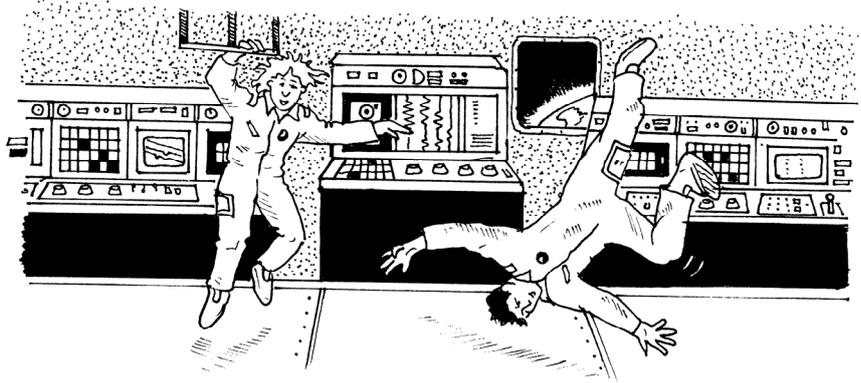


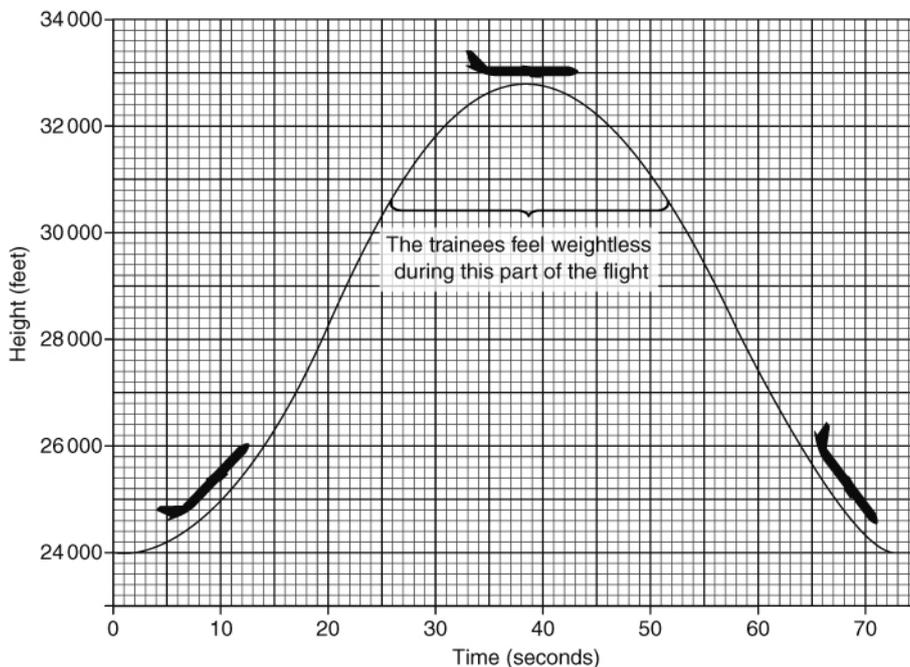
You have probably seen pictures of astronauts floating around in the International Space Station (ISS). When astronauts are floating around like this people often refer to them as being 'weightless' or being in 'zero gravity' but this is not correct. If there were no gravity in space, the ISS would not stay in orbit around the earth but would just fly off into space.



At the altitude that the ISS orbits, gravity is pulling on every kilogram of mass with over 9 N of force. Gravity is still pulling on the astronauts, so they still have weight. So why do they feel weightless?

When you are standing on the ground, gravity is trying to pull you downwards. You can't go down because the ground is in the way. If you went into orbit around the earth, your spacecraft would be 'falling' around the earth and you would be falling with it. The spacecraft is not pushing up on your feet, so you feel as if you do not have any weight. It is a bit like the feeling you get in a lift when it suddenly starts going down.

Astronauts are trained to cope with this weightless feeling in a special aeroplane, which is sometimes called the 'Vomit Comet'. The aeroplane flies up and down and during parts of the flight the trainee astronauts feel weightless. There are also commercial companies who arrange flights like this so that ordinary people can experience the feeling of weightlessness.



When the aircraft is pushing over the top of each curve, it is falling at the same speed as the people in it. They feel weightless.

- 1 In which direction does gravity act:
 - a on the Earth
 - b on the Moon
 - c on astronauts in the International Space Station?

- 2 How are astronauts trained to cope with the feeling of weightlessness?
- 3 Why do you think the aircraft is often called the 'Vomit Comet'?
- 4 Look at the graph. The Vomit Comet completes 10 of these curves in one flight.
 - a How much height does the aeroplane gain and lose for each curve?
 - b How long do the trainees feel weightless during the flight?
- 5 Astronauts have visited the Moon.
 - c Explain why astronauts on the Moon do not feel weightless.
 - d Why do astronauts have a different weight on the Moon compared to their weight on Earth?
- 6 An astronaut has a mass of 70 kg. The gravitational field strength on Earth is approximately 10 N/kg.
 - e What would her weight be on Earth?
 - f What would be the force of gravity on her when she is in orbit?
- 7
 - a Why do people refer to astronauts being in 'zero gravity'?
 - b Why is this phrase not really correct?
- 8 Why do astronauts feel weightless when they are in orbit?
- 9 Are astronauts on the Moon affected by the Earth's gravity? Explain your answer.

I can...

- calculate weights
- describe how gravity affects astronauts in different places
- explain what 'weightlessness' means.