AIR TRACK EXPERIMENTS

Using the IEC Linear Air Track and Photo Gates

SETTING UP FOR EXPERIMENTS: general info.

Connect the IEC Variable Air Blower to the track and adjust the air so that the short glider just glides smoothly. Do not use too much more air than required. Adjust the air track feet so that the track is level and the glider does not try to slide in either direction.

Push the extension legs firmly into an IEC Photo Gate and spread them and 'click' them to the edges of the track so that the Gate is firmly fixed to the track at about the mid point. Check that the glider will pass through the Gate but is too short to break the light beam.

Connect the Photo Gate to an IEC digital timer. Some IEC timers have power for the Photo Gate lights on the rear or end panel. Connect the light source to a 12V.AC or DC power source or use a 12V.AC or DC Plug Pak. Connect the 2 Gate cables to the **Start** sockets on the front panel. Use the correct polarity.

Use the **Function** button on the timer to select the **Photo Gate mode**. This mode allows the timer to run when the light is broken and to stop when the light is restored. If this is repeated, up to 20 readings will be stored in the timer's memory and can be recalled. There is no need to zero the display between runs.

Before the first run is made through the photo gates, always press **Stop** then **Reset** on the timer to zero the display. The timer will also automatically examine the connections made to the sockets and set itself into the correct operating mode.

To clear the memory of times from previous experiments, press the **Clear** button until 2 beeps are heard. Then test the Photo Gate by breaking the light beam with your finger. The timer should show the time that the light beam was broken in increments of 0.1 milliseconds. This reading will be displayed and also stored in memory. Any further readings will also be stored in memory with the last reading showing on the display.

USING FLAGS TAPED TO THE SIDE OF A GLIDER:

To measure the times taken for gliders to pass through the gates, a piece of stiff opaque card is taped to the side of the glider so that the card breaks the light beam of the gate.

When using gliders with a flag attached to the side, **ALWAYS** have the flag on the side furthest away from the light source and closest to the sensor. This will give you the sharpest light cutoff and the best timing accuracy.

NOTE:: For best motion accuracy, please read the following note:

Because of slight errors in cutting the card for flags and the sensitivity of the Photo Gate, it is important to check the exact distance travelled by the glider between the switching on and off of the photogate. The flag might be cut exactly 100mm long, but the actual distance travelled by the glider to switch on and off the gate might be slightly different from this dimension. Check as follows:

Very slowly slide the glider into the photo gate and, at the instant when the gate switches (see the monitor light on the gate), use a sharp pencil to mark the track with a fine line exactly level with the end of the glider. Then continue passing the glider through the gate and mark the track again at the instant the gate switches again. The exact distance between these lines is the **"effective"** length of the flag. It should be close to the cut length of the flag, but write this exact dimension on the flag for future reference when using this flag.

EXPERIMENTS:

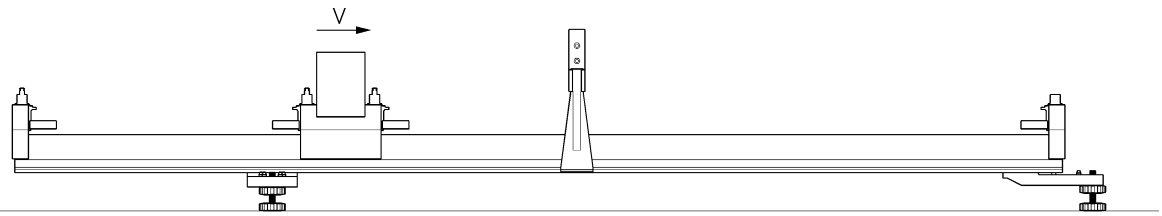
1) Measurement of velocity
2) Average velocity and instantaneous velocity
3) Average velocity over a long distance
4) Measurement of acceleration
5) Measurement of acceleration due to gravity
6) Acceleration of a constant mass by a variable force
7) Acceleration of a variable mass by a constant force
8) Momentum in 'sticky' collisions
9) Energy in 'sticky' collisions
10) Momentum in 'elastic' collisions
11) Energy in 'elastic' collisions
12) Conversion of gravitational potential energy to kinetic energy

EXP: 1 MEASUREMENT OF VELOCITY:

Velocity is: Distance travelled / Time D/t

SETUP:

The air track should be adjusted to be level and a glider should not try to move either direction.



METHOD:

Tape a 100mm long piece of black card to the side of a short glider so that the card breaks the light beam of the Photo Gate mounted across the track. Turn on the air and slide the glider through the Photo Gate. See the time displayed.

As a small experiment, see if you can repeat the same speed exactly. Try to slide it again through the Gate at exactly the same speed to get exactly the same time. Try a few times to see if you can read exactly the same speed.

