SCALARS AND VECTORS

Scalar = A quantity that has magnitude only.

Vector = A quantity that has magnitude and direction.

Scalars		**Vectors**
Density	Power	Displacement
Mass	Charge	Velocity (Rate of change of displacement)
Volume	Time	Acceleration (Rate of change of velocity)
Distance	Resistance	Force
Length	Temprature	Momentum
Work	Potential differance / v	Electric field strength
Energy (all forms)	Capacitance	Magnetic field strength
Activity	Luminosity	Gravitational field strength
Speed (Rate of change in distance, no direction)	Pressure (even though it's force/area, because it acts in all directions and it's the area that decides the direction of the force.)	

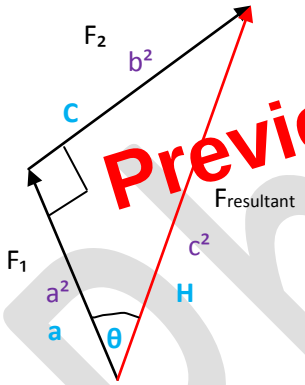
NEWTONS FIRST LAW

"Things travel at constant velocity (or stationary) unless you have unbalanced forces."

Force = A push or pull acting on a body from some external body.

'Unbalanced forces make things change velocity'

Adding vectors:



***Vectors must be joined tip to tail.**

***The triangle must have a 90° angle to make the following calculations:**

$F_1 = 2N$

$F_2 = 3N$

1. PYTHAGORAS

$c^2 = a^2 + b^2$

$c^2 = 2^2 + 3^2$

$c^2 =$ ___

c = 3.6 N

2. TRIGONOMETRY

Sin=– Cos=– Tan=–

$\cos\theta = \frac{\quad}{\quad}$

$\theta = \cos^{-1}(\frac{\quad}{\quad})$

θ = 56°

ANSWER: MAGNITUDE = 3.6N

DIRECTION = 56° (AS SHOWN ON DIAGRAM)

NEWTONS THIRD LAW

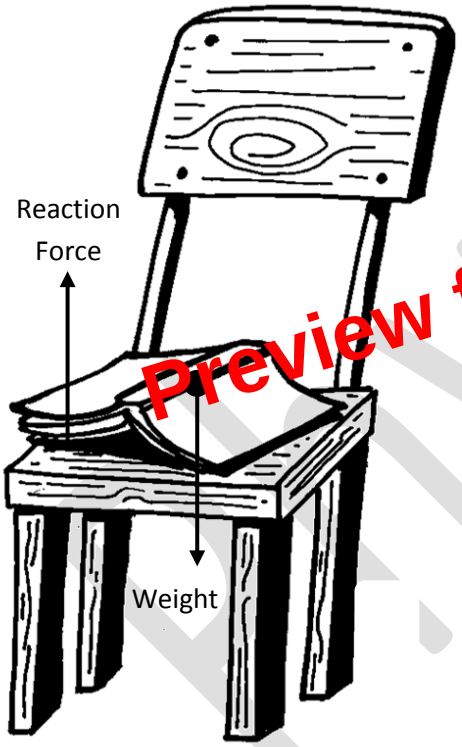
"IF BODY A EXERTS A FORCE ON BODY B, THEN BODY B EXERTS AN EQUAL AND OPPOSITE FORCE ON BODY A."

Rules:

1) The forces of Newton's third law are always in pairs.
2) The forces act on different bodies.
3) The forces are equal.
4) The forces act in opposite directions.
5) The forces are the same type i.e. both are gravitational forces.

Free body diagrams = A simplified representation of the body along with arrows showing the forces acting on the body. Also note lengths of arrows.

Example:
A cricket bat hitting a ball, it's obvious the bat is exerting a force on the ball, hence its accelerating in a changed direction. But Newton's third law tells us that the ball exerts an equal but opposite force on the bat, to prove this, a used bat will have dents where a ball has been hit repeatedly; Newton's third law.



Example

Give the Newton's third law equal and opposite force to each of the two named forces, a) reaction force and b) weight.

