A Level Physics Online

AQA Physics - 7407/7408

Module 4: Mechanics and Materials

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
	1	2	3	4
4.1 Force, Energy and Momentum				
4.1.1 Scalars and Vectors				
Nature of scalars and vectors. Examples should include: velocity/speed, mass, force/weight, acceleration, displacement/distance.				
Addition of vectors by calculation or scale drawing. Calculations will be limited to two vectors at right angles. Scale drawings may involve vectors at angles other than 90°.				
Resolution of vectors into two components at right angles to each other. Examples should include components of forces along and perpendicular to an inclined plane.				
Problems may be solved either by the use of resolved forces or the use of a closed triangle.				
Conditions for equilibrium for two or three coplanar forces acting at a point. Appreciation of the meaning of equilibrium in the context of an object at rest or moving with constant velocity.				
4.1.2 Moments				
Moment of a force about a point. Moment defined as *force × perpendicular distance from the point to the line of action of the force*.				
Couple as a pair of equal and opposite coplanar forces. Moment of couple defined as *force × perpendicular distance between the lines of action of the forces*.				

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
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Principle of moments.				
Centre of mass. Knowledge that the position of the centre of mass of uniform regular solid is at its centre.				
4.1.3 Motion along a Straight Line				
Displacement, speed, velocity, acceleration.				
$v = \Delta s / \Delta t$				
$a = \Delta v / \Delta t$				
Calculations may include average and instantaneous speeds and velocities.				
Representation by graphical methods of uniform and non-uniform acceleration.				
Significance of areas of velocity–time and acceleration–time graphs and gradients of displacement–time and velocity–time graphs for uniform and non-uniform acceleration eg. graphs for motion of bouncing ball.				
Equations for uniform acceleration: $v = u + at$ $s = \left(\frac{u+v}{2}\right)t$ $s = ut + \frac{1}{2} at^2$ $v^2 = u^2 + 2as$				
Acceleration due to gravity, g.				
4.1.4 Projectile Motion				
Independent effect of motion in horizontal and vertical directions of a uniform gravitational field. Problems will be solvable using the equations of uniform acceleration.				
Qualitative treatment of friction.				
Distinctions between static and dynamic friction will not be tested.				
Qualitative treatment of lift and drag forces.				

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
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Terminal speed.				
Knowledge that air resistance increases with speed.				
Qualitative understanding of the effect of air resistance on the trajectory of a projectile and on the factors that affect the maximum speed of a vehicle.				
4.1.5 Newton's Laws of Motion				
Knowledge and application of the three laws of motion in appropriate situations.				
$F = ma$ for situations where the mass is constant.				
4.1.6 Momentum				
momentum = mass × velocity				
Conservation of linear momentum.				
Principle applied quantitatively to problems in one dimension.				
Force as the rate of change of momentum: $F = \Delta mv / \Delta t$				
Impulse = change in momentum				
$F\Delta t = \Delta mv$ Where F is constant.				
Significance of the area under a force–time graph.				
Quantitative questions may be set on forces that vary with time. Impact forces are related to contact times (eg kicking a football, crumple zones, packaging).				
Elastic and inelastic collisions; explosions.				
Appreciation of momentum conservation issues in the context of ethical transport design.				
4.1.7 Work, Energy and Power				
Energy transferred, $W = Fs \cos\theta$				

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rate of doing work = rate of energy transfer, $P = \Delta W / \Delta t = Fv$				
Quantitative questions may be set on variable forces.				
Significance of the area under a force–displacement graph.				
$efficiency = \frac{useful\ output\ power}{input\ power}$				
Efficiency can be expressed as a percentage.				
4.1.8 Conservation of Energy				
Principle of conservation of energy.				
$\Delta E_p = mg\Delta h$ and $E_k = \frac{1}{2} mv^2$				
Quantitative and qualitative application of energy conservation to examples involving gravitational potential energy, kinetic energy, and work done against resistive forces.				
4.2 Materials				
4.2.1 Bulk Properties of Solids				
Density: $\rho = m / V$				
Hooke's law, elastic limit.				
$F = k\Delta L$ *k* as stiffness and spring constant.				
Tensile strain and tensile stress.				
Elastic strain energy, breaking stress.				
energy stored = $\frac{1}{2} F\Delta L$ = *area under force–extension graph*				
Description of plastic behaviour, fracture and brittle behaviour linked to force–extension graphs.				

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Quantitative and qualitative application of energy conservation to examples involving elastic strain energy and energy to deform.				
Spring energy transformed to kinetic and gravitational potential energy.				
Interpretation of simple stress–strain curves.				
Appreciation of energy conservation issues in the context of ethical transport design.				
4.2.2 The Young Modulus				
Young modulus = tensile stress / tensile strain = $FL / A \Delta L$				
Use of stress–strain graphs to find the Young modulus.				
One simple method of measurement of Young Modulus required				