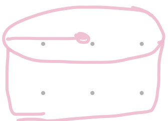
1. Measurment & Error

purpose. measure Density

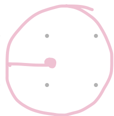
$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

unit g/cm^3

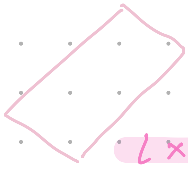
Volvem of shapes:



$V = \pi r^2 h$



$\frac{4}{3} \pi r^3$



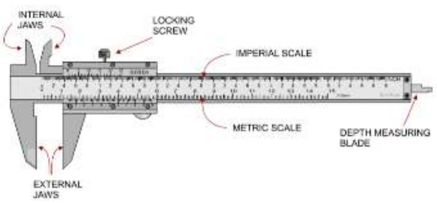
$l \times w \times$ thikness

Apparatus

1. Triple beam Balance

to find mass

2. Vernier Calliper



to find r or l or w

$$\text{zero value} + \frac{\text{line value} \times 0.01}{10}$$ from bottom

→ $\frac{25 + 5 \times 0.01}{10}$ → ☆ the scale is 10 points it's mm

→ to cm

or just devide all by 1000 mm → m

3. Micrometer Calliper

to find thikness

→ $\frac{6.5 + 8 \times 0.01}{10}$

$$\frac{\text{the not coverd value} + \text{zero value} \times 0.01}{10}$$

procedure

1. find Mass using T BB
2. Mesure Volume using Vernier caliper / micrometer
3. Calculate Density using calc
4. calculate error using calc

Relative Error

$$\frac{\text{real val} - \text{measured}}{\text{real}} \times 100$$

Conclusion.

measured Density

2. Thermal

purpose. Find Thermal Expantion Cofficent.

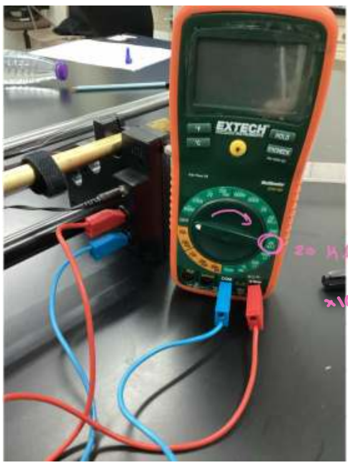
$$\alpha = \frac{\Delta L}{\Delta T\, L} \qquad \text{unit: } \frac{1}{C^{\circ}}$$

Apparatus

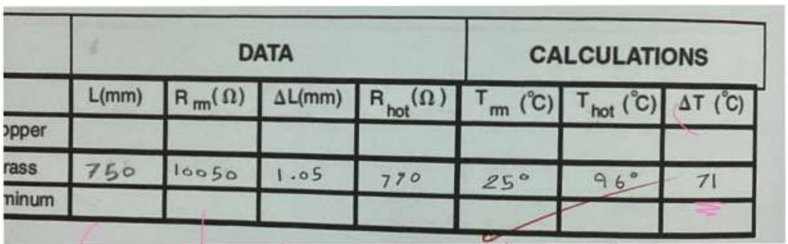
1. Metal tube
2. steam generator and water
3. Ruler
4. Oh'ms meter and wires
5. Thermostat / dial gauge

procedure

1. oppen the steam generator after adding water
2. mesure the length L of the Tube (from middle of Black circle Left to right)
3. mesure R from ohm meter then look in the table to find Tempreture
4. Apply the steam then mesure resistant from oh'ms meter and find final Tempreture from table.
5. mesure ΔL directly from digital guage
6. calculate thermal expantion $\frac{\Delta L}{\Delta T . L}$



Red → Temp (1rst connection)
Blue → Com (Sec connection)



	DATA				CALCULATIONS		
	L(mm)	R_{rm} (Ω)	ΔL(mm)	R_{hot} (Ω)	T_{rm} (°C)	T_{hot} (°C)	ΔT (°C)
opper							
rass	750	10050	1.05	770	25°	96°	71
minum							

ruler

from reading

R_{rm} = reading x 10^3 → Ω

then search table for T_{rm} = C°

from circle ◯ directly after Steam

after the Steam

from table

after the Steam from table

change in T

when water comes from tupe take values. (after they are stable)

3. Energy Conservation

purpose. Approve that Energy Is conserved

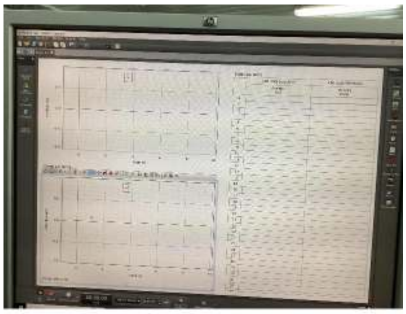
$KE_i + PE_i = KE_f + PE_f$

$KE = \frac{1}{2} m v^2$

$PE = mhg$

Apparatus

1. pasco software
2. motion Sensor
3. interface
4. free fall system

40 Hz

procedure

1. pasco sittings → chose 2 graphs + table
   - motion
   - velocity

   Data Sammary
   position → sittings → N. Format → 3 → okay

   * for position and velocity

2. connect motion Sensor with interface

3. Drop the ball on the sensor

+ Same connection in detals in Free fall exp.

