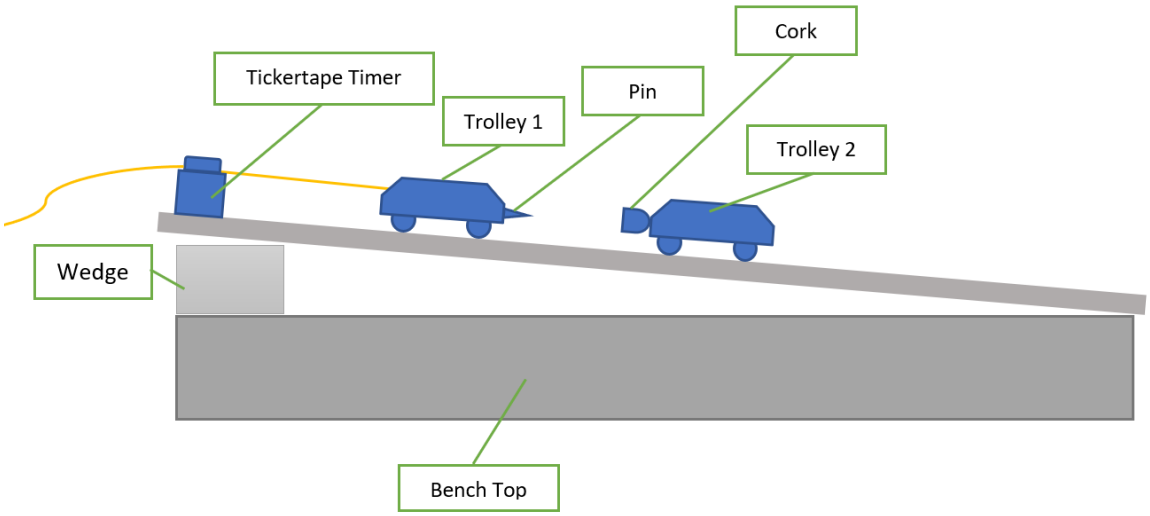
Aim: To Verify the Principle of Conservation of Momentum

Apparatus Needed: Runway, two trolleys with Velcro attached, Power Supply, Ticker Timer, Ticker Tape, Balance, and Ruler.

Precautions:

- Raise one end of the runway to negate friction and ensure the trolleys travel at a constant velocity.
- Dust the runway to remove any dirt or grit.
- Use trolleys with frictionless wheels.
- Ensure there is enough ticker tape out for the trolley to use.
- Zero the balance before measuring the mass of the trolleys.
- Position the trolleys so that they will collide and move off together (Use Velcro).

Diagram:



Method:

(1) Set up the apparatus as in the diagram.

(2) Switch on the ticker tape timer and give Trolley A a gentle push.

(3) After Trolley A and Trolley B have collided stop them before they reach the end of the runway.

(4) Stop the timer and remove the tape.

(5) Take ten spaces on the tape just before collision and divide this distance by 0.2 because each space is 0.02 of a second. Record this result as velocity before collision U_1 of Trolley A.

(6) Take ten spaces immediately after collision and divide this distance by 0.2. Record this result and velocity after collision V.

(7) Measure the mass of each trolley using a zeroed balance.

(8) Now find the momentum before and after collision using the formula:

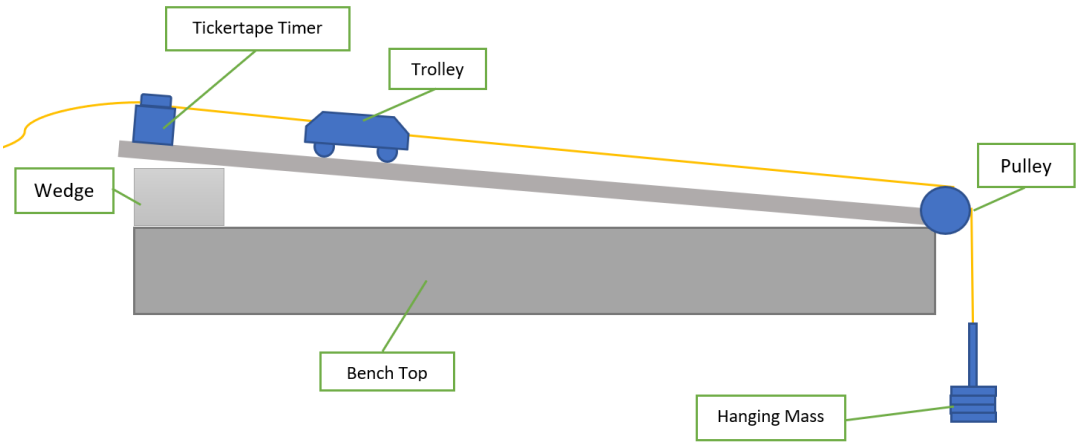
$$M_1U_1 + M_2U_2 = (M_1 + M_2)\,V$$

Aim: To Verify Newton's Second Law of Motion

Apparatus Needed: Runway, One trolley, Power Supply, Ticker Timer, Ticker Tape, Balance,