NOTE:: For best motion accuracy, please read the following note:

Because of slight errors in cutting the card and the sensitivity of the Photo Gate, it is important to check the exact distance travelled by the glider between the switching on and off of the photogate. The flag might be 100mm long, but the actual distance travelled by the glider to switch on and off the gate might be slightly different from this dimension. Check as follows:

Very slowly slide the glider into the photo gate and, at the instant when the gate switches (see the monitor light on the gate), use a sharp pencil to mark the track with a fine line exactly level with the end of the glider. Then continue passing the glider through the gate and mark the track again at the instant the gate switches again. The exact distance between these lines is the **"effective"** length of the flag. It should be close to the cut length of the flag, but write this exact dimension on the flag for future reference when using this flag.

ANALYSIS:

All the readings are stored in the timer's memory. Press the MEM arrow down button to recall earlier readings. One by one, recall them all. If some are mistakes, you must erase these from the memory. To erase a reading from the set, press button marked **Purge** and hold it pressed for short time until 2 beeps are heard. The selected reading is now erased from the set. All the remaining readings are the ones when the glider validly passed through the gate.

Go back to the first reading when you first passed the glider through the gate. Note this reading.

Velocity is: Distance travelled / Time

Distance travelled is 100mm (or the **"effective"** length of your cardboard flag). The time is the reading shown on the timer in seconds for each time the glider passed through the Gate.

Divide the effective length of the flag in millimetres by the time in seconds and you have Velocity of the glider's movement in mm per second.

Divide the effective length of the flag by the average time in seconds (press the **Average** button on the timer until 2 beeps are heard to see the average of all the times) that you noted from the timer and you have the average velocity of all the tries.

Try the experiment again using a long glider and using a 200mm long flag.

FURTHER EXPERIMENT:

Now cut another flag say 10mm wide and check its **"effective"** length, Tape the original 100mm long flag displaced to one side and tape the 10mm wide flag beside it so that both flags will pass through the Photo Gate one after the other. Leave say 5mm between them.

Press the **Clear** button until beeps are heard to clear out the memory readings. Repeat the passing of the glider once gently through the gate.

Using the arrow button on the timer and note the first and second times. The time for the 100mm wide flag should be 10 times the value of the 10mm wide flag (or the ratio of the effective lengths). Calculate the velocities as shown above and note that, because the speed of the glider was constant, the velocities measured by the different flags are the same.

EXP: 2 AVERAGE VELOCITY and INSTANTANEOUS VELOCITY:

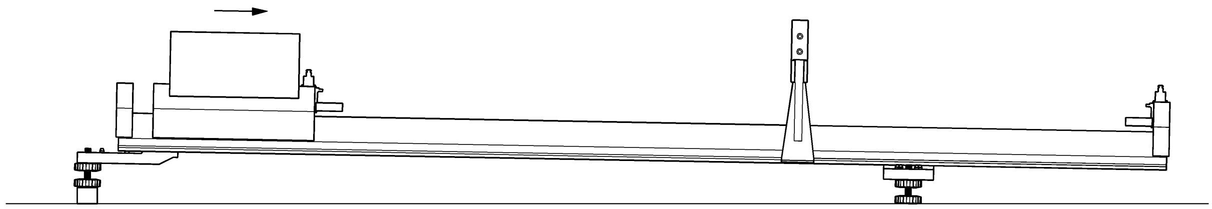
Instantaneous velocity is the velocity taken over an infinitely short distance. Average velocity is calculated from the time taken over a long distance.

If the glider velocity is changing, the measurement taken in experiment 1 using the 100mm wide flag will be the average velocity over the 100mm distance. The 10mm wide flag will provide the average velocity over a much shorter distance.

If the flag was 3mm wide, the velocity is almost the instant velocity because it is the average over a very short distance.

SETUP:

Lift the single track levelling adjustment screw at one end of the air track and place one of the track inclination blocks provided under the adjustable foot. Use the 20mm thick block. The blocks in the kit are marked with their thickness. The track has inclination and gravity will cause the gliders to slide down the track.



METHOD:

This time, use a 200mm long glider and a 200mm long flag. Repeat experiment 1 by holding the glider to one end of the track and gently releasing it so it glides **BY ITSELF** down the track. Before releasing the glider, be very careful not to compress the spring buffers or provide ANY other initial force to the glider. To be sure of this, it is often best to remove the buffers from the track end and the glider at the starting point.

ANALYSIS:

Measure average velocity of the glider through the Photo Gate using the 200mm wide flag (check the **"effective"** length of the flag). Repeat the motion 2 more times and, using the timer's averaging button, note the average of the 3 readings.

Remove the 200mm wide flag and replace it with the 10mm wide flag taped at the **MID POINT** of the glider. Release the glider in exactly the same way and note the average of 3 readings.

Reposition the 10mm flag to be level with the front end of the glider and repeat to get an average of 3 readings.

Reposition the 10mm flag to be level with the rear end of the glider and repeat to get an average of 3 readings.

* What do you notice about the readings ?

* Do the readings prove that the velocity is increasing as the glider moves along ?

