Australian Journal of Physics

Volume 37

Melbourne 1984

Australian Journal of Physics

A journal for the publication of results of original scientific research in pure and applied physics.

This journal is one of the Australian Journals of Scientific Research published by the Commonwealth Scientific and Industrial Research Organization with the co-operation of the Australian Academy of Science. Editorial policy for the journal series is developed by a Board of Standards appointed jointly by CSIRO and the Australian Academy of Science.

Issued six times a year

Annual subscription
\$A120 (surface)
\$A132 (airmail)
\$A40 (microfiche)

ISSN 0004-9506

The Notice to Authors is published in the first issue of each volume. Copies are available on request.

All inquiries and manuscripts should be forwarded to:

The Editor-in-Chief
Australian Journal of Physics
314 Albert Street
East Melbourne, Victoria 3002

Volume 36, Number 6, was published on 23 January 1984

Australian Journal of Physics

Contents

Volume 37 Number 1 1984

[*Continued overleaf*]

Australian Journal of Physics

Contents Volume 37 Number 2 1984

AUJPAS 37(2) 119–239 (1984)

Volume 37, Number 1, was published on 14 March 1984

Australian Journal of Physics

Contents Volume 37 Number 3 1984

AUJPAS 37(3) 241–357 (1984)

Volume 37, Number 2, was published on 7 May 1984

Australian Journal of Physics

Contents Volume 37 Number 4 1984

Papers presented at the Australia–New Zealand Condensed Matter Physics Meeting, Pakatoa Island, New Zealand, 8–10 February 1984.

AUJPAS 37(4) 359–462 (1984)

Volume 37, Number 3, was published on 5 June 1984

Australian Journal of Physics

Contents

Volume 37 Number 5 1984

AUJPAS 37(5) 463–581 (1984)

Volume 37, Number 4, was published on 12 September 1984

Volume 37, Number 5, was published on 2 November 1984

Australian Journal of Physics

Contents Volume 37 Number 6 1984

[*Continued overleaf*]

INTERNATIONAL SYSTEM OF UNITS

The Système International d'Unités (SI) was adopted by the eleventh General Conference on Weights and Measures and endorsed by the International Organization for Standardization in 1960. The system is an extension and refinement of the traditional metric system and is superior to any other in being completely coherent, rational and comprehensive. In the system there is one, and only one, unit for each physical quantity and the product or quotient of any two SI units yields the unit of the resulting quantity; no numerical factors are involved.

The seven base and two supplementary units on which the SI is based are listed in Table 1.

Table 1. Base and supplementary SI units

Quantity	Name of unit	Unit symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol
Plane angle	radian	rad
Solid angle	steradian	sr

The base units are defined as follows:

Metre: The metre is the length of the path travelled by light in vacuum during a time interval of 1/299 792 458 of a second.

Kilogram: The kilogram is the mass of the International Prototype Kilogram which is in the custody of the Bureau International des Poids et Mesures at Sèvres, France.

Second: The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels ($F = 4$, $M_F = 0$ and $F = 3$, $M_F = 0$) of the ground state of the atom of pure ^{133}Cs.

Ampere: The ampere is that constant current which, if maintained in two parallel rectilinear conductors, of infinite length and of negligible circular cross-section, at a distance apart of 1 metre in a vacuum, would produce a force between the conductors equal to 2×10^{-7} newton per metre of length.

Kelvin: The kelvin is completely defined by the decision of the 1954 Conférence Générale to assign the value 273·16 kelvin (exactly) to the thermodynamic temperature at the triple point of water. It is 1/273·16 of the thermodynamic temperature of the triple point of water.

Candela: The candela is the luminous intensity, in a given direction, of a source emitting monochromatic radiation of frequency 540×10^{12} Hz and the radiant intensity of which in that direction is 1/683 watt per steradian.

Mole: The mole is the amount of substance of a system which contains as many elementary units as there are carbon atoms in 0·012 kg (exactly) of the pure nuclide ^{12}C. The elementary unit must be specified and may be an atom, a molecule, an ion, an electron, a photon, etc., or a specified group of such entities.

All the other necessary units can be derived from these base units. Tables 2 and 3 list some of the derived units.

