Common Equations of Motion (M1.3)

Equations without ***DISPLACEMENT***	$v = u + a t$
Equations without ***FINAL VELOCITY***	$s = u t + ½ a t^2$
Equations without ***INITIAL VELOCITY***	$s = v t - ½ a t^2$
Equations without ***TIME***	$v^2 = u^2 + 2as$
Equations without ***ACCELERATION***	$s = ½ (u + v) t$

Momentum and Impulse (M1.4)

Momentum *Velocity and Mass*	$= m\,v$
Impulse *Combining Momentum*	$= m\,v - m\,u$

For collisions.

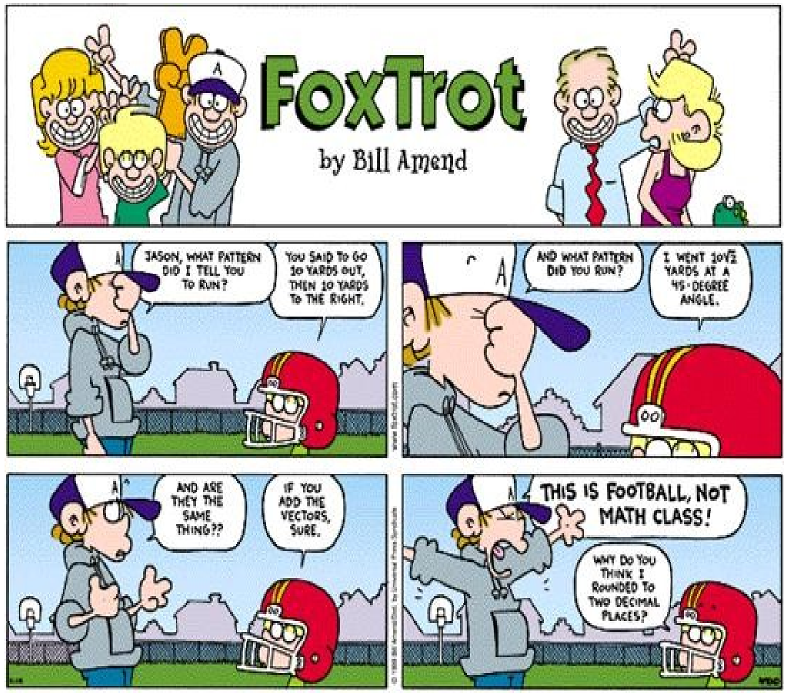
Vectors in Mechanics – M1.2

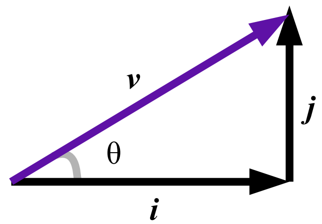
Magnitude and direction of a vector.

Vectors can be considered as triangles.

You use *SIN*, *COS* and *TAN* to **RESOLVE** vectors to multiple dimensions, just as you'd use them for unknown lengths of sides.

You can use the rules of Pythagoras to determine the magnitude of the **RESULTANT**.





$$v^2 = j^2 + i^2$$

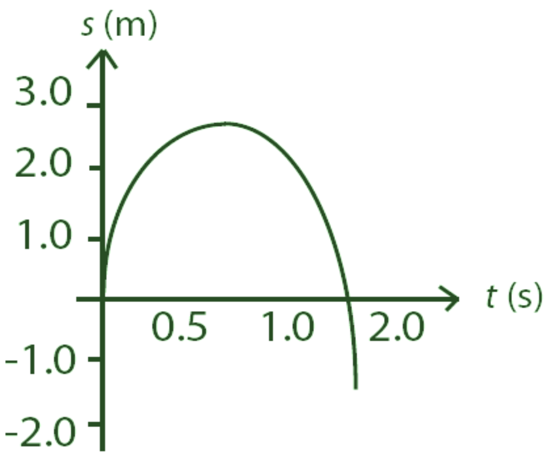
the magnitude of the vector

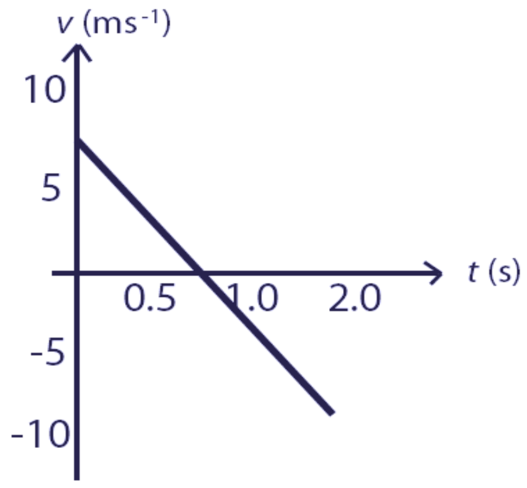
$$j = v \sin(\theta)$$

resolving into dimensions

Kinematics of a Particle – M1.3

Motion in a straight line with constant acceleration.



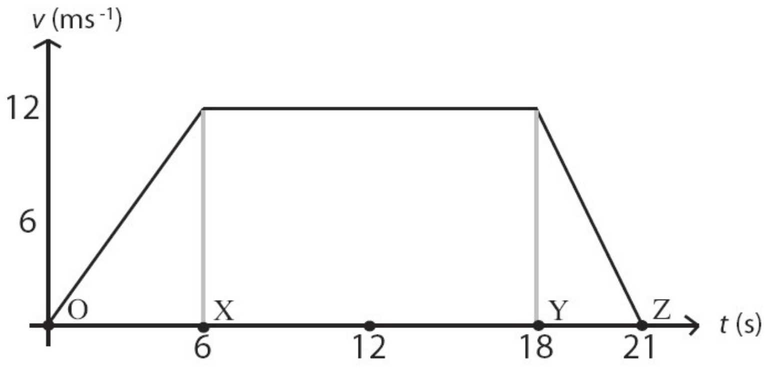


The *gradient* of a **displacement-time** graph is the **VELOCITY**.