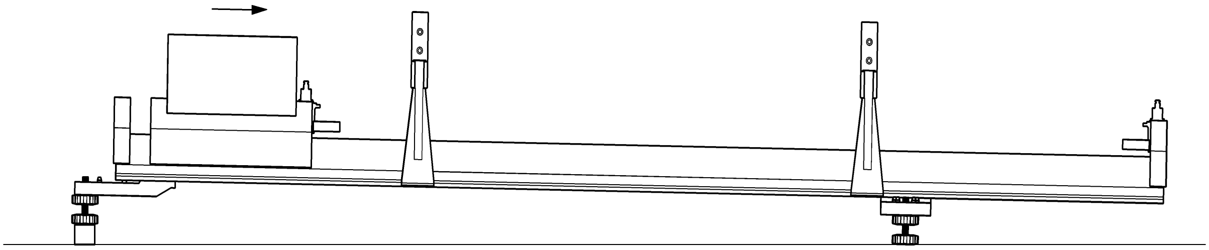
* To know the accurate velocity of the front end of the glider passing through the Gate, which flag would you use and where would you tape it ?

EXP: 3 AVERAGE VELOCITY OVER A LONG DISTANCE:

SETUP:

Use the same setup as the experiment 2 with the track on a slope, but now 'click' two Photo Gates at say 800mm apart on the track.

Use 2x 4mm banana plug cables to loop the power from the first Gate's light source to the second Gate. Use two more cables to connect the second Gate signal to the **Stop** sockets on the timer.



METHOD:

Use the **Function** button on the timer to select **Start/Stop** mode. This means that the front edge of the flag entering the first gate will start the timer and the same front edge of the flag entering the second gate will stop the timer.

Press **Stop** the **Reset** on the timer to zero the display and set the mode.

Use any flag taped to the side of a glider and, starting the glider at the higher end of the slope, release it carefully without adding any forces and allow the glider to pass forward through both gates.

Stop it before it rebounds back through the second gate.

As the front edge of the flag breaks the first gate the timer starts timing and as the front edge of the flag breaks the second gate, the timer will stop. The timer will show the time taken between the two breaks.

ANALYSIS:

Using the scale along the length of the Air Track, measure the distance between the centres of the two gates.

Divide this distance in millimetres by the time taken in seconds and calculate the average velocity of the glider between the two gates in mm/sec.

* Why is the average velocity measurement useful ?

AN EXAMPLE OF THE TWO TYPES OF VELOCITY MEASUREMENT:

If you take a long trip in a car, the car starts and stops and changes its speed along the way. The distance travelled and the time taken calculates the average velocity for the trip. This is needed to let you know how much time to allow for a car journey.

If a policeman stops you for speeding, he is interested only in your 'instantaneous speed' at the time his radar checked you. Your car speedometer is telling you your instantaneous velocity at any moment.

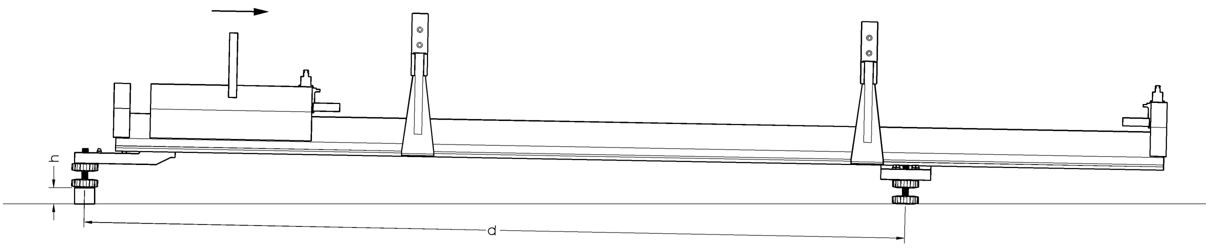
Both average and instantaneous velocities are very useful to be able to measure.

EXP: 4 MEASUREMENT OF ACCELERATION:

Acceleration is change of Velocity over Time: V/t Deceleration is: -V/t

SETUP:

Use the same setup as the experiment 3 with the Air Track on a slope. Leave the two Photo Gates fixed to the track at say 800mm apart.



METHOD:

Tape a 10mm wide flag and tape it to the side of a glider. Be sure the glider is placed on the track so that the flag is furthest away from the light source and closer to the sensor side of the gate. If necessary, check the **"effective"** length of the flag.

Initially, use the timer **Function** button to select **Start/Stop** mode and connect the first gate to the **Start** sockets and the second gate to the **Stop** sockets. Press **Stop** then **Reset** buttons to zero the display and to set the mode. Clear the timer memory by pressing the **Clear** button until 2 beeps are heard. Carefully release the glider so that the total time taken for the glider to pass from one gate to the other will be measured.

Repeat the motion 3 times and press the timer Average button until 2 beeps are heard to see and note the the average of the readings.

