Extracellular homeostasis

The kidney is responsible for maintaining a balance of the following substances:

Substance	Description	Proximal tubule	Loop of Henle	Distal tubule	Collecting duct
Glucose	If glucose is not reabsorbed by the kidney, it appears in the urine, in a condition known as glucosuria. This is associated with diabetes mellitus.[1].	reabsorption (almost 100%) via sodium-glucose transport proteins[2] (apical) and GLUT (basolateral).	-	-	-
Oligopeptides, proteins, and amino acids	All are reabsorbed nearly completely.[3]	reabsorption	-	-	-
Urea	Regulation of osmolality. Varies with ADH[4][5]	reabsorption (50%) via passive transport	secretion	-	reabsorption in medullary collecting ducts
Sodium	Uses Na-H antiport, Na-glucose symport, sodium ion channels (minor)[6]	reabsorption (65%, isosmotic)	reabsorption (25%, thick ascending, Na-K-2Cl symporter)	reabsorption (5%, sodium-chloride symporter)	reabsorption (5%, principal cells), stimulated by aldosterone via ENaC
Chloride	Usually follows sodium. Active (transcellular) and passive (paracellular)[6]	reabsorption	reabsorption (thin ascending, thick ascending, Na-K-2Cl symporter)	reabsorption (sodium-chloride symporter)	-
Water	Uses aquaporin water channels. See also diuretic.	absorbed osmotically along with solutes	reabsorption (descending)	-	reabsorption (regulated by ADH, via arginine vasopressin receptor 2)
Bicarbonate	Helps maintain acid-base balance. [7]	reabsorption (80-90%) [8]	reabsorption (thick ascending) [9]	-	reabsorption (intercalated cells, via band 3 and pendrin)
Protons	Uses vacuolar H+ATPase	-	-	-	secretion (intercalated cells)
Potassium	Varies upon dietary needs.	reabsorption (65%)	reabsorption (20%, thick ascending, Na-K-2Cl	-	secretion (common, via Na+/K+-ATPase, increased by

			symporter)		aldosterone), or reabsorption (rare, hydrogen potassium ATPase)
Calcium	Uses calcium ATPase, sodium-calcium exchanger	reabsorption	reabsorption (thick ascending) via passive transport	-	-
Magnesium	Calcium and magnesium compete, and an excess of one can lead to excretion of the other.	reabsorption	reabsorption (thick ascending)	reabsorption	-
Phosphate	Excreted as titratable acid.	reabsorption (85%) via sodium/phosphate cotransporter[2]. Inhibited by parathyroid hormone.	-	-	-
Carboxylate		reabsorption (100%[10]) via carboxylate transporters.			

There are several more formal tests and ratios involved in estimating renal function:

Measurement	Calculation	Details
renal plasma flow	$RPF = \frac{\text{effective RPF}}{\text{extraction ratio}}$[14]	Volume of blood plasma delivered to the kidney per unit time. PAH clearance is a renal analysis method used to provide an estimate.
renal blood flow	$RBF = \frac{RPF}{1 - HCT}$ (HCT is hematocrit)	Volume of blood delivered to the kidney per unit time. In humans, the kidneys together receive roughly 20% of cardiac output, amounting to 1 L/min in a 70-kg adult male.
glomerular filtration rate	$GFR = \frac{U_{[\text{creatinine}]} x V}{P_{[\text{creatinine}]}}$) (estimation using creatinine clearance)	Volume of fluid filtered from the renal glomerular capillaries into the Bowman's capsule per unit time. Estimated using inulin. Usually a creatinine clearance test is performed but other markers, such as the plant polysaccharide inulin or radiolabelled EDTA, may be used as well.

filtration fraction	$FF = \frac{GFR}{RPF}$[15]	Measures portion of renal plasma that is filtered.
anion gap	AG = $[Na^+] - ([Cl^-] + [HCO_3^-])$	Cations minus anions. Excludes K^+ (usually), Ca^{2+}, $H_2PO_4^-$. Aids in the differential diagnosis of metabolic acidosis
Clearance (other than water)	$C = \frac{UV}{P}$ where U = concentration, V =urine volume / time, U*V = urinary excretion, and P = plasma concentration [16]	Rate of removal
free water clearance	$C = V - C_{osm}$ or $V - \frac{U_{osm}}{P_{osm}}V = C_{H_2O}$[17]	The volume of blood plasma that is cleared of solute-free water per unit time.
Net acid excretion	$NEA = V(U_{NH_4} + U_{TA} - U_{HCO_3})$	Net amount of acid excreted in the urine per unit time