# Grade 12 Physics revision cards

Grade 12

Temari.et
temari.et/study

## Dimensions of mechanical quantities

Use this table to check an equation before you trust it. Both sides of a correct physics equation always carry the same dimensions, so a mismatch tells you a mistake happened without you having to find it first.

| QUANTITY | HOW IT IS DEFINED | DIMENSIONS | SI UNIT |
|---|---|---|---|
| **Area** | $l \times b$ | $[L^2]$ | $m^2$ |
| **Volume** | $l \times b \times h$ | $[L^3]$ | $m^3$ |
| **Density** | $m \div V$ | $[M\,L^{-3}]$ | $kgm^{-3}$ |
| **Velocity** | $s \div t$ | $[L\,T^{-1}]$ | $ms^{-1}$ |
| **Acceleration** | $\Delta v \div t$ | $[L\,T^{-2}]$ | $ms^{-2}$ |
| **Force** | $m \times a$ | $[M\,L\,T^{-2}]$ | N |
| **Momentum** | $m \times v$ | $[M\,L\,T^{-1}]$ | $kgms^{-1}$ |
| **Impulse** | $F \times t$ | $[M\,L\,T^{-1}]$ | Ns |
| **Work and energy** | $F \times d$ | $[M\,L^2\,T^{-2}]$ | J |
| **Power** | $W \div t$ | $[M\,L^2\,T^{-3}]$ | W |
| **Pressure and stress** | $F \div A$ | $[M\,L^{-1}\,T^{-2}]$ | Pa |
| **Young's modulus** | $\sigma \div \varepsilon$ | $[M\,L^{-1}\,T^{-2}]$ | Pa |
| **Surface tension** | $F \div l$ | $[M\,T^{-2}]$ | $Nm^{-1}$ |
| **Coefficient of viscosity** | $F \div (A \times \Delta v / \Delta x)$ | $[M\,L^{-1}\,T^{-1}]$ | Pas |
| **Angular displacement** | $s \div r$ | $[M^0L^0T^0]$ | rad |
| **Angular velocity** | $\theta \div t$ | $[T^{-1}]$ | $rads^{-1}$ |
| **Angular acceleration** | $\omega \div t$ | $[T^{-2}]$ | $rads^{-2}$ |
| **Torque** | $F \times r$ | $[M\,L^2\,T^{-2}]$ | Nm |
| **Moment of inertia** | $m \times r^2$ | $[M\,L^2]$ | $kgm^2$ |
| **Angular momentum** | $I \times \omega$ | $[M\,L^2\,T^{-1}]$ | $kgm^2s^{-1}$ |
| **Gravitational constant** | $Fr^2 \div m_1m_2$ | $[M^{-1}\,L^3\,T^{-2}]$ | $Nm^2kg^{-2}$ |
| **Spring constant** | $F \div x$ | $[M\,T^{-2}]$ | $Nm^{-1}$ |
| **Strain** | $\Delta l \div l$ | $[M^0L^0T^0]$ | none |

WATCH OUT
Equal dimensions do not make an equation correct. Dimensional analysis cannot see a missing half, a stray $2\pi$ or a wrong sign, because pure numbers have no dimensions at all. It rules equations out; it never rules them in.

## Dimensions of heat quantities

Reach for this whenever temperature appears in a formula. Θ is a base dimension of its own, and forgetting it is the most common way a thermal calculation goes wrong on paper after looking right in your head.

| QUANTITY | HOW IT IS DEFINED | DIMENSIONS | SI UNIT |
|---|---|---|---|
| **Heat and internal energy** | $F \times d$ | $[M\,L^2\,T^{-2}]$ | J |
| **Temperature** | — | $[\Theta]$ | K |

# Grade 12 Physics revision cards

Grade 12

Temari.et
temari.et/study

| QUANTITY | HOW IT IS DEFINED | DIMENSIONS | SI UNIT |
|---|---|---|---|
| **Specific heat capacity** | $Q \div (m \Delta T)$ | $[L^2 T^{-2} \Theta^{-1}]$ | $J\,kg^{-1}\,K^{-1}$ |
| **Latent heat** | $Q \div m$ | $[L^2 T^{-2}]$ | $J\,kg^{-1}$ |
| **Thermal conductivity** | $QL \div (A \Delta T t)$ | $[M L T^{-3} \Theta^{-1}]$ | $W\,m^{-1}\,K^{-1}$ |
| **Entropy** | $Q \div T$ | $[M L^2 T^{-2} \Theta^{-1}]$ | $J\,K^{-1}$ |
| **Universal gas constant** | $PV \div nT$ | $[M L^2 T^{-2} \Theta^{-1} N^{-1}]$ | $J\,mol^{-1}\,K^{-1}$ |
| **Boltzmann constant** | $R \div N_A$ | $[M L^2 T^{-2} \Theta^{-1}]$ | $J\,K^{-1}$ |
| **Coefficient of linear expansion** | $\Delta L \div (L \Delta T)$ | $[\Theta^{-1}]$ | $K^{-1}$ |

WATCH OUT
Specific heat capacity carries no mass dimension, but heat capacity does. One is per kilogram and the other is for the whole object, so swapping them silently changes an answer by a factor of the mass.