Table 2. Derived SI units with special names

Physical quantity	Name of unit	Symbol for unit	Definition of unit
Energy	joule	J	$kg\,m^2\,s^{-2}$
Force	newton	N	$kg\,m\,s^{-2} = J\,m^{-1}$
Pressure	pascal	Pa	$kg\,m^{-1}\,s^{-2} = N\,m^{-2}$
Power	watt	W	$kg\,m^2\,s^{-3} = J\,s^{-1}$
Electric charge	coulomb	C	$A\,s$
Electric potential difference	volt	V	$kg\,m^2\,s^{-3}\,A^{-1} = J\,A^{-1}\,s^{-1}$
Electric resistance	ohm	Ω	$kg\,m^2\,s^{-3}\,A^{-2} = V\,A^{-1}$
Electric conductance	siemens	S	$kg^{-1}\,m^{-2}\,s^3\,A^2 = \Omega^{-1}$
Electric capacitance	farad	F	$A^2\,s^4\,kg^{-1}\,m^{-2} = A\,s\,V^{-1}$
Magnetic flux	weber	Wb	$kg\,m^2\,s^{-2}\,A^{-1} = V\,s$
Inductance	henry	H	$kg\,m^2\,s^{-2}\,A^{-2} = V\,s\,A^{-1}$
Magnetic flux density	tesla	T	$kg\,s^{-2}\,A^{-1} = V\,s\,m^{-2}$
Luminous flux	lumen	lm	$cd\,sr$
Illumination	lux	lx	$cd\,sr\,m^{-2}$
Frequency	hertz	Hz	s^{-1}
Activity (radioactive)	becquerel	Bq	s^{-1}
Absorbed dose (radiation)	gray	Gy	$J\,kg^{-1}$
Equivalent dose	sievert	Sv	$J\,kg^{-1}$

Table 3. Other derived SI units

Physical quantity	SI unit	Symbol
Area	square metre	m^2
Volume	cubic metre	m^3
Density	kilogram per cubic metre	$kg\,m^{-3}$
Velocity	metre per second	$m\,s^{-1}$
Angular velocity	radian per second	$rad\,s^{-1}$
Acceleration	metre per second squared	$m\,s^{-2}$
Kinematic viscosity	square metre per second	$m^2\,s^{-1}$
Dynamic viscosity	pascal second	$Pa\,s$
Electric field strength	volt per metre	$V\,m^{-1}$
Magnetic field strength	ampere per metre	$A\,m^{-1}$
Luminance	candela per square metre	$cd\,m^{-2}$
Heat capacity	joule per kelvin	$J\,K^{-1}$
Thermal conductivity	watt per metre kelvin	$W\,m^{-1}\,K^{-1}$
Surface tension	newton per metre	$N\,m^{-1}$
Thermal coefficient of expansion	reciprocal kelvin	K^{-1}

Some of the SI units are of inconvenient size, but the prefixes listed in Table 4 may be used to indicate fractions or multiples of the base or derived units.

Table 4. Prefixes for SI units

Fraction	Prefix	Symbol	Multiple	Prefix	Symbol
10^{-1}	deci	d	10	deca	da
10^{-2}	centi	c	10^{2}	hecto	h
10^{-3}	milli	m	10^{3}	kilo	k
10^{-6}	micro	μ	10^{6}	mega	M
10^{-9}	nano	n	10^{9}	giga	G
10^{-12}	pico	p	10^{12}	tera	T
10^{-15}	femto	f	10^{15}	peta	P
10^{-18}	atto	a	10^{18}	exa	E

Also, there are a number of familiar units which differ from the corresponding SI units only by powers of ten. They are not part of SI but will probably continue in use for some time. The list of such units in Table 5 is not exhaustive.

Table 5. Named units which are decimal fractions or multiples of SI units

Physical quantity	Name	Symbol	Definition
Length	ångström	Å	10^{-10} m
Length	micron	μm	10^{-6} m
Area	hectare	ha	10^{4} m^{2}
Volume	litre	l	10^{-3} m^{3}
Mass	tonne	t	10^{3} kg
Force	dyne	dyn	10^{-5} N
Pressure	bar	bar	10^{5} Pa
Energy	erg	erg	10^{-7} J
Kinematic viscosity	stokes	St	10^{-4} m^{2} s^{-1}
Dynamic viscosity	poise	P	10^{-1} Pa s
Magnetic flux	maxwell	Mx	10^{-8} Wb
Magnetic flux density (magnetic induction)	gauss	G	10^{-4} T
Absorbed dose (radiation)	rad	rad	10^{-2} Gy

