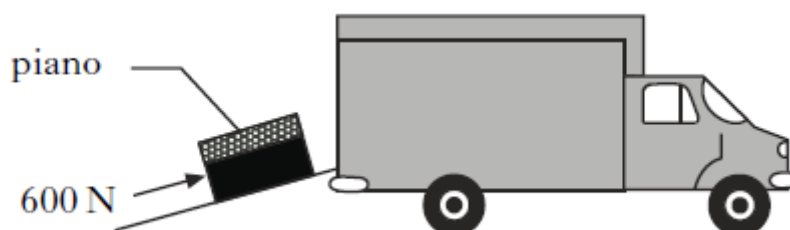
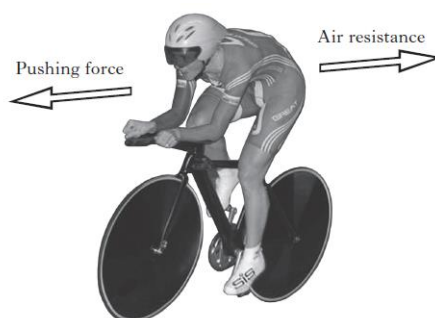


Forces Questions – NAT 5

- 1) When a rocket pushes forwards, what happens to its engine gases?
- 2) In outer space, the engine of a space probe is switched on for a short time.
What happens to the rocket when the engine is switched off?
- 3) Two objects are dropped from the same height and both fall freely.
Object A has a mass of 9.8kg and object B has a mass of 1kg.
If object A accelerates at 9.8ms^{-2} , then what will object B accelerate at?
- 4) A piano of mass 250kg is pushed up a ramp into a van by applying a constant force of 600N as shown below.
The ramp is 3m long and the van floor is 0.75m above the ground.



- a) Calculate the weight of the piano.
 - b) What is the minimum force required to lift the piano **vertically** into the van?
 - c) Calculate the work done pushing the piano up the ramp.
- 5) The diagram shows some of the forces acting on a cyclist during a race.



- a) Suggest **one** way in which the cyclist reduces air resistance.
- b) Suggest **one** place where the cyclist requires the force of friction.

6) A skier takes part in a downhill competition.



- a) State **two** ways that the skier can reduce force of friction in order to reach high speeds.
- b) When the skier reaches the maximum speed of 65ms^{-1} , this speed is maintained over the rest of the course.

State how the size of the downhill force compares with the size of the frictional force during this part of the course.

- c) At the end of the course, the frictional force brings the skier to rest over a horizontal distance of 500m. During this distance, the average frictional force is 346N.

Calculate the work done to bring the skier to rest.

7) A passenger at an airport pulls a suitcase towards the check-in desk.



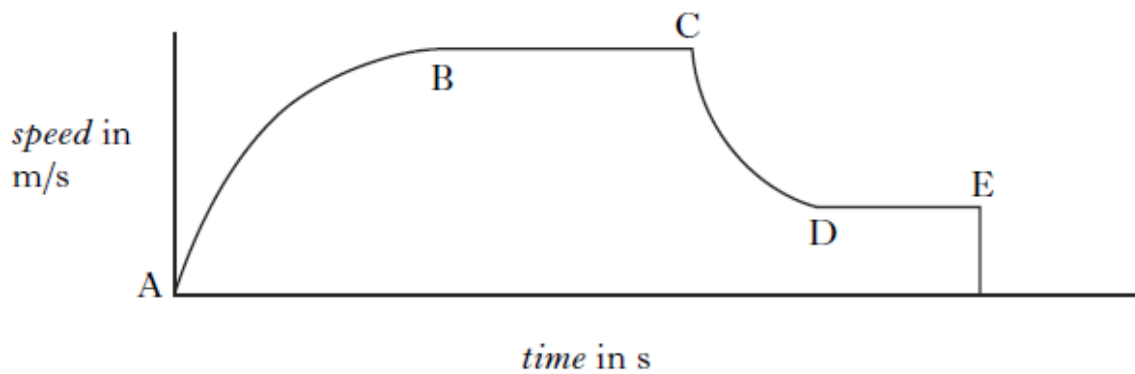
- a) The suitcase has been designed to reduce the effects of friction when it is pulled.
 - i) Explain how the suitcase has been designed to reduce friction.
 - ii) Why is it important to reduce the force of friction on the suitcase?
- b) The suitcase is pulled a distance of 15m using a force of 20N.

Calculate the work done in pulling the suitcase.

