

Newton's First & Second Laws — $F = ma$

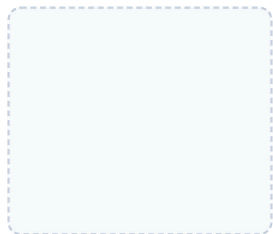
Instructions: Use the keywords to explain each law, then draw your own example. For every calculation, work out the **resultant force first** and give your answer a **unit**.

Newton's First Law

resultant force = 0 N

resultant force zero balanced
stationary constant velocity
straight line

DRAW AN EXAMPLE

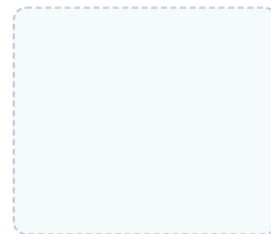


Newton's Second Law

resultant force $\neq 0$ N

resultant force not zero
unbalanced accelerates
change in velocity speed
direction

DRAW AN EXAMPLE



Newton's Second Law — in Words

... in Symbols

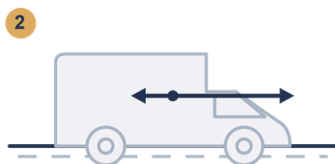
Which Law Is Acting?

arrow length = size of the force



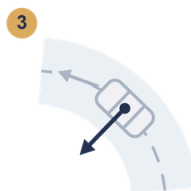
car on a straight, level road

LAW ☐ N1L ☐ N2L
VELOCITY ☐ constant ☐ changing
CHANGES ☐ speed ☐ direction
☐ neither



van on a straight, level road

LAW ☐ N1L ☐ N2L
VELOCITY ☐ constant ☐ changing
CHANGES ☐ speed ☐ direction
☐ neither



car on a bend at a steady 12 m/s (from above)

LAW ☐ N1L ☐ N2L
VELOCITY ☐ constant ☐ changing
CHANGES ☐ speed ☐ direction
☐ neither



skydiver falling at terminal velocity

LAW ☐ N1L ☐ N2L
VELOCITY ☐ constant ☐ changing
CHANGES ☐ speed ☐ direction
☐ neither

Example — Write Your Own $F = ma$ Question

include a mass, a force and a unit

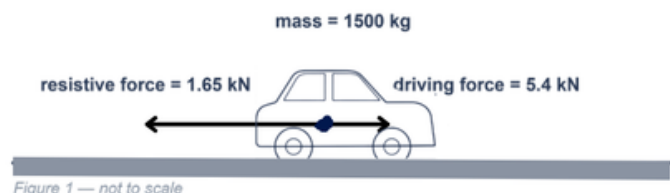
YOUR QUESTION

WORKING & ANSWER

Exam-Style Question

[5 marks]

A car of mass **1500 kg** is driven along a straight, level road, as shown in Figure 1. The engine provides a driving force of **5.4 kN**. The total resistive force on the car is **1.65 kN**.



(a) Calculate the resultant force on the car. Give your answer in newtons.

[2]

(b) Calculate the acceleration of the car. [3]

Force, Mass and Acceleration

Aim: investigate how the **force** on an object (of constant mass) affects its **acceleration**.

Apparatus — tick each item as you add it to your diagram

draw your set-up here

Use these to draw your set-up:

- ☐ table
 ☐ pulley
- ☐ trolley
 ☐ string
- ☐ masses
 ☐ light gate
- ☐ computer
 ☐ stop clock

Method — fill in the gaps

1. Compensate for friction by raising one end of the table, so the trolley moves at _____ speed with no force applied.
2. Attach string to the trolley, over a pulley, with masses hanging on the end to provide the _____.
3. Position the light gate a set distance away and connect it to the computer.
4. Keep the total mass of the trolley + masses _____. Calculate the force: $F = m \times g$
5. Release the trolley from the same point each time; time from release to the light gate = _____.
6. Record the _____ and _____ speeds at the light gate; calculate $a = (v - u) / t$
7. Move a mass from trolley to hanger to increase force, keeping total mass _____. Repeat steps 4–6.
8. Plot a graph of _____ (y) against _____ (x).

Results

mass / kg	force / N	time between start and light gate / s	initial speed (u) / m/s	final speed (v) / m/s	acceleration / m/s ²

Graph



Conclusion

SENTENCE STARTER

The _____ is directly proportional to the _____, as the graph is a _____ line through the _____. The mass of the trolley and all the masses = force / acceleration ($m = F/a$), which is $1/\text{gradient} =$ _____ kg.

Evaluation

The recorded resultant force is too high as friction acts. To reduce friction, _____.