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| OCR Physics AModule 3 : Forces and motion | Module RAG sheet |

Use this sheet to track and review your learning and revision.

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| **3.1** | **Motion**  | RAG1 | RAG2 | RAG3 |
| **3.1.1** | **Kinematics**  |  |  |  |
| (a) | displacement, instantaneous speed, average speed, velocity and acceleration |  |  |  |
| (b) | graphical representations of displacement, speed, velocity and acceleration (Using data-loggers to analyse motion.) |  |  |  |
| (c) | Displacement–time graphs; velocity is gradient |  |  |  |
| (d) | Velocity–time graphs; acceleration is gradient; displacement is area under graph. Including estimates under non-linear graphs |  |  |  |
| **3.1.2** | **Linear motion**  |  |  |  |
| (a)(i) | 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 + ats = ½ (u + v)ts = ut + ½ at2v2 = u2 + 2as* |  |  |  |
| (a)(ii) | techniques and procedures used to investigate the motion and collisions of objectsApparatus may include trolleys, air-track gliders, ticker timers, light gates, data-loggers and video techniques. |  |  |  |
| (b)(i) | acceleration *g* of free fall |  |  |  |
| (b)(ii) | techniques and procedures used to determine the acceleration of free fall using trapdoor and electromagnet arrangement or light gates and timer  |  |  |  |
|  | **Determining *g* in the laboratory.** |  |  |  |
| (c) | reaction time and thinking distance; braking distance and stopping distance for a vehicle. |  |  |  |
| **3.1.3** | **Projectile motion**  |  |  |  |
| (a) | independence of the vertical and horizontal motion of a projectile |  |  |  |
| (b) | two-dimensional motion of a projectile with constant velocity in one direction and constant acceleration in a perpendicular direction. |  |  |  |
|  |  |  |  |  |
| **3.2** | **Forces in action**  | RAG1 | RAG2 | RAG3 |
| **3.2.1** | **Dynamics**  |  |  |  |
| (a) | net force = mass × acceleration; *F* = *ma* Recall this equation. |  |  |  |
| (b) | the newton as the unit of force |  |  |  |
| (c) | weight of an object; *W* = *mg* Recall this equation. |  |  |  |
| (d) | the terms tension, normal contact force, upthrust and friction |  |  |  |
| (e) | free-body diagrams |  |  |  |
| (f) | one- and two-dimensional motion under constant force. |  |  |  |
| **3.2.2** | **Motion with non-uniform acceleration**  |  |  |  |
| (a) | drag as the frictional force experienced by an object travelling through a fluid |  |  |  |
| (b) | factors affecting drag for an object travelling through air  |  |  |  |
| (c) | motion of objects falling in a uniform gravitational field in the presence of drag  |  |  |  |
| (d)(i) | terminal velocity |  |  |  |
| (d)(ii) | techniques and procedures used to determine terminal velocity in fluids. e.g. ball-bearing in a viscous liquid or cones in air. |  |  |  |
|  | **Investigating factors affecting terminal velocity.** |  |  |  |
| **3.2.3** | **Equilibrium**  |  |  |  |
| (a) | moment of force |  |  |  |
| (b) | couple; torque of a couple |  |  |  |
| (c) | the principle of moments |  |  |  |
| (d) | centre of mass; centre of gravity; experimental determination of centre of gravity |  |  |  |
| (e) | equilibrium of an object under the action of forces and torques |  |  |  |
| (f) | condition for equilibrium of three coplanar forces; triangle of forces. |  |  |  |
| **3.2.4** | **Density and pressure**  |  |  |  |
| (a) | density; *ρ = m / V* |  |  |  |
| (b) | pressure; *p* = *F / A* for solids, liquids and gases |  |  |  |
| (c) | *p=hρg;* upthrust on an object in a fluid; Archimedes’ principle |  |  |  |
|  |  |  |  |  |
| **3.3** | **Work, energy and power**  | RAG1 | RAG2 | RAG3 |
| **3.3.1** | **Work and conservation of energy**  |  |  |  |
| (a) | work done by a force; the unit joule |  |  |  |
| (b) | *W = Fx* cos θ for work done by a force |  |  |  |
| (c) | the principle of conservation of energy  |  |  |  |
| (d) | energy in different forms; transfer and conservation |  |  |  |
| (e) | transfer of energy is equal to work done. |  |  |  |
| **3.3.2** | **Kinetic and potential energies**  |  |  |  |
| (a) | kinetic energy of an object; *EK = ½ mv2*Recall this equation and derive it from first principles. |  |  |  |
| (b) | gravitational potential energy of an object in a uniform gravitational field; *E*p = *mgh*Recall this equation and derive it from first principles. |  |  |  |
| (c) | the exchange between gravitational potential energy and kinetic energy. |  |  |  |
| **3.3.3** | **Power**  |  |  |  |
| (a) | power; the unit watt; *P = W / t* |  |  |  |
| (b) | *P* = *Fv*Recall this equation and derive it from first principles |  |  |  |
| (c) | efficiency of a mechanical system; |  |  |  |
|  |  |  |  |  |
| **3.4** | **Materials**  | RAG1 | RAG2 | RAG3 |
| **3.4.1** | **Springs**  |  |  |  |
| (a) | tensile and compressive deformation; extension and compression |  |  |  |
| (b) | Hooke’s law |  |  |  |
| (c) | force constant *k* of a spring or wire; *F* = *kx* |  |  |  |
| (d)(i) | force–extension (or compression) graphs for springs and wires |  |  |  |
| (d)(ii) | techniques and procedures used to investigate force–extension characteristics for arrangements which may include springs, rubber bands, polythene strips. |  |  |  |
| **3.4.2** | **Mechanical properties of matter**  |  |  |  |
| (a) | force–extension (or compression) graph; work done is area under graph  |  |  |  |
| (b) | elastic potential energy; *E = ½ F x = ½ k x2* |  |  |  |
| (c) | stress, strain and ultimate tensile strength |  |  |  |
| (d)(i) | Young modulus = tensile stress / tensile strain, *E = σ / ε* |  |  |  |
| (d)(ii) | techniques and procedures used to determine the Young modulus for a metal |  |  |  |
| (e) | stress–strain graphs for typical ductile, brittle and polymeric materials |  |  |  |
| (f) | elastic and plastic deformations of materials |  |  |  |
|  | **Investigating the properties of materials** |  |  |  |
|  | **89** |  |  |  |
| **3.5** | **Newton’s laws of motion and momentum**  | RAG1 | RAG2 | RAG3 |
| **3.5.1** | **Newton’s laws of motion**  |  |  |  |
| (a) | Newton’s three laws of motion |  |  |  |
| (b) | linear momentum; *p* = *mv*; vector nature of momentum |  |  |  |
| (c) | net force = rate of change of momentum; *F = Δp/Δt*Know that *F = ma* is a special case of this equation. |  |  |  |
| (d) | impulse of a force; impulse = *F*Δ*t* |  |  |  |
| (e) | impulse is equal to the area under a force–time graph, including estimating the area under non-linear graphs. |  |  |  |
|  | **Using a spreadsheet to determine impulse from *F*–*t* graph.** |  |  |  |
| **3.5.2** | **Collisions**  |  |  |  |
| (a) | the principle of conservation of momentum  |  |  |  |
| (b) | collisions and interaction of bodies in one dimension and in two dimensions.Two-dimensional problems will only be assessed at A level. |  |  |  |
| (c) | perfectly elastic collision and inelastic collision. |  |  |  |