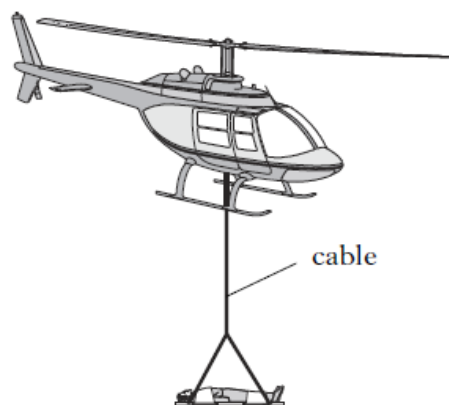
8) A parachutist jumps out of an aircraft. Sometime later the parachute is opened.



The graph shows the motion of the parachutist from leaving the aircraft until landing.



- Which parts of the graph show when the forces acting on the parachute are balanced?
- The parachutist lands badly and is airlifted to hospital by helicopter.



The stretcher and the parachutist have a total mass of 90kg.

- Calculate the weight of the stretcher and parachutist.
- Calculate the acceleration of the stretcher and parachutist if the helicopter cable provides an upward force of 940.5N.

9) A motoring journalist tests the grip on two new designs of tyre.

One set of tyres is placed on car A and another set of tyres are placed on car B.



Car A



Car B

Each car is driven at a speed of 28ms^{-1} on a dry surface then the brakes are applied until the car stops. The distance travelled by each car is measured.

a) Estimate the **braking distance** of **Car A** using the information from the table below.

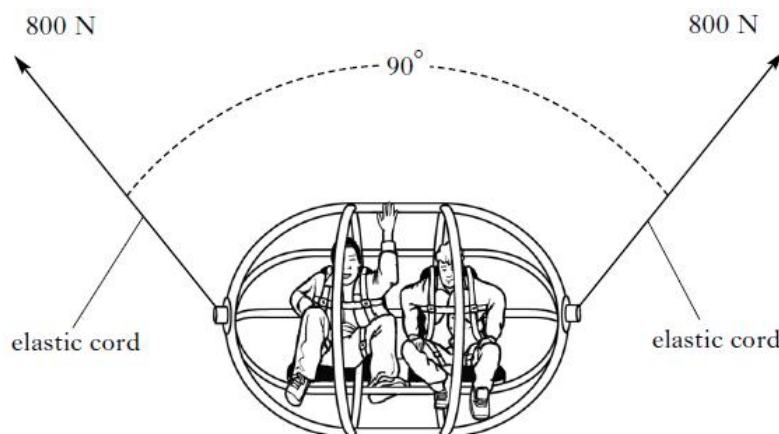
Car	Mass of Car (kg)	Braking Distance (m)
A	1500	
B	800	50

b) i) Calculate the time taken for **Car B** to come rest if it decelerates at 8ms^{-2} .

ii) Calculate the force required during braking for **Car B**.

iii) Calculate the work done on **Car B** during braking.

10) A fairground ride uses a giant catapult to launch people upwards using elastic chords.

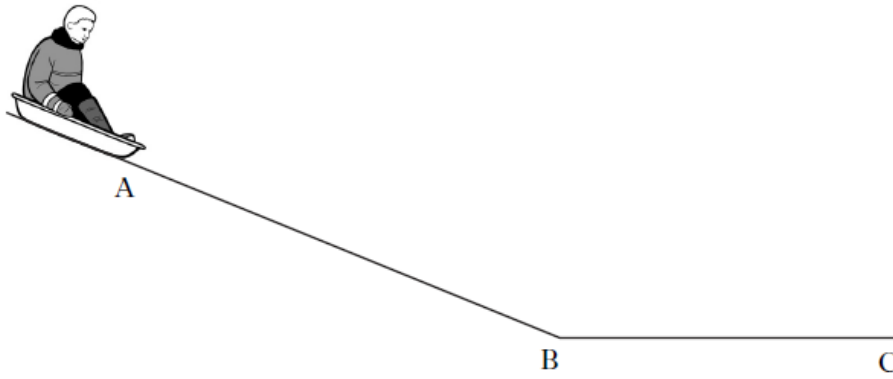


The cage is then pulled further down before release. The chords produce an upward resultant force of **2700N**. If the cage and the occupants have a total mass of 180kg then calculate or find:

a) The weight of the cage and the occupants

b) The acceleration of the cage and the occupants when they are released.

11) A child sledges down a hill.



The child and sledge are released from rest at point A. They reach a speed of 3ms^{-1} at point B.

a) The child and the sledge take 5s to reach point B.

Calculate the acceleration.

