S2 Forces and Motion

Self Checks

Self Check 1

1. A cyclist travels a distance of 100 metres in 10 seconds. Calculate her average speed in m/s.

2. A slow athlete runs 200 metres in 25 seconds. Calculate his average speed in m/s.

3. A man walks 50 metres in 100 seconds. Calculate his average speed in m/s.

4. Copy and complete the following table:

Speed	**Distance**	**Time**
100 m/s	200 metres	
	25 metres	5 seconds
50 m/s	150 metres	
40 km/s		3 seconds
	500 metres	1000 seconds
10 mph	100 miles	
	5 km	5 s
20 ms^{-1}		4 s
	12 m	6 s

5. A coach departs from St Ninian's H.S. taking a group of lucky pupils to Glasgow Airport for a school trip to Spain. The coach leaves the school at 10.50 am and arrives at the airport at 11.20 am.

   (a) How many seconds did the journey take?

   (b) How many hours did the journey take?

   (c) Calculate the average speed of the coach if the airport is 8 miles (12 800 metres) away from the school in

      (i) Miles per hour.

      (ii) Metres per second.

Self Check 2

1. A student is writing a laboratory report which investigates how the instantaneous speed of a trolley down a ramp varies with the angle of the ramp.
Using a diagram, explain how the student would measure the instantaneous speed of the trolley (include any measurements taken).

2. The table below shows the three best times for the Formula 1 Italian Grand Prix.

Lewis Hamilton (McLaren)	1 hr 18mins 43 seconds
Kimi Raikkonen (Ferrari)	1 hr 19mins 5 seconds
Fernando Alonso (McLaren)	1 hr 18mins 37 seconds

(a) Which driver won the race?

(b) Which driver had the lowest average speed?

(c) Explain your answer to part b.

3. The police use a speed gun to find the instantaneous speed of cars which pass a particular point on the road. One car has a length of 4 m and takes 0.32 seconds to cut the speed gun's beam.

(a) Find the instantaneous speed of the car.

(b) If the speed limit is 30 mph for this particular road is the car speeding?
(30 mph = 13.4 m/s)

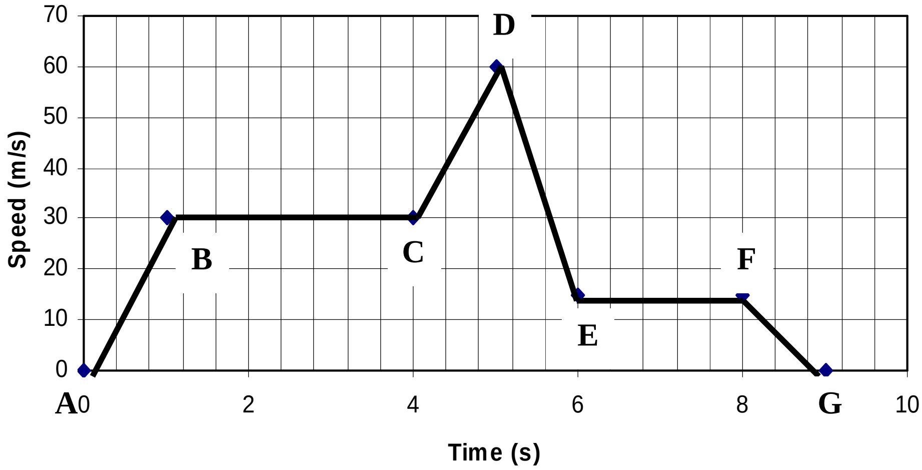
(c) Why do the police monitor the speed of the motorists in this way?

4. On a snowy day, a light gate and timer are placed at the bottom of a hill. They are used to time how long it takes a sledge of width 1.25 metres to cut the beam.

If the sledge takes 0.65 seconds to cut the beam find the sledges instantaneous speed at the bottom of the hill.

Self Check 3

1. The graph below shows how the speed of a car varies with time during a journey.



(a) What is the car's maximum speed?