4. collect data

   The Table will fill itself
   look for value when V = 0.00
   - take the value of position
   - then calculate 3/4 and look for the closest value of p in table
   take the value of V
   Same thing to find V when p = 1/2
   and p = 1/4

Calculate KE and PE.

Conc.

- total Energy at different hight are equal
- total Energy in closed System is conserved.

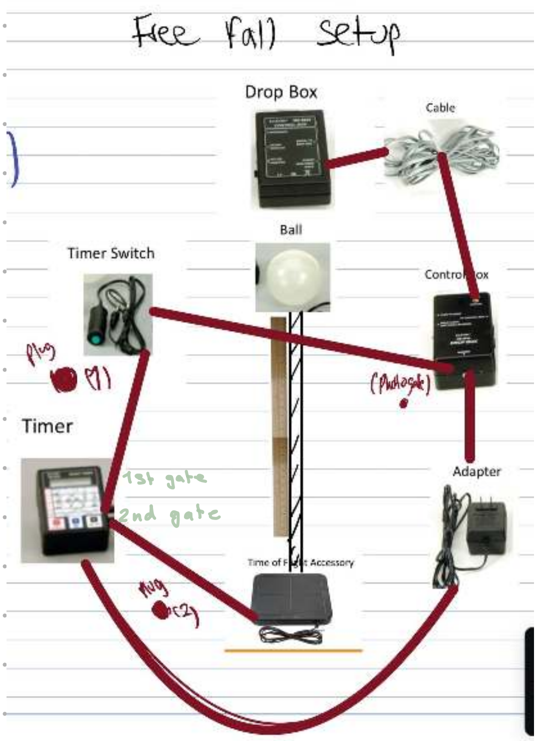
4. Free Fall

purpose. Study the relationship between Time and displacement on freely falling object, measure g

$$y_i = \frac{1}{2} g t^2$$

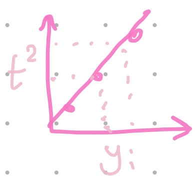
Apparatus.

1. Drop box
2. Control box
3. Time switch
4. adapter
5. Time of flight
6. Ball
7. Ruler
8. cable
9. timer



procedure.

1. connection
2. use ruler to measure initial distance y_i from the bottom of the ball to the Time of flight.
3. drop the Ball and read the timer
4. calculate the acceleration of gravity
   plog the time when hight = 80, 60, 40, 20, 0 and find t^2.
   plog the point on graph



find slop between any two points (not the ones u ploged).

$$\boxed{g = \frac{2}{\text{slop}}}$$

The real Value of g = 9.81
find relative error.

Conc.

calculated acc of gravity

5. vector

purpose: Finding resultant Force F_R
resultant angle θ_R
Equilibrant angle θ_e

$F = ma$

$F_x = F_{x_1} \cos\theta + F_2 \cos\theta$

$F_y = F_1 \sin\theta + F_2 \sin\theta$

$F_R = \sqrt{(F_x)^2 + (F_y)^2}$

$\theta_R = \tan^{-1}\left(\frac{F_y}{F_x}\right)$ $\theta_R = \theta_e - 180$ $\theta_e = \theta_R + 180$

Apparatus.

1. Force table
2. mass & hanger Set
3. protactor
4. Graph paper
5. pencil
6. ruler

Experimental
[always comming]

☆ m_1 θ_1 m_2 θ_2 will be givin.

1. add them to the table
(the blue hanger is 5g)
2. Try different m and θ until the circle is centered
3. now u have m_e θ_e
4. find F_R

$|F_R| = |F_e| = m_e g$

$\theta_R = \theta_E - 18$

Graphical

1. use protractor to draw θ_1 and use ruler to draw m_1 (the length is the grams ÷10)
if m = 45 g the legth = 4.5 cm
start from zero point
2. Same for m_2 θ_2 but start from wherever you end $m_1 \theta_1$
3. connect them to find m_R θ_R the θ take it
- from zero point
- m_R = cm ×10 → g
$\theta_e = \theta_R + 180$

Theoretical

apply Formelas

$F_x = F_1 \cos\theta + F_2 \cos\theta$

$F_y = F_1 \sin\theta + F_2 \sin\theta$

$F_R = F_E = \sqrt{F_x^2 + F_y^2}$

$\theta_R = \tan^{-1}\left(\frac{F_y}{F_x}\right)$

$\theta_E = \theta_R + 180$

Relative Error:
$\frac{\text{real value (from exp)} - \text{this}}{\text{real}} \times 100$

Conc.
calculated resultant force for two other forces

6. Projectiles

Purpose. determanation of the horizontal range (R) of projectile shot for various velocities and angles.