Table 6 lists a number of other units which are not part of SI and defines them exactly in terms of the base SI units. *Their use is to be discouraged.*

Table 6. Some common units defined exactly in terms of SI units

Physical quantity	Name	Symbol	Definition
Length	inch	in	$2\cdot54\times10^{-2}$ m
Area	acre	ac	$4046\cdot8564224$ m^2
Mass	pound (avoirdupois)	lb	$0\cdot453\,592\,37$ kg
Force	kilogram-force	kgf	$9\cdot806\,65$ N
Pressure	atmosphere	atm	101 325 Pa
Pressure	torr	Torr	(101 325/760) Pa
Pressure	conventional millimetre of mercury	mmHg	$13\cdot5951\times980\cdot665\times10^{-1}$ Pa
Energy	kilowatt-hour	kW h	$3\cdot6\times10^{6}$ J
Energy	thermochemical calorie	cal (thermochem.)	$4\cdot184$ J
Energy	international table calorie	$\mathrm{cal}_{\mathrm{IT}}$	$34\cdot1868$ J
Activity	curie	Ci	$3\cdot7\times10^{10}$ Bq

Australian Journal of Physics

EDITORIAL

Since its inception in 1953, the *Australian Journal of Physics* has been produced using the Monotype system of typesetting. This system was originally developed almost a hundred years ago and in many respects represents one of the most sophisticated examples of the pre-electric technology of the nineteenth century. During 1984 the Monotype system will be phased out of production at CSIRO and replaced by an advanced method of computer phototypesetting. The contrast between the old and the new printing technologies could hardly be greater—probably as great as the difference between classical physics as it stood before the revolutionary ideas introduced earlier this century and the modern physics we know in the 1980s.

The new method is based on a computer typesetting language, known as TeX, which was developed during the 1970s by Donald E. Knuth at Stanford University specifically for the setting of mathematics, and which has already been adopted for use by several journals published by the American Mathematical Society. TeX is soon to be released nationwide on the CSIRONET computing network and, in addition, a specialized TeX system is being developed for in-house production of the nine *Australian Journals of Scientific Research*. When introduced later this year, the production methods of the *Australian Journal of Physics* will therefore be at the forefront of contemporary printing technology.

A major advantage of the TeX system is that directly after a manuscript is typeset it can be printed ready for proof reading, bypassing the time consuming steps of casting the type from hot metal and then composing by hand each page and each complicated mathematical formula. The new system therefore promises to lead to a substantial reduction in the overall publication time of papers published in the Journal, which in recent times has been on average 7 months.

In 1983 the *Australian Journal of Physics* published 71 papers (or 904 pages) representing about a 15% increase over the corresponding figures for 1982. In order to encourage this growth in the Journal, several new features have been introduced recently, including the decision to publish *review articles*. The policy of the Journal is to encourage the submission of reviews preferably directed at developments in physics which have taken place largely in Australia, although this should not necessarily be seen as a limitation on their nature or scope. Authors interested in publishing a review in the Journal are welcome to contact and discuss the proposed topic with an appropriate member of the Advisory Committee.

Another feature introduced recently was the appointment of two *Corresponding Members* to the Advisory Committee. They are Professor R. H. Dalitz (Oxford University), renowned for his contributions to particle physics, and Professor M. A. Morrison (University of Oklahoma), a leading theorist in the field of electron–molecule collisions. As well as increasing the fund of expertise of the Advisory Committee, the corresponding members will broaden the international coverage of the Journal.

In January this year Dr J. L. Caswell of the CSIRO Division of Radiophysics was also appointed to the Advisory Committee. Dr Caswell is one of Australia's leading radio astronomers and will provide advice on papers in the field of astronomy and astrophysics. Dr Caswell replaces Professor B. Y. Mills of the University of Sydney and it is with pleasure that we thank Professor Mills for his valuable service over the past six years.

During the coming year the *Australian Journal of Physics* will continue its policy of publishing special issues or special collections of papers, beginning with the papers delivered by the keynote speakers at the Australia–New Zealand Condensed Matter Physics Meeting held in February 1984. Organizers of major physics conferences who are interested in publishing invited or keynote papers are encouraged to contact the Editor or Chairman of the Advisory Committee at the earliest possible opportunity. Guidelines for the publication of special issues or of conference papers are available on request.

T. F. Smith
(*Chairman*)

R. P. Robertson
(*Editor*)