(b) Identify the points on the graph where:

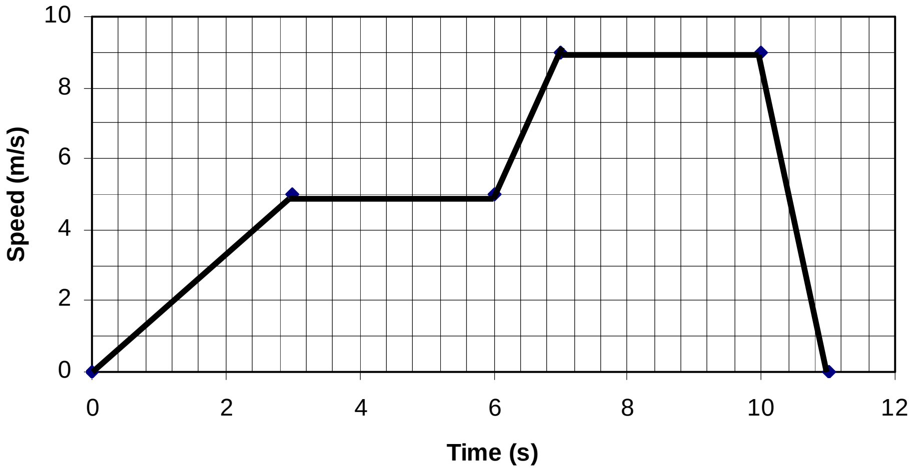
(i) The car is accelerating.

(ii) The car is decelerating.

(c) At which points does the car have an acceleration of 0 m/s^2?

2. An object's motion is shown on the speed - time graph.

Describe the motion for the first 10 seconds of the journey.



Self Check 4

1. (a) What is the name given to the instrument used to measure force?

   (b) Why is a spring suitable for use in this instrument?

2. What three things can a force change when applied to an object?

3. Describe what forces are used in the following situations:

   (a) Opening a jar of jam.

   (b) Closing a cupboard door.

   (c) A tug of war competition.

4. (a) What is meant by a non contact force?

   (b) Give two examples of non contact forces.

5. (a) What is the difference between mass and weight?

   (b) A man has a mass of 70 kg on Earth. Calculate the man's weight on Earth.

6. A woman has a weight of 450 N on Earth. What does this statement mean?

Self Check 5

1. Copy and complete the following sentence:

   Friction is a _________ which ___________ motion.

2. Below is a photograph of a bicycle:

   (a) Describe one example on the bicycle where friction is **useful.**

   (b) Describe one example on the bicycle where friction is a **nuisance.**

   (b) What is done to the bicycle chain to reduce friction?

3. A diagram of a downhill skier is shown:

   (a) Why is the helmet curved in shape?

   (b) What other method shown helps the skier to pick up speed?

   (c) Describe what the skier could do to slow down?

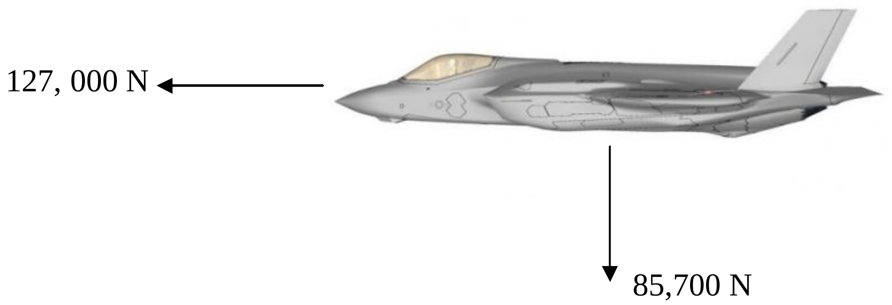
4. (a) List three situations where friction is **useful** in our everyday lives.

   (b) List three situations where friction is a **nuisance** in our everyday lives.

