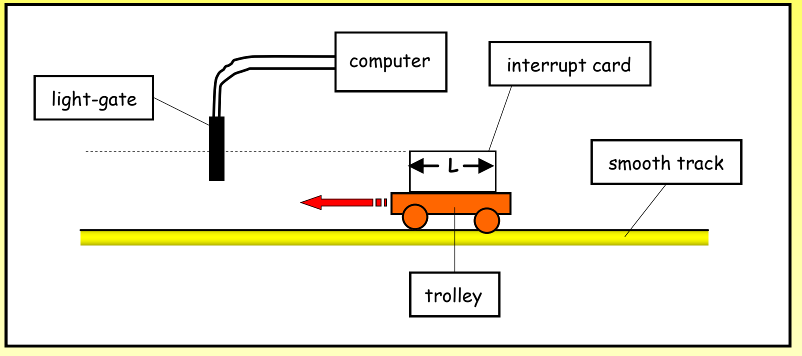
PRACTICAL WORK

1. MEASURING SPEED

- The apparatus shown below can be used to measure **speed** in the laboratory.



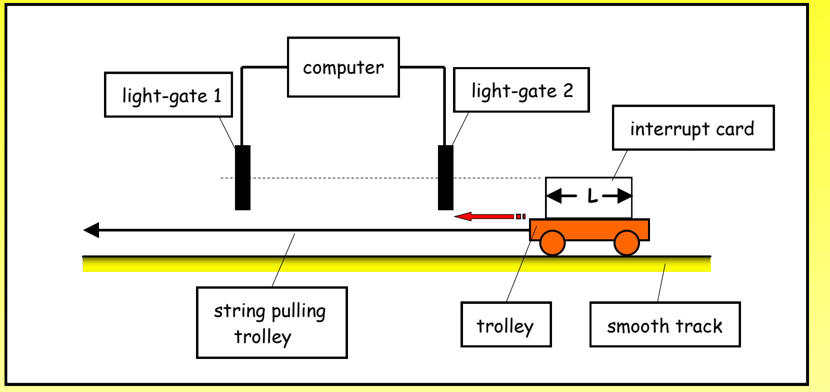
- As the trolley enters the light-gate, the leading edge of the 'interrupt' card (of length = L) breaks the light beam in the gate and this automatically starts the timer in the computer.

- Once the trailing edge of the card has passed through the gate, the light beam is no longer interrupted and the timer stops.

- The computer then calculates the **speed (s)** of the trolley from :

$$\text{speed } (s) = \frac{\text{length of card } (L)}{\text{time for card to pass gate } (t)}$$

2. MEASURING ACCELERATION



- The trolley is released from rest and it is pulled along by a weighted string which passes over a pulley at the end of the track.

- The interrupt card on the trolley breaks the light beam as it passes through **light-gate 1** and this enables the computer to work out the trolley's **initial velocity (v_i)**.

- The trolley then continues to accelerate for a **time (t)** until it enters **light-gate 2** and the card breaks the light beam as it passes through.

- The computer automatically calculates the trolley's **final velocity (v_f)** as well as the **time (t)** over which the acceleration occurs (this is the time taken by the trolley to move from **light-gate 1** to **light-gate 2**).

- The trolley's **acceleration (a)** is given by :

$$a = \frac{v_f - v_i}{t}$$

and this is also automatically calculated by the computer.

3. THE WORLD'S FASTEST INDIAN DISTANCE-TIME GRAPH ACTIVITY

- The film used for this activity is based on the true story of New Zealander **Burt Munro**, who spent 20 years modifying a 1920 Indian Scout motorcycle. He used it to set the land-speed record for bikes under 1000 cc at **Utah's Bonneville Salt Flats in 1967**……… a record which still stands today! Burt was **68** years old and was riding a **47** year old machine when he set the record!

- Watch the film clip and complete the table shown below by noting the bike's speed which is given as the bike goes through each mile marker.

- Use : **speed = distance / time**

to calculate the **time (hours)** taken to cover **each mile**.

DISTANCE / miles	SPEED / mph	TIME / hours
1		
2		
3		
4		
5		
6		
7		
8		

- Use the data in your table to plot a **DISTANCE-TIME** graph. Remember to **label the axes** and **include units**.

QUESTIONS

- What was the bike's **speed** at **4.5 miles**?

- How far would Munro have travelled after **0.03 hours**?

- At what **speed** would you predict that Munro might have been travelling (had he not crashed) if he had reached the **9-mile** marker?

- The distance-time graph yields a curve which slopes upward slightly. What does this tell you about the bike's motion?