## Dimensions of electrical quantities

Every electrical dimension on this list is built from current, because current is the base quantity and charge is not. Derive charge as current × time first, and the rest of the column follows without memorising anything.

| QUANTITY | HOW IT IS DEFINED | DIMENSIONS | SI UNIT |
|---|---|---|---|
| **Electric current** | — | $[I]$ | $A$ |
| **Electric charge** | $I \times t$ | $[I T]$ | $C$ |
| **Potential difference** | $W \div q$ | $[M L^2 T^{-3} I^{-1}]$ | $V$ |
| **Resistance** | $V \div I$ | $[M L^2 T^{-3} I^{-2}]$ | $\Omega$ |
| **Resistivity** | $RA \div l$ | $[M L^3 T^{-3} I^{-2}]$ | $\Omega\,m$ |
| **Conductance** | $1 \div R$ | $[M^{-1} L^{-2} T^3 I^2]$ | $S$ |
| **Capacitance** | $q \div V$ | $[M^{-1} L^{-2} T^4 I^2]$ | $F$ |
| **Electric field** | $F \div q$ | $[M L T^{-3} I^{-1}]$ | $N\,C^{-1}$ |
| **Permittivity of free space** | $q^2 \div (4\pi F r^2)$ | $[M^{-1} L^{-3} T^4 I^2]$ | $F\,m^{-1}$ |
| **Magnetic flux** | $V \times t$ | $[M L^2 T^{-2} I^{-1}]$ | $Wb$ |
| **Magnetic flux density** | $\Phi \div A$ | $[M T^{-2} I^{-1}]$ | $T$ |
| **Inductance** | $\Phi \div I$ | $[M L^2 T^{-2} I^{-2}]$ | $H$ |
| **Permeability of free space** | $2\pi r B \div I$ | $[M L T^{-2} I^{-2}]$ | $H\,m^{-1}$ |

WATCH OUT
Resistance and resistivity differ by one power of length, and that is the direction students reverse most. Resistivity is a property of the material and never changes with the shape of the wire; resistance is a property of that particular wire.

## Dimensions of wave and modern physics quantities

This is the shortest of the four cards and the one entrance-exam questions reach for most, because Planck's constant and angular momentum share the dimensions of $[ML^2T^{-1}]$ and examiners like asking why.

| QUANTITY | HOW IT IS DEFINED | DIMENSIONS | SI UNIT |
|---|---|---|---|
| **Frequency** | $1 \div T$ | $[T^{-1}]$ | $Hz$ |
| **Wavelength** | — | $[L]$ | $m$ |

# Grade 12 Physics revision cards

Grade 12

**Temari.et**
temari.et/study

| QUANTITY | HOW IT IS DEFINED | DIMENSIONS | SI UNIT |
|---|---|---|---|
| **Wave number** | $1 \div \lambda$ | $[L^{-1}]$ | $m^{-1}$ |
| **Intensity** | $P \div A$ | $[M\,T^{-3}]$ | $W\,m^{-2}$ |
| **Planck's constant** | $E \div f$ | $[M\,L^2\,T^{-1}]$ | $J\,s$ |
| **Work function** | $h\,f_0$ | $[M\,L^2\,T^{-2}]$ | $J$ |
| **Decay constant** | $1 \div t$ | $[T^{-1}]$ | $s^{-1}$ |

WATCH OUT
Frequency and angular velocity both come out as $[T^{-1}]$, and so does the decay constant. Dimensions cannot tell those three apart, which is a useful reminder of what the method is actually for.

## Inverse Square Law of Apparent Brightness

Use this to relate the apparent brightness of an astronomical body to its luminosity and distance.

$$\mathrm{b\ propto\ L/(d^2)}$$

WATCH OUT
Apparent brightness decreases with the square of distance, not linearly.

## Missile Propulsion and Flight Comparison

Use this to contrast the flight phases, engines, and trajectories of cruise versus ballistic missiles.

| MISSILE TYPE | PROPULSION | TRAJECTORY | GOVERNING PHYSICS |
|---|---|---|---|
| **Cruise missile** | Jet-propelled throughout flight | Controlled path | Conservation of momentum |
| **Ballistic missile** | Rocket-powered in initial phase only | Arc trajectory | Newtonian mechanics and gravity |

WATCH OUT
Ballistic missiles carry rocket engines that fire only in the initial launch phase, not throughout the flight.

