Department of Mechanical Engineering

2023-2024

(Somaiya Vidyavihar University)

K J Somaiya College of Engineering

(A Constituent College of Somaiya Vidyavihar University)

Batch: Roll No.:
Experiment / assignment / tutorial No.
Grade: AA / AB / BB / BC / CC / CD /DD

Signature of the Staff In-charge with date

Title: Collision of Bodies

CO5 : Analyze the dynamic system using D'Alembert, work energy and impulse momentum principle.

Objective

To determine the coefficient of restitution between two steel balls.

Theory

A Collision between two bodies which occur in a very short duration of time and during which two bodies exert relatively large forces on each other is called impact.The line joining the common normal of the colliding bodies is known as line of impact. When the mass centers of the two colliding bodies lie on the line of impact, the impact is known as central impact. When the velocities of both the colliding bodies arecollinear with the line of impact the impact is called as direct impact.

Coefficient of restitution "e" is the ration of relative velocity of separation to relative velocity of approach. If u_A and u_B are the velocities before impact and V_A and V_B are the velocities after impact the

$$e = \frac{V_{B} - V_{A}}{u_{A} - u_{B}}$$

AIM:

To determine the coefficient of restitution between two steel balls.

APPARATUS:

The impact apparatus, steel balls, meter scale and carbon paper, drawing sheet.

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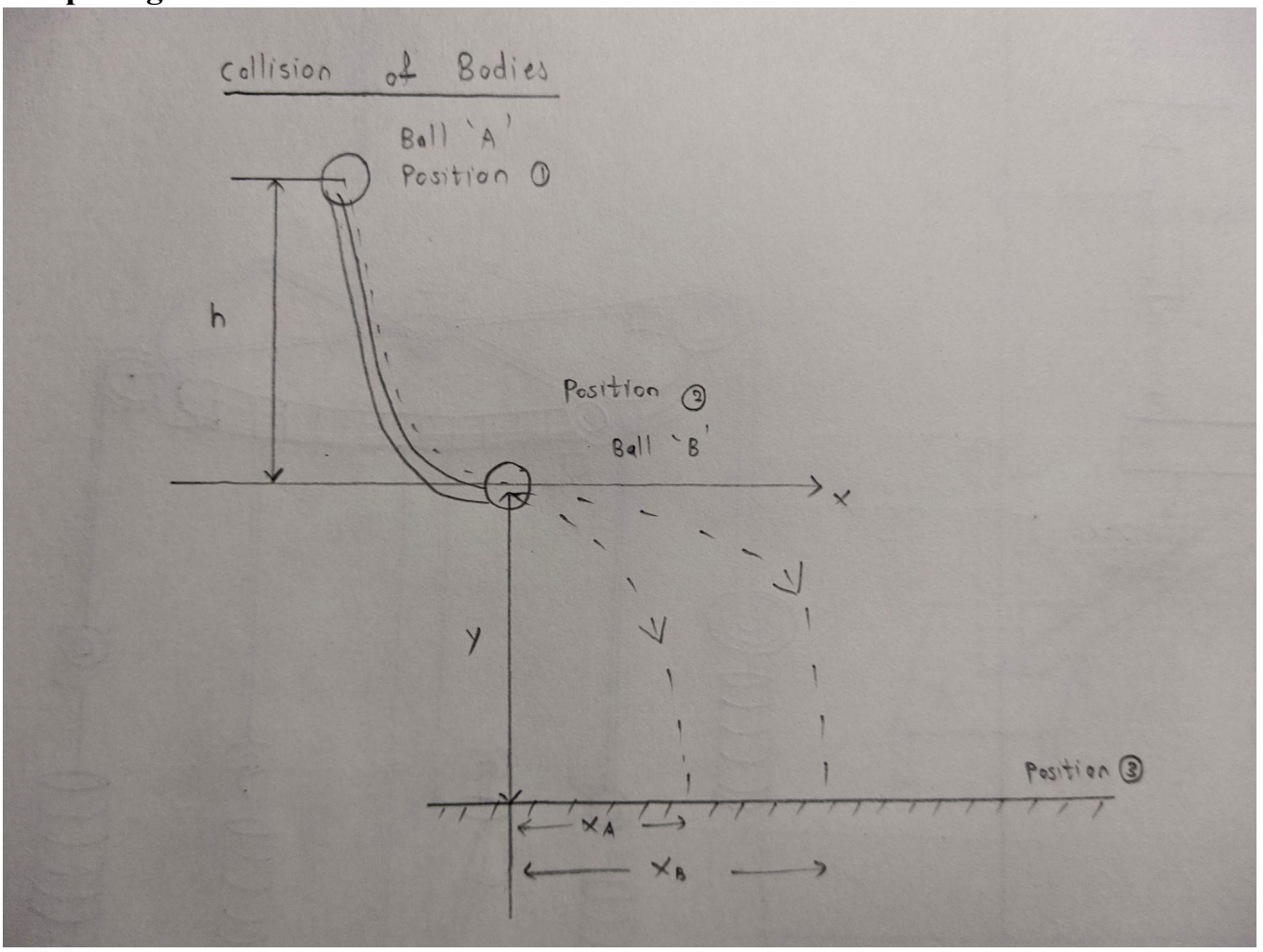
Setup Diagram:



