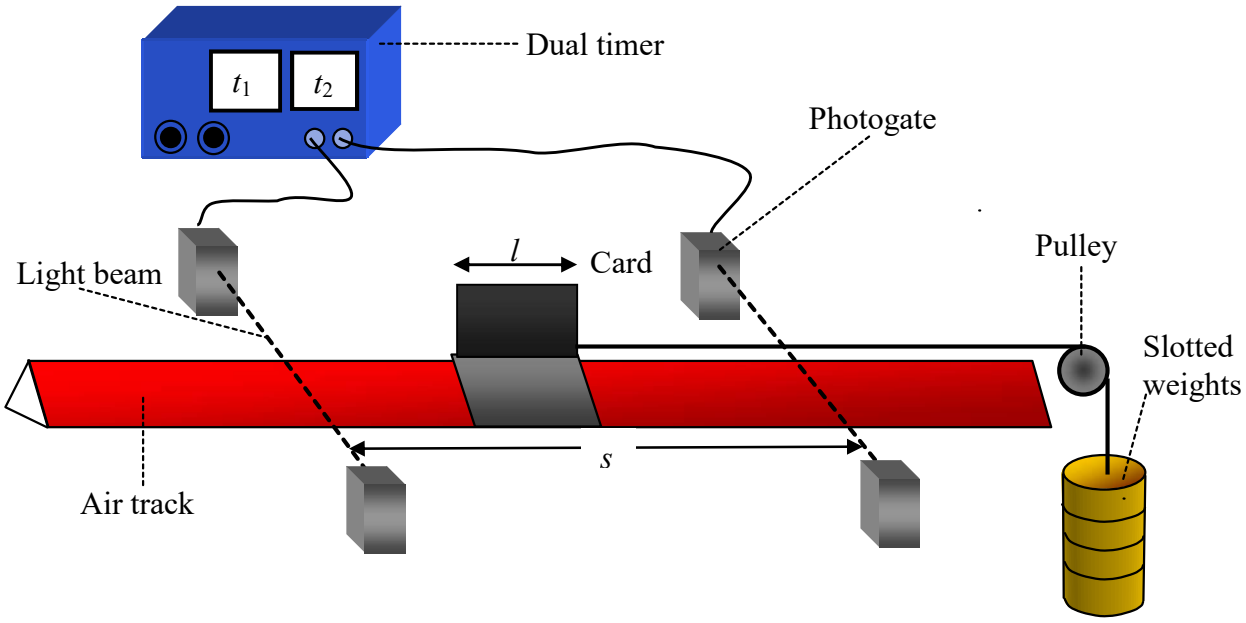
## TO SHOW THAT $a \propto F$

## Apparatus

Air-track with one vehicle, pulley and blower, two photogates, two retort stands, dual timer, metre-stick, black card, set of slotted weights (1 N total).




## Procedure

1. Set up the apparatus as in the diagram. Make sure the card cuts both light beams as it passes along the track.
2. Level the air track.
3. Set the weights $F$ at 1 N. With the card at one end of the track start the blower and release the card from rest.
4. Note the times $t_1$ and $t_2$.
5. Remove one 0.1 N disc from the slotted weight, store this on the vehicle, and repeat.
6. Continue for values of $F$ from 1.0 N to 0.1 N.
7. Use a metre-stick to measure the length of the card $l$ and the separation of the photogate beams $s$.
8. Record results as shown.
9. Draw a graph of $a$/m s$^{-2}$ against $F$/N.

## Results

$l$ = ……. m.

$s$ = ……. m.

Initial velocity $u = \frac{l}{t_1}$

Final velocity $v = \frac{l}{t_2}$

Acceleration $a = \frac{v^2 - u^2}{2s}$

| $F$/N | $t_1$/s | $t_2$/s | $u$/m s$^{-1}$ | $v$/m s$^{-1}$ | $a$/m s$^{-2}$ |
|---|---|---|---|---|---|
| 1.0 | | | | | |
| 0.9 | | | | | |
| 0.8 | | | | | |
| 0.7 | | | | | |
| 0.6 | | | | | |
| 0.5 | | | | | |
| 0.4 | | | | | |
| 0.3 | | | | | |
| 0.2 | | | | | |
| 0.1 | | | | | |

## Conclusion

A straight line through the origin shows that, for a constant mass, the acceleration is proportional to the applied force.

## Notes

The total accelerating mass must be kept constant; hence the need to transfer the masses. Block the ten pairs of air holes nearest the buffer/pulley end of the track with cellotape. This part of the track will now act as a brake on the vehicle.

Occasionally check the air holes on the linear air-track with a pin, to clear any blockages due to grit or dust.

This experiment may be performed using a trolley on a friction-compensated ramp.