PHYSICS FORMULA SHEET

Vectors are indicated by arrows. If only the magnitude of a vector quantity is used, the arrow is not used.

Symbols of common quantities

acceleration	$\vec{a}$	force	$\vec{F}$	magnetic flux	Φ	time	t
charge	q	frequency	f	mass	m	velocity	$\vec{v}$
displacement	$\vec{s}$	kinetic energy	E_K	momentum	$\vec{p}$	wavelength	λ
electric current	I	length	l	period	T		
electromotive force	ε	magnetic field	$\vec{B}$	potential difference	ΔV		

Magnitude of physical constants

acceleration due to gravity at the Earth's surface	$g = 9.80\ \text{m s}^{-2}$	Planck's constant	$h = 6.63 \times 10^{-34}\ \text{J s}$
constant of universal gravitation	$G = 6.67 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2}$	charge of an electron	$e = 1.60 \times 10^{-19}\ \text{C}$
speed of light in a vacuum	$c = 3.00 \times 10^{8}\ \text{m s}^{-1}$	mass of an electron	$9.11 \times 10^{-31}\ \text{kg}$
Coulomb's Law constant	$\frac{1}{4\pi\varepsilon_0} = 8.99 \times 10^{9}\ \text{N m}^2\ \text{C}^{-2}$	mass of a proton	$1.67 \times 10^{-27}\ \text{kg}$
constant for the magnetic field around a conductor	$\frac{\mu_0}{2\pi} = 2.00 \times 10^{-7}\ \text{T m A}^{-1}$	mass of Earth	$5.97 \times 10^{24}\ \text{kg}$
		mean radius of Earth	$6.37 \times 10^{6}\ \text{m}$

Topic 1: Motion and relativity

$\vec{v} = \vec{v}_0 + \vec{a}t$	$\vec{v}$ = velocity at time t $\vec{v}_0$ = initial velocity	$v = \frac{2\pi r}{T}$	
$\vec{s} = \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$		$\vec{g} = \frac{\vec{F}}{m}$	$\vec{g}$ = gravitational field strength
$v^2 = v_0^2 + 2as$		$F = G\frac{m_1 m_2}{r^2}$	r = distance between masses m_1 and m_2
$v_H = v\cos\theta$ $v_V = v\sin\theta$	θ = angle to horizontal	$v = \sqrt{\frac{GM}{r}}$	M = mass of object orbited by satellite r = radius of orbit
$E_K = \frac{1}{2}mv^2$		$T^2 = \frac{4\pi^2}{GM}r^3$	
$\vec{a} = \frac{\Delta\vec{v}}{\Delta t}$		$\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$	γ = Lorentz factor
$\vec{F} = m\vec{a}$		$t = \gamma t_0$	t_0 = time interval in the moving frame of reference
$\vec{F} = \frac{\Delta\vec{p}}{\Delta t}$		$l = \frac{l_0}{\gamma}$	l_0 = length in the moving object's frame of reference
$\vec{p} = m\vec{v}$		$p = \gamma m_0 v$	m_0 = mass in the frame of reference where the object is stationary
$a = \frac{v^2}{r}$	r = radius of circle		

This formula sheet will be provided in Physics examinations from November 2023.

Topic 2: Electricity and magnetism

$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$	r = distance between charges q_1 and q_2	$F = qvB\sin\theta$	θ = angle between magnetic field $\vec{B}$ and velocity $\vec{v}$
$\vec{E} = \frac{\vec{F}}{q}$	$\vec{E}$ = electric field	$r = \frac{mv}{qB}$	r = radius of circle
$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$	r = distance from charge	$T = \frac{2\pi m}{qB}$	
$W = q\Delta V$	W = work done	$E_K = \frac{q^2B^2r^2}{2m}$	r = radius at which ions emerge from cyclotron
$E = \frac{\Delta V}{d}$	d = distance between parallel plates	$f = \frac{1}{T}$	f = frequency of the alternating potential difference
$\vec{a} = \frac{q\vec{E}}{m}$		$\Phi = BA_\perp$	$A_\perp$ = area perpendicular to the magnetic field
$B = \frac{\mu_0}{2\pi}\frac{I}{r}$	r = distance from conductor	$\varepsilon = \frac{N\Delta\Phi}{\Delta t}$	N = number of conducting loops
$F = IlB\sin\theta$	θ = angle between magnetic field and direction of current	$\frac{V_{\text{input}}}{V_{\text{output}}} = \frac{N_{\text{input}}}{N_{\text{output}}}$	V = potential difference in transformer coils

Topic 3: Light and atoms

$v = f\lambda$		$W = hf_0$	W = work function of the metal f_0 = threshold frequency
$d\sin\theta = m\lambda$	d = distance between slits θ = angular position of m^{th} maximum m = integer (0, 1, 2, …)	$E_{K\max} = eV_s$	$E_{K\max}$ = maximum kinetic energy of electrons V_s = stopping voltage
$\Delta y = \frac{\lambda L}{d}$	Δy = distance between adjacent minima or maxima L = slit-to-screen distance	$E_{K\max} = hf - W$	
$E = hf$	E = energy of photon	$f_{\max} = \frac{e\Delta V}{h}$	ΔV = potential difference across the X-ray tube
$p = \frac{h}{\lambda}$		$E = \Delta mc^2$	E = energy

Table of prefixes

Prefix	Symbol	Value
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}

Quarks

Quark	Symbol	Charge (e)
Up	u	$+\frac{2}{3}$
Down	d	$-\frac{1}{3}$
Strange	s	$-\frac{1}{3}$
Charm	c	$+\frac{2}{3}$
Top	t	$+\frac{2}{3}$
Bottom	b	$-\frac{1}{3}$