Zero lunch angle:

$t = \sqrt{\frac{2h}{g}}$ $R = v_0 \sqrt{\frac{2h}{g}}$ unit: m

General launch angle

$R = \left(\frac{V_i^2}{g}\right) \sin 2\theta$

Apparatus.

1. projectile launcher
2. smart timer
3. 2 photo gate heads
4. metric measerment tape
5. Carbon - while paper
6. Adapter
7. Loading Rod
8. Ball
9. tape + scissors

Procedure.

1. connect smart timer with two photogates
2. connect smart timer with adapter
3. put ball inside projectile (1-3 clics)
4. using ruler measure initial hight and d to measure initsial velocities and time

angle

draw line on Table

5. check angles

6. Turn on smart timer

7. pull the ball and mark where will it first hit the carboon paper
   (first try to see where u should place
   the white paper)

8. measure horizontal Range using metric measumat tabe.

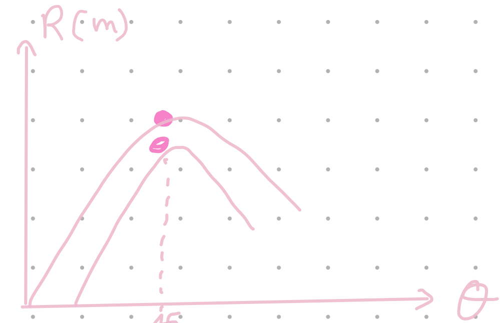
Relative Error

$$\frac{\text{real value (R calculated)} - \text{R mesured (Experemental)}}{\text{real}} \times 100$$

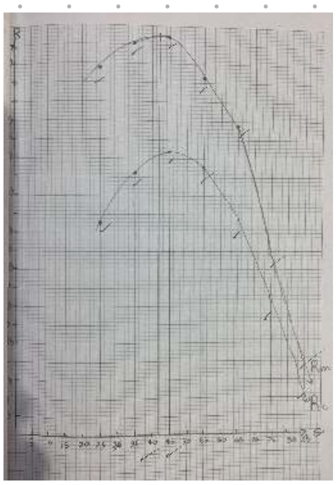
Gate 1 = short
Gate 2 = Medium
Gate 3 = Long

For General Launch Angle:

plog a graph between R measured and it's angle
R calculaten and it's angle



max at $\theta = 45°$



Conc.

used the equation of motion to determain R of projectile.

7. Newton Law

purpose. Finding mass of a car using newton's 2nd law By Studing the relation ship between a and F of the car

$$F = m\,a$$

by force sensor ← F m → our goal a → $a = \frac{v}{t}$

Apparatus.

1. force Sensor
2. dynamics System the road of the car
3. computer interface
4. pas car
5. pasco Software
6. Smart pully
7. mass and hanger Set
8. motion Sensor

Motion sensor

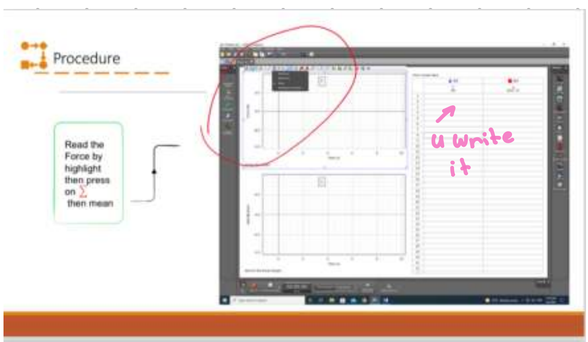
procedure.

☆ sitting → choose 3
+ chang Sign

1. open pasco - chose 2 graphs + table

2. Connect force / motion sensors to interface

3. add hanger and masses to the car
4. read the force and acceleration (slope of v,t)

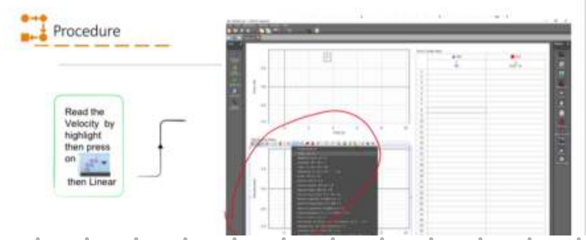


→ force (mean)

$$\boxed{\text{slope } \frac{\Delta F}{\Delta a}}$$

↳ the expermental m

compare it with real m to find Relative Error.