## Radar Range Equation

Use this to calculate the distance between a radar station and a target from the time taken for the radio pulse to go and return.

$$\mathrm{R = (c\ t)/2}$$

WATCH OUT
Always divide the total travel time by 2. The measured time covers the distance to the target and back.

## Ultrasound Image Display Regions

Use this to identify and classify the different shade regions on a medical ultrasound monitor.

| TERM | IMAGE APPEARANCE | ECHO PROPERTY | BODY FEATURE |
|---|---|---|---|
| **Anechoic** | Black | No sound reflected | Fluid-filled regions |
| **Hypoechoic** | Dark gray | Fewer sound reflections | Soft body tissues |
| **Hyperechoic** | Light gray | Many sound reflections | Dense structures |

# Grade 12 Physics revision cards

Grade 12



WATCH OUT
Anechoic regions appear black because fluids reflect zero echo, not because sound is blocked.

## Kepler Third Law and Orbital Period

Use when relating the orbital period of a planet or satellite to its average orbital radius around a central mass.

$$(\mathrm{T}^2)/(\mathrm{r}^3) = (4\pi^2)/(\mathrm{G\ M})$$

WATCH OUT
The mass M in the denominator is the mass of the central body being orbited, not the orbiting satellite.

## Newton Law of Universal Gravitation

Use to compute the gravitational attraction force acting between any two bodies with mass.

$$\mathrm{F_g} = (\mathrm{G\ m_1\ m_2})/(\mathrm{r}^2)$$

WATCH OUT
The separation distance r is measured between the centers of the bodies, not between their surfaces.

## Projectile Motion Range

Use when finding the horizontal range of a projectile launched from and landing on the same level ground.

$$\mathrm{R} = (\mathrm{v_0}^2 \sin 2\theta)/\mathrm{g}$$

WATCH OUT
This equation applies only when the launch elevation and landing elevation are identical.

## Rotational Kinematics Analogy

Use to solve rotational motion problems with constant angular acceleration by mapping directly from linear kinematics.

| LINEAR MOTION | ROTATIONAL MOTION |
|---|---|
| $\mathrm{v_f} = \mathrm{v_0} + \mathrm{a\ t}$ | $\omega_\mathrm{f} = \omega_0 + \alpha\ \mathrm{t}$ |
| $\Delta\ \mathrm{s} = \mathrm{v_0\ t} + 1/2\ \mathrm{a\ t}^2$ | $\Delta\theta = \omega_0\ \mathrm{t} + 1/2\alpha\ \mathrm{t}^2$ |
| $\mathrm{v_f}^2 = \mathrm{v_0}^2 + 2\ \mathrm{a}\ \Delta\ \mathrm{s}$ | $\omega_\mathrm{f}^2 = \omega_0{}^2 + 2\alpha\ \Delta\theta$ |
| $\Delta\ \mathrm{s} = (\mathrm{v_0} + \mathrm{v_f})/2\ \mathrm{t}$ | $\Delta\theta = (\omega_0 + \omega_\mathrm{f})/2\ \mathrm{t}$ |

WATCH OUT
All angular displacements must be converted to radians before substituting into these kinematic equations.

## Torque and Angular Acceleration

Use to connect the net rotational force with rotational inertia and angular acceleration of a rigid body.

$$\tau = \mathrm{I}\ \alpha$$

WATCH OUT
Angular acceleration must always be in radians per second squared, never revolutions per second squared.

## Absolute and Gauge Pressure Relation

Use to convert between pressure gauge readings and the true absolute pressure relative to complete vacuum.

$$P_{abs} = P_{atm} + P_{gage}$$

WATCH OUT
Pressure measuring gauges read zero at atmospheric pressure. Never substitute gauge pressure directly into the ideal gas equation without adding atmospheric pressure.

## Archimedes Principle for Buoyant Force

Use to determine the upward buoyant force acting on any partially or completely submerged object in a fluid.

$$F_B = \rho_{fluid}\, g\, V_{disp}$$

WATCH OUT
Use the density of the fluid, not the density of the object, to calculate the buoyant force.

## Floating Fraction of an Object

Use to calculate the fraction or percentage of a floating object submerged beneath the surface of a fluid.

$$(V_{disp})/(V_{obj}) = (\rho_{obj})/(\rho_{fluid})$$

WATCH OUT
This equation applies only to floating objects in static equilibrium, where the object density is less than the fluid density.

## Pascal Principle in Hydraulic Systems

Use when finding the force or piston area in hydraulic lifts, brakes, and presses where confined fluid transmits pressure equally.

$$(F_1)/(A_1) = (F_2)/(A_2)$$

WATCH OUT
Make sure the areas A_1 and A_2 are in the same units before calculating. If diameters are given, use area proportional to diameter squared.

