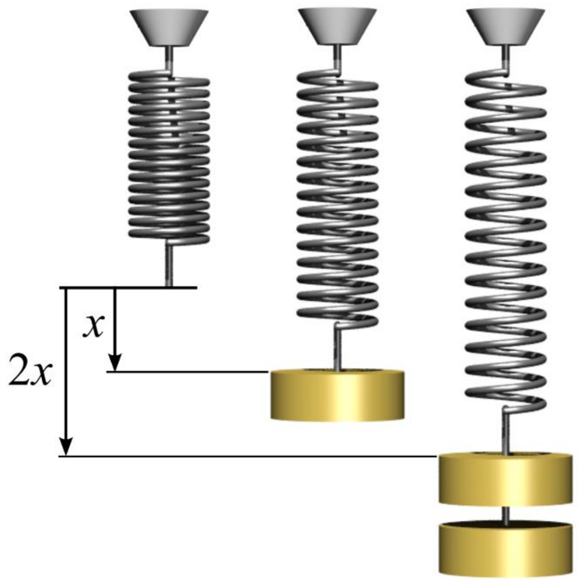
Work and Energy

1	**Make sure you get the sign of the work done right.** Remember that the work done by a force is the force multiplied by the distance moved in the direction of the force, so if the motion is in the opposite direction to the force, then the work done is negative.
2	**Make sure that you get the sign of an energy change right.** Think about whether energy has been gained or lost, and remember that in calculating G.P.E., positive height is upwards.
3	**In two-dimensional work, remember to resolve the force into components.** You must use only the component of a force in the direction of the motion, when calculating the work done by that force.
4	**Use the work-energy principle rather than Newton's 2nd law.** Many questions you meet in this chapter could be solved by using Newton's 2nd law and the constant acceleration formulae. However, the work-energy principle provides a more efficient method.

Power

1	**Make sure you use the correct force in the equation Power = force × velocity.** The force in this equation is the driving force of the engine only.
2	**Make sure you know definitions.** You need to know the how the definitions of work and power are affected when a force is variable.
3	**Remember constants of integration.** If an object starts from rest, don't assume that this means that the constant of integration is zero – it may be sometimes, but not always!



Hooke's Law

1	**Make sure that you don't confuse stiffness (k) with modulus of elasticity (λ) .** The modulus of elasticity λ depends only on the type of string and is the same no matter what the natural length (l). The form of Hooke's law which involves the modulus of elasticity is given by $T = \frac{\lambda x}{l}$. The stiffness k depends on the natural length, e.g. it is doubled if the natural length of a string is halved (because x is halved for the same force). The form of Hooke's law which involves the stiffness is given by T =kx.
2	**Remember to draw clear diagrams showing all forces and extensions.** This is particularly important if there is more than one string or spring.
3	**Remember that the tension is the same throughout a string or spring.** This is the case even if two strings or springs are joined together, unless there is a mass in between the two strings or springs. In this case the tensions may be different, and you will probably need to resolve forces to find them.
4	**Remember that in a spring, tension can be negative.** Tension is negative if a spring is compressed. In this case the force is usually referred to as thrust or compression.

Beckfoot

Further Maths	AS Further Mechanics	Year 12

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Elastic Potential Energy (E.P.E.)

1	**Draw clear diagrams.** Make sure you show velocities, extensions and zero PE level. Always indicate the natural length.
2	**Be careful when finding the work done in extending a string.** Remember that the tension in an elastic string or spring depends on its length so the work done in stretching it is *not* force × distance. The work done in extending a string from its natural length l to a length $(l+x)$ is: $\frac{\lambda x^2}{2l}$= elastic energy stored in the string.
3	**Always calculate the elastic energy stored in a string or spring using its extension from its *natural length*.** For example, an elastic string of natural length l has initial length a and final length b (> a). The energy used to stretch the string is: Elastic energy at length b - elastic energy at length a i.e. $\frac{\lambda(b-l)^2}{2l} - \frac{\lambda(a-l)^2}{2l}$. **Don't** be tempted to use (b – a).
4	**Remember to be aware of whether you are dealing with a spring or a string.** A **string** can only be in tension and cannot be compressed. It always has a positive or zero extension. It has no elastic energy if it is slack. A **spring** can also be compressed and then it is in compression and has a negative extension. It always has elastic energy except at instants when it takes its natural length.

