

Grade 10 Science — formula sheet

Motion, light, heat, electricity and weather · 37 formulas · metric edition 1

MODULE 1 · MOTION — SPEED, DISTANCE, TIME

Science 10-1 Speed, Distance & Time

$$v = \frac{d}{t}$$

Average speed from distance travelled and elapsed time.

Science 10-2 Displacement from Average Velocity

$$d = \frac{v_0 + v}{2} t$$

Displacement as the average of initial and final velocities multiplied by the elapsed time, valid...

MODULE 2 · LIGHT & GEOMETRIC OPTICS

Science 10-3 Wave Speed ($v = f\lambda$)

$$v = f\lambda$$

The universal wave equation: a wave's speed equals its frequency times its wavelength.

Science 10-4 Period-Frequency Relation

$$T = \frac{1}{f}$$

Period and frequency are reciprocals: seconds per cycle versus cycles per second.

Science 10-5 Index of Refraction ($n = c/v$)

$$n = \frac{c}{v}$$

How much a medium slows light: the ratio of c to the speed of light in the medium.

Science 10-6 Snell's Law of Refraction

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

Light bends at an interface so that $n \sin \theta$ stays the same on both sides.

Science 10-7 Critical Angle for Total Internal Reflection

$$\sin \theta_c = \frac{n_2}{n_1}$$

Beyond this angle of incidence, light in the denser medium reflects totally instead of refracting.

Science 10-8 Focal Length of a Spherical Mirror

$$f = \frac{R}{2}$$

A spherical mirror focuses parallel rays at half its radius of curvature.

Science 10-9 Thin Lens Equation

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

Relates a thin lens's focal length to its object and image distances.

Science 10-10 Lens Magnification ($m = -d_i/d_o$)

$$m = -\frac{d_i}{d_o}$$

Image magnification from the ratio of image to object distance; the minus sign tracks inversion.

Science 10-11 Magnification from Heights ($m = h_i/h_o$)

$$m = \frac{h_i}{h_o}$$

Magnification as the ratio of image height to object height.

Science 10-12 Lens Power in Diopters

$$P = \frac{1}{f}$$

The optician's unit: lens power in diopters is the reciprocal of focal length in meters.

MODULE 3 · HEAT & TEMPERATURE

Science 10-13 Sensible Heat ($Q = mc\Delta T$)

$$Q = mc\Delta T$$

Heat needed to change a mass's temperature: mass times specific heat times the temperature change.

Science 10-14 Latent Heat

$$Q = mL$$

Heat absorbed or released when a mass changes phase at constant temperature.

Science 10-15 Thermal Linear Expansion

$$\Delta L = \alpha L_0 \Delta T$$

Length change of a solid caused by a temperature change, via the linear expansion coefficient.

Science 10-16 Heat Conduction Rate

$$P = \frac{kA\Delta T}{d}$$

Steady-state heat flow through a slab by Fourier's law of conduction.

MODULE 4 · ELECTRICITY — CIRCUITS & POWER

Science 10-17 Electric Charge ($Q = It$)

$$Q = It$$

Total charge transferred by a steady current flowing for a given time.

Science 10-18 Ohm's Law

$$V = IR$$

Relates the voltage across a conductor to the current through it and its resistance.

Science 10-19 Two Resistors in Series

$$R_t = R_1 + R_2$$

Total resistance of two resistors connected end to end is simply their sum.

Science 10-20 Two Resistors in Parallel

$$R_t = \frac{R_1 R_2}{R_1 + R_2}$$

Total resistance of two resistors connected side by side: product over sum, always less than either...

Science 10-21 Electrical Power ($P = VI$)

$$P = VI$$

Power delivered to a component as the product of the voltage across it and the current through it.

Science 10-22 Electrical Power ($P = I^2 R$)

$$P = I^2 R$$

Power dissipated as heat in a resistance carrying a current (Joule heating).

Science 10-23 Electrical Energy ($E = Pt$)

$$E = Pt$$

Energy consumed by a device drawing constant power over a period of time.

Science 10-24 Energy Cost from a Utility Rate

$$C_e = E p_e$$

Cost of the energy a system consumes: kilowatt-hours or fuel BTUs times the utility rate, for tower...

MODULE 5 · WEATHER, CLIMATE & THE ATMOSPHERE

Science 10-25 Pressure ($P = F/A$) $P = \frac{F}{A}$ Pressure as perpendicular force spread over an area.	Science 10-26 Hydrostatic Pressure ($P = \rho gh$) $P = \rho gh$ Gauge pressure at depth h in a fluid of density ρ, using $g = 9.80665$ m/s².	Science 10-27 Barometric Pressure with Altitude $P = P_0 e^{-Mgz/RT}$ Atmospheric pressure at a height above a reference level, for an isothermal layer.	Science 10-28 Relative Humidity from Vapour Pressure $\varphi = \frac{p_v}{p_{ws}}$ Relative humidity as what it actually is: the vapour pressure present divided by the saturation...
Science 10-29 Saturation Vapour Pressure (Magnus / Alduchov–Eskridge) $p_{ws} = 610.94 \exp\left(\frac{17.625\,t}{t + 243.04}\right)$ The vapour pressure of water at saturation, from temperature alone, by the Alduchov–Eskridge Magnus...	Science 10-30 Dew Point (Magnus Approximation) $T_d = \frac{c\,\gamma}{b - \gamma}, \quad \gamma = \ln\frac{RH}{100} + \frac{b\,T}{c + T}$ Dew point from air temperature and relative humidity by the Magnus formula with the WMO's Sonntag...		
Science 10-31 Humidex (Canadian Humidity Index) $H = T + 0.5555\,(e - 10), \quad e = 6.11\,e^{5417.753\left(\frac{1}{273.16} - \frac{1}{T_d}\right)}$ Environment Canada's humidex: air temperature raised by the excess vapour pressure computed from...	Science 10-32 Wind Chill (2001 North American Formula) $T_{wc} = 13.12 + 0.6215\,T - 11.37\,V^{0.16} + 0.3965\,T\,V^{0.16}$ The wind chill index adopted by Canada and the United States in 2001, from air temperature and wind...		
Science 10-33 Heat Index (Rothfusz Regression) $HI = c_1 + c_2T + c_3R + c_4TR + c_5T^2 + c_6R^2 + c_7T^2R + c_8TR^2 + c_9T^2R^2$ The US National Weather Service heat index, Rothfusz's nine-term regression through Steadman's...	Science 10-34 Albedo and Reflected Radiation $G_r = \alpha\,G$ Shortwave radiation reflected by a surface, as its albedo times the incident irradiance.	Science 10-35 Environmental Lapse Rate $\Gamma = \frac{T_1 - T_2}{z_2 - z_1}$ How fast the air cools with height, from two temperatures at two altitudes.	
Science 10-36 Flash-to-Bang Distance to a Lightning Strike $d = (331.3 + 0.606\,T_C)\,t$ Light arrives effectively instantly and sound does not, so the gap between the flash and the...	Science 10-37 Speed of Sound in Air $v = 331.3 + 0.606\,T_C$ The speed of sound in dry air grows about 0.6 m/s for every degree Celsius above freezing.		