Displacement and distance

1	**Don't confuse vectors and scalars** Remember, a scalar quantity, like distance or distance travelled, has only magnitude (size), whereas a vector quantity like position or displacement has both magnitude and direction. Saying a ship is 25 km away gives its distance from you (a scalar quantity). If you are told it is 25 km away on a bearing of 067°, you know its position (a vector quantity).
2	**Make sure that you know the differences between displacement, position, distance and distance travelled**
3	**Don't misinterpret the position–time graph of a particle** The position-time graph of a particle shows how the position of a particle changes with time. This is not the same as the path of the particle, which gives the route it travels.
4	**Don't confuse speed and velocity** Speed is a scalar quantity and so has only magnitude; velocity is a vector and so has both magnitude and direction. Speed is the magnitude of velocity. Speed is the rate at which distance (a scalar) changes with time. Velocity is the rate at which displacement (a vector) changes with time.

Speed and velocity

1	**Remember that velocity and acceleration can have different directions** If you apply the brakes to slow down on your bicycle, your velocity vector is in the direction you are moving but your acceleration vector is in the opposite direction. If your direction of motion is taken to be positive, when you are slowing down your velocity is positive but your acceleration is negative. However, if you are travelling in a negative direction and speeding up, your acceleration is negative.
2	**Remember that acceleration is given by the gradient of a velocity-time graph** If the gradient of the velocity-time graph is negative, then the acceleration is negative. Section 4: Using areas
3	**Don't confuse speed-time graphs and velocity-time graphs** Always check how the axes of a graph are labelled. Speed is a scalar and so can never be negative. Velocity is a vector and can be both positive and negative.
4	**Make sure you interpret the area under a graph correctly** The area enclosed between a speed-time graph and the time axis gives the distance travelled, which like speed is a scalar. The area enclosed between a velocity-time graph and the time axis (with areas beneath the time axis counted as negative) gives the displacement, which like velocity is a vector. If you want to find the distance travelled from a velocity-time graph, then find the total area enclosed between the graph and the time axis, counting all areas as positive.

The constant acceleration formulae

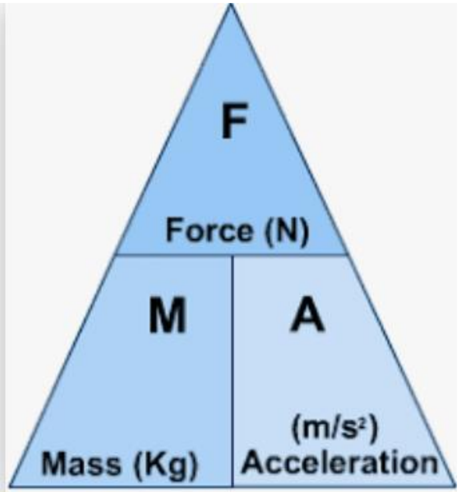
1	**Make sure you know the constant acceleration formulae thoroughly** If you know the five equations this work is much easier
2	**Make sure you choose to use an appropriate equation** Write down the values of whichever of s, u, v, a and t are given in the question. The equation to use is the one that includes only those variables whose values you are given in the question, together with the variable you wish to calculate.
3	**Check that you are using consistent units** If, for example, you are given a speed in kmh^{-1} , you must either convert this to ms^{-1} or work with times in hours, distances in km and acceleration in kmh^{-2} .
4	**Make sure you can solve simultaneous equations and quadratic equations confidently** These techniques may be required in some questions. This is basic Pure Maths and if you are not fluent with it you will be held back in all areas of maths. Make sure you practise these techniques thoroughly if you are not already confident with them.
5	**Don't confusing position and displacement** Position is displacement from the origin; displacement is displacement from initial position. The 's' in the suvat equations is displacement. If an object has initial position s_0 , its final position will be $s_0 + s$.
6	**Sketch graphs or draw diagrams to help you solve problems where possible** Always be ready to sketch a graph or draw a diagram. Usually this will help give you a better understanding of the problem.

