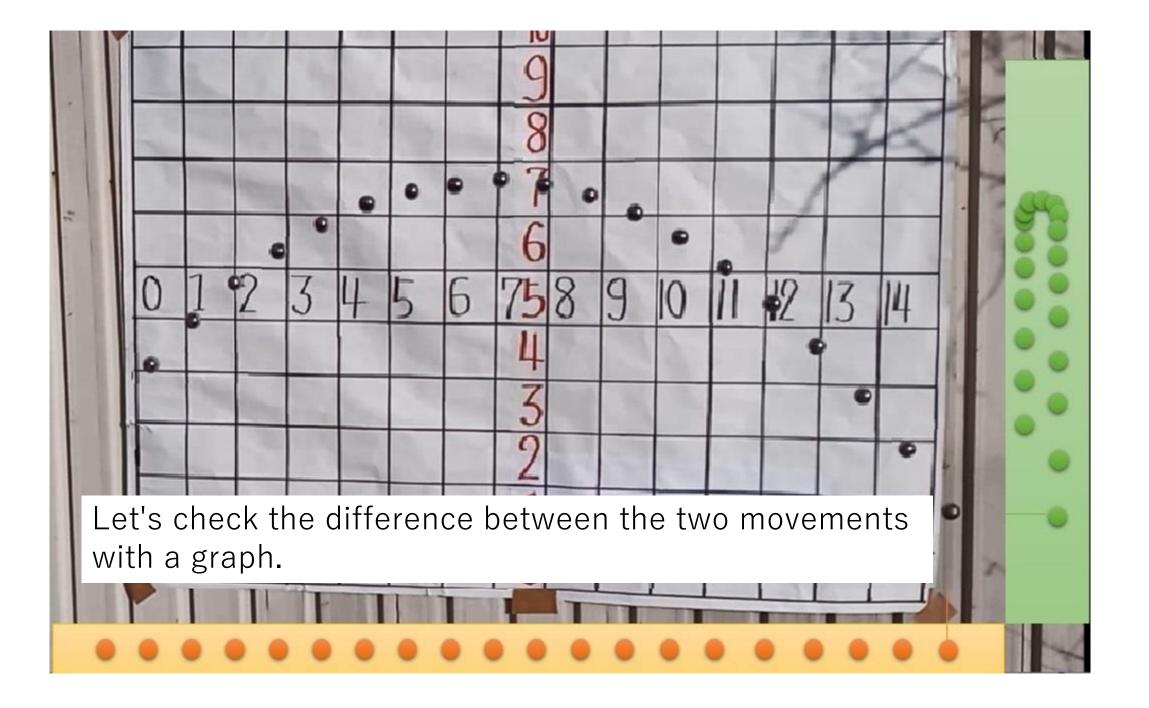


Vertical movement

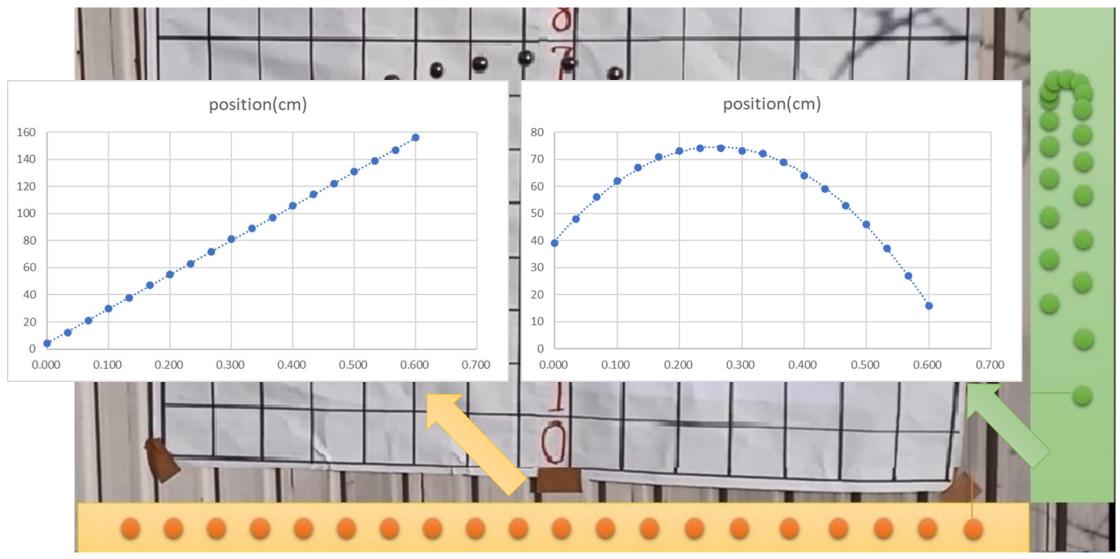








The position changes in direct proportion in the horizontal direction, and it changes in the vertical direction with a quadratic curve.



No force works in the horizontal direction, it moves at a constant velocity. Gravity works in the vertical direction, the velocity changes at a constant rate.

