C/P Equation Sheet ANSWER KEY

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Name _____ Date _____

Every equation, with what it is for. Check your sheet line by line. Anything you missed goes on tomorrow's list.

01 Kinematics

A)	$v = v_0 + at$	velocity with constant a
B)	$\Delta x = v_0 t + \frac{1}{2}at^2$	displacement, no final v
C)	$v^2 = v_0^2 + 2a\Delta x$	no time given
D)	$\Delta x = \frac{1}{2}(v_0 + v)t$	no acceleration given
E)	$v_x = v\cos\theta \quad v_y = v\sin\theta$	velocity components

02 Forces and Equilibrium

A)	$F_{net} = ma$	Newton's second law
B)	$w = mg$	weight
C)	$F_g = Gm_1m_2 / r^2$	universal gravitation
D)	$f_s \leq \mu_s N$	static friction (max)
E)	$f_k = \mu_k N$	kinetic friction
F)	$F_{\parallel} = mg\sin\theta \quad N = mg\cos\theta$	incline components
G)	$F_c = mv^2 / r \quad a_c = v^2 / r$	centripetal
H)	$\tau = rF\sin\theta$	torque
I)	$F = -kx$	Hooke's law

03 Work, Energy, Power, Momentum

A)	$W = Fd\cos\theta$	work
B)	$KE = \frac{1}{2}mv^2$	kinetic energy
C)	$PE = mgh$	gravitational PE
D)	$PE_{spring} = \frac{1}{2}kx^2$	elastic PE
E)	$W_{net} = \Delta KE$	work-energy theorem
F)	$P = W / t = \Delta E / t \quad P = Fv$	power
G)	$p = mv$	momentum
H)	$J = F\Delta t = \Delta p$	impulse
I)	$MA = F_{out} / F_{in}$	mechanical advantage
J)	efficiency $= W_{out} / W_{in}$	efficiency

04 Fluids

A)	$\rho = m / V$	density
B)	$SG = \rho / \rho_{water}$	specific gravity
C)	$P = F / A$	pressure
D)	$P = P_0 + \rho gh$	hydrostatic (absolute) pressure
E)	$F_b = \rho_{fluid} V_{sub} g$	buoyant force
F)	$A_1v_1 = A_2v_2$	continuity
G)	$P + \frac{1}{2}\rho v^2 + \rho gh = \text{constant}$	Bernoulli
H)	$F_1 / A_1 = F_2 / A_2$	Pascal's principle
I)	$Q = \pi r^4 \Delta P / 8nL$	Poiseuille's law

05 Electrostatics and Magnetism

A)	$F = kq_1q_2 / r^2$	Coulomb's law
B)	$E = F / q = kq / r^2$	electric field
C)	$U = kq_1q_2 / r$	electric potential energy
D)	$V = kq / r$	electric potential
E)	$W = q\Delta V$	work by a field
F)	$\Delta V = Ed$	parallel plates
G)	$F = qvB\sin\theta$	force on a moving charge
H)	$F = IlB\sin\theta$	force on a current-carrying wire
I)	$B = \mu_0 I / 2\pi r$	field around a long wire

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06 Circuits

A)	$I = Q / t$	current
B)	$V = IR$	Ohm's law
C)	$R = \rho L / A$	resistivity
D)	$P = IV = I^2R = V^2 / R$	electrical power
E)	$R_{eq} = R_1 + R_2 + \ldots$	resistors in series
F)	$1/R_{eq} = 1/R_1 + 1/R_2 + \ldots$	resistors in parallel
G)	$C = Q / V$	capacitance
H)	$C = \kappa\varepsilon_0 A / d$	parallel-plate capacitor
I)	$U = \frac{1}{2}CV^2 = \frac{1}{2}QV = Q^2/2C$	energy in a capacitor
J)	$1/C_{eq} = 1/C_1 + 1/C_2 + \ldots$	capacitors in series
K)	$C_{eq} = C_1 + C_2 + \ldots$	capacitors in parallel