## Variation of Pressure with Depth

Use to calculate total hydrostatic pressure at any depth below the open surface of a static liquid.

$$P = P_0 + \rho\, g\, h$$

WATCH OUT
Always add atmospheric pressure P_0 when asked for absolute pressure. If only gauge pressure is required, omit P_0.

## Faraday Law of Induction

Use to calculate the electromotive force induced in a coil by a changing magnetic flux.

$$\varepsilon = \text{-N } (\Delta \Phi_{\mathrm{B}})/(\Delta \text{ t})$$

WATCH OUT
The negative sign represents Lenz law, indicating that the induced emf opposes the change in flux.

## Magnetic Field of a Straight Wire

Use to calculate the magnetic field strength at a given distance from a long straight current-carrying wire.

$$\mathrm{B} = (\mu_0 \, \mathrm{I})/(2\pi \, \mathrm{r})$$

WATCH OUT
The distance r must be in meters, not centimeters or millimeters.

## Magnetic Flux

Use to determine the total magnetic flux passing through a surface placed in a magnetic field.

$$\Phi_{\mathrm{B}} = \mathrm{B} \; \mathrm{A} \; \cos\theta$$

WATCH OUT
The angle theta is between the magnetic field and the area normal vector, not the surface plane.

## Surface Angle in Magnetic Flux

Use when given the angle between the magnetic field and the surface of a loop rather than its normal line.

WATCH OUT
If the problem gives an angle with the surface plane, you must use 90 minus that angle for theta in the flux equation.

## Transformer Turns Ratio

Use to relate primary and secondary voltages with the number of turns in an alternating current transformer.

$$(\mathrm{N_p})/(\mathrm{N_s}) = (\mathrm{V_p})/(\mathrm{V_s})$$

WATCH OUT
Transformers operate only with alternating current and cannot step up or step down direct current.

## Extrinsic Semiconductor Types

Use to distinguish between N-type and P-type semiconductors, their impurities, and their charge carriers.

| TYPE | DOPANT GROUP | DOPANT EXAMPLES | MAJORITY CARRIER | MINORITY CARRIER |
|---|---|---|---|---|
| **N-type** | Group V (pentavalent) | As, P, Sb, Bi | Electrons | Holes |
| **P-type** | Group III (trivalent) | B, Al, Ga, In | Holes | Electrons |

WATCH OUT
Doped semiconductors remain electrically neutral overall even though one carrier type outnumbers the other.

# Grade 12 Physics revision cards

Grade 12

**Temari.et**
temari.et/study

## Logic Gates Summary

Use to evaluate Boolean logic operations and outputs for digital logic circuits.

| GATE | LOGIC OPERATION | OUTPUT IS 1 WHEN | UNIVERSAL GATE |
|---|---|---|---|
| **OR** | Addition: $y = A + B$ | At least one input is 1 | No |
| **AND** | Multiplication: $y = A \cdot B$ | All inputs are 1 | No |
| **NOT** | Inversion: single input | Input is 0 | No |
| **NOR** | Inverted OR | All inputs are 0 | Yes |
| **NAND** | Inverted AND | At least one input is 0 | Yes |

WATCH OUT
In Boolean logic addition, 1 + 1 equals 1, representing TRUE OR TRUE, not arithmetic 2.

## Transistor Biasing Condition

Use when determining the bias voltage polarities required across the junctions of a bipolar transistor for proper amplifier operation.

WATCH OUT
The emitter-base junction must be forward biased and the collector-base junction must be reverse biased. Setting both junctions to forward bias is incorrect.

## Transistor Current and Current Gain

Use when calculating terminal currents or common-emitter current amplification in a bipolar junction transistor.

$$\beta = (\mathrm{I_C})/(\mathrm{I_B}),\mathrm{quad}\ \mathrm{I_E} = \mathrm{I_B} + \mathrm{I_C}$$

WATCH OUT
Base current is given in microamperes while collector and emitter currents are in milliamperes. Convert all currents to amperes before computing.

## Transistor Regions Comparison

Use to compare the doping levels, physical dimensions, and functions of the three regions of a bipolar junction transistor.

| REGION | DOPING LEVEL | PHYSICAL SIZE | FUNCTION |
|---|---|---|---|
| **Emitter** | Heavily doped | Medium size | Supplies charge carriers |
| **Base** | Lightly doped | Very thin | Passes carriers to collector |
| **Collector** | Moderately doped | Largest size | Collects charge carriers |

WATCH OUT
The base is both the thinnest and the most lightly doped layer, while the collector is the largest in physical size.