Precautions:

- Raise one end of the runway to negate friction.
- Dust the runway to remove any dirt or grit.
- Use a trolley with frictionless wheels.
- Ensure there is enough ticker tape out for the trolley to use.
- Zero the balance before measuring the mass of the trolley.



Method:

(1) Set up the apparatus as in the diagram.

(2) The runway is then tilted until the trolley moves with a uniform velocity (i.e. doesn't speed up) when given a small push.

(3) A force of 0.1 N (i.e. a mass of 100g) is placed on the scale pan and this causes the trolley to accelerate down the track.

(4) As the trolley moves, the ticker tape, which is attached to it, passes through the ticker tape timer and the resultant dots can be used to find the acceleration.

(5) Select two sets of five dots at either end of the tape and number them 0, 1, 2, 3 and 4. The time for the trolley to travel the distance between dot 1 and dot 4 is 4(1/50) s. The distance between the dots can be measured with a metre stick. The average velocity is calculated from speed = distance / time. Find initial and final velocities. To find the acceleration the number of dots between u and v is counted and this multiplied by 1 / 50s gives the time between u and v.

(6) Repeat steps 3 and 4 for forces of 0.2N, 0.3N,

(7) Now find the momentum before and after collision using the formula:

$$M_1U_1 + M_2U_2 = (M_1 + M_2)\,V$$

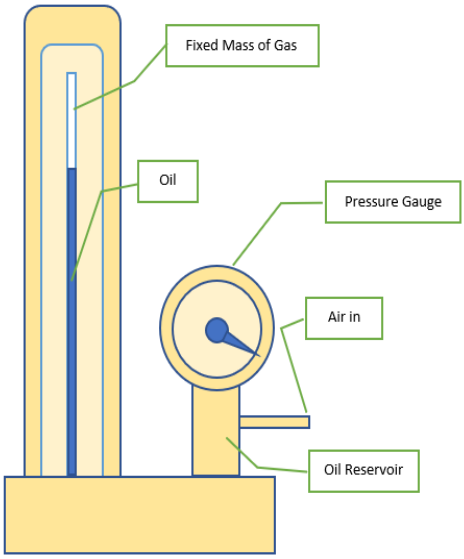
Aim: To Verify Boyle's Law

Apparatus needed: A Boyle's Law Apparatus, Air Pump, Hand Vacuum Pump.

Precautions:

- After changing the pressure of the trapped air wait a minute or two before reading the pressure or volume, to allow the air to reach room temperature. This is necessary because when the air is compressed or expanded there may be slight changes in temperature which will affect t the volume of gas) due to expansion or contraction)
- When reading volume make sure your eye is level with the Mercury Meniscus.
- Make sure air is connected tightly to oil reservoir in-let.
- If a hand suction pump is available, you will be able to reduce the pressure of the gas below atmospheric pressure. You can then take a future series of values of p and V include them in the table and graph.

Method:



1) Set up apparatus as shown in the diagram.

2) Connect air pump to the in-let of the oil reservoir.

3) Open air tap and pump in air until pressure gauge reads its max value.

4) Quickly close tap.

5) Leave for a minute or two, after changing the pressure of the trapped air wait a minute or two before reading the pressure or volume, to allow the air to reach room temperature. This is necessary because when the air is compressed or expanded there may be slight changes in temperature.

6) Then measure the gas pressure by reading it off the Bourdon gauge. Record these volumes.

7) Read the volume of gas off the scale next to the glass tube.

8) Gently open then quickly close tap to release some air.
9) Leave for a minute or two, then measure the gas pressure by reading it off the Bourdon gauge.
10) Record these values.
11) Repeat steps 7-9 at least six times until the pressure of the gas is back to atmospheric pressure
12) Plot a graph of pressure (p) against the inverse of volume (1/V)

Results:

The graph is a straight line through the origin, verifying that the pressure (p) is proportional to (1/V), verifying Boyles Law. Also, all values of pV are the same.

P α 1/V **therefore p=k(1/V)** **therefore *pV*=k**