**Newton’s Laws of Motion (Answers)**

1. What is Newton’s first law of motion?

An object at rest will remain at rest until an unbalanced force acts on it. An object in motion will remain in motion until an unbalanced force acts on it.

1. Use Newton’s law to explain why you feel as if you have been thrown forwards when you are in a car that brakes suddenly?

You and the car are both in motion. The force applied by the brakes stops the motion of the car. There is no force acting on your body so your body remains in motion.

1. Why are seatbelts an important safety feature of cars?

Seat belts apply a force to stop the motion of your body when a car brakes. Without seatbelts, your body stays in its original state of motion because there is no unbalanced force acting on your body.

1. 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.

The objects are initially at rest. An unbalanced force is applied to the table cloth when it is pulled, causing it to move. There is no unbalanced force applied to the china, so they remain in their original positions / at rest.

* 1. In reality, the china will probably still move slightly in the direction of the table cloth. Explain why this happens.

There is small amount of friction between the table cloth and the china. This force causes the china to move slightly.

1. Rockets and satellites in space keep moving without needing engines to do so. Use your knowledge of Newtons 1st Law and the composition of space to explain why this occurs.

The rocket / satellite is in a state of motion. There is no unbalanced force acting on the rocket / satellite so it remains in motion.

1. Explain the concept of inertia, and describe how mass affects the inertia of an object.

Inertia is the tendency of an object to resist changes to its motion.

As the mass of an object increases, the inertia of the object also increases. It is harder to move or stop the object with a larger mass/inertia.

1. A car on ice is almost impossible to stop.
   1. Use the concept of inertia to explain why.

A car has a large mass, therefore large inertia. A lot of force will be needed to stop the car. There is very little force between the ice and the car.

* 1. What is the force that is required to regain control? Friction

1. Are passengers in the rear of a car safe when not wearing seatbelts? Explain why or why not.

They are not safe. If the car brakes suddenly, the people will continue to move forward because there is no unbalanced force acting on their body. They could then hit their head on the seat in front of them.

1. What is Newton’s second law of motion?

Fnet = m x a

1. Describe what happens to the acceleration when the same force pushes larger and larger masses.

As the mass increases, the acceleration of the object decreases when moved with the same amount of force.

1. Describe what happens to the acceleration of an object if the force pushing it is increased.

As the force increases, the acceleration of the object also increases when the mass stays the same.

1. Calculate the force, in Newtons (N), being applied if: Fnet = m x a
   1. A 5 kg box accelerates at 4.1 m/s2. Fnet = 5 x 4.1 = 20.5 N
   2. A 1.3 tonne car accelerates at 2 m/s2. Fnet = 1300 x 2 = 2600 N
   3. A 400 g ball accelerates at 4 m/s2. Fnet = 0.4 x 4 = 1.6 N
2. Calculate the acceleration, in m/s2 caused by: a = Fnet ÷ m
   1. A 40 N force applied to a 0.5 kg mass. a = 40 ÷ 0.5 = 80 m/s2
   2. A 0.5 N force applied to a 50 kg mass. a = 0.5 ÷ 50 = 0.01 m/s2
3. Calculate the mass, in kg, of: m = Fnet ÷ a
   1. A block accelerating at 2.5 m/s2 pushed by a 65 N force. m=65 ÷ 2.5 = 26kg
   2. A force of 1 N accelerating a toy car at 3 m/s2. m = 1 ÷ 3 = 0.33 kg
4. What force would cause a 1.5 kg glass salad bowl to accelerate across a table at 0.3 m/s2?

Fnet = m x a = 1.5 x 0.3 = 0.45 N

1. 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?

Cart B has the brick because it accelerates more slowly.

* 1. If the acceleration of Cart A is 2 m/s2, what is the force acting on each cart?

Fnet = m x a = 1 x 2 = 2 N

* 1. If the acceleration of Cart B is 0.5 m/s2, what is the mass of the brick?

mtotal = Fnet ÷ a = 2 ÷ 0.5 = 4 kg

mbrick = mtotal – mcart = 4 – 1 = 3 kg

1. What is Newton’s third law of motion?

For every action force there is an equal and opposite reaction force.

1. Describe two pairs of ‘action’ and ‘reaction’ forces by drawing a diagram and briefly explaining the forces involved.

See examples in Newton’s 3rd Law PowerPoint.

1. Explain why a balloon shoots around the room when it is allowed to deflate.

A balloon shoots around the room when it deflates because the air is being pushed out of the balloon. This is the action force. The reaction force is the balloon being pushed in the opposite direction to the air.

1. Describe how a row boat is propelled through the water. Use the words ‘action force’ and ‘reaction force’ in your answer.

The oars of the boat push on the water, which is the action force. The water then pushes back on the oars with an equal and opposite reaction force. This causes the boat to move forward.