Dimensional Analysis

1	**You will make mistakes in this topic if you are not familiar with the definitions of mechanical quantities such as acceleration, force, work, energy, momentum etc.** It's also helpful if you remember what units quantities are measured in. For example, if you need to know the dimensions of impulse, you could remember that it is equal m(v – u) , and since velocity is measured in ms^{-1} , it has dimensions LT^{-1} and therefore impulse has dimensions MLT^{-1} .
2	**Make sure you are competent in the use of indices.** You need to be able to use the laws of indices with confidence.
3	**Remember that all terms of an expression must have the same dimensions.** If a quantity involves adding two expressions together, these must both have the same dimensions. Remember also that unlike an ordinary equation, you cannot subtract dimensions from both sides of a dimensional "equation". e.g. consider the equation $v = u + at$. If you are thinking about the dimensions, you get $LT^{-1} = LT^{-1} + LT^{-2}T$. You can't subtract LT^{-1} from both sides to give $0 = LT^{-2}T$. All you are interested in is checking that all three terms have the same dimensions, which clearly they do.

Impulse and Momentum

1	**Always draw "before" and "after" diagrams when dealing with conservation of momentum.** This will help you to get the signs right.
2	**Make sure you get signs right.** It is essential to consider the direction of motion when using velocities in calculations about impulse and momentum. Make sure that you decide which direction you are considering to be positive. It is a good idea to mark an arrow on your diagrams to indicate the positive direction.
3	**Remember that impulse and velocity are vector quantities.** When you are asked to find an impulse or a velocity, you must give the directions.
4	Remember how to work with variable forces. If an impulse is due to a variable force, then $I = \int F dt$.
5	**Remember that the law of conservation of momentum applies however many impacts are involved.** Some questions deal with several impacts. Remember that the total momentum of the system is conserved throughout, and sometimes when you are dealing with the final situation it is easier to look at the original and final momentums rather that any of the "in-between" situations.

Newton's Experimental Law

1	**Always draw "before" and "after" diagrams when dealing with conservation of momentum.** This will help you to get the signs right
2	**Make sure you get signs right.** It is essential to consider the direction of motion when using velocities in calculations about impulse and momentum. Make sure that you decide which direction you are considering to be positive. It is a good idea to mark an arrow on your diagrams to indicate the positive direction
3	**Make sure that you use Newton's Experimental Law correctly.** Make sure that you know the meanings of the terms "speed of separation" and "speed of approach". Again, be sure that you have decided which direction is positive and ensure that you get the signs right.
4	**Remember that the law of conservation of momentum applies however many impacts are involved.** Some questions deal with several impacts. Remember that the total momentum of the system is conserved throughout, and sometimes when you are dealing with the final situation it is easier to look at the original and final momentums rather that any of the "in-between" situations.

Circular Motion

1	**Be careful with units when dealing with speed and angular velocity.** Remember $v = r\omega$ will only give the speed an object is moving round a circle in ms^{-1} if r is in metres and ω is in $rad\ s^{-1}$. Convert from rpm (revolutions per minute) to $rad\ s^{-1}$ by multiplying by 2π and dividing by 60.
2	**Make sure you know the key equations.** You must understand where these equations come from and you should know them by heart. For a particle moving in a circle at constant speed: a) Tangential speed $v = r\omega$ b) Radial acceleration $= r\omega^2 = \frac{v^2}{r}$ towards the centre of the circle
3	**Draw force diagrams carefully.** Make sure that you include all forces, such as reaction forces, tensions, friction and weight, acting in the correct directions. Draw in the direction of the acceleration (usually shown by a double arrow). Remember that the resultant force in the direction perpendicular to the radial acceleration is zero, and that you need to apply $F = ma$ in the radial direction.