Overview of YEAR 13 SPRING MECHANICS

Week	Statements	Teaching activities	Notes
1	3.03p Understand the term 'resultant' as applied to two or more forces acting at a point and be able to use vector addition in solving problems involving resultants and components of forces. *Includes understanding that the velocity vector gives the direction of motion and the acceleration vector gives the direction of resultant force.* *Includes being able to find and use perpendicular components of a force, for example to find the resultant of a system of forces or to calculate the magnitude and direction of a force.* [*Solutions will involve calculation, not scale drawing.*]		CHAPTER 19 APPLICATIONS OF VECTORS Page 424 SECTION 1 DESCRIBING MOTION IN 2D Page 423 EXERCISE 19A Page 429

Week	Statements	Teaching activities	Notes
2	3.02e Be able to extend the constant acceleration formulae to motion in two dimensions using vectors: $\mathbf{v} = \mathbf{u} + \mathbf{a}t$ $\mathbf{s} = \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$ $\mathbf{s} = \frac{1}{2}(\mathbf{u} + \mathbf{v})t$ $\mathbf{s} = \mathbf{v}t - \frac{1}{2}\mathbf{a}t^2$ *Questions set involving vectors may involve either column vector notation, e.g.* $\boldsymbol{u} = \begin{pmatrix} u_1 \\ u_2 \end{pmatrix}$ *or* $\boldsymbol{i}$, $\boldsymbol{j}$ *notation, e.g.* $\boldsymbol{u} = u_1\mathbf{i} + u_2\mathbf{j}$ [*The formula* $\boldsymbol{v} \cdot \mathbf{v} = \mathbf{u} \cdot \mathbf{u} + 2\mathbf{a} \cdot \mathbf{s}$ *is excluded.*]		SECTION 2 CONSTANT ACCELERATION EQUATIONS Page 431 EXERCISE 19B Page 432

Week	Statements	Teaching activities	Notes
3	3.02g Be able to extend the application of differentiation and integration to two dimensions using vectors: $\mathbf{x} = \mathrm{f}(t)\mathbf{i} + \mathrm{g}(t)\mathbf{j}$ $\mathbf{v} = \frac{\mathrm{d}\mathbf{x}}{\mathrm{d}t} = \dot{\mathbf{x}} = \mathrm{f}'(t)\mathbf{i} + \mathrm{g}'(t)\mathbf{j}$ $\mathbf{a} = \frac{\mathrm{d}\mathbf{v}}{\mathrm{d}t} = \dot{\mathbf{v}} = \frac{\mathrm{d}^2\mathbf{x}}{\mathrm{d}t^2} = \mathrm{f}''(t)\mathbf{i} + \mathrm{g}''(t)\mathbf{j}$		SECTION 3 CALCULUS WITH VECTORS Page 433 use when acceleration is not constant EXERCISE 19C Q1,2 Page 438

	$\mathbf{x} = \int \mathbf{v} \mathrm{d}t$ and $\mathbf{v} = \int \mathbf{a} \mathrm{d}t$ *Questions set may involve either column vector or* $\boldsymbol{i}$, $\boldsymbol{j}$ *notation.*		

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4	3.03d Understand and be able to use Newton's second law $(F = ma)$ in simple cases of forces given as two dimensional vectors. e.g. Find in vector form the force acting on a body of mass 2 kg when it is accelerating at $(4\mathbf{i} - 3\mathbf{j})$ m s $^{-2}$. Questions set involving vectors may involve either column vector notation $\mathbf{F} = \begin{pmatrix} F_1 \\ F_2 \end{pmatrix}$ or $\mathbf{i}$, $\mathbf{j}$ notation $\mathbf{F} = F_1\mathbf{i} + F_2\mathbf{j}$.		SECTION 3 CALCULUS WITH VECTORS Page 436 FORCES IN 2D EXERCISE 19C Page 438 Q3 onwards

Week	Statements	Teaching activities	Notes
5	1.10g Be able to use vectors to solve problems in pure mathematics and in context, including forces.		SECTION 4 VECTORS IN THREE DIMENSIONS Page 439 EXERCISE 19D Page 442

