

A L e v e l P h y s i c s

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:** |
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| **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 + ½ at2* *s = ½ (u+v)t* *v2 = u2 + 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. |  |  |  |  |
| 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;  *ρ = m / V*  |  |  |  |  |
| Pressure for solids, liquids and gases;  *p = F / A*  |  |  |  |  |
| Upthrust on an object in a fluid; Archimedes’ principle;  *p = hρg* |  |  |  |  |
| **3.3 Work, Energy and Power** |
| Work done by a force; the unit joule. |  |  |  |  |
| *W* = *Fx* cos θfor 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;  *Ek = ½ mv2* 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 = total input energy x 100%* *useful output energy*  |  |  |  |  |
| **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 kx2* |  |  |  |  |
| Stress, strain and ultimate tensile strength. |  |  |  |  |
|  Young’s modulus = Tensile strain  Tensile stress *E = σ/ε* |  |  |  |  |
| 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 = Δp / Δt* |  |  |  |  |
| 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**](http://www.ocr.org.uk/qualifications/as-a-level-gce-physics-a-h156-h556-from-2015/) by Oxford, Cambridge and RSA Examinations.