THE ACADEMY OF ST NICHOLAS	Y13 Applied	CH05 5.1,5.2	Mechanics Forces & Friction - Resolving forces	Lessons 2

Essential Knowledge Milestones

- understand the language relating to forces;
- be able to identify the forces acting on a particle and represent them in a force diagram;
- understand how to find the resultant force (magnitude and direction);
- be able to find the resultant of several concurrent forces by vector addition;
- be able to resolve a force into components and be able to select suitable directions for resolution.

Success Criteria

- ❑ You can resolve forces into components
- ❑ You can use the triangle law to find a resultant force

- Begin by considering two forces acting at right angles to one another (horizontal and vertical), use Pythagoras and trigonometry to find the hypotenuse (resultant *R*) and angle (direction θ above the horizontal) respectively. [You could also link to velocity from speed and vector addition rule.]
- It is easy going from component form to magnitude/direction; but can we go backwards?
- Guide students to consider the right-angled triangle and use trigonometry to show that the horizontal component is $R\cos\theta$ and the vertical component is $R\sin\theta$ of the Resultant, *R* (hypotenuse).
- Show that forces given in the form **i**, **j** can be simply drawn as a right-angled triangle and the resultant and direction can be found the same way. Extend to finding the resultant of a system of forces given in **i – j** form by adding **i** and **j** components.
- Look at two forces acting at *any* angle and show that the triangle can be solved using the cosine rule (to find the resultant) and sine rule (to find the direction).
- Extend to more than two forces and resolve the system using *R*(→) and *R*(↑) to create two perpendicular forces, then use Pythagoras and trigonometry to calculate the resultant and direction.
- Show that the weight component of a particle on an inclined plane acts in two directions: along and perpendicular to the plane. This will be a critical skill for solving the statics/dynamics questions in the next unit.

Assumed Prior Knowledge/ Links / Interleaving

<u>GCSE (9-1) in Mathematics at Higher Tier</u>

- 2D trigonometry
- Cosine and sine rules

<u>AS Mathematics – Pure</u>

- $\frac{\sin x}{\cos x}$ = tan x (to find the angle of the resultant)
- Basic vectors, magnitude and direction (kinematics)
- **i**, **j** vectors
- Force diagrams and assumptions

Opportunities for Reasoning/Problem Solving/Proofs

- Discuss car's braking distances and how the it is determined and then bring the variable of weather and the affect it could have

Potential Barriers to Access /Misconceptions

- When resolving common errors are: to omit *g*; sign errors; reversal or confusion* of when to use cos and/or sin; to omit one force (usually weight).
- Students may also easily get confused by the vocabulary and mix up 'resultant' and 'reaction'
- For students who find these concepts difficult it is possible to simplify most questions by restricting the resolving of a force to using just cos θ. This can be done by using the method of 'cos across the number of degrees the force has to be turned to reach the direction we want to resolve in'

Key Mathematical Vocabulary	Force, weight, tension, thrust, friction, coefficient of friction, μ, limiting, reaction, resultant, magnitude, direction, bearing, force diagram, equilibrium, inextensible, light, negligible, particle, smooth, rough, uniform, perpendicular.

Personal Development	**Notes**	**Resources**
Pupils are taught that they must show 'resilience' in their approach to completing questions always showing their working to ensure they achieve method marks.		