The AS specification content that is developed or required for the A2 units in 2021.

AS Unit 1 – Motion, energy and matter

1. Basic physics

(a) the 6 essential base SI units (kg, m, s, A, mol, K)

(b) representing units in terms of the 6 base SI units and their prefixes

(c) checking equations for homogeneity using units

(d) the difference between scalar and vector quantities and to give examples of each – displacement, velocity, acceleration, force, speed, time, density, pressure etc

(e) the addition and subtraction of coplanar vectors, and perform mathematical calculations limited to **two** perpendicular vectors

(f) how to resolve a vector into two perpendicular components

(g) the concept of density and how to use the equation $\rho = \frac{m}{V}$ to calculate mass, density and volume

(h) what is meant by the turning effect of a force

(i) the use of the principle of moments (needed for option C)

(j) the use of centre of gravity, for example in problems including stability: identify its position in a cylinder, sphere and cuboid (beam) of uniform density (needed in option C)

(k) when a body is in equilibrium the resultant force is zero and the net moment is zero, and be able to perform simple calculations (needed in option C)

2. Kinematics

(a) what is meant by displacement, mean and instantaneous values of speed, velocity and acceleration

(b) the representation of displacement, speed, velocity and acceleration by graphical methods

(c) the properties of displacement-time graphs, velocity-time graphs, and interpret speed and displacement-time graphs for non-uniform acceleration

(f) the independence of vertical and horizontal motion of a body moving freely under gravity

(g) the explanation of the motion due to a uniform velocity in one direction and uniform acceleration in a perpendicular direction, and perform simple calculations

3. Dynamics

(a) the concept of force and Newton's 3rd law of motion

(b) how free body diagrams can be used to represent forces on a particle or body

(c) the use of the relationship $\Sigma F = ma$ in situations where mass is constant

(d) the idea that linear momentum is the product of mass and velocity

(e) the concept that force is the rate of change of momentum, applying this in situations where mass is constant

(f) the principle of conservation of momentum and use it to solve problems in one dimension involving elastic collisions (where there is no loss of kinetic energy) and inelastic collisions (where there is a loss of kinetic energy)

4. Energy concepts

(a) the idea that work is the product of a force and distance moved in the direction of the force when the force is constant

(c) the principle of conservation of energy including knowledge of gravitational potential energy $(mg\Delta h)$, elastic potential energy $(\frac{1}{2}kx^2)$ and kinetic energy $(\frac{1}{2}mv^2)$

(d) the work-energy relationship: $Fx = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$

(e) power being the rate of energy transfer

(f) dissipative forces for example, friction and drag cause energy to be transferred from a system and reduce the overall efficiency of the system

(g) the equation efficiency = $\frac{\text{useful energy transfer}}{\text{total energy input}}$ × 100% (needed for option D)

5. Solids under stress

(a) Hooke's law and use $F = kx$ where the spring constant k is the force per unit extension

6. Using radiation to investigate stars

(c) the shape of the black body spectrum and that the peak wavelength is inversely proportional to the absolute temperature (defined by:
T (K) = θ (°C) + 273.15) (needed for option D)

(d) Wien's displacement law, Stefan's law and the inverse square law to investigate the properties of stars – luminosity, size, temperature and distance [N.B. stellar brightness in magnitudes will not be required] (needed for option D)

AS Unit 2 – Electricity and light

1. Conduction of electricity

(a) the fact that the unit of charge is the coulomb (C), and that an electron's charge, e, is a very small fraction of a coulomb

(b) the fact that charge can flow through certain materials, called conductors

(c) electric current being the rate of flow of charge

(d) the use of the equation $I = \frac{\Delta Q}{\Delta t}$

(e) current being measured in ampères (A), where A = C s^{-1}

(f) the mechanism of conduction in metals as the drift of free electrons

(g) the derivation and use of the equation $I = nAve$ for free electrons

2. Resistance

(a) the definition of potential difference

(b) the idea that potential difference is measured in volts (V) where V = J C^{-1}

(d) Ohm's law, the equation $V = IR$ and the definition of resistance

(e) resistance being measured in ohms (Ω), where Ω = V A^{-1}

(f) the application of $P = IV = I^2R = \frac{V^2}{R}$

(g) the application of $R = \frac{\rho l}{A}$, the equation for resistivity

3. D.C. circuits

(a) the idea that the current from a source is equal to the sum of the currents in the separate branches of a parallel circuit, and that this is a consequence of conservation of charge (needed for option A)

(b) the sum of the potential differences across components in a series circuit is equal to the potential difference across the supply, and that this is a consequence of conservation of energy (needed for option A)

(c) potential differences across components in parallel are equal

(e) the use of a potential divider in circuits

4. The nature of waves

(e) the terms displacement, amplitude, wavelength, frequency, period and velocity of a wave

(h) graphs of displacement against time, and displacement against position for transverse waves only

(i) the equation $c = f\lambda$

7. Photons

(e) photon energy = hf (needed for option B)