

International System of Units (SI Units)

Système International d'Unités, or SI units, are an extension of the meter, kilogram, second, ampere (MKSA) system proposed in 1950. In 1966, the International Federation of Clinical Chemistry (IFCC) recommended the use of selected, or favored, SI units for the clinical laboratory: whenever possible, use *mole* and *liter* units to express concentration, and express whole-unit multiples of three as powers of ten (eg, millimole = 10^{-3} moles, micromole = 10^{-6} moles, nanomole = 10^{-9} moles, picomole = 10^{-12} moles). This approach was designed to provide clearer quantitative relationships among molecular species and some standardization of databases.

This partial application of SI units to laboratory data has been accepted by many scientific journals and is used increasingly in day-to-day clinical medicine. The operative words are “whenever possible.” In many instances the molecular weight or the homogeneity of the measured analyte is not clear, and gravimetric units rather than molar units are preferred.

With regard to laboratory reports, we remain in a transition state between conventional (gravimetric) units and SI units. Quest Diagnostics is moving to SI units but continues to use selected conventional units during what has become a prolonged transition period. For your convenience, we have included a guide for interconversion of conventional and SI units, along with definitions of abbreviations used. The following table lists gravimetric and possible international unitage for a variety of laboratory tests. The conversion factor (CF) is used as follows:

$$\begin{aligned}\text{gravimetric} \times \text{CF} &= \text{international unit} \\ \text{international} \div \text{CF} &= \text{gravimetric unit}\end{aligned}$$

Abbreviation	Definition
BCE	bone collagen equivalent
creat	creatinine
d	day
dL	deciliter
g	gram
h	hour
IU	international units
kat	katal (mol/s)
L	liter
mg	milligram
min	minute
mL	milliliter
mL/h	milliliter/hour
mol	mole
mmol	millimole
mIU	milli international units
ng	nanogram
pg	picogram
pmol	picomole
s	second
U	units
μg	microgram
μmol	micromole
μU	microunits
y	year

Part 4

Analyte	Gravimetric Unit	Conversion Factor	International Unit
ACTH	pg/mL	0.22	pmol/L
Albumin	µg/dL	0.01	mg/L
	g/dL	10	g/L
Aldosterone, S	ng/dL	0.0277	nmol/L
Aldosterone, U	µg/24 h	2.77	nmol/d
Alkaline Phosphatase, Bone Specific	µg/L	1.0	µg/L
Alpha Subunit	ng/mL	1.0	µg/L
3α-Androstanediol Glucuronide	ng/dL	0.0213	nmol/L
Androstenedione	ng/dL	0.0349	nmol/L
Angiotensin Converting Enzyme	U/L	0.017	µKat/L
Angiotensin II	ng/L	1.0	ng/L
1,5-Anhydroglucitol (1,5-AG)	µg/mL	6.0918	µmol/L
Anti-Müllerian Hormone	ng/mL	7.1429	pmol/L
Apolipoprotein A1	mg/dL	0.01	g/L
Apolipoprotein B	mg/dL	0.01	g/L
Arginine Vasopressin	pg/mL	0.926	pmol/L
B-Type Natriuretic Peptide	pg/mL	1.0	ng/L
C-peptide, 24-h U	µg/g creat	0.0377	nmol/mmol creat
C-Peptide, S	ng/mL	0.333	nmol/L
Calcitonin	pg/mL	1.0	ng/L
Calcium, Ionized	mg/dL	0.25	mmol/L
Calcium, S	mg/dL	0.25	mmol/L
Calcium, U	mg/24 h	0.025	mmol/d
	mg/g creat	2.828	mmol/mol creat
	mg/mg creat	2.828	mmol/mmol creat
Catecholamines, P			
Epinephrine	pg/mL	5.454	pmol/L
Norepinephrine	pg/mL	5.914	pmol/L
Dopamine	pg/mL	6.524	pmol/L
Catecholamines, U			
Epinephrine	µg/24 h	5.454	nmol/d
Norepinephrine	µg/24 h	5.914	nmol/d
Dopamine	µg/24 h	6.524	nmol/d
Epinephrine	µg/g creat	0.617	µmol/mol creat
Norepinephrine	µg/g creat	0.669	µmol/mol creat
Dopamine	µg/g creat	0.738	µmol/mol creat
Cholesterol, HDL	mg/dL	0.0259	mmol/L
Cholesterol, HDL Subclasses	mg/dL	0.0259	mmol/L
Cholesterol, LDL, Direct	mg/dL	0.0259	mmol/L

S, serum; U, urine; P, plasma; ACTH, adrenocorticotropic hormone.

