

**Victorian Certificate of Education**  
**Year**

**PHYSICS**

**Written examination**

**FORMULA SHEET**

**Instructions**

This formula sheet is provided for your reference.  
A question and answer book is provided with this formula sheet.

**Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.**

## Physics formulas

### Motion and related energy transformations

velocity; acceleration	$v = \frac{\Delta s}{\Delta t}; \quad a = \frac{\Delta v}{\Delta t}$
equations for constant acceleration	$v = u + at$ $s = ut + \frac{1}{2}at^2$ $s = vt - \frac{1}{2}at^2$ $v^2 = u^2 + 2as$ $s = \frac{1}{2}(v + u)t$
Newton's second law	$\Sigma F = ma$
circular motion	$a = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$
Hooke's law	$F = -k\Delta x$
elastic potential energy	$\frac{1}{2}k(\Delta x)^2$
gravitational potential energy near the surface of Earth	$mg\Delta h$
kinetic energy	$\frac{1}{2}mv^2$
Newton's law of universal gravitation	$F = G \frac{M_1 M_2}{r^2}$
gravitational field	$g = G \frac{M}{r^2}$
impulse	$F\Delta t$
momentum	$mv$
Lorentz factor	$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$
time dilation	$t = t_0 \gamma$
length contraction	$L = \frac{L_0}{\gamma}$
rest energy	$E_{\text{rest}} = mc^2$
relativistic total energy	$E_{\text{total}} = \gamma mc^2$
relativistic kinetic energy	$E_K = (\gamma - 1)mc^2$

**Fields and application of field concepts**

electric field between charged plates	$E = \frac{V}{d}$
energy transformations of charges in an electric field	$\frac{1}{2}mv^2 = qV$
field of a point charge	$E = \frac{kq}{r^2}$
force on an electric charge	$F = qE$
Coulomb's law	$F = \frac{kq_1q_2}{r^2}$
magnetic force on a moving charge	$F = qvB$
magnetic force on a current	$F = IlB$
radius of a charged particle in a magnetic field	$r = \frac{mv}{qB}$

**Generation and transmission of electricity**

voltage; power	$V = RI; \quad P = VI = I^2R$
resistors in series	$R_T = R_1 + R_2$
resistors in parallel	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$
ideal transformer action	$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$
AC voltage and current	$V_{\text{RMS}} = \frac{1}{\sqrt{2}}V_{\text{peak}} \quad I_{\text{RMS}} = \frac{1}{\sqrt{2}}I_{\text{peak}}$
electromagnetic induction	EMF: $\varepsilon = -N \frac{\Delta\Phi}{\Delta t}$ flux: $\Phi = BA$
transmission losses	$V_{\text{drop}} = I_{\text{line}} R_{\text{line}} \quad P_{\text{loss}} = I_{\text{line}}^2 R_{\text{line}}$

**Wave concepts**

wave equation	$v = f\lambda$
constructive interference	path difference = $n\lambda$
destructive interference	path difference = $\left(n - \frac{1}{2}\right)\lambda$
fringe spacing	$\Delta x = \frac{\lambda L}{d}$
Snell's law	$n_1 \sin\theta_1 = n_2 \sin\theta_2$
refractive index and wave speed	$n_1 v_1 = n_2 v_2$

**The nature of light and matter**

photoelectric effect	$E_{K \max} = hf - W$
photon energy	$E = hf$
photon momentum	$p = \frac{h}{\lambda}$
de Broglie wavelength	$\lambda = \frac{h}{p}$
Heisenberg's uncertainty principle	$\Delta p_x \Delta x \geq \frac{h}{4\pi}$

**Data**

acceleration due to gravity at Earth's surface	$g = 9.8 \text{ m s}^{-2}$
mass of the electron	$m_e = 9.1 \times 10^{-31} \text{ kg}$
magnitude of the charge of the electron	$e = 1.6 \times 10^{-19} \text{ C}$
Planck's constant	$h = 6.63 \times 10^{-34} \text{ J s}$ $h = 4.14 \times 10^{-15} \text{ eV s}$
speed of light in a vacuum	$c = 3.0 \times 10^8 \text{ m s}^{-1}$
gravitational constant	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
mass of Earth	$M_E = 5.98 \times 10^{24} \text{ kg}$
radius of Earth	$R_E = 6.37 \times 10^6 \text{ m}$
Coulomb constant (in air)	$k = 8.99 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$

**Prefixes/Units**

p = pico = $10^{-12}$	n = nano = $10^{-9}$	$\mu$ = micro = $10^{-6}$	m = milli = $10^{-3}$
k = kilo = $10^3$	M = mega = $10^6$	G = giga = $10^9$	t = tonne = $10^3 \text{ kg}$