Topics	What students need to learn:		
	Content		**Guidance**
7 **Kinematics**	7.1	**Understand and use the language of kinematics: position; displacement; distance travelled; velocity; speed; acceleration.**	Students should know that distance and speed must be positive.
	7.2	**Understand, use and interpret graphs in kinematics for motion in a straight line: displacement against time and interpretation of gradient; velocity against time and interpretation of gradient and area under the graph.**	**Graphical solutions to problems may be required.**
	7.3	**Understand, use and derive the formulae for constant acceleration for motion in a straight line.** Extend to 2 dimensions using vectors.	**Derivation may use knowledge of sections 7.2 and/or 7.4** **Understand and use *suvat* formulae for constant acceleration in 2-D,** e.g. $\mathbf{v} = \mathbf{u} + \mathbf{a}t$, $\mathbf{r} = \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$ with vectors given in $\mathbf{i} - \mathbf{j}$ or column vector form. Use vectors to solve problems.
	7.4	**Use calculus in kinematics for motion in a straight line:** $$v = \frac{\mathrm{d}r}{\mathrm{d}t} \ , \ a = \frac{\mathrm{d}v}{\mathrm{d}t} = \frac{\mathrm{d}^2 r}{\mathrm{d}t^2}$$ $$\mathbf{r} = \int \mathbf{v} \ \mathrm{d}t, \ \mathbf{v} = \int \mathbf{a} \ \mathrm{d}t$$ Extend to 2 dimensions using vectors.	**The level of calculus required will be consistent with that in Sections 7 and 8 in Paper 1** and Sections 6 and 7 in Paper 2. Differentiation and integration of a vector with respect to time. e.g. Given $\mathbf{r} = t^2 \mathbf{i} + t^{\frac{3}{2}} \mathbf{j}$, find $\dot{\mathbf{r}}$ and $\ddot{\mathbf{r}}$ at a given time.
	7.5	Model motion under gravity in a vertical plane using vectors; projectiles.	Derivation of formulae for time of flight, range and greatest height and the derivation of the equation of the path of a projectile may be required.