→ velocity (same time, linear slope)

8. Friction Force

purpose. find coefficant of static friction
find coefficant of Kinatic friction

$\mu_k = \frac{f_k}{N}$

$\mu_s = \frac{f_s}{N}$ → static friction f

N → N = W = mg

no unit

Apparatus.

1. force sensor
2. Triple bean balance
3. pasco software
4. computer interface
5. Friction Accessory + String
6. Bar masses
7. Motion Sensor

procedure.

1. open pasco + choose 2 graphs + Table
2. Connect motion / force Sensor to interface
3. connect force sensor with friction Accesory
   face the motion sensor to " "

4. read the f_s (Max) from the graph
   read the f_k (mean)

Relative error → depending on the material see the real value

Conc. $\mu_s > \mu_k$

4. Spring Force

purpose. find spring constant K

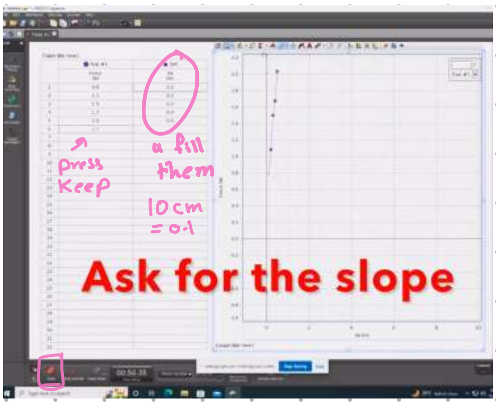
$F = K \Delta x$ → displasment

↓ our goal

Slope $\frac{\Delta F}{\Delta x} = K$

Apparatus.

1. Force Sensor
2. pasco
3. com interface
4. clamp
5. roler
6. springs



procedure.

1. open pasco, chose graph + Table Force + d
   - choose KEEP mode
   - change force sign
   - press zero on sensor
2. connect force sensor with interface
3. Connect the spring with the clamp + the force sensor. fix the roler
4. Expand the spring 10cm each time (press keep)

find K from the slop.

Long, Shiny, Doll — Expand

Heave, Light — compress

conc. found K for differend kinds of springs

10. momentom

purpose. investigate the conservation of momentom & Kinatic energy of a system in collision.

Elastic

$KE_i = KE_f$

Kinatic energy is conserved

Inelastic

K Energy is not conserved

P is conserved in Both

$$P = m \times v$$

$$KE = \frac{1}{2} m v^2$$

☆ $$P_{total\,i} = P_{total\,f}$$

Apparatus.

1. Mass balance
2. pasco
3. com interface
4. Dynamic track
5. two pas cars
6. Smart pully
7. 250 g mass
8. Rotary motion Sensors

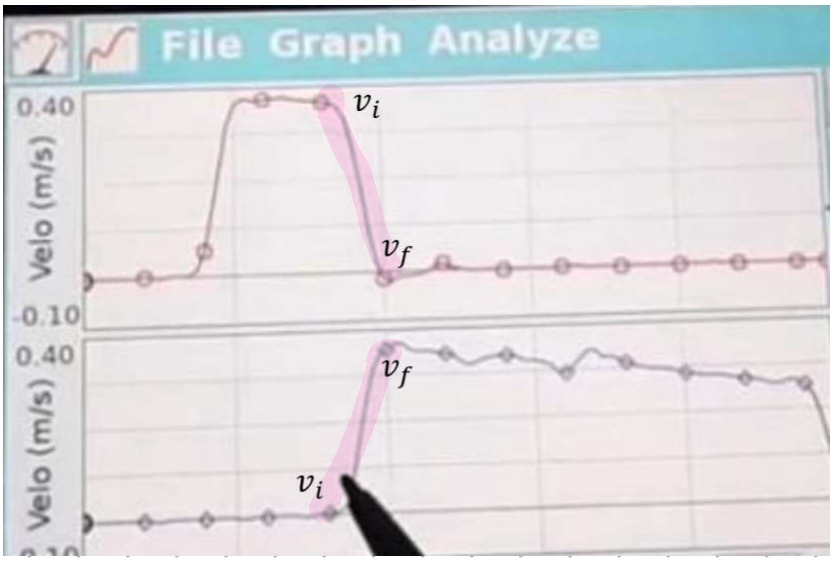
procedure.

☆ you have to add Senso manually (digital - RM) 1 and 2

1. open pasco, choose 2 graphs
2. Connect rotary-motion sensors with inteface
3. Do the collicions when $m_1 = m_2$, $m_1 \neq m_2$

Elastic Inelastic

4. From graph take values of $V_i - V_f$



moving car

stable car

☆ if u got negativ values exchange yellow and black gates

Highligt + find [min max]

$p = m \times v$

add p_i and p_f to find p_{total}

Relative error the inisial p is the real valve

Conc. the momentom in ellastic / inelastic is conserved.