

Newton's laws

Application of Newton's laws and balanced forces to explain constant velocity (or speed), making reference to frictional forces.

1. (a) For each of the following scenarios draw a free body diagram. Each force vector must be labelled.

- i) A car is at rest, the driver pushes the accelerator and the engine exerts a force on the car to the right.
- ii) The car is now travelling to the right with a speed of 10 ms^{-1} and getting faster.
- iii) The car is now travelling to the right with a constant speed of 20 ms^{-1} .
- iv) The car is now travelling to the right with a speed of 10 ms^{-1} and is slowing down.
- v) The car is at rest.

(b) In which scenario above were the forces balanced? (6)

Use of an appropriate relationship to solve problems involving unbalanced force, mass and acceleration for situations where more than one force is acting.

2. Copy and complete the statement below

The _____ of a body is _____ to the _____ force acting on the body and _____ to its mass. (1)

3. A 45 kg boy is pushing his 45 kg friend on a 5 kg sledge to the right. The boy is pushing the sledge with a force 100 N and the sledge speeds up with an acceleration of 1.5 ms^{-2} .

- i) Calculate the magnitude of the unbalanced force on the sledge and state its direction.
- ii) Calculate the magnitude of the frictional forces on the sledge and state their direction. (2)

Use of an appropriate relationship to solve problems involving work done, unbalanced force and distance/displacement.

4. A car engine exerts a force of 2000 N on a car.

- i) If the car travels 2.0 m then calculate the work done by the car's engine.
- ii) How much energy is transferred to the car during the two meters.
- iii) Suppose the 2000 N is unbalanced, what is the main energy change?
- iv) Suppose the 2000 N is balanced, what is the energy change? (4)

5. A sledge is pushed 10.0 m with a force of 75.0 N. During the push the force of friction acting on the sledge is 25.0 N

- i) Calculate the work done by the pushing force.
- ii) Calculate the work done by the frictional force.
- iii) Calculate the work done by the unbalanced force.
- iv) Compare your answers to i) and ii) with iii) and make a connection. (4)