A Level Physics Online

OCR Physics Specification A - H156/H556

Module 3: Forces and Motion

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
	1	2	3	4
3.1 Motion				
Displacement, instantaneous speed, average speed, velocity and acceleration.				
Graphical representations of displacement, speed, velocity and acceleration.				
Displacement–time graphs; velocity is gradient.				
Velocity–time graphs; acceleration is gradient; displacement is area under graph. You will also be expected to estimate the area under non-linear graphs.				
The equations of motion for constant acceleration in a straight line, including motion of bodies falling in a uniform gravitational field without air resistance; $v = u + at$ $s = ut + \frac{1}{2} at^2$ $s = \frac{1}{2} (u+v)t$ $v^2 = u^2 + 2as$				
Techniques and procedures used to investigate the motion and collisions of objects. Apparatus may include trolleys, air-track gliders, ticker timers, light gates, data-loggers and video techniques.				
Acceleration, *g,* of free fall.				
Techniques and procedures used to determine the acceleration of free fall in the laboratory using trapdoor and electromagnet arrangement or light gates and timer.				
Reaction time and thinking distance; braking distance and stopping distance for a vehicle.				
The independence of the vertical and horizontal motion of a projectile.				

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
	1	2	3	4
Two-dimensional motion of a projectile with constant velocity in one direction and constant acceleration in a perpendicular direction.				
3.1 Forces in Action				
Net force = mass × acceleration; $F = ma$ [not in the data book]				
The newton as the unit of force.				
Weight of an object; $W = mg$ [not in the data book]				
The terms tension, normal contact force, upthrust and friction.				
Free-body diagrams.				
One- and two-dimensional motion under constant force.				
Drag as the frictional force experienced by an object travelling through a fluid.				
Factors affecting drag for an object travelling through air.				
Motion of objects falling in a uniform gravitational field in the presence of drag.				
Terminal velocity.				
Techniques and procedures used to determine terminal velocity in fluids, e.g. ball-bearing in a viscous liquid or cones in air.				
Moment of force.				
Couple; torque of a couple.				
The principle of moments.				
Centre of mass; centre of gravity; experimental determination of centre of gravity.				
Equilibrium of an object under the action of forces and torques.				
Condition for equilibrium of three coplanar forces; triangle of forces.				
Density; $\rho = m / V$				

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
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Pressure for solids, liquids and gases; $p = F / A$				
Upthrust on an object in a fluid; Archimedes' principle; $p = h\rho g$				
3.3 Work, Energy and Power				
Work done by a force; the unit joule.				
$W = Fx \cos \theta$ for work done by a force.				
The principle of conservation of energy.				
Energy in different forms; transfer and conservation.				
Transfer of energy is equal to work done.				
Kinetic energy of an object; $E_k = ½ mv^2$ You will also be expected to recall this equation and derive it from first principles.				
Gravitational potential energy of an object in a uniform gravitational field; $E_p = mgh$ You will also be expected to recall this equation and derive it from first principles.				
The exchange between gravitational potential energy and kinetic energy.				
Power; the unit watt; $P = W/ t$				
Power; $P = Fv$ You will also be expected to derive this equation from first principles.				
Efficiency of a mechanical system; $efficiency = \frac{useful\ output\ energy}{total\ input\ energy} \times 100\%$				

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
	1	2	3	4
3.4 Materials				
Tensile and compressive deformation; extension and compression.				
Hooke's law.				
Force constant *k* of a spring or wire; $F = kx$				
Force–extension (or compression) graphs for springs and wires.				
Techniques and procedures used to investigate force–extension characteristics for arrangements which may include springs, rubber bands, polythene strips.				
Force–extension (or compression) graph where work done is area under graph.				
Elastic potential energy; $E = 1/2Fx$ $E = ½ kx^2$				
Stress, strain and ultimate tensile strength.				
Young's modulus = $\frac{\text{Tensile stress}}{\text{Tensile strain}}$ $E = \sigma/\varepsilon$				
Techniques and procedures used to determine the Young's modulus for a metal.				
Stress–strain graphs for typical ductile, brittle and polymeric materials.				
Elastic and plastic deformations of materials.				
3.5 Newton's Laws of Motion and Momentum				
Newton's three laws of motion.				
Linear momentum; vector nature of momentum; $p = mv$				
Net force = rate of change of momentum; $F = \Delta p / \Delta t$				

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
	1	2	3	4
Impulse of a force; *impulse = FΔt*				
Impulse is equal to the area under a force–time graph. You will also be expected to estimate the area under non-linear graphs.				
The principle of conservation of momentum.				
Collisions and interaction of bodies in one dimension and in two dimensions. Two-dimensional problems will only be assessed at A level.				
Perfectly elastic collision and inelastic collision.				

The material in this checklist is based on the OCR Physics A Specification published at ocr.org.uk/**alevelphysicsa** by Oxford, Cambridge and RSA Examinations.