M1 Summary

EQUATIONS OF MOTION:

$v^2 = u^2 + 2as$ $v = u + at$ $s = vt - \frac{1}{2}at^2$ $s = ut + \frac{1}{2}at^2$ $s = \frac{(u+v)}{2}t$

SPEED-TIME GRAPHS:

Acceleration is given by the gradient of the line
Distance is given by the area under the graph
A downward slope indicates a retardation (deceleration)

VECTORS:

A vector has both magnitude and direction, whereas a scalar just has magnitude. Force, velocity, displacement and acceleration are all vectors.

The magnitude of vector $(a\underset{\sim}{i} + b\underset{\sim}{j})$ is $\sqrt{a^2 + b^2}$

A unit vector in the direction of $(a\underset{\sim}{i} + b\underset{\sim}{j})$ is given by $\frac{1}{\sqrt{a^2+b^2}}(a\underset{\sim}{i} + b\underset{\sim}{j})$

A vector of magnitude k in the direction of $(a\underset{\sim}{i} + b\underset{\sim}{j})$ is given by $\frac{k}{\sqrt{a^2+b^2}}(a\underset{\sim}{i} + b\underset{\sim}{j})$

The speed of an object is the magnitude of its velocity vector

The position vector of A relative to B is $\vec{BA} = \vec{OA} - \vec{OB} = \underset{\sim}{r}_A - \underset{\sim}{r}_B$

$\underset{\sim}{v} = \frac{\underset{\sim}{r}_2 - \underset{\sim}{r}_1}{t}$

$\underset{\sim}{a} = \frac{\underset{\sim}{v}_2 - \underset{\sim}{v}_1}{t}$

Position vector at time t: $\underset{\sim}{r}_t = \underset{\sim}{r}_0 + t\underset{\sim}{v}$

STATICS OF A PARTICLE:

To find the resultant of more than one force we normally resolve either horizontally and vertically, or parallel to and perpendicular to the plane. We then add the components in each direction and work out the resultant.
If a particle is in equilibrium, then there is zero resultant force, i.e. the sum of the components of the forces in any direction is zero.

Forces we must consider when drawing a diagram are:
WEIGHT (W): This acts vertically downwards and is equal to mg. You must ALWAYS include weight
TENSION (T): This must be included wherever a particle is attached to a string, and acts along the string away from the particle. Thrust acts like tension, but in the opposite direction.
NORMAL REACTION (R): This must be included whenever a particle is on a surface, and acts at right angles to the surface, away from the surface
FRICTION (F): This acts parallel to a surface in the direction to oppose motion. It must be included wherever we have a rough surface. μ is called the coefficient of friction and takes values between 0 and 1. $F = \mu R$ when a particle is moving or is limiting equilibrium. Otherwise $F < \mu R$

KINEMATICS:

Newton's 2nd Law states that $F = ma$ (here F is resultant force NOT friction)

STANDARD S.I. UNITS:

Quantity	Symbols Used	Units
Force	F, W, R, T	N
Velocity	u, v	ms^{-1}
Displacement	s	m
Acceleration	a, g	ms^{-2}
Time	t	s
Momentum	p	Ns
Impulse	I	Ns

PRINCIPLE OF CONSERVATION OF MOMENTUM:

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

The Impulse exerted on a particle is equal to the change in momentum of that particle