THE ACADEMY OF ST NICHOLAS	**Y13 Applied**	**CH08** 8.1,8.2	**Mechanics** **Further Kinematics - Constant Acceleration**	**Lessons** **3**

Essential Knowledge Milestones	**Teaching Points**
• be able to recognise when the use of constant acceleration formulae is appropriate; • be able to write positions, velocities and accelerations in vector form; • understand the language of kinematics appropriate to motion in 2 dimensions • be able to find the magnitude and direction of vectors; • be able to extend techniques for motion in 1 dimension to 2 dimensions by using vectors; • know how to use velocity triangles to solve simple problems; • understand and use *suvat* formulae for constant acceleration in 2D; • know how to apply the equations of motion to **i**, **j** vector problems; • be able to use $\boldsymbol{v} = \boldsymbol{u} + \boldsymbol{a}t$, $\boldsymbol{r} = \boldsymbol{u}t + \frac{1}{2}\boldsymbol{a}t^2$ etc. with vectors given in **i** , **j** or column vector form.	• This topic enables us to use the familiar *suvat* formulae for constant acceleration for more complex motions in two dimensions. It is important to stress that the acceleration may have different values for the **i** and **j** components, but is fixed in value for that direction and is therefore constant. Illustrate this by reviewing projectile motion (covered in Unit 6), which showed that the acceleration was zero in the horizontal direction and ±9.8 m s^{-2} in the vertical direction, hence for a full trajectory $\boldsymbol{a}$ = (0**i** – 9.8**j**) m s^{-2}. This gives a curved (parabolic) path even though the accelerations are constant. • Cover examples which ask for the speed, distance and direction of motion. Make sure that students can pick out the keywords, and realise when the answer can be left in **i**, **j** form and when to form a triangle and use Pythagoras and tan to calculate the magnitude and direction (e.g. when asked for the speed and direction of motion of a particle). • Also stress that the *angle* of the velocity vector gives the true direction of motion and that the acceleration's magnitude does not have a special keyword, but will just be asked for as magnitude of the acceleration.
Success Criteria	**Assumed Prior Knowledge/ Links / Interleaving**
❑ You can work with factors for displacement, velocity and acceleration when the vector equations of motion unknown.	GCSE (9-1) in Mathematics at Higher Tier • Basic trigonometry, Pythagoras and vectors • Find the magnitude and direction of vectors AS Mathematics – Mechanics • Kinematics 1 and equations of motion • Kinematics 2 (variable force) AS Mathematics – Pure • 2D vectors – **i**, **j** system

Potential Barriers to Access /Misconceptions	Opportunities for Reasoning/Problem Solving/Proofs
• Candidates are generally able to use *suvat* equations in 2D to find unknown heights, velocities etc. However, some common errors are: finding a solution in vector form and not extracting one component e.g. to find the height; incorrectly finding velocity rather than speed and vice versa; and equating scalars and vectors and forgetting to split e.g. velocities into **i** and **j** components. • If there is change in motion, we have a dynamics problem. These are solved by applying Newton's second law in vector form: $\boldsymbol{F} = m\boldsymbol{a}$. This naturally leads onto the next section in which the force is variable.	• Projectile questions could also be tackled using the vector equations of motion rather than separating out the horizontal and vertical motions (Unit 6). • Some graphical packages will draw the graphs using **i - j** vectors; these can be used to help students visualise the problems. •

Key Mathematical Vocabulary	Distance, displacement, speed, velocity, constant acceleration, constant force, variable force, variable acceleration, retardation, deceleration, initial (t = 0), stationary (speed = 0), at rest (speed = 0), instantaneously, differentiate, integrate, turning point.

Personal Development	Notes	Resources
Pupils are taught to be able to identify a situation whereby a particular maths skill is applied to a problem solve a question, and to have belief in their own ability.		