	1.10h Be able to use vectors to solve problems in kinematics. *e.g. The equations of uniform acceleration may be used in vector form to find an unknown. See section 3.02e.*		

Week	Statements	Teaching activities	Notes
6	1.10g Be able to use vectors to solve problems in pure mathematics and in context, including forces.		SECTION 5 SOLVING GEOMETRICAL PROBLEMS Page 443 EXERCISE 19E Page 446
	1.10h Be able to use vectors to solve problems in kinematics. *e.g. The equations of uniform acceleration may be used in vector form to find an unknown. See section 3.02e.*		

Week	Statements	Teaching activities	Notes
7			MIXED PRACTICE 19 Page 448-449

Week	Statements	Teaching activities	Notes
8	3.02i Be able to model the motion of a projectile as a particle moving with constant acceleration and understand the limitation of this model. *Includes being able to:* *1. Use horizontal and vertical equations of motion to solve problems on the motion of projectiles.* *2. Find the magnitude and direction of the velocity at a given time or position.* *3. Find the range on a horizontal plane and the greatest height achieved.* *4. Derive and use the cartesian equation of the trajectory of a projectile.* [*Projectiles on an inclined plane and problems with resistive forces are excluded.*]		CHAPTER 20 PROJECTILES Page 450 SECTION 1 MODELLING PROJECTILE MOTION Page 420 EXERCISE 20A Page 455

Week	Statements	Teaching activities	Notes
9	3.02i Be able to model the motion of a projectile as a particle moving with constant acceleration and understand the limitation of this model. *Includes being able to:* *1. Use horizontal and vertical equations of motion to solve problems on the motion of projectiles.* *2. Find the magnitude and direction of the velocity at a given time or position.* *3. Find the range on a horizontal plane and the greatest height achieved.* *4. Derive and use the cartesian equation of the trajectory of a projectile.* [*Projectiles on an inclined plane and problems with resistive forces are excluded.*]		SECTION 2 THE TRAJECTORY OF A PROJECTILE Page 457 EXERCISE 20B Page 460

Week	Statements	Teaching activities	Notes
10	3.02i Be able to model the motion of a projectile as a particle moving with constant acceleration and understand the limitation of this model.		MIXED PRACTICE 20 Page 463-465

	Includes being able to: *1. Use horizontal and vertical equations of motion to solve problems on the motion of projectiles.* *2. Find the magnitude and direction of the velocity at a given time or position.* *3. Find the range on a horizontal plane and the greatest height achieved.* *4. Derive and use the cartesian equation of the trajectory of a projectile.* [*Projectiles on an inclined plane and problems with resistive forces are excluded.*]		

Week	**Statements**	**Teaching activities**	**Notes**
11	3.03l Be able to extend use of Newton's third law to situations where forces need to be resolved (restricted to two dimensions).		CHAPTER 21 FORCES IN CONTEXT Page 466 SECTION 1 RESOLVING FORCES Page 466 EXERCISE 21A Page 472
	3.03e Be able to extend use of Newton's second law to situations where forces need to be resolved (restricted to two dimensions).		

	e.g. A force acting downwards on a body at a given angle to the horizontal or the motion of a body projected down a line of greatest slope of an inclined plane.		

Week	**Statements**	**Teaching activities**	**Notes**
12	3.03t Understand and be able to use the coefficient of friction and the $\boldsymbol{F} \leq \mu\boldsymbol{R}$ model of friction in one and two dimensions, including the concept of limiting friction. [*Knowledge of the angle of friction is excluded.*]		SECTION 2 COEFFICIENT OF FRICTION Page 474 EXERCISE 21B Page 481

Week	**Statements**	**Teaching activities**	**Notes**
13	3.03u Understand and be able to solve problems regarding the static equilibrium of a body on a rough surface and solve problems regarding limiting equilibrium.		SECTION 3 MOTION ON A SLOPE Page 483 EXERCISE 21C Page 488

	3.03v Understand and be able to solve problems regarding the motion of a body on a rough surface. *e.g. The motion of a body projected down a line of greatest slope on a rough inclined plane.* [*Problems set on inclined planes will only consider motion along the line of greatest slope and therefore a vector consideration of the motion will not be required.*]		