- After crashing, describe how the shape of the graph would change as the bike comes to rest. Use a sketch graph to illustrate your answer.

4. TERMINATOR 2 VELOCITY-TIME GRAPH ACTIVITY

- In this activity, you will view a clip from the film **Terminator 2** and use it to obtain data from which you can plot a detailed **velocity-time** graph.

- Pupils should work in pairs and it is advisable to view the clip a couple of times before doing the actual timings.

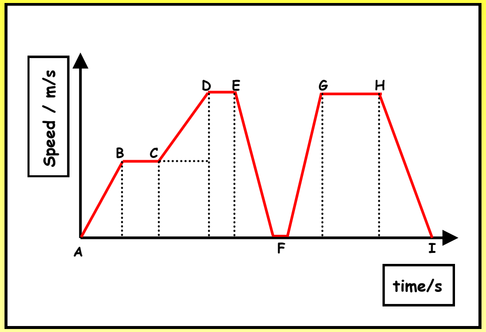
- Start the stop-clock at the moment when **the boy kick-starts the motor-bike and sets off**.

- Complete the table below by recording the **TIME (in s)** when the film reaches each if the events shown.

EVENT	SPEED / m/s	TIME / s
Boy starts bike and sets off.	0	0
Boy leaps bike over hedge.	6	
Bike swerves in front of lorry.	6	
Lorry hits first car.	9	
Bike goes down ramp.	9	
Bike comes to a stop near bridge.	0	
Lorry hits ground & bike starts moving again.	0	
We first see bad cop terminator.	12	
Good terminator shoots at gates chain.	12	
Good terminator's bike drops into drain.	12	
Lorry's tyre is shot and bursts.	12	
Lorry explodes.	0	

- Use the data in your table, to plot a **SPEED-TIME** graph with speed on the y-axis and time on the x-axis. Remember to **label the axes** and **include units**.

- Your graph should look something like that shown opposite.



- Label each point at which there is a change of motion, **A, B,............and I**.

- Divide the area below the graph into **five** triangles and **four** rectangles as shown.

QUESTIONS

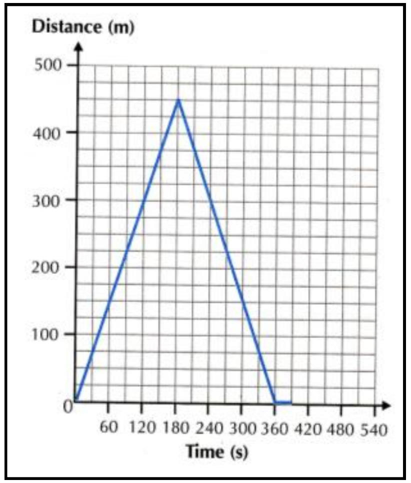
- What is the **acceleration A to B**?
- What is the **acceleration E to F**?
- Calculate the **total distance** travelled over the whole journey (= the area of the **5** triangles + **4** rectangles).
- Calculate the bike's **average speed** over the whole

- **HOMEWORK QUESTIONS (1)**

1 A man walks away from his house and when he gets to his car, he realises he has forgotten his car keys.

He then **walks back** home, where he spends **30 s resting**.

Not wanting to be late to work, he then runs back to the car at **twice** his walking speed.



(a) **How far** was the car from the man's home?

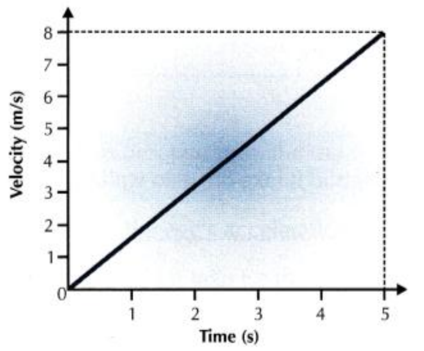
(b) **How long** did it take the man to walk to his car?

(c) Use the graph to calculate the man's **walking speed**.

(d) Copy the graph and complete it to show the part when he **runs back to the car**.

2 The **velocity-time** graph shown opposite represents the motion of a lunar vehicle as it falls towards the Moon's surface.

It accelerates as a result of the Moon's gravitational pull.



(a) Use the graph to calculate the vehicle's **acceleration**.

(b) Calculate the **distance travelled** by the vehicle during the **5 s** of descent shown on the graph.

