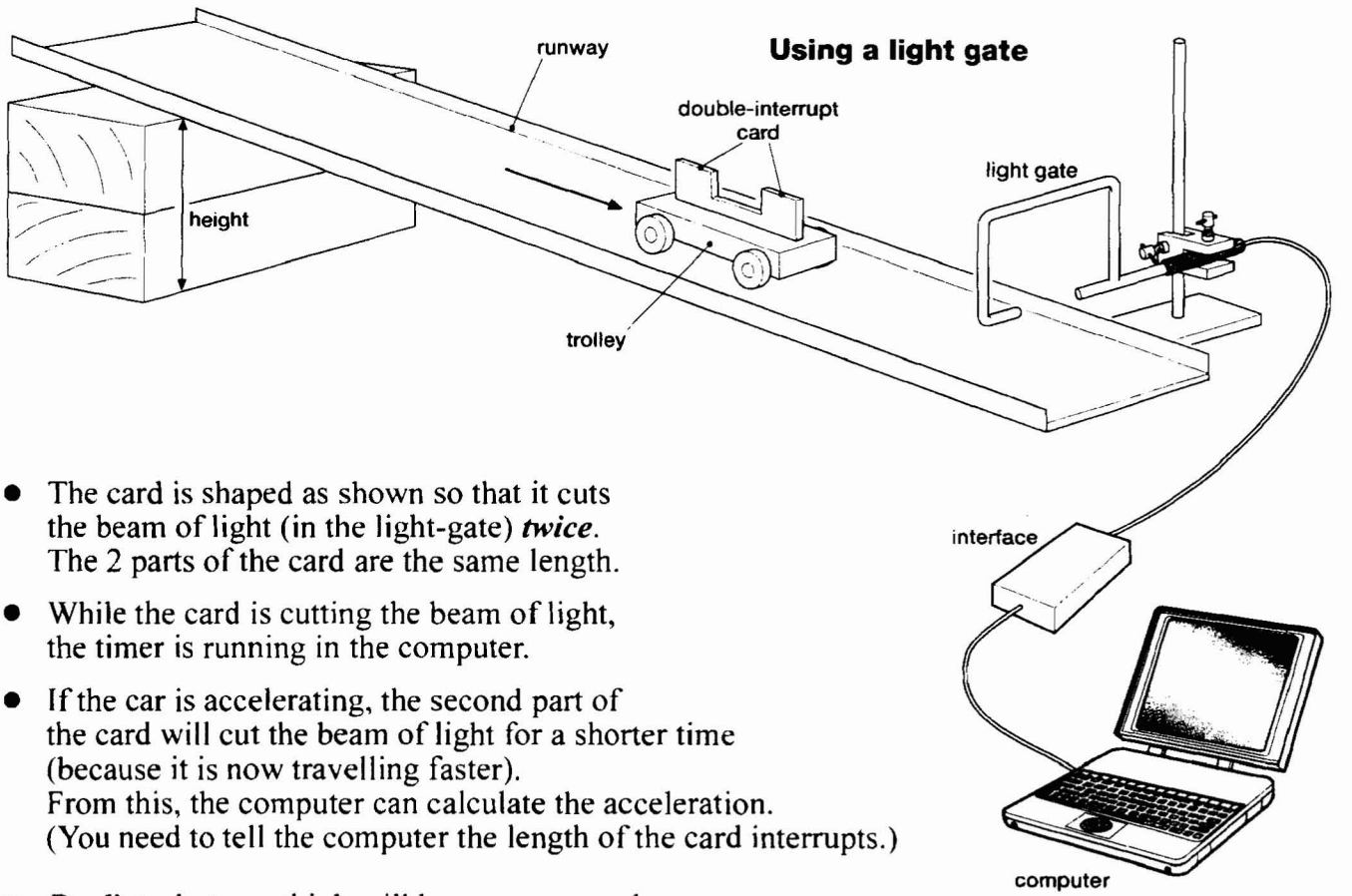
pages 130, 137

Investigating acceleration

Help Sheet

How does the acceleration of a car depend on the steepness of the slope?

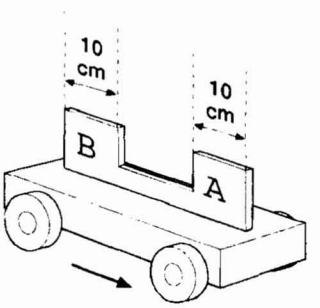


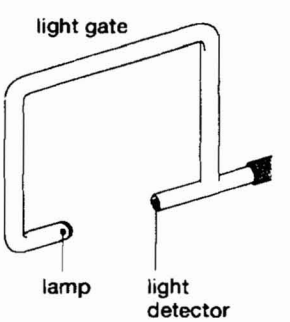
- The card is shaped as shown so that it cuts the beam of light (in the light-gate) ***twice***. The 2 parts of the card are the same length.
- While the card is cutting the beam of light, the timer is running in the computer.
- If the car is accelerating, the second part of the card will cut the beam of light for a shorter time (because it is now travelling faster). From this, the computer can calculate the acceleration. (You need to tell the computer the length of the card interrupts.)
- ***Predict*** what you think will happen as you change the steepness of the slope, or the weight of the car.
- Test your predictions by experiments.

How does the computer calculate the acceleration?

Suppose that while the first part (A) is cutting the beam of light, the timer counts 0.2 seconds. Then (from page 130):

$$\text{Average speed} = \frac{\text{distance travelled}}{\text{time taken}} = \frac{10\text{ cm}}{0.2\text{ s}} = 50\text{ cm/s}$$





Suppose a similar calculation for B gives 80 cm/s

Now suppose the time taken to travel from the middle of A to the middle of B is measured by the timer as 0.3 seconds.

Then (from page 130):

$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{time taken for change}} = \frac{80 - 50}{0.3} = \frac{30}{0.3} = 100\text{ cm/s}^2\ (1\text{ m/s}^2)$$

PROBLEMS

	a	v	u	t	WORKING OUT	ANSWER (WITH UNITS)
1	?	25 m/s	0	5 s		
2	?	50 km/h	20 km/h	10 s		
3	10 m/s^2	100 m/s	10 m/s	?		
4	5 km/h/s	40 km/h	20 km/h	?		
5	5 cm/s^2	?	0	15 s		
6	20 m/s^2	400 m/s	?	10 s		
7	?	16 m/s	64 m/s	8 s		

8. A train starts from rest and reaches a speed of 50 m/s in 9.5 s. What is the acceleration?

9. A racing car in the Macau Grand Prix brakes as it approaches a corner. If its velocity drops from 80 m/s to 10 m/s in the space of 3 s what is its deceleration?

10. A tanker moving at a speed of 3.5 m/s switches the engines off and comes to rest. If the deceleration is 0.25 m/s^2 , find how long it takes for the tanker to stop.