Analyte	Gravimetric Unit	Conversion Factor	International Unit
Cholesterol, Total	mg/dL	0.0259	mmol/L
Chromogranin A	ng/mL	1.0	µg/L
Collagen Cross-Linked N-Telopeptide (NTx)	nmol BCE/ mmol creat	1.0	nmol BCE/ mmol creat
Collagen Type 1 C-Telopeptide (CTx)	pg/mL	1.0	ng/L
Corticosterone	ng/dL	0.0289	nmol/L
Corticotropin Releasing Hormone	pg/mL	1.0	ng/L
Cortisol Binding Globulin	mg/L	17.18	nmol/L
Cortisol, Free, S	µg/dL	27.6	nmol/L
Cortisol, Free, U	µg/24 h µg/g creat	2.76 0.3122	nmol/d µmol/mol creat
Cortisol, S and Saliva	µg/dL	27.6	nmol/L
Cortisone, S	µg/dL	0.0277	µmol/L
Cortisone, U	µg/24 h	2.774	mmol/d
Creatinine	mg/dL g/24 h	88.4 8.84	µmol/L mmol/d
Cyclic AMP, Urine	nmol/mL	1.0	µmol/L
Cystatin C	mg/L	1.0	mg/L
Deoxycorticosterone	ng/dL	0.0303	nmol/L
11-Deoxycortisol	ng/dL	0.0289	nmol/L
Dexamethasone	ng/dL	25.48	pmol/L
DHEA	ng/dL µg/24 h µg/g creat	0.0347 0.0035 0.3922	nmol/L µmol/d µmol/mol creat
DHEA Sulfate	µg/dL	0.0271	µmol/L
Dihydrotestosterone	ng/dL	0.0344	nmol/L
Dihydrotestosterone, Free	pg/mL	3.440	pmol/L
Estradiol (E ₂), Free	pg/mL	3.67	pmol/L
Estradiol (E ₂), S	pg/mL	3.67	pmol/L
Estrogen, Total, S	pg/mL	1.0	ng/L
Estrogens, Fractionated, S			
Estrone	pg/mL	3.699	pmol/L
Estradiol	pg/mL	3.67	pmol/L
Estrinol	ng/mL	3.47	nmol/L
Estrone (E ₁), S	pg/mL	3.699	pmol/L
Estrone Sulfate	pg/mL	2.730	pmol/L
Fructosamine	µmol/L	1.0	µmol/L
FSH	mIU/mL	1.0	IU/L

S, serum; U, urine; P, plasma; DHEA, dehydroepiandrosterone; FSH, follicle stimulating hormone.

Part 4

Analyte	Gravimetric Unit	Conversion Factor	International Unit
GAD-65 Antibodies	U/mL	1.0	kU/L
Gastrin	pg/mL	1.0	ng/L
Glucagon	pg/mL	1.0	ng/L
Glucose, S	mg/dL	0.0555	mmol/L
Growth Hormone	ng/mL	1.0	µg/L
Growth Hormone Binding Protein	pmol/L	1.0	pmol/L
hCG, Beta Subunit	mIU/mL	1.0	IU/L
hCG, Total	mIU/mL	1.0	IU/L
5-HIAA	mg/24 h	5.23	µmol/d
	mg/g creat	0.592	µmol/mmol
Histamine			
Plasma or whole blood	ng/mL	8.997	nmol/L
Urine	µg/g creat	1.018	nmol/mmol creat
	mg/24 h	8.997	µmol/d
Homovanillic Acid	mg/24 h	5.49	µmol/d
	mg/g creat	0.621	µmol/mmol creat
17-Hydroxycorticosteroids	mg/24 h	2.76	µmol/d
	mg/g creat	0.312	mmol/mol creat
18-Hydroxycorticosterone	ng/dL	0.0276	nmol/L
6β-Hydroxycortisol	µg/24 h	2.642	nmol/d
18-Hydroxycortisol	µg/24 h	2.642	nmol/d
21-Hydroxylase Antibody	U/mL	1.0	kU/L
17-Hydroxypregnenolone	ng/dL	0.0301	nmol/L
17-Hydroxyprogesterone	ng/dL	0.0303	nmol/L
Hydroxyproline	mg/dL	76.3	µmol/L
Hyperglycosylated hCG (h-hCG)	pg/mL	0.0255	pmol/L
IA-2 Antibody	U/mL	1.0	kU/L
IGFBP-1	ng/mL	1.0	µg/L
IGFBP-2	ng/mL	1.0	µg/L
IGFBP-3	mg/L	1.0	mg/L
IGF-I	ng/mL	1.0	µg/L
IGF-II	ng/mL	1.0	µg/L
Inhibin A	pg/mL	1.0	ng/L
Inhibin B	pg/mL	1.0	ng/L
Insulin Antibodies	U/mL	1.0	kU/L
Insulin, Free	µIU/mL	7.175	pmol/L
Insulin, Total	µIU/mL	7.175	pmol/L

S, serum; U, urine; P, plasma; GAD-65, glutamic acid decarboxylase-65; hCG, human chorionic gonadotropin; 5-HIAA, 5-hydroxyindoleacetic acid; IGFBP, IGF binding protein; IGF, insulin-like growth factor.