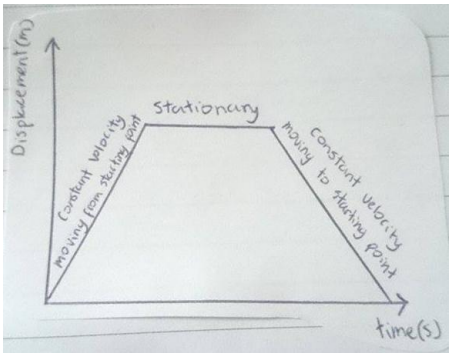
Answer:
Reaction Force = The chair pushes up on the book.
The equal and opposite force is that the book pushes down on the chair (these are in fact electromagnetic forces due to the atoms in the book and the chair being slightly squashed).

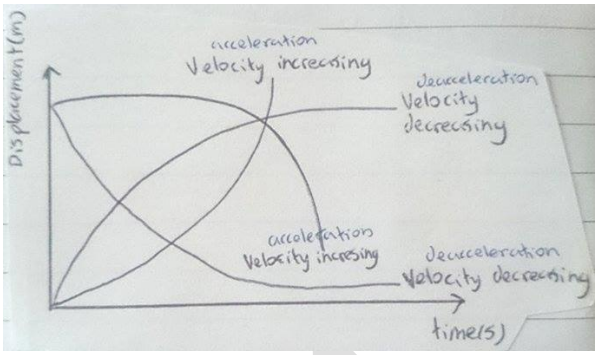
Weight = The Earth exerts a gravitational force downwards on the book.
The equal and opposite force to this is the book exerts a gravitational force upwards on the Earth.

To conclude:
One type of force
Two different bodies
Force of equal magnitude
Exerted in opposite directions

MOTION GRAPHS

Displacement - time graph



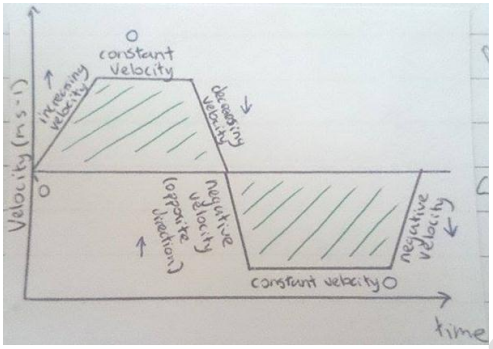


Gradient = VELOCITY

Steeper the gradient, higher the velocity.

Flatter the gradient, lower the velocity.

Velocity - time graph



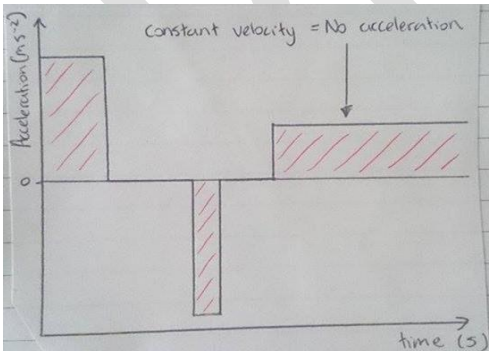
Gradient = ACCELERATION

Steeper the gradient, higher the acceleration.

Flatter the gradient, lower the acceleration.

Area between line and x-axis = DISPLACEMENT

Acceleration - time graph



Area between line and x-axis = VELOCITY (The change in velocity only)

***You might be asked to plot an acceleration-time graph, using a velocity-time graph given. This means that you must transfer the values of the gradient (acceleration) in the velocity-time graph.**

PROJECTILE MOTION

*** Vertical motion is completely independent of horizontal motion.**

*** Vertical motion = 9.81ms^{-2} (constant acceleration)**
Apply TUVAX equation vertically.

*** Horizontal motion = constant velocity (no acceleration)**

Effect of air resistance on projectile motion

- Air resistance always opposes the motion of an object.
- Vertical velocity is always lower with air resistance.
- Falling time is longer.
- Large resistive force horizontally due to high velocity.
- Overall decrease in range due to larger effect horizontally.

When the object is at its greatest height, the vertical velocity is **zero**.

***Remember the pay attention in all questions whether the directions (up or down) are given in positive or negative values.**