07 Waves and Sound

A)	$v = f\lambda$	wave speed
B)	$T = 1 / f$	period
C)	$v = \sqrt{(T / \mu)}$	speed on a string
D)	$\beta = 10 \log(I / I_0)$	sound level (dB)
E)	$\lambda = 2L / n \quad (n = 1, 2, 3\ldots)$	string or pipe open at both ends
F)	$\lambda = 4L / n \quad (n = 1, 3, 5\ldots)$	pipe closed at one end
G)	$f' = f\,(v \pm v_D) / (v \mp v_S)$	Doppler effect
H)	$f_{beat} = \lvert f_1 - f_2 \rvert$	beat frequency
I)	$I = P / A \quad (\text{sphere: } A = 4\pi r^2)$	intensity

08 Light and Optics

A)	$c = f\lambda$	speed of light
B)	$E = hf = hc / \lambda$	photon energy
C)	$n = c / v$	index of refraction
D)	$n_1 \sin\theta_1 = n_2 \sin\theta_2$	Snell's law
E)	$\sin\theta_c = n_2 / n_1$	critical angle
F)	$1/f = 1/o + 1/i$	thin lens / mirror
G)	$m = -i / o = h_i / h_o$	magnification
H)	$f = R / 2$	mirror focal length
I)	$P = 1 / f \quad (f \text{ in meters})$	lens power (diopters)
J)	$P_{total} = P_1 + P_2 + \ldots$	lenses in contact

09 Atomic and Nuclear

A)	$KE_{max} = hf - \Phi$	photoelectric effect
B)	$N = N_0(\frac{1}{2})^{t\,/\,t_{1/2}}$	radioactive decay
C)	$E = mc^2 \quad (1\text{ u} \approx 931.5\text{ MeV})$	mass defect / binding energy
D)	$E_n = -13.6\text{ eV} / n^2$	hydrogen energy levels

10 Thermodynamics and Gases

A)	$\Delta U = Q - W$	first law (W = work by system)
B)	$q = mc\Delta T$	heat and temperature change
C)	$q = mL$	phase change (latent heat)
D)	$\Delta L = \alpha L \Delta T$	thermal expansion
E)	$PV = nRT$	ideal gas law
F)	$P_1V_1 / T_1 = P_2V_2 / T_2$	combined gas law
G)	$P_i = X_i P_{total}$	Dalton's law
H)	$rate_1 / rate_2 = \sqrt{(M_2 / M_1)}$	Graham's law
I)	$KE_{avg} = (3/2)k_BT \quad v_{rms} = \sqrt{(3RT / M)}$	kinetic molecular theory
J)	$W = P\Delta V$	work by an expanding gas

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11 Kinetics, Equilibrium, Thermochemistry

A)	$\text{rate} = k[A]^m[B]^n$	rate law
B)	$k = Ae^{-Ea/RT}$	Arrhenius equation
C)	$K_{eq} = [C]^c[D]^d / [A]^a[B]^b$	equilibrium constant
D)	$\Delta G = \Delta H - T\Delta S$	Gibbs free energy
E)	$\Delta G° = -RT \ln K$	$\Delta G°$ and K
F)	$\Delta G = \Delta G° + RT \ln Q$	ΔG away from standard state
G)	$\Delta H_{rxn} = \Sigma\Delta H_f(\text{products}) - \Sigma\Delta H_f(\text{reactants})$	heats of formation
H)	$\Delta H_{rxn} = \Sigma(\text{bonds broken}) - \Sigma(\text{bonds formed})$	bond enthalpies

12 Solutions, Acids and Bases

A)	$M = \text{mol solute} / \text{L solution}$	molarity
B)	$M_1V_1 = M_2V_2$	dilution
C)	$pH = -\log[H^+]$	pH
D)	$K_w = [H^+][OH^-] = 10^{-14}$ $pH + pOH = 14$	water autoionization (25 °C)
E)	$pH = pK_a + \log([A^-] / [HA])$	Henderson–Hasselbalch
F)	$K_a \times K_b = K_w$	conjugate pairs
G)	$\Delta T_b = iK_bm$	boiling point elevation
H)	$\Delta T_f = iK_fm$	freezing point depression
I)	$\Pi = iMRT$	osmotic pressure
J)	$P = X_{solvent}P°$	Raoult's law
K)	$A = \varepsilon bc$	Beer–Lambert law

13 Electrochemistry

A)	$E°_{cell} = E°_{cathode} - E°_{anode}$	cell potential
B)	$\Delta G° = -nFE°$	free energy and cell potential
C)	$E = E° - (RT / nF) \ln Q$	Nernst equation
D)	$q = It = n_{e^-}F$	electrolysis (Faraday)

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