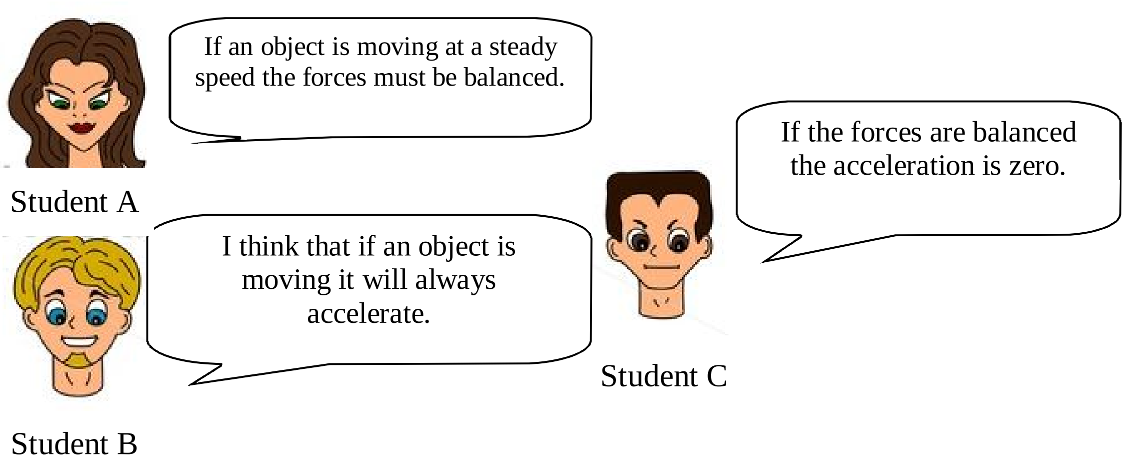
Self Check 6

1. A boy on a skateboard is travelling at a constant speed.
   Describe the forces that are acting on the boy.

2. Complete the diagram below showing all the forces acting on the jet if it is flying at a **constant height** and at a **constant speed.**



3. Students are having a discussion about forces:



Which student or students is / are correct? Explain your answer.

Self Check 6 Continued

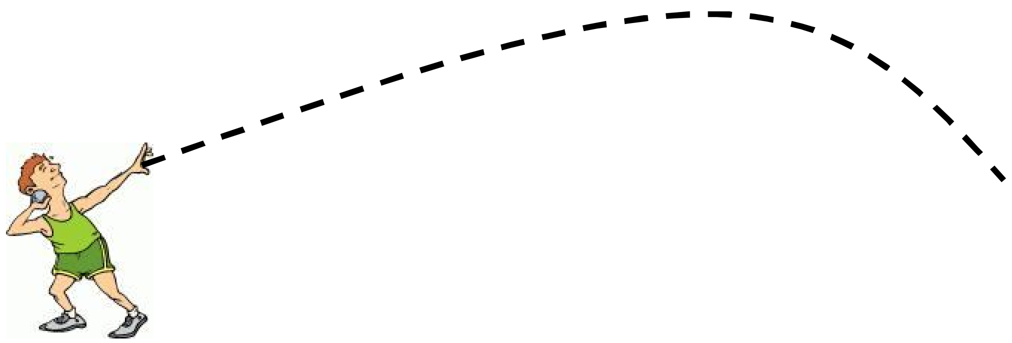
4. A car is travelling at 70mph.

(a) What speed will the passengers be travelling at.

(b) If the brakes are applied suddenly what safety device prevents the passengers from continuing to travel at that speed?

(c) If they are not wearing the safety device what will happen to the passengers?