After this time is determined, the timer connection must be changed.

Connect the two gate signals together to the same **Start** sockets on the timer. Plug the 4mm banana plugs from the second Gate into the tops of the other 4mm plugs.

Use the **Function** button on the timer to select **Photogate** mode. In this setting, the first gate will start and stop the timer as the flag covers the light beam and the second gate will also start and stop the timer. Both readings are stored in memory and the second reading is displayed.

Note the reading on the timer and, using the memory recall (arrow down) button, the note the previously stored reading. If the glider is moving slowly enough, it is usually possible to take note of the first time as it is measured and to take note of the second time at the finish. This avoids needing to use the memory recall button.

Repeat the experiment two or three more times and average the readings from the first gate and from the second gate.

ANALYSIS:

Calculate the two velocities and subtract them to get the change in velocity.

Take the average time taken for the glider to pass between the two Gates.

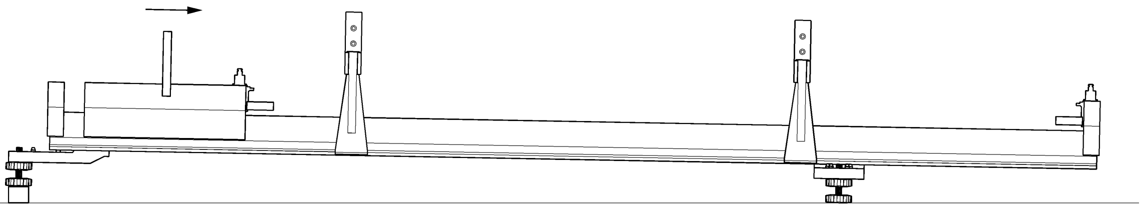
Divide the change in velocity by the time taken between the gates to have average acceleration in **mm/sec/sec** **or** **mm/sec^2**

EXP: 5 MEASUREMENT OF ACCELERATION DUE TO GRAVITY:

SETUP:

The setup is exactly the same as in the previous experiment. Set the air flow so that heavier gliders will float on the track without dragging.

The angle of the track will be altered and the glider will be changed in weight and the average accelerations measured. The force due to gravity acting on the glider will be calculated by using vectors.



METHOD:

The acceleration down the Air Track should follow Newton's laws of motion and gravity.

Pre-set several long and short gliders with extra weights. Say 100g, 150g, 200g and 300g. **Check each glider's exact mass on a balance.** With the track set to the existing angle, place one glider behind the other and see if one races the other down the track. Try say 100g against 200g and 150g against 300g.

Repeat experiment 4 to measure average acceleration of different mass gliders.

Change the angle of the Air Track to maybe half or double the present angle.

Check average acceleration again for the various mass gliders.

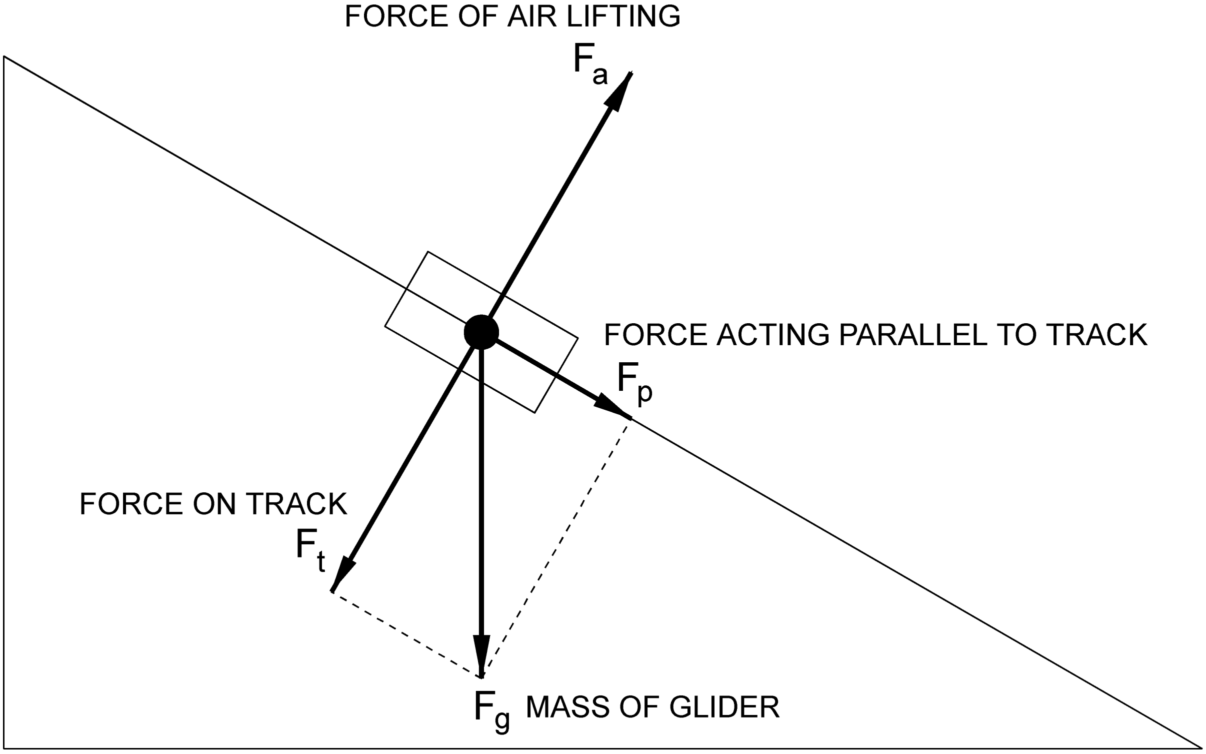
Measure the exact height (h) of the inclination blocks (the thickness is marked on them) and the distance (d) between the feet along the Air Track to determine the exact angle of inclination. **Sine angle = h/d (opposite side over hypotenuse)**

