AQA

A Level

Data and Formulae v1.0 Jun 2021

$a^2 + b^2 = c^2$ SOH CAH TOA $A_{sphere} = 4\pi r^2$ $V_{sphere} = \frac{4}{3}\pi r^3$

$c = 3.00 \times 10^8$ m s^{-1}
$\mu_0 = 4\pi \times 10^{-7}$ H m^{-1}
$\varepsilon_0 = 8.85 \times 10^{-12}$ F m^{-1}
$e = 1.60 \times 10^{-19}$ C
$h = 6.63 \times 10^{-34}$ J s
$G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}
$N_A = 6.02 \times 10^{23}$ mol^{-1}
$R = 8.31$ J K^{-1} mol^{-1}
$k = 1.38 \times 10^{-23}$ J K^{-1}
$\sigma = 5.67 \times 10^{-8}$ W m^{-2} K^{-4}
$\alpha = 2.90 \times 10^{-3}$ m K
$m_e = 9.11 \times 10^{-31}$ kg
$m_p = 1.67(3) \times 10^{-27}$ kg
$m_n = 1.67(5) \times 10^{-27}$ kg
$e/m_e = 1.76 \times 10^{11}$ C kg^{-1}
$e/m_p = 9.58 \times 10^{7}$ C kg^{-1}
$g = 9.81$ N kg^{-1} or m s^{-2}
$u = 1.661 \times 10^{-27}$ kg
$u = 931.5$ MeV
$m_{Sun} = 1.99 \times 10^{30}$ kg
$r_{Sun} = 6.96 \times 10^{8}$ m
$m_{Earth} = 5.97 \times 10^{24}$ kg
$r_{Earth} = 6.37 \times 10^{6}$ m

$E = hf = hc / \lambda$ $hf = \phi + E_{k(max)}$
$hf = E_1 - E_2$ $\lambda = h / p = h / mv$

$c = f\lambda$ $f = 1 / T$
$f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$ $w = \lambda D / s$
$d\sin\theta = n\lambda$
$n = c / c_s$ $n_1\sin\theta_1 = n_2\sin\theta_2$
$\sin\theta_c = n_2 / n_1$ for $n_1 > n_2$

$M = Fd$ $v = \Delta s / \Delta t$
$a = \Delta v / \Delta t$ $v = u + at$
$v^2 = u^2 + 2as$ $s = \left(\frac{u + v}{2}\right)t$
$s = ut + \frac{1}{2}at^2$
$F = ma$ $F = \Delta(mv) / \Delta t$
$F\Delta t = \Delta(mv)$ $W = Fs\cos\theta$
$E_k = \frac{1}{2}mv^2$ $\Delta E_p = mg\Delta h$
$P = \Delta W / \Delta t$ $P = Fv$
efficiency = $\frac{\text{useful power output}}{\text{power input}}$

$\rho = m / V$ $F = k\Delta L$ $E = \frac{1}{2}F\Delta L$

tensile stress = F / A tensile strain = $\Delta L / L$

Young modulus = tensile stress / tensile strain

$I = \Delta Q / \Delta t$ $V = W / Q$
$R = V / I$ $\rho = RA / L$
$R_T = R_1 + R_2 + \ldots$ $P = VI = I^2R = V^2 / R$
$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$ $\varepsilon = E / Q$
$\varepsilon = I(R + r)$

$\omega = v / r$ $\omega = 2\pi f$
$a = v^2 / r = \omega^2 r$ $F = mv^2 / r = m\omega^2 r$
$a = -\omega^2 x$ $v = \pm\omega\sqrt{(A^2 - x^2)}$
$x = A\cos(\omega t)$ $v_{max} = \omega A$
$a_{max} = \omega^2 A$
$T = 2\pi\sqrt{\frac{m}{k}}$ $T = 2\pi\sqrt{\frac{l}{g}}$

$Q = mc\Delta\theta$ $Q = ml$
$pV = nRT$ $pV = NkT$
$pV = \frac{1}{3}Nm(c_{rms})^2$
$\frac{1}{2}m(c_{rms})^2 = \frac{3}{2}kT = 3RT / 2N_A$

$F = (1/4\pi\varepsilon_0)Q_1Q_2 / r^2$
$F = EQ$ $E = V / d$
$E = (1/4\pi\varepsilon_0)Q / r^2$ $\Delta W = Q\Delta V$
$V = (1/4\pi\varepsilon_0)Q / r$ $E = \Delta V / \Delta r$
$C = Q / V$ $C = A\varepsilon_0\varepsilon_r / d$
$E = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2}Q^2 / C$
$Q = Q_0(1 - e^{-t/RC})$ $Q = Q_0 e^{-t/RC}$
time constant = RC

$F = BIl$ $F = BQv$
$\phi = BA$ $N\phi = BAN\cos\theta$
$\varepsilon = N\Delta\phi / \Delta t$ $\varepsilon = BAN\omega\sin\omega t$
$I_{rms} = I_0 / \sqrt{2}$ $N_s / N_p = V_s / V_p$
$V_{rms} = V_0 / \sqrt{2}$ efficiency = I_sV_s / I_pV_p