5. The diagram below shows the path that a shot putt follows once it has been thrown.

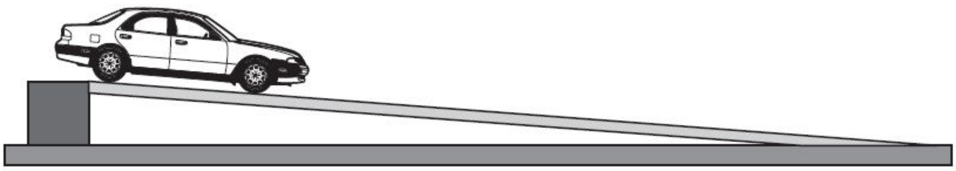


(a) Why does the projectile follow this path?

(b) What should the athlete do to ensure that the shot putt goes as far as possible?

Extra Work Self Check 1

1. A car is released and allowed to roll down a ramp as shown:



The length of the ramp is 25 m and the length of the car is 3 m.

(a) What is the cars average speed if it takes the car 2.25 seconds to roll down the ramp?

In a second test run the car is found to have an average speed of 10 ms^{-1}.

(b) How long did it take the car to roll down the ramp?

2. Find the average speed in ms^{-1} of a ship that takes 4 hours to travel a distance of 25 km.

3. During a 400 m race the times of the three athletes are displayed.

Athlete A	55.53 s
Athlete B	55.64 s
Athlete C	55.60 s

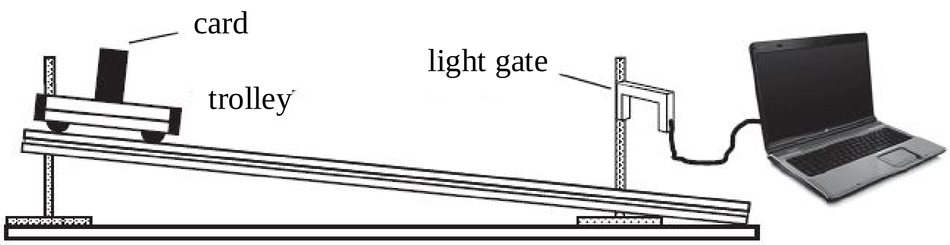
(a) Without doing any calculations, explain which athlete had the largest average speed.

(b) Calculate the average speed for this athlete.

(c) Is it possible for another athlete to be going faster at any point in the race than the eventful winner? Explain your answer.

Extra Work Self Check 2

1. A pupil sets up the following experiment.



(a) Is the student going to measure the average or instantaneous speed of the trolley? Explain your answer.

The student carries out the experiment and records the following results:

Height of ramp	0.75 m
Length of card	4 cm
Time to cut beam	0.246s
Length of ramp	1.25 m

(b) Use these result to find the cars speed as it passes the light gate.

The pupil carries out the experiment a total of 6 times and the times recorded for the trolley to cut the beam are listed below.

0.246 s 0.249 s 0.246 s 0.243 s 0.244 s 0.247 s

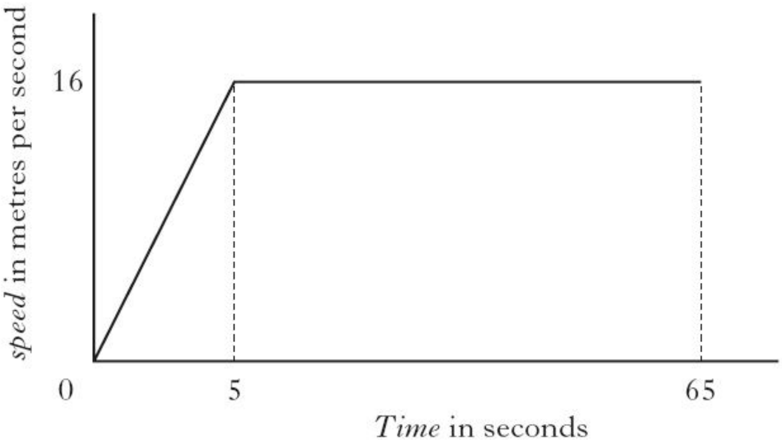
(c) (i) Give a reason for the pupil repeating the experiment.

(ii) Calculate the average time for the trolley to cut the light beam.