ANALYSIS:

* What did you notice when you tried to race the gliders of different mass down any Air Track slope ?

* Does this mean that there is a "constant" phenomenon acting on all the gliders of different masses ?

Calculate the slope angle by using **sine angle = h/d**. Then using vectors and the value of the various slope angles to determine what proportion of the forces due to gravity are acting down the slope. Then you can determine how much of the weight of the glider is pushing it down the slope.



From the diagram above, the force of the air lifting F_a equals and cancels the force at the normal to the track F_t. The remaining forces are the action of gravity vertically F_g and also parallel with the track down the slope F_p.

Knowing the Force of gravity acting down the slope and knowing the mass of the glider, use the formula **F=ma** to determine the expected acceleration down the slope due to gravity.

* Are your measurements close to the correct figure of the acceleration due to gravity ?

EXP: 6 ACCELERATION OF CONST.MASS BY VARIABLE FORCE:

SETUP:

The setup is the same as Experiment 3 using two Photo Gates, **BUT** this time make the air track exactly level so that a glider does not try to float either direction.

On one end of the track, fit the plastic pulley by sliding the plastic strip holding the pulley into the groove in the end fitting of the track. Tighten the flat-top screw to clamp the strip into the end fitting.

Take a 200mm long glider complete with its spring buffers fitted and add the 100g mass to make the total mass 300g. **Check the exact mass on a balance.** Tape the 100mm long flag to the side of the glider and check the exact distance ("effective" length) of glider movement that makes the photo gate switch on and off.

Take a piece of fine thread and form a loop at one end. Place the glider on the track and adjust the air blower so the glider floats freely.

Pass the loop in the thread over the grooved peg extending from the screw that holds the buffer spring into the end of the glider.

Position the air track so the pulley overhangs the end of the work bench. Place the thread over the pulley and tie a 10g mass to the thread. Make the length of the thread correct so that when the 10g mass is released to fall to the floor, it will pull the glider along the track through both gates.

METHOD:

Use the **Function** button to set **Photogate** mode and join both gates to the same **Start** sockets as in previous experiments.

Press the **Stop** then **Reset** buttons on the timer to reset the display and set the switching mode. Clear the memory of the timer.

Hold the glider at one end of the track and the weight should be at the highest point. Release the glider and it will be pulled through the two gates by the falling weight. Do not allow the glider to rebound.

Take the two times from the timer (the first gate time will be stored in memory). Note the two times.

Repeat the motion 3 times to note the average for each of the gate times.

Now, set **Start/Stop** mode on the timer and put the second gate plugs into the **Stop** sockets of the timer. Press **Stop** then **Reset** buttons to zero the display and set the mode. Clear the memory of the timer.

Using the same 300g glider and releasing the glider in exactly the same way, measure the time for the glider to travel between the two gates. Repeat this 3 more times to get an average of the time between the two gates.

Now repeat the above experiment using say a 25g mass on the thread.

Then repeat the experiment using say a 50g mass on the thread.

Document all the results as below:

m = mass of glider m_w = mass of falling weight

t_1 = time through 1st gate t_2 = time through 2nd gate t_3 = time between gates

v_1 = av.velocity 1st gate v_2 = av.velocity 2nd gate a = average acceleration

F_g = force applied to the glider by the falling mass.

m	m_w	t_1	t_2	t_3		v_1	v_2	a	F_g

Prove the formula **F = ma**

EXP: 7 ACCELERATION OF VARIABLE MASS BY CONST.FORCE:

SETUP:

The setup is the same as the previous experiment using two Photo Gates. The air track must be exactly level so that a glider does not try to float either direction.