Force diagrams and equilibrium

1	**Don't confuse mass and weight Mass is a scalar quantity**. It is a measure of the amount of matter in an object. The mass of an object is the same on the moon as on the earth. Weight is a vector quantity. It is the force that acts upon objects subject to gravity. On the earth, the force of weight is always directed downwards, towards the centre of the earth. From Newton's second law, W = mg, where W is the weight of an object m is its mass and g is the acceleration due to gravity. On the moon, the acceleration due to gravity is less, so objects with the same mass weigh less on the moon than on the earth. Students often forget to multiply the mass of objects by g to give their weight.
2	**Make sure that you know Newton's laws thoroughly** Newton's three laws are fundamental to the whole of mechanics. If you know and understand them well, they can really help you to avoid mistakes in mechanics problems. You should learn them carefully. In particular, remember that Newton's first law deals with two possibilities: an object at rest, and an object moving at constant speed.
3	**Always draw large, simple force diagrams** Force diagrams do not need to be artistic, they do need to be large enough to label easily and show all relevant forces. Students often either do not draw diagrams at all, or draw small, confusing ones. Try to get into the habit of drawing good force diagrams; they will help you in all of your Mechanics work.
4	**Remember what is meant by equilibrium** An object in equilibrium is either at rest, or moving at constant speed. In either case, the resultant force acting on the object is zero.

Applying Newton's second law

1	**Remember to use weight rather than mass when dealing with forces** In situations involving a weight force, remember to multiply the mass of an object by g to give its weight.
2	**Make sure that signs and directions on force diagrams are clear** It's generally safest to make the direction of motion the positive direction and have your acceleration arrow pointing that way. If the acceleration turns out to be negative, you will know that the object is slowing down.
3	**Set out your work clearly** Remember to draw a clear diagram, labelling all the forces.



Connected objects

1	**Remember to use weight rather than mass when dealing with forces** In situations involving a weight force, remember to multiply the mass of an object by g to give its weight.
2	**Remember that all parts of a connected system have the same acceleration** If you can calculate the acceleration of any part of a connected system, this will apply to the whole system and to each connected part of it. Often you begin by finding the acceleration of the system as a whole and then apply this acceleration to different parts of the system to find tensions and thrusts in couplings between the connected parts.
3	**Deal with internal forces appropriately** In a connected system, forces act between different parts of the system (e.g. tension in a string connecting two masses). If you are looking at the system as a whole, then the internal forces cancel out; if you are looking at separate components of the system, you must include all forces.
4	**Make sure you can set up and solve simple simultaneous equations confidently** You should really make sure you are fluent at this. If you are not confident with it, you must practice until you are. It will help you in all areas of Maths and Science.

Using calculus	
1	**Don't assume that the acceleration is constant** In all the work so far, you have dealt with situations where acceleration is constant. Now you are extending your knowledge to situations when the acceleration is not constant. Remember that the definition of acceleration is that it is the rate at which velocity changes, a=dv/dt. It is only when the acceleration is constant that you may use the constant acceleration equations.
2	**Make sure you know the definitions of velocity and acceleration** These are very important. Velocity is defined as the rate at which position changes, so s=ds/dt , and acceleration is defined as the rate at which velocity changes, so a=dv/dt.
3	**Make sure you are confident with basic differentiation** In Mechanics you often need to work with velocities and accelerations. These are both rates of change and to calculate a rate of change you must differentiate with respect to time.
4	**Make sure you are confident with basic integration** You already know that differentiation and integration are opposites, so to calculate position from velocity, or velocity from acceleration you must integrate with respect to time: s=$\int v\,dt$ and v $= \int a\,dt$
5	**Remember the constant of integration** Remember that whenever you work out an indefinite integral (one without limits), you must either find the value of constant of integration, or write '+ c' after the function you have obtained by integration. Often, in Mechanics, you will know some extra information about the situation that will enable you to calculate the value of the constant. For example, if the object you are dealing with started from rest, you know that v = 0 when t = 0.
6	**Don't muddle up constants of integration** If you integrate more than once, there will be more than one constant of integration. To avoid muddling them up, call them different things, like c and k.