(iii) Use your answer to part (ii) to find the average speed at which the trolley cut the light beam.

Extra Work Self Check 3

1. The graph below shows the speed - time graph for a cyclist during a sprint race.



(a) What is the maximum speed of the cyclist during the race?

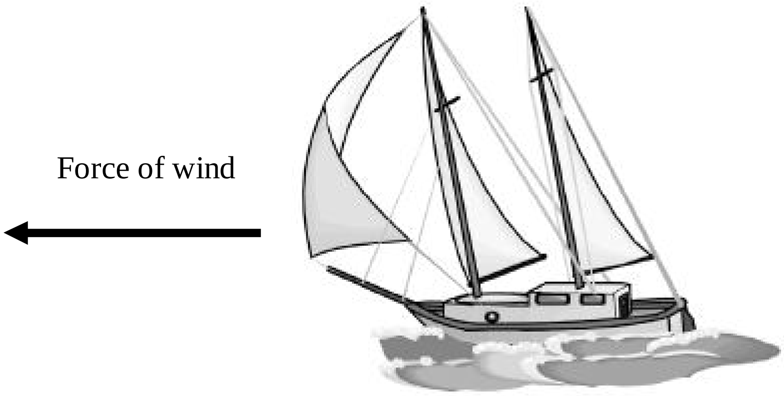
(b) The length of the race is 1 km. Find the average speed of the cyclist during the race.

When the cyclist crosses the finishing line after 65 seconds it takes her 3 seconds to come to rest.

(c) Copy and complete the speed time above adding in the section for the cyclist coming to rest.

Extra Work Self Check 4

1. The forces that act on a yacht during a race are shown below:



   (a) There is another force acting on the yacht in the opposite direction.
   Name this force.

   (b) The yacht must be lifted out of the water for repairs.

   A machine for lifting the yacht can lift a maximum force of 14 000 N.
   The boat has a mass of 1100 kg.

   (i) Find the yachts weight.

   (ii) Will the machine be able to lift the yacht out of the water?
   Explain your answer.

2. A sky diver jumps from a height of 600 m. At one stage of the jump he falls at a constant speed.

   (a) Draw a diagram showing the forces acting on the sky diver.

   (b) The sky diver has a mass of 75 kg what is his weight?

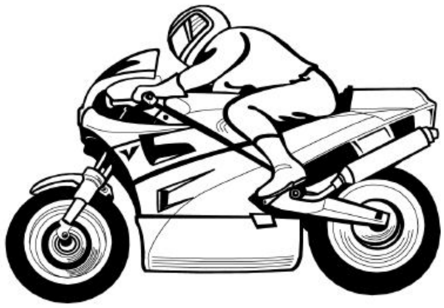
   (c) At one stage of the jump the sky divers speed is constant.

   (i) What can be said about the forces acting on the sky diver at this point?

   (ii) What is the size of the air resistance at this point?

Extra Work Self Check 5

1. The diagram below shows a motorcyclist on a motorbike.



   (a) Explain why the front of the motorbike is curved and the motorcyclist is not sitting upright.

   (b) The motorcyclist is checking his tyres and decides that he should buy new ones as the tread has worn. Explain why he should do this.

   (c) The gear lever often sticks and is hard to move.
   Explain how the motorcyclist could fix this.

2. Football boot manufacturers spend a lot of time researching how friction can both help and hinder the boot's performance.

   (a) Explain why football boots have studs at the bottom.

   (b) Describe one way in which friction would be a nuisance to the player.

Extra Work Self Check 5 Cont

3. A safety device in roller coasters is the safety bar as shown below.

(a) If a roller coaster is travelling at 30 mph at what speed are the riders moving?

(b) State the purpose of the safety bar when the roller coaster applies the brakes.

(c) An engineer is seen applying oil to the moving parts of the roller coaster.

Explain why she would do this?

(d) The mass of a typical roller coaster cart is 5000 kg.
Calculate the weight of the cart.