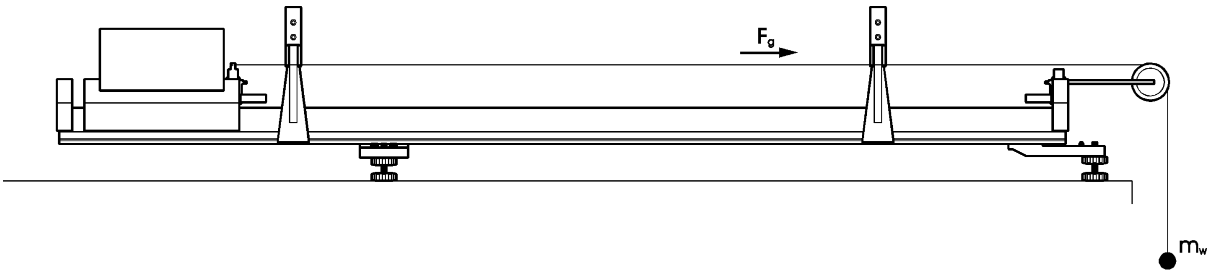
On one end of the track, fit the plastic pulley by sliding the plastic strip holding the pulley into the groove in the end fitting of the track. Tighten the flat-top screw to clamp the strip into the end fitting.

Take a 200mm long glider complete with its spring buffers fitted and remove any added weights. **Check the exact mass on a balance.** Tape the 100mm long flag to the side of the glider and, if not performed previously, check the exact distance of glider movement that makes the photo gate switch on and off (the "effective" length of the flag).

Take a piece of fine thread and form a loop at one end. Place the glider on the track and adjust the air blower so the glider floats freely.

Pass the loop in the thread over the grooved peg extending from the screw that holds the buffer spring into the end of the glider.

Position the air track so the pulley overhangs the end of the work bench. Place the thread over the pulley and tie a 25g mass to the thread. Make the length of the thread correct so that when the 25g mass is released to fall to the floor, it will pull the glider along the track through both gates.



METHOD:

Use the **Function** button to set **Photogate** mode and join both gates to the same **Start** sockets as in previous experiments.

Press the **Stop** then **Reset** buttons on the timer to reset the display and set the switching mode. Clear the memory of the timer.

Hold the glider at one end of the track and the weight should be at the highest point. Release the glider and it will be pulled through the two gates by the falling weight. Do not allow the glider to rebound.

Take the two times from the timer (the first gate time will be stored in memory). Note the two times.

Repeat the motion 3 times to obtain the average for each of the gate times and note them.

Now, set **Start/Stop** mode on the timer and put the second gate plugs into the **Stop** sockets of the timer. Press **Stop** then **Reset** buttons to zero the display and set the mode. Clear the memory of the timer.

Using the same glider and releasing the glider in exactly the same way, measure the time for the glider to travel between the two gates. Repeat this 3 more times to get an average of the time between the two gates.

Now repeat the above experiment using the same 25g mass but add weights to the glider.

Document all the results as below:

m = mass of glider m_w = mass of falling weight

t_1 = time through 1st gate t_2 = time through 2nd gate t_3 = time between gates

v_1 = av.velocity 1st gate v_2 = av.velocity 2nd gate a = average acceleration

F_g = force applied to the glider by the falling mass.

m	m_w	t_1	t_2	t_3		v_1	v_2	a	F_g

Prove the formula **F = ma**

EXP: 8 MOMENTUM - in 'sticky' collisions:

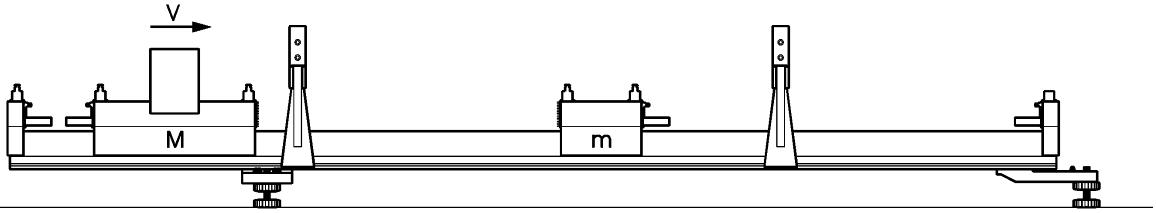
SETUP:

Set the air track as level as possible where the glider will not float in either direction. Take a long glider, remove the buffer spring from one end and fit a "Velcro" pad to replace the normal buffer spring. Load this glider with an extra 100g. Take a short glider and fit the mating "velcro" pad to one end while leaving a buffer spring fitted to the other end. Do not load it with extra weight. Weigh both gliders.

Set up 2x Photo Gates across the track about 500mm apart and join them together to the same **Start** sockets of the timer.

Using the **Function** button, set the timer to **Photogate** mode. Press **Stop** then **Reset** to zero the display and to set the operation mode of the timer. Clear the memory of the timer.

Tape a 100mm long flag to the 200mm long glider. If not already done, check the "effective" length of this flag. Place the 200mm glider at one end of the track and place the lighter glider between the two gates with the "Velcro" pads facing.



