Level 3 Technical Level
DESIGN ENGINEERING
MECHATRONIC ENGINEERING

Unit 1 Materials technology and science

Formula sheet

Area of a circle $A = \pi r^2$ or $A = \frac{\pi D^2}{4}$	Density $\rho = \frac{m}{V}$
Stress $\sigma = \frac{F}{A}$	Strain $\varepsilon = \frac{\delta L}{L}$
Angular measure $360^J \equiv 2\pi$ radians	Newton's second law $F = ma$
Trigonometry $\sin = \frac{opp}{hyp}$, $\cos = \frac{adj}{hyp}$ and $\tan = \frac{opp}{adj}$	Young's Modulus $E = \frac{\sigma}{\varepsilon}$
Ohm's Law $V = IR$	Electrical power $P = VI$, $P = I^2R$ and $P = \frac{V^2}{R}$
Resistance in series $R_{total} = R_1 + R_2 + R_3 \ldots$	Resistance in parallel $R_{total} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots$ Two resistors in parallel $R_{total} = \frac{R_1 R_2}{R_1 + R_2}$
Straight line graph $y = mx + c$	Energy $PE = mgh$ and $KE = \frac{mv_2}{2}$
Frequency $f = \frac{1}{T}$ and $f = \frac{\omega}{2\pi}$	Boyle's law $P_1V_1 = P_2V_2$
Charles' law $\frac{V_1}{T_2} = \frac{V_2}{T_2}$	The combined gas laws $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

Turn over ▶

The equation of state $\frac{PV}{T} = mR$	The pressure law $\frac{P_1}{T_1} = \frac{P_2}{T_2}$
Torque $T = Fr$	Gear ratio (2 gears) $R = \frac{\omega_{in}}{\omega_{out}} = \frac{N_{out}}{N_{in}}$
Friction $F = \mu N$	Efficiency $\eta = \frac{\text{Output}}{\text{Input}}$ and $\eta_{\%} = \frac{\text{Output}}{\text{Input}} \times 100$
Conversion from bar to Pascals $bar \times 101 \times 10^3 N\ m^{-2}$	The gravitation constant g = 9.81 $m\ s^{-2}$