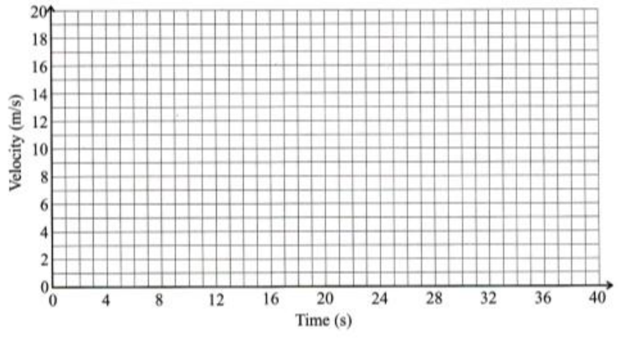
3 John is driving at **15 m/s** along a flat, straight road.

He maintains the car's speed for **285 m** before the traffic lights ahead turn to red. John then decelerates at a constant rate before coming to a standstill **7 s** later at the traffic lights.

He then waits at the traffic lights for **12 s**.

(a) **How long** did it take John to cover the initial **285 m**?

(b) **(i)** Sketch a **velocity-time** graph of John's motion on the axes below. Include the time John waits at the traffic lights.



(ii) Use the graph to calculate John's **acceleration**.

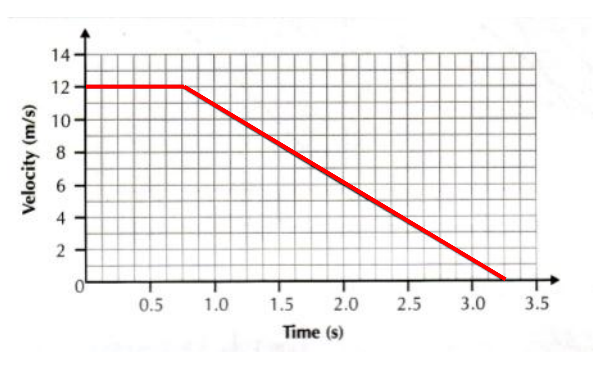
- **HOMEWORK QUESTIONS (2)**

1 A motorist sees a sheep standing in the middle of the road **25 m** ahead of him.

It takes him **0.75 s** to react and slam on the brakes.

The **velocity-time** graph opposite shows the car's deceleration.

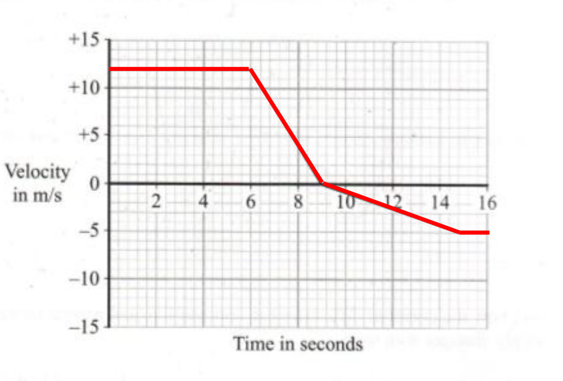
Use the graph to work out whether the motorist was able to stop the car before hitting the sheep.



2 A car is driven along a straight road.

The graph opposite shows how the velocity of the car changes during part of the journey.

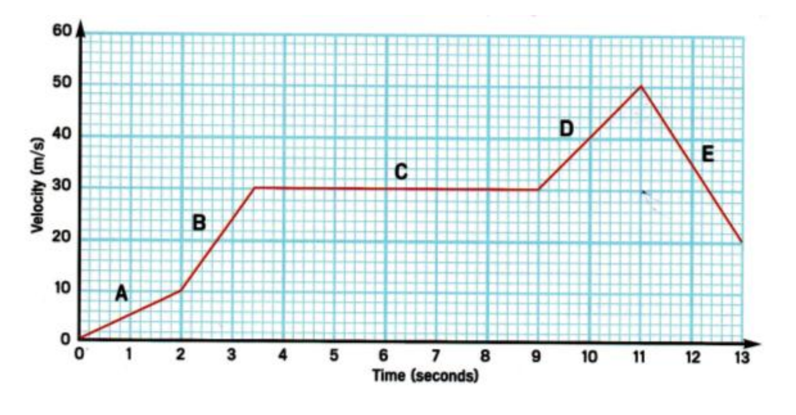
(a) Use the graph to calculate the car's **deceleration** between **6** and **9 seconds.** Show clearly how you work out your answer and **give the unit**.



(b) At **what time** did the car **change direction?**

(c) **How far** does the car travel in the **first 9 seconds**?

3 The graph below shows the velocity of a motorbike over a **13 second** period. **14**



(a) Describe the motion of the motorbike during stages **A, C** and **E**.

(b) Calculate the motorbike's **acceleration** at : **(i)** Stage **D** and **(ii)** Stage **E**.

(c) Calculate the **distance travelled** by the motorbike during the **first 9 seconds** of the motion.