OCR (B) Physics GCSE

Topic 4.3 - What is the connection between forces and motion?

Flashcards

Define resultant force

Define resultant force

The sum of all the individual forces acting on an object (taking directions into account).

What happens if a resultant force acts on an object?

What happens if a resultant force acts on an object?

It causes a change of momentum in the direction of the force.

What is Newton's first law?

What is Newton's first law?

If the resultant force on an object is zero, the object will remain stationary or continue to move with constant speed and direction.

Explain how terminal velocity is reached

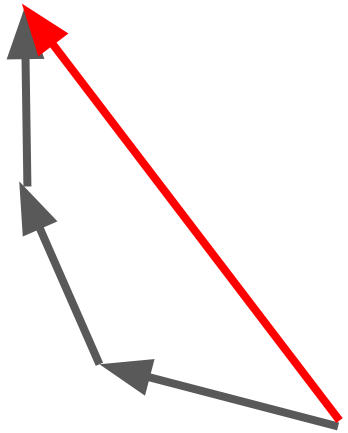
Explain how terminal velocity is reached

- In freefall, initially the only force is weight, causing acceleration downwards.
- As speed increases, air resistance increases, acting upwards.
- This decreases the resultant force.
- Eventually air resistance = weight, so there is no resultant force, resulting in terminal velocity.

Describe how resultant forces can be represented visually (Higher)

Describe how resultant forces can be represented visually (Higher)

Use scale drawings of vector diagrams.



- Add force vectors tip to tail
- Connect them for the resultant force.

Give the equation for momentum, including units (Higher)

Give the equation for momentum, including units (Higher)

Momentum (kgm/s) = mass (kg) x velocity (m/s)

The time taken for the change in momentum to occur is proportional to the… (Higher)

The time taken for the change in momentum to occur is proportional to the... (Higher)

Resultant force felt by the object (Newton's second law: F=ma, where mass x acceleration is the rate of change of momentum).

Give the equation linking resultant force and momentum (Higher)

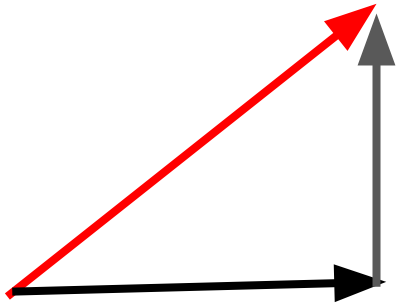
Give the equation linking resultant force and momentum (Higher)

change in momentum (kgm/s) = resultant force (N) x time (s)

What does it mean to resolve a force? (Higher)

What does it mean to resolve a force? (Higher)

The horizontal and vertical components are calculated using a vector diagram and pythagoras' theorem.



What is the principle of conservation of momentum? (Higher)

What is the principle of conservation of momentum? (Higher)

Momentum is always conserved in an explosion or collision; momentum before = momentum after (provided there are no external forces).

What happens if the force is always perpendicular to the direction of the motion? (Higher)

What happens if the force is always perpendicular to the direction of the motion? (Higher)

The object will move in a circle at a constant speed.

Describe the speed and velocity of an object in circular motion (Higher)

Describe the speed and velocity of an object in circular motion (Higher)

The speed is constant; the velocity is always changing (since it is constantly changing direction).

Give an example of a force causing circular motion (physics only)

Give an example of a force causing circular motion (physics only)

Gravity causes the earth to orbit the sun.

What is a moment? (physics only)

What is a moment? (physics only)

The rotational effect of a force.

Give the equation for moments (physics only)

Give the equation for moments (physics only)

moment (Nm) = force (N) x distance (m)

(note: distance is the perpendicular distance from the force to the pivot)

When does rotational equilibrium occur? (physics only)

When does rotational equilibrium occur? (physics only)

When the sum of clockwise moments = the sum of anticlockwise moments

This is the **principle of moments.**

What are levers and gears used for? (physics only)

What are levers and gears used for? (physics only)

They are used to transmit rotational forces.

How do gears work? (physics only)

How do gears work? (physics only)

When the first gear is connected to a gear with fewer teeth, the second gear turns faster but with less force.

When the first gear is connected to a gear with more teeth, the second gear turns slower but with more force.

How do levers work? (physics only)

How do levers work? (physics only)

Levers use the principle of moments to act as **force multipliers**. They decrease the force needed for tasks.

What is inertial mass? (Higher)

What is inertial mass? (Higher)

A measure of how hard it is to change an object's velocity.

Define inertial mass in terms of force and acceleration (Higher)

Define inertial mass in terms of force and acceleration (Higher)

The ratio force/acceleration.

Derived from Newton's Second Law, F=ma)

Define mass

Define mass

The amount of matter in an object (measured in kg).

Give the equation for Newton's second law

Give the equation for Newton's second law

force (N) = mass (kg) x acceleration (m/s²)

F = ma

What is the overall stopping distance of a car?

What is the overall stopping distance of a car?

Thinking distance + braking distance

What factors affect thinking distance?

What factors affect thinking distance?

- Speed
- Reaction time
- Concentration
- Tiredness
- Drugs/alcohol
- Distractions

What factors affect braking distance?

What factors affect braking distance?

- Speed
- Road conditions
- Tyre conditions
- Weight (of car/passengers)

What is the typical overall stopping distance at 20mph? (physics only)

What is the typical overall stopping distance at 20mph? (physics only)

12m

(6m thinking, 6m braking)

What is the typical overall stopping distance at 30mph? (physics only)

What is the typical overall stopping distance at 30mph? (physics only)

20m

(9m thinking, 14m braking)

What is the typical overall stopping distance at 40mph? (physics only)

What is the typical overall stopping distance at 40mph? (physics only)

36m

(12m thinking, 24m braking)

What is the typical overall stopping distance at 50mph? (physics only)

What is the typical overall stopping distance at 50mph? (physics only)

53m

(15m thinking, 38m braking)

What is the typical overall stopping distance at 60mph? (physics only)

What is the typical overall stopping distance at 60mph? (physics only)

73m

(18m thinking, 55m braking)

What is the typical overall stopping distance at 70mph? (physics only)

What is the typical overall stopping distance at 70mph? (physics only)

96m

(21m thinking, 75m braking)

What is the typical reaction time for a human?

What is the typical reaction time for a human?

0.2-0.9s

How can reaction times be measured?

How can reaction times be measured?

Drop a ruler through a person's open hand. The point at which they catch it gives the displacement, s. Use $s = ut + \frac{1}{2}at^2$ to calculate t (where u=0 and a=g).

Why can braking quickly be dangerous?
(Higher only)

Why can braking quickly be dangerous? (Higher only)

There is a large deceleration over a short period of time, so a large force is experienced by the passengers.

What are safety precautions in cars designed for? (Higher only)

What are safety precautions in cars designed for? (Higher only)

To reduce the force on passengers by increasing the time taken for the change in momentum to occur.

How do seatbelts work? (Higher only)

How do seatbelts work? (Higher only)

They strap passengers in place, and stretch under large forces, decreasing the rate of change of momentum and therefore reducing the force.

How do crumple zones work?
(Higher only)

How do crumple zones work? (Higher only)

These are softer areas of the car which crumple upon impact, absorbing energy in order to deform. This increases the time taken for the car to stop moving and reduces the energy of the impact, therefore reducing the force.

How do airbags work? (Higher only)

How do airbags work? (Higher only)

They inflate instantaneously upon impact. A passenger/driver's head will hit the airbag and slow down more gradually, reducing the force on the neck.