

O-Level Physics Formula Sheet

O-Level and SEC (G3) · Physics



The Singapore Syllabus

NO FORMULA LIST: MEMORISE

Formulas the O-Level Physics paper does not give you

There is no formula list in the O-Level Physics paper, so these all have to be known by heart. Each one is in the syllabus.

PHYSICAL QUANTITIES, UNITS AND MEASUREMENT

Prefixes for sub-multiples nano, micro, milli, centi, deci

$$n = 10^{-9}, \quad \mu = 10^{-6}, \quad m = 10^{-3}, \quad c = 10^{-2}, \quad d = 10^{-1}$$

Prefixes for multiples kilo, mega, giga, tera

$$k = 10^3, \quad M = 10^6, \quad G = 10^9, \quad T = 10^{12}$$

KINEMATICS

Average speed in m/s, km/h or cm/s. Speed has no direction. Velocity is speed in a stated direction

$$\text{average speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

Acceleration

change in velocity divided by time taken, in m/s^2 . u is the initial velocity and v the final velocity

$$a = \frac{v - u}{t}$$

Displacement from a velocity-time graph

for motion with uniform velocity or uniform acceleration

displacement = area under the velocity-time graph

Acceleration of free fall

constant for a body near the Earth

$$g \approx 10 \text{ m/s}^2$$

DYNAMICS

Weight

g is the gravitational field strength, the gravitational force per unit mass, in N/kg

$$W = mg$$

Resultant force

F is the resultant force in N , m the mass in kg and a the acceleration in m/s^2

$$F = ma$$

TURNING EFFECTS OF FORCES

Moment of a force

d is the perpendicular distance from the pivot to the line of the force. Unit N m

$$\text{moment} = F \times d$$

Principle of moments about any pivot, for a body in equilibrium

sum of clockwise moments = sum of anticlockwise moments

PRESSURE

Pressure force per unit area, in Pa or N/m^2

$$p = \frac{F}{A}$$

Density in kg/m^3 or g/cm^3

$$\rho = \frac{m}{V}$$

Pressure due to a liquid column

h is the height of the column and ρ the density of the liquid

$$p = h\rho g$$

ENERGY

Kinetic energy in J, with m in kg and v in m/s

$$E_k = \frac{1}{2}mv^2$$

Gravitational potential energy

near the Earth's surface

$$E_p = mgh$$

Work done

d is the distance moved in the direction of the force

$$W = F \times d$$

Power energy transferred divided by time taken, in W

$$P = \frac{E}{t}$$

Efficiency multiply by 100% to give a percentage

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$$

THERMAL PROPERTIES OF MATTER

Heat capacity

energy needed per unit change in temperature, in J/°C or J/K

$$C = \frac{E}{\Delta\theta}$$

Energy to change temperature

c is the specific heat capacity and $\Delta\theta$ the change in temperature

$$E = mc\Delta\theta$$

Energy to change state

l is the specific latent heat, in J/kg or J/g. The temperature stays the same

$$E = ml$$

GENERAL PROPERTIES OF WAVES

Wave speed

f is the frequency in Hz and λ the wavelength in m

$$v = f\lambda$$

Period and frequency T is the period in s

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

LIGHT

Law of reflection

angle of incidence equals angle of reflection, both measured from the normal

$$i = r$$

Refraction

i is the angle of incidence and r the angle of refraction. The constant is the refractive index n

$$\frac{\sin i}{\sin r} = \text{constant}$$

Refractive index a ratio, so it has no unit

$$n = \frac{\text{speed of light in vacuum}}{\text{speed of light in the medium}}$$

CURRENT OF ELECTRICITY

Charge Q in C, I in A, t in s

$$Q = It$$

Electromotive force

work done per unit charge by the source in driving charges around a complete circuit, in V

$$E = \frac{W}{Q}$$

Potential difference

work done per unit charge in driving charges through a component, in V

$$V = \frac{W}{Q}$$

Total e.m.f. of sources in series

$$E = E_1 + E_2 + E_3 + \dots$$

Resistance in Ω

$$R = \frac{V}{I}$$

Resistance of a wire

proportional to the length l and inversely proportional to the cross-sectional area A

$$R \propto \frac{l}{A}$$

D.C. CIRCUITS

Series circuit

the same current at every point, and the p.d.s add up

$$I = I_1 = I_2, \quad V = V_1 + V_2$$

Parallel circuit

the branch currents add up, and every branch has the same p.d.

$$I = I_1 + I_2, \quad V = V_1 = V_2$$

Resistors in series

$$R = R_1 + R_2 + R_3 + \dots$$

Resistors in parallel

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

PRACTICAL ELECTRICITY

Electrical power

in W. With $V = IR$ this also gives $P = I^2R = V^2/R$

$$P = VI$$

Electrical energy in J

$$E = VIt$$

Cost of electricity

energy in kW h is power in kW times time in hours

cost = energy used in kW h $\times$ cost per kW h

ELECTROMAGNETIC INDUCTION

Transformer turns ratio

P is the primary coil and S the secondary coil

$$\frac{V_P}{V_S} = \frac{N_P}{N_S}$$

Ideal transformer power

for an ideal transformer, power in equals power out

$$V_P I_P = V_S I_S$$

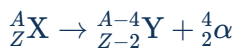
RADIOACTIVITY

Nuclide notation

A is the nucleon (mass) number and Z the proton (atomic) number. Number of neutrons is $A - Z$



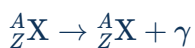
Alpha decay



Beta decay beta particles are taken to be β^- particles only



Gamma emission A and Z do not change



Half-life (working method) n is the number of half-lives that have passed, the time taken divided by $t_{1/2}$
amount left = **initial amount** $\times \left(\frac{1}{2}\right)^n$