Analyte	Gravimetric Unit	Conversion Factor	International Unit
17-Ketosteroids	mg/24 h	3.47	μmol/d
	mg/g creat	0.392	μmol/mmol creat
Leptin	ng/mL	1.0	μg/L
LH (Luteinizing Hormone)	mIU/mL	1.0	IU/L
Lipoprotein (a)	mg/dL	0.01	g/L
Macroprolactin	ng/mL	1.0	μg/L
Magnesium, S	mg/dL	0.4114	mmol/L
Magnesium, U	mg/24 h	0.0411	mmol/d
	mg/g creat	4.6542	mmol/mol creat
Metanephrines, P			
Metanephrine	pg/mL	5.07	pmol/L
Normetanephrine	pg/mL	5.46	pmol/L
Total	pg/mL	5.26	pmol/L
Metanephrines, U			
Metanephrine	μg/24 h	5.07	nmol/d
Normetanephrine	μg/24 h	5.46	nmol/d
Total	μg/24 h	5.26	nmol/d
Metanephrine	μg/g creat	0.574	nmol/mmol creat
Normetanephrine	μg/g creat	0.617	nmol/mmol creat
Total	μg/g creat	0.595	nmol/mmol creat
Microalbumin, U	mg/24 h	1.0	mg/d
	μg/min	1.0	μg/min
	mg/g creat	0.113	mg/mmol creat
	μg/mg creat	0.113	μg/μmol creat
Osmolality, S	mOsm/kg	1.0	mmol osmotically active particles/kg H ₂ O
Osmolality, U	mOsm/kg	1.0	mmol osmotically active particles/kg H ₂ O
Osteocalcin	ng/mL	1.0	μg/L
	ng/dL	0.01	μg/L
Pancreatic Polypeptide	pg/mL	1.0	ng/L
Plasma Renin Activity (PRA)	ng/mL/h	1.0	μg/L/h
	ng/mL/h	0.2778	ng/L·s
Prealbumin	μg/dL	0.01	mg/L
Pregnanetriol	μg/24 h	2.97	nmol/d
	μg/g creat	0.336	μmol/mol creat
Pregnenolone	ng/dL	0.0316	nmol/L
Procollagen Type I Intact N-Terminal Propeptide	μg/L	0.0286	nmol/L

S, serum; U, urine; P, plasma.

Part 4

Analyte	Gravimetric Unit	Conversion Factor	International Unit
Progesterone	ng/mL ng/dL	3.18 0.0318	nmol/L nmol/L
Proinsulin	pg/mL	0.1134	pmol/L
Prolactin	ng/mL	0.04348	nmol/L
Prolactin, Monomeric	ng/mL	0.04348	nmol/L
PTH, Intact	pg/mL	0.1061	pmol/L
PTH-Related Protein (PTH-RP)	pg/mL	1.0	ng/L
Serotonin	ng/mL	5.675	nmol/L
Sex Hormone Binding Globulin	nmol/L	1.0	nmol/L
Somatostatin	pg/mL	0.611	pmol/L
T3, Free	pg/dL pg/mL	0.0154 1.5362	pmol/L pmol/L
T3, Reverse	ng/dL	0.0154	nmol/L
T3, Total	ng/dL	0.0154	nmol/L
T4, Free	ng/dL	12.87	pmol/L
T4, Total	µg/dL	12.87	nmol/L
TBG	µg/mL	0.0185	µmol/L
Testosterone, Bioavailable	ng/dL	0.0347	nmol/L
Testosterone, Free	pg/mL	3.47	pmol/L
Testosterone, Total	ng/dL	0.0347	nmol/L
Testosterone, Urine	µg/24 h µg/g creat	3.47 0.3922	nmol/d µmol/mol creat
Tetrahydroaldosterone	µg/24 h µg/g creat	1.0 0.113	µg/d µg/mmol creat
Thyroglobulin	ng/mL	1.0	µg/L
Thyroglobulin Antibody	IU/mL	1.0	kIU/L
Thyroid Peroxidase Antibody (Anti-TPO)	IU/mL	1.0	kIU/L
Thyroid Stimulating Hormone (TSH)	mIU/L	1.0	mIU/L
Triglycerides	mg/dL	0.0113	mmol/L
Vasoactive Intestinal Polypeptide	pg/mL	1.0	ng/L
Vitamin D ₂ (Ergocalciferol)	ng/mL	2.5211	nmol/L
Vitamin D, 1,25-Dihydroxy	pg/mL	2.400	pmol/L
Vitamin D, 25-Hydroxy	ng/mL	2.496	nmol/L
VMA, Urine	mg/24 h mg/g creat	5.05 0.571	µmol/d mmol/mol creat

S, serum; U, urine; P, plasma; TBG, thyroxine binding globulin; VMA, vanillylmandelic acid.