$\gamma = 0$ MeV $\pi^\pm = 139.576$ MeV $e^-, \nu_e, \mu^-, \nu_\mu$ (L) +1
$\nu_e = 0$ MeV $\pi^0 = 134.972$ MeV $e^+, \overline{\nu_e}, \mu^+, \overline{\nu_\mu}$ (L) -1
$\nu_\mu = 0$ MeV $K^\pm = 493.821$ MeV
$e^\pm = 0.510999$ MeV $K^0 = 497.762$ MeV u_{quark} (Q) +2/3e (B) +1/3 (S) 0
$\mu^\pm = 105.659$ MeV $p = 938.257$ MeV d_{quark} (Q) -1/3e (B) +1/3 (S) 0
$n = 939.551$ MeV s_{quark} (Q) -1/3e (B) +1/3 (S) -1

$I = k / x^2$ $\Delta N / \Delta t = -\lambda N$
$N = N_0 e^{-\lambda t}$ $A = \lambda N$
$T_{\frac{1}{2}} = \ln 2 / \lambda$ $R = R_0 A^{\frac{1}{3}}$
$E = mc^2$

$F = Gm_1m_2 / r^2$ $g = F / m$
$\Delta W = m\Delta V$ $g = GM / r^2$
$V = -GM / r$ $g = -\Delta V / \Delta r$

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Options

$1\ AU = 1.50 \times 10^{11}\ m$

$1\ ly = 9.46 \times 10^{15}\ m$

$1\ pc = 2.06 \times 10^{5}\ AU$

$1\ pc = 3.08 \times 10^{16}\ m$

$1\ pc = 3.26\ ly$

$M = \dfrac{\text{angle subtended by image at eye}}{\text{angle subtended by object at unaided eye}}$

$M = f_0 / f_e$

$m - M = 5 \log (d / 10)$

$\theta \approx \lambda / D$

$\lambda_{max} T = 2.9 \times 10^{-3}\ mK$

$P = \sigma A T^4$

$R_s \approx 2GM / c^2$

$\Delta f / f = -\Delta\lambda / \lambda = v / c$

$z = -v / c$

$v = Hd$ $\quad H = 65\ km s^{-1}\ Mpc^{-1}$

$P = 1 / f$

$m = v / u$

$1 / f = 1 / u + 1 / v$

$I_0 = 1.0 \times 10^{-12}\ W\ m^{-2}$

$\text{intensity level} = 10 \log (I / I_0)$

$I = I_0\ e^{-\mu x}$

$\mu_m = \mu / \rho$

$Z = \rho c$

$I_r / I_i = ((Z_2 - Z_1) / (Z_2 + Z_1))^2$

$1 / T_E = 1 / T_B + 1 / T_P$

$I = \Sigma m r^2$

$E_k = \frac{1}{2} I \omega^2$

$\omega_2 = \omega_1 + \alpha t$

$\omega_2^2 = \omega_1^2 + 2\alpha\theta$

$\theta = \omega_1 t + \frac{1}{2}\alpha t^2$

$\theta = \left(\dfrac{\omega_1 + \omega_2}{2} \right) t$

$T = I\alpha$

$T = Fr$

$L = I\omega$

$T\Delta t = \Delta(I\omega)$

$W = T\theta$

$P = T\omega$

$Q = \Delta U + W$

$W = p\Delta V$

$pV^{\gamma} = \text{constant}$

$pV = \text{constant}$

$\text{efficiency} = \dfrac{W}{Q_H} = \dfrac{Q_H - Q_C}{Q_H}$

$\text{maximum theoretical efficiency} = \dfrac{T_H - T_C}{T_H}$

$COP_{ref} = \dfrac{Q_C}{W} = \dfrac{Q_C}{Q_H - Q_C}$

$COP_{hp} = \dfrac{Q_H}{W} = \dfrac{Q_H}{Q_H - Q_C}$

work done per cycle = area of loop

friction power = indicated power – brake power

input power = calorific value x fuel flow rate

indicated power = (area of p-V loop) x (no. of cycles per second) x (no. of cylinders)

$F = eV / d$

$F = Bev$

$r = mv / Be$

$\frac{1}{2} m v^2 = eV$

$QV / d = mg$

$F = 6\pi\eta r v$

$c = 1 / \sqrt{\mu_0 \varepsilon_0}$

$\lambda = h / p = h / \sqrt{2meV}$

$t = \dfrac{t_0}{\sqrt{1 - \dfrac{v^2}{c^2}}}$

$l = l_0 \sqrt{1 - \dfrac{v^2}{c^2}}$

$E = mc^2 = \dfrac{m_0 c^2}{\sqrt{1 - \dfrac{v^2}{c^2}}}$

$f_0 = \dfrac{1}{2\pi\sqrt{LC}}$

$Q = f_0 / f_B$

$V_{out} = A_{OL} (V_+ - V_-)$

inverting $\dfrac{V_{out}}{V_{in}} = -\dfrac{R_f}{R_{in}}$

non-inverting $\dfrac{V_{out}}{V_{in}} = 1 + \dfrac{R_f}{R_1}$

summing $V_{out} = -R_f \left(\dfrac{V_1}{R_1} + \dfrac{V_2}{R_2} + \dfrac{V_3}{R_3} \dots \right)$

difference $V_{out} = (V_+ - V_-) \dfrac{R_f}{R_1}$

$\text{bandwidth}_{AM} = 2f_M$

$\text{bandwidth}_{FM} = 2(\Delta f + f_M)$

This data and formulae sheet is for you to use while you're learning A Level Physics and working through practice questions.

Make sure you are also familiar with the official AQA Data and Formulae booklet: especially before you use it for any real exams in the future.