PROCEDURE:

1. Fix the impact apparatus on the edge of table.
2. Place a steel ball B on the holder. Adjust the height of the holder such that the collision of the steel ball B with ball A is direct central.
3. Note the height ‘y’ of the holder from the ground using scale.

4. Place the steel ball on the slide at a certain vertical height ‘h’ from the holder. Note down the height ‘h’ with scale.
5. Release the ball from the position 1 and let it slide down and strike the stationary ball. Both the balls after impact undergo projectile motion, fallingthrough a height ‘y’ land at different spots on the ground. Marks the spots and measure the horizontal distances of both balls.
6. Repeat the above steps by changing the height ‘h’.

$V=X/t$ $u_A=\sqrt{2gh}$
$V_A=X_A/t$ $u_B=0$

$V_B=X_B/t$
$S = (ut + 1/2at^2)_X$
$X = V/t$ $a_X=0$ $V=X/t$
$V=X/\sqrt{2y/g}$

$S = (ut + 1/2at^2)_y$ $y=$
$(u_yt) + ½ * 9.81t^2$ $y=$
$0 + ½ * 9.81t^2$ $t=$
$\sqrt{2y/g}$

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OBSERVATION TABLE:

Sr No	X_A	X_B	Y	h	Initial Velocity		Final Velocity		Coefficient of restitution "e"
					u_A	u_B	$V = {}^{A}\sqrt{\quad}$	$V = {}^{B}\sqrt{\quad}$	
1	16.3	49.3	65	25	221.3	0	44.75	135.35	0.409
2	19.2	45	65	19.5	195.4	0	52.71	123.55	0.362
3	19.8	41.8	65	17.5	185.2	0	54.36	114.76	0.326

CALCULATION:

(i)Initial velocity(u_A) = √2gh

√2*980*25 = 221.3
√2*980*19.5 = 195.4
√2*980*17.5 = 185.2

(ii)Final velocities(V_A&V_B)

$V_A=X_A/\sqrt{(2Y/g)}$
$V_B=X_B/\sqrt{(2Y/g)}$

V_A=16.3/√(2*65/980)=44.75
V_B=49.3/√(2*65/980)=135.35

V_A=19.2/√(2*65/980)=52.71
V_B=45/√(2*65/980)=123.55

V_A=19.8/√(2*65/980)=54.36
V_B=41.8/√(2*65/980)=114.76

(iii)Coefficient of restitution"e"

$e = V_B - V_A / U_A$

(135.35-44.75)/221.3=0.409
(123.55-52.71)/195.4=0.362

(114.76-54.36)/185.2=0.326

RESULT: The coefficient of restitution ‘e’ for the different heights of steel balls is 0.409, 0.362 & 0.326 respectively.

CONCLUSION:

Hence, we have determined the coefficient of restitution between two steel balls.

Signature of faculty in-charge