METHOD:

By hand, start the motion of the heavy glider to make it pass through the first gate to measure the average velocity. After it strikes and sticks to the second glider, we then measure the new average velocity as the pair of gliders pass through the second gate. As the heavy glider sticks to the second glider, the total mass will increase and the velocity will decrease.

ANALYSIS:

Let 'M' be the mass of the heavy glider. Let 'm' be the mass of the lighter glider.

Let 'V' be the velocity of the heavy glider through the first gate.

Let 'v' be the velocity of the combined mass of both gliders passing through the second gate.

Initial momentum = MxV (initial mass x initial velocity)

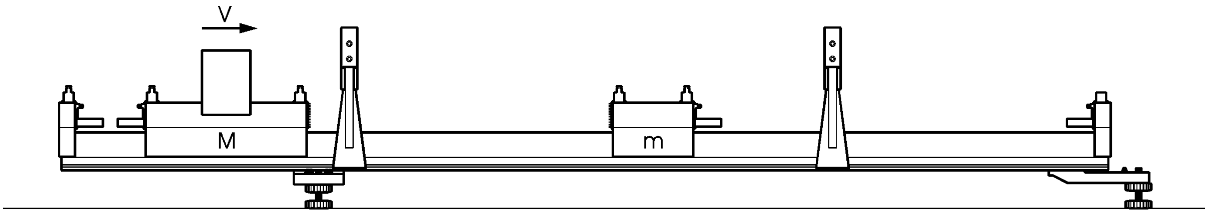
Final momentum = (M+m) x 'v' (total mass x final velocity)

*** Is momentum conserved ?**

EXP: 9 ENERGY - in 'sticky' collisions:

SETUP:

This is the same setup exactly as the previous experiment.



METHOD:

Use the same method and use the same results and tabulations.

ANALYSIS:

Let 'M' be mass of first glider. Let 'm' be mass of the lighter glider.

Let 'V_1' = initial velocity of 1st glider Let 'V_2' = initial velocity of 2nd glider.

Let 'V_b' = final velocity of both gliders stuck together.

Calculate the kinetic energy of the first glider before the collision: $1/2\ MV_1^2$

Calculate the kinetic energy of the first glider after the collision: $1/2\ MV_b^2$

Calculate the kinetic energy of the second glider before the collision: $1/2\ mV_2^2$

Calculate the kinetic energy of the second glider after the collision: $1/2\ mV_b^2$

Calculate the loss of kinetic energy from the first glider after the collision.

$1/2\ M(V_1^2 - V_b^2)$

Calculate the gain in kinetic energy in the second glider after the collision.

$1/2\ m(V_2^2 + V_b^2)$ (remember glider was stationary, so 'V_2' was zero)

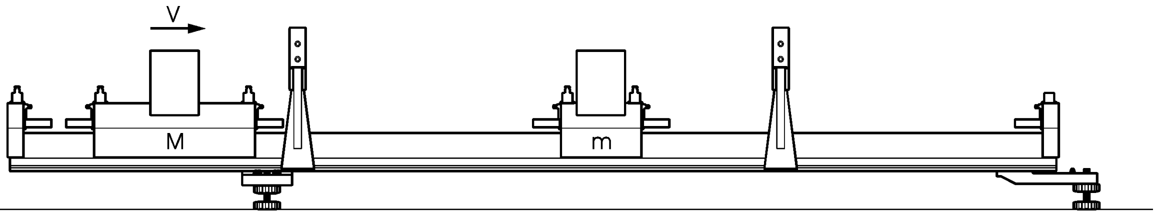
*** Is kinetic energy conserved ?**

EXP: 10 MOMENTUM - in 'elastic' collisions:

SETUP:

Repeat the same setup as experiment 8, BUT this time remove the 'Velcro' pads from the ends of the gliders and replace them with the spring buffers. Also, this time, fit a 100mm long flag to the lighter glider.

Because the gliders will bounce quickly away from each other, it is useful to practise a few times to be sure the gliders pass through the gates AFTER they have separated from each other. Also, after the collision, it will be necessary to quickly stop a glider or to remove it from the track to avoid rebounding back through a gate.



METHOD:

The method is the same as in experiment 8 and the results can be tabulated in the same way. The time through the second gate will be separate times made by the smaller glider and the larger glider separately. The calculations are the same as experiment 8 but the two separate mass and times through the second gate must be added to get the total momentum of both gliders.

This experiment is initially done with the second glider stationary, but it can be repeated with the second glider moving towards the first glider or away from it before the collision occurs. When both gliders are moving, you must be very careful with your timing of the collision so that all initial and final velocities are measured for both gliders.

