**Newton’s Laws of Motion**

1. What is Newton’s first law of motion?
2. Use Newton’s law to explain why you are pushed backwards into your seat as a car accelerates.
3. Why do you feel as if you have been thrown forwards when you are in a car that is braking suddenly?
4. Why do you think seatbelts are an important safety feature of cars?
5. Magicians often pull a table cloth from under a table set with china.
   1. Use Newton’s first law to explain how this is possible.
   2. In reality, the china will probably still move slightly in the direction of the table cloth. Explain why this happens.
6. Rockets in space keep moving without needing engines to do so. Use your knowledge of the composition of space to explain why this happens.
7. Explain the concept of inertia, and describe how mass affects the inertia of an object.
8. A car on ice is almost impossible to stop.
   1. Use the concept of inertia to explain why.
   2. What is the force that is required to regain control?
9. Propose a reason why truck cabins need to be rigid and able to withstand a heavy blow from the rear.
10. Seatbelts can leave bad bruising and cracked ribs in a car accident.
    1. Explain why they do this.
    2. Your friend is arguing that this is a good reason not to wear a seatbelt. What reason would you give you friend to convince them to wear a seatbelt?
11. Are passengers in the rear of a car safe when not wearing seatbelts? Explain why or why not.
12. What is Newton’s second law of motion?
13. Use your knowledge of how to use a speed triangle to draw a triangle for the force equation.
14. Describe what happens to the acceleration when the same force pushes larger and larger masses.
15. Describe what happens to the acceleration of an object if the force pushing it is increased.
16. Calculate the force, in Newtons (N), being applied if:

**Force**

**Accel-eration**

**Mass**

* 1. A 5 kg box accelerates at 4.1 m/s2.
  2. A 1.3 tonne car accelerates at 2 m/s2.
  3. A 400 g ball accelerates at 4 m/s2.

1. Calculate the acceleration, in m/s2 caused by:
   1. A 40 N force applied to a 0.5 kg mass.
   2. A 0.5 N force applied to a 50 kg mass.
2. Calculate the mass, in kg, of:
   1. A block accelerating at 2.5 m/s2 pushed by a 65 N force.
   2. A force of 1 N accelerating a toy car at 3 m/s2.
3. What force would cause a 1.5 kg glass salad bowl to accelerate across a table at 0.3 m/s2?
4. Two identical toy carts, A and B, each with a mass of 1 kg, are pushed across a smooth, level table top with the same force. One of them contains a heavy brick. Cart A accelerates more rapidly that Cart B.
   1. Which toy cart contains the brick? How do you know?
   2. If the acceleration of Cart A is 2 m/s2, what is the force acting on each cart?
   3. If the acceleration of Cart B is 0.5 m/s2, what is the mass of the brick?
5. What is Newton’s third law of motion?
6. Describe two pairs of ‘action’ and ‘reaction’ forces. State what each force is acting on.
7. Explain why a balloon shoots around the room when it is allowed to deflate.
8. Describe how a row boat is propelled through the water. Use the words ‘action force’ and ‘reaction force’ in your answer.
9. A person jumps from a boat to a jetty.
   1. What happens to the boat as the person jumps?
   2. Use the terms ‘action force’ and ‘reaction force’ to explain how the boat moves.
10. An astronaut is working outside the space station and the tether that holds him to the space station breaks halfway along and he can’t reach the broken end to pull himself back to the space station.
    1. The astronaut remembers his high school science and realises that he cannot get back to the space station by making motions like walking, running or swimming. Explain why these types of motions will not get him back to the space station.
    2. Luckily, he then remembers he has his tool belt with him. How could he use objects from his tool belt to return to the space station?