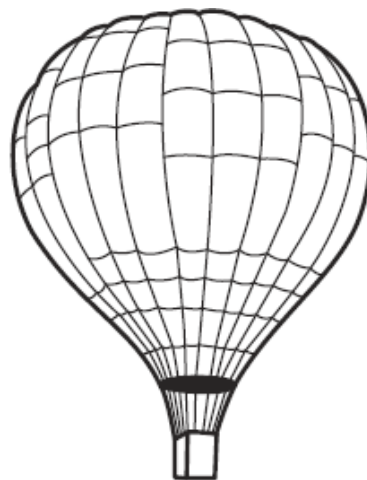
b) The sledge and the child have a combined mass of 40kg.

Calculate the unbalanced force acting on them.

c) After the sledge and the child pass point B, they slow down, coming to a halt at point C.

Explain this motion in terms of forces.

12) A balloon of mass 400kg rises vertically above the ground with a constant acceleration of 0.1ms^{-2} .



Calculate or find:

a) The weight of the balloon

b) The total upwards force acting on the balloon.

13) A plane of mass 750kg is at rest on a runway. The engine applies a force of 4500N.



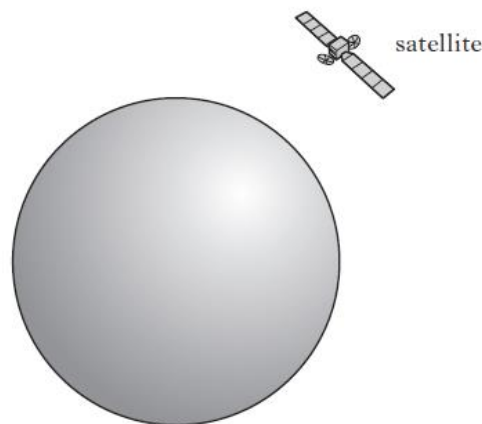
a) Calculate the magnitude of the acceleration of the plane, assuming there are no other forces acting on the plane at this point.

b) The required speed for take-off is 54ms^{-1} .

Calculate the time it takes to reach this speed assuming the acceleration is constant.

c) In practice the acceleration is not constant. Give a reason for this.

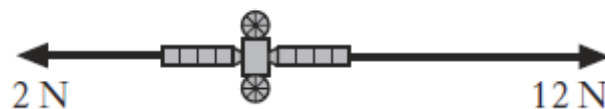
14) A satellite moves in a circular orbit around a planet. The satellite moves at a constant speed while accelerating.



a) i) Define the term acceleration.

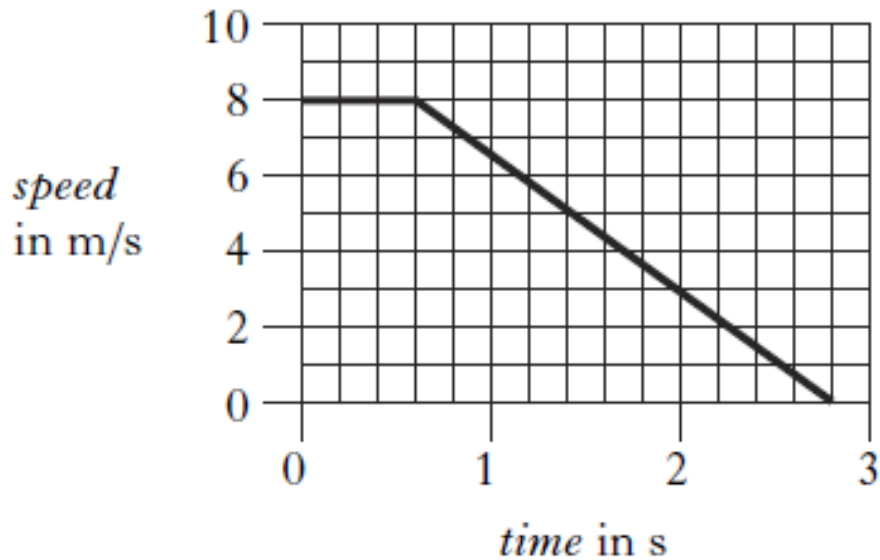
ii) Explain how the satellite can be accelerating when it is travelling at a constant speed.

b) At one particular point in its orbit the satellite fires two rockets. The forces exerted on the satellite by these two rockets are shown on the diagram.



The satellite has a mass of 50kg. Calculate the resultant acceleration due to these forces.

- 15) A cyclist is approaching traffic lights at a constant speed. The cyclist sees the lights change to red. The graph shows how the speed of the cyclist varies with time from the instant the cyclist sees the lights change to red.



- a) i) How long did it take the cyclist to react before applying the brakes?
ii) Calculate the distance travelled from the instant that the cyclist sees the traffic lights change to red until stationary.
- b) The cyclist now sees the traffic lights change to green and accelerates away from the lights. The combined mass of the cycle and the cyclist is 75kg. An unbalanced force of 150N acts on the combined mass.
Calculate the acceleration.