ANALYSIS:

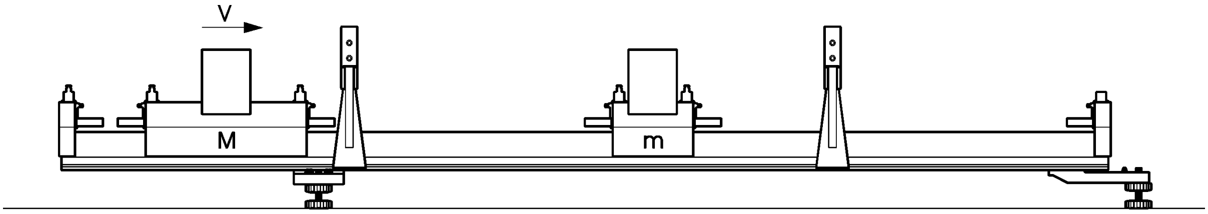
The analysis is the same as in experiment 8.

EXP: 11 ENERGY - in 'elastic' collisions:

SETUP:

Repeat the same setup as experiment 9, BUT this time remove the 'Velcro' pads from the ends of the gliders and replace them with the spring buffers. Also, this time, fit a 100mm long flag to the lighter glider.

Because the gliders will bounce quickly away from each other, it is useful to practise a few times to be sure the gliders pass through the gates AFTER they have separated from each other. Also, after the collision, it will be necessary to quickly stop a glider or to remove it from the track to avoid rebounding back through a gate.



METHOD:

The method is the same as in experiment 9 and the results can be tabulated in the same way. The time through the second gate will be separate times made by the smaller glider and the larger glider separately. The calculations are the same as experiment 9 but the two separate mass and times through the second gate must be added to get the total energy of both gliders.

This experiment is initially done with the second glider stationary, but it can be repeated with the second glider moving towards the first glider or away from it before the collision occurs. When both gliders are moving, you must be very careful with your timing of the collision so that all initial and final velocities are measured for both gliders.

ANALYSIS:

The analysis is the same as in experiment 9.

EXP: 12 CONVERSION OF GRAVITATIONAL POTENTIAL ENERGY TO KINETIC ENERGY:

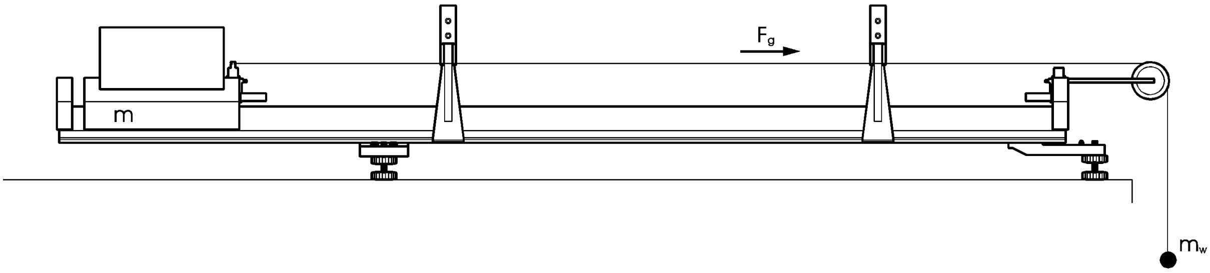
SETUP:

The track must be set level for this experiment and one gate is placed across the track at about 300mm from the end of the track.

The pulley is fitted into the end of the track as in experiment 6 and 7 and the thread with a loop tied at one end is used to attach a falling mass to a glider.

The thread must be arranged so that the weight hits the floor **BEFORE** the glider flag enters the gate.

The weight should accelerate the glider from zero and, when the weight hits the floor, the glider will continue to move **but at constant velocity.**



METHOD:

Using a balance, measure the weight of the glider with the 100mm long flag taped to it. If not done previously, check the "effective" length of the 100mm long glider flag.

Loop the thread over the peg extending from the buffer spring attachment screw. When the glider is held against the end of the track and the weight is at its highest point, carefully measure the distance from the bottom of the weight to the floor. This is the distance that the weight will be accelerating the glider before the glider moves at constant velocity.

Do a trial to check that the weight hits the floor before the glider enters the gate.

Set the timer to **Photogate** mode and connect the gate to the **Start** sockets. Press **Stop** then the **Reset** button on the timer to zero the display and to set the switching mode.

Release the glider and allow the weight to fall to the fall and note the time for the glider to pass through the gate. Repeat the experiment 3 more times to obtain an average of the time.

ANALYSIS:

Calculate the velocity of the glider after the weight has finished acting upon it.

Calculate the change of gravitational potential energy of the fallen weight. This is **mass x height fallen x g.**

Knowing the mass of the glider and the mass of the weight and the final velocity of the masses, calculate the kinetic energy of the combination of the glider and the mass together.

* Does this experiment prove the conservation of energy ?

* Explain where 'losses' would make the experiment lose accuracy. For example, friction in the pulley pivot, air friction on the moving parts.

FURTHER EXPERIMENT:

Repeat the experiment several more times using heavier and heavier masses so that the glider and mass velocities become greater.

* After calculating the energies, do you notice that the accuracy is becoming better or worse ?

* Try to explain why.