Week	**Statements**	**Teaching activities**	**Notes**
14	3.03m Be able to use the principle that a particle is in equilibrium if and only if the sum of the resolved parts in a given direction is zero. *Problems may involve the resolving of forces, including cases where it is sensible to:* *1. resolve horizontally and vertically,* *2. resolve parallel and perpendicular to an inclined plane,* *3. resolve in directions to be chosen by the learner, or* *4. use a polygon of forces.*		SECTION 4 FURTHER EQUILIBRIUM PROBLEMS Page 491 EXERCISE 21D Page 494

	3.03n Be able to solve problems involving simple cases of equilibrium of forces on a particle in two dimensions using vectors, including connected particles and smooth pulleys. *e.g. Finding the required force* $\boldsymbol{F}$ *for a particle to remain in equilibrium when under the action of forces* $\boldsymbol{F}_1, \boldsymbol{F}_2, \ldots$ *For stage 1 learners, examples can be restricted to problems in which the forces acting on the body will be collinear, in two perpendicular directions or given as 2-D vectors.*		

Week	Statements	Teaching activities	Notes
15			MIXED PRACTICE 21 Page 496-502

Week	Statements	Teaching activities	Notes
16			MIXED PRACTICE 21 CONTINUED Page 496-502

Week	Statements	Teaching activities	Notes
17	3.04a Be able to calculate the moment of a force about an axis through a point in the plane of the body. *For coplanar forces, moments may be described as being about a point.* [*Understanding of the vector nature of moments is excluded.*]		CHAPTER 22 MOMENTS Page 503 SECTION 1 THE TURNING EFFECT OF A FORCE Page 503 EXERCISE 22A Page 507

Week	Statements	Teaching activities	Notes
18	3.04b Understand that when a rigid body is in equilibrium the resultant moment is zero and the resultant force is zero.		SECTION 2 EQUILIBRIUM Page 511 EXERCISE 22B Page 513

Week	Statements	Teaching activities	Notes
19	3.04c Be able to use moments in simple static contexts. *e.g. To determine the forces acting on*		SECTION 3 NON-UNIFORM RODS Page 516 EXERCISE 22C Page 517

	a horizontal beam or to determine the forces acting on a ladder resting on horizontal ground against a vertical wall. *Questions will be set in which the context of the problem can be modelled using rectangular laminas, uniform and non-uniform rods only.* *Learners may assume that:* *1. for a uniform rod the weight acts at the midpoint of the rod,* *2. for a non-uniform rod the weight acts at either a specified given point or is to be determined by moments,* *3. for a rectangular lamina the weight acts at its point of symmetry.*		

Week	**Statements**	**Teaching activities**	**Notes**
20	3.04c Be able to use moments in simple static contexts. *e.g. To determine the forces acting on a horizontal beam or to determine the forces acting on a ladder resting on horizontal ground against a vertical wall.* *Questions will be set in which the*		SECTION 4 FURTHER EQUILIBRIUM PROBLEMS Page 518 EXERCISE 22D Page 520

	context of the problem can be modelled using rectangular laminas, uniform and non-uniform rods only. *Learners may assume that:* *1. for a uniform rod the weight acts at the midpoint of the rod,* *2. for a non-uniform rod the weight acts at either a specified given point or is to be determined by moments,* *3. for a rectangular lamina the weight acts at its point of symmetry.*		

Week	Statements	Teaching activities	Notes
21			MIXED PRACTICE 22 Page 523-525

Week	Statements	Teaching activities	Notes
22			CROSS TOPIC REVIEW EXERCISE 4 Page 529-532

Week	Statements	Teaching activities	Notes
23			PAPER 1 PRACTICE QUESTIONS Page 533-534

Week	Statements	Teaching activities	Notes
24			PAPER 2 PRACTICE QUESTIONS Page 535-538

Week	Statements	Teaching activities	Notes
25			

Week	Statements	Teaching activities	Notes
26			

Week	Statements	Teaching activities	Notes
27			
