

5.1 Forces

What is the difference between a scalar and a vector?

Scalar quantities have magnitude (size) only.

Name some non-contact and contact forces?

Contact forces – friction; air resistance; tension; normal contact force

Non-contact forces – gravitational force; electrostatic force; magnetic force

What is the resultant force if a 5N force pulls against a 20N force pushing to the left?

The resultant force will be 15N to the left

5.2 Work done and energy transfer

What is the equation for work done and what is it measured in? What do the letters stand for?

$W = F s$ measured in joules, J

W is work done; F is force; s is distance (or displacement)

1 newton-metre is also known as what?

1 joule, J

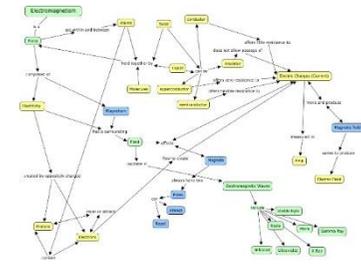
30 Quick questions: Answer these in your book

- 1 Name three forces.
- 2 What is mass measured in?
- 3 Is mass a force?
- 4 What would the mass of a 90kg man be if he was on the moon?
- 5 Give an example of a contact force and a non-contact force
- 6 What is the average speed of a car when it travels 50m in 3 seconds? Include the units of speed and answer to the nearest whole number.
- 7 If $g=9.8 \text{ N/kg}$ on the Earth, what is the weight of a 60kg girl?
- 8 What does a horizontal line on a distance-time graph tell us?
- 9 On a distance-time graph, what is represented by a straight line sloping upwards?
- 10 What is the equation linking force, work done and distance?
- 11 Name two factors that could increase thinking distance.
- 12 Name two factors that could increase braking distance.
- 13 What does speed affect more out of thinking distance and braking distance?
- 14 How can a car be accelerating but travelling at a steady speed?
- 15 What is the equation linking initial velocity, final velocity and acceleration?
- 16 What equation links force and acceleration?
- 17 If there is a force of 145N pushing an object to the right but 75N of friction resisting the force, what is the resultant force on the object and in which direction does it move?
- 18 What is acceleration measured in?
- 19 If a car of mass 750kg needs to accelerate at 3 m/s^2 , how much force must the engine provide?
- 20 What units are forces measured in?
- 21 Work done against the frictional forces on an object causes what to happen to the object?
- 22 1 joule can also be described as a newton-metre, Nm. How many joules is 1.7 kNm?
- 23 What useful energy output is there from an archery bow and what was the input energy?
- 24 $F = ke$ and $E_e = 0.5 ke^2$ both contain the quantity e. What does this stand for and what are its units?
- 25 Referring to the equation $E_e = 0.5 ke^2$, what would happen to the amount of elastic potential energy stored if a spring's extension was doubled?
- 26 If you run 400m around a standard running track, how far have you been displaced from the start?
- 27 If the average walking pace is 1.5 m/s and running is twice that and cycling is twice as fast as running, give some average values for running and cycling.
- 28 Is 330 m/s the average speed for sound or light?
- 29 Why can you see a firework before you hear it?
- 30 What is another way of describing a negative acceleration?

Module 5 FORCES

Foundation

Knowledge Organiser



**“May the force be with you”
(...and easy to recall during
the exams).**

KEY WORDS/IDEAS TO REMEMBER

contact force	balanced forces
displacement	equilibrium
newtons (N)	Newton's first law
non-contact force	resultant force
scalar	Gravitational mass
vector	Inertia
velocity	Inertial mass
average speed	rate of change
distance–time graph	sketch graph
gradient	velocity–time graph
speed	graph
tangent	Uniform motion
acceleration	gravitational field strength
air resistance (or drag)	mass
deceleration	newtonmeter
displacement	weight
gradient	

5.3 Elasticity

With an elastic spring, the extension is directly proportional to what?

The force applied.

What do the letters stand for in

$$F = ke$$

F = force; k = spring constant; e = extension

What is the equation for elastic potential energy?

$$E_e = 0.5 ke^2$$

What measurements would you need to make to find the spring constant of a spring?

The extension as different forces are applied.

If you plotted the extension against the force for a piece of elastic that obeys Hooke's Law, what shape would it be?

A diagonal straight line that passes through the origin.

5.4.1 Motion

Distance and speed are scalar quantities. What are the equivalent vector quantities?

Velocity and displacement

Write down some typical values for the following in m/s; i) walking; ii) running; iii) cycling

i) 1.5 m/s; ii) 3 m/s; iii) 6 m/s

What is the equation for speed?

$$v = st$$

How would you calculate the speed of an object from a distance time graph?

The gradient of the line.

What is the equation for acceleration?

$$a = (v-u)/t$$

What does a horizontal line on a velocity-time graph mean?

Steady speed (velocity)

$v^2 - u^2 = 2as$ If an apple falls out of a tree and falls 3m, how fast will it be going when it hits the ground?

$$v = \sqrt{2 \times 9.81 \times 3} = 7.67 \text{ m/s}$$

5.4.2 Newton's Laws

Newton's first law of motion

An object will remain stationary or travelling at a steady speed unless what?

A resultant (unbalanced) force acts on it.

What is the equation that summarises **Newton's second** law of motion?

$$F=ma$$

If you double the force on an object, what happens to the acceleration of the object?

It also doubles as acceleration is proportional to the force.

Newton's Third law of motion

If I try to push a car and it doesn't move, what does this tell you about the forces involved?

The car pushes you back with an equal force. The forces are equal and opposite.

5.4.3 Stopping distance

Define braking distance and thinking distance.

Braking distance is the distance a vehicle travels under braking force.

Thinking distance is the distance travelled during the driver's reaction time.

What affects reaction time (and therefore thinking distance)?

Tiredness; drugs including alcohol; distractions.

What can affect braking distance?

Adverse road and weather conditions like loose gravel, wet leaves and ice. Poor condition of the car's brakes or tyres.

Where does all the kinetic energy go when brakes are applied?

The temperature of the brakes increases as work is done by the friction force between the brakes and wheels.

What could happen if a vehicle slows down too quickly?

Vehicle could skid or passengers could be injured.