The *gradient* of a **velocity-time** graph is the **ACCELERATION**.

The *area under* a **velocity-time** graph is the **DISPLACEMENT**.

Example graph from Question:



*Knowledge and use of **formulae for constant acceleration** will be required.*

(Refer to Common Equations of Motion M1.3.)

Newton's Laws (M1.4)

Newton's First Law.

An object will not change its velocity until an unbalanced force acts upon it.

Think 'frame of reference'.

Newton's Second Law.

$$f = ma$$

Force (in Newtons) equals **mass** times **acceleration**.

Newton's Third Law.

Every action has an equal and opposite 're-action'.

Image by 'Benjamin Crowell' of Wikipedia.

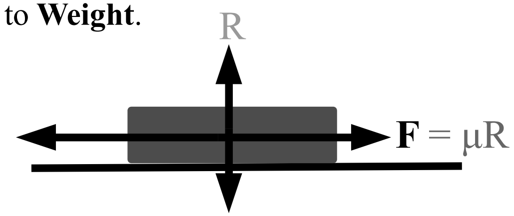
Single-dimension Dynamics of a Particle (M1.4)

You should know:

- Newton's Three Laws.
- 1 Newton (mass times acceleration) is 1 kg m s^{-2}.
- Impulse, Momentum and applications (e.g. collisions).
- ***Co-efficient of Friction:***

On a rough surface, with Co-efficient of Friction 0.7, the Friction can be determined with the equation ***Friction*** = *0.7* * ***Reaction***.

The object is not moving upwards, so **Reaction** is equal to **Weight**.



$$F = \mu R$$

The Co-efficient of Friction, multiplied by the Reaction force equals the Friction. ***This applies to surfaces of uniform Friction.***

Statics of a Particle (M1.5)

Friction

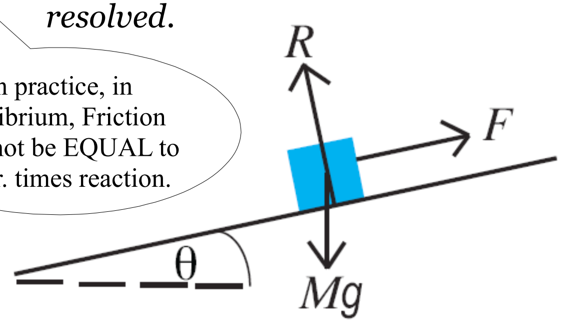
- Friction acts opposite the resultant force.
- Friction is always less than or equal to the resultant force.

$F \leq \mu R$

In practice, in equlibrium, Friction may not be EQUAL to c.o.fr. times reaction.

Sometimes it can be quicker to RESOLVE forces with a **different frame of reference**.

For instance, perpendicular to a plane, so *less forces have to be resolved*.



When a particle is not moving, **all of the FORCES** acting upon it **must be equal**. Since all FORCES are VECTORS, they can be resolved per dimension.

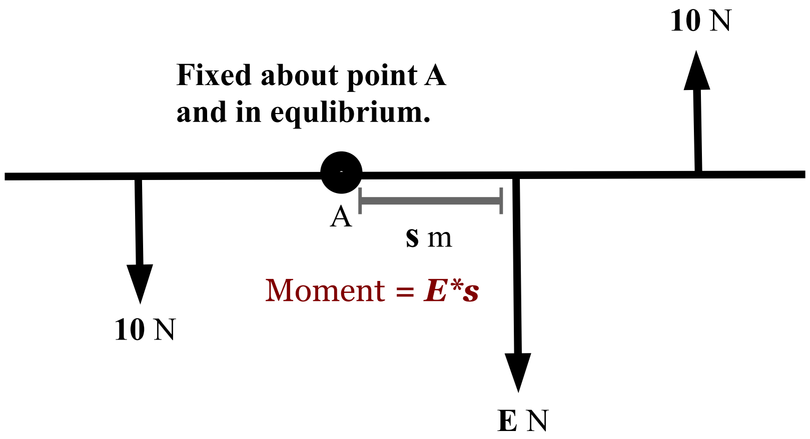
If this is the case, dimensions **x** and ***y*** will both resolve to ***0***.

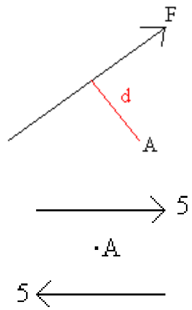
For instance;

*Reaction – (Mass * Gravity) = 0*

Acting Force – Friction = 0

Moments (M1.5)





In the first diagram, the moment of force 'F' about point 'A' is F * d.

The second diagram represents a couple. Across any direction, it resolves to nothing, so the object would rotate but not move.

For some problems, you must also **RESOLVE HORIZONTALLY**, and for some just as moments.

$$M = F * s$$

Moment =
Force x Distance

Moments in each direction (clockwise and anti-clockwise) are equal while in equilibrium.

M(^) - M (v) = R(^)

Mechanical Models and Terms – M1.1

Particle	*A single object without specific structure or internal motion.*	***Inextensible***	*Cannot change in length.*
		Smooth/Rough	*No friction/subject to friction.*
Lamina	*Thin plate or layer.*	***Pulley***	*Adjusts direction of motion*
Rigid Body	*Size and shape are fixed definitely.*	***Bead***	*Particle confined to wire.*
Rod	*Single-dimension lamina.*	***Wire***	*Inextensible string to which beads are confined.*
Light	*No conceivable mass.*		
Uniform	*Of a consistent density/structure.*	***Peg***	*To fix within a certain range.*