BME 303: Modern Imaging Diagnostic Systems
Final Formula Sheet

Material	μ@ 30keV	μ@ 100keV	Z $(kg/(m^2s)x10^6)$	c (m/s)	$\rho(kg/m^3)$	T_1	T_2	M_0
Water	.80 cm^{-1}	.1707 cm^2/g	1.5	1480	1000	1500	1500	1.0
Alien Bone	$.9cm^{-1}$	.1855 cm^2/g	64	4080	1500	550	5	0.8
Muscle	$.25cm^{-1}$	$.1693cm^2/g$	1.6	1070	1070	600	40	0.9
Alien Air	$.9.3x10^{-4}cm^{-1}$	$.1541cm^2/g$	0.04	330	1.2	500	15	.0004

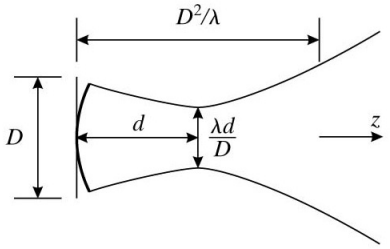
Ultrasound

$Z = \rho c$, $p = Zc$, $f\lambda = c$, $I = \frac{p^2}{Z}$

$A_z = A_0 e^{-\mu_a z}$, $\alpha = 20log_{10}(e)\mu_a$

speed of light $c = 3.0x10^8 m/s$, $f_T = \frac{c_T}{2d_T}$

$\frac{sin(\theta_i)}{sin(\theta_t)} = \frac{c_1}{c_2}$, $\frac{p_r}{p_i} = \frac{Z_2 - Z_1}{Z_2 + Z_1}$, $\frac{p_t}{p_i} = \frac{2Z_2}{Z_2 + Z_1}$



Magnetic Resonance Imaging

$M_0 = \frac{B_0 \gamma_{bar}^2 \hbar^2}{4k_{bar}T} P_D$, $\omega_0 = \gamma B_0$, $f_0 = \gamma_{bar} B_0$, $\gamma_{bar} = 42.57 MHz/T$,

$\hbar = 6.626x10^{-34} Js$, $E = \hbar f$ 1eV=$1.602x10^{-19}$J

$M_z(t) = M_0(1 - e^{-t/T_1})$, Spin Echo: $M_{xy} = M_0(1 - e^{-TR/T1})e^{-TE/T_2}$

$\frac{1}{T_2^*} = \frac{1}{T_2} + \frac{1}{T_2'}$

X-ray Imaging

$SNR = \sqrt{\mu}$ $SNR = \frac{\sqrt{\mu}}{\sigma^2}$ $N = N_0 e^{-\mu x}$

$m = \frac{d-z}{z}$ $M = d/z$ $I_d(x,y) = S(x/m, y/m) * t(x/M, y/M)$

$SNR = \frac{I_t - I_d}{\sigma_b}$

$C = \frac{f_t - f_g}{f_g}$ $I = I_o e^{-\mu x}$

Radon Transform

$G(L,\theta) = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f(x,y)\delta(xcos(\theta) + ysin(\theta) - l)dxdy$

Nuclear Medicine

$R_{ext}^2 = R_i^2 + R_c^2$ $R_C = \frac{d}{l}(l + b + |z|)$ $I_d = \frac{AE}{4\pi r^2}$

$X = \frac{1}{Z}\Sigma_{k=1}^K x_k a_k$ $Y = \frac{1}{Z}\Sigma_{k=1}^K y_k a_k$ $N_t = N_0 e^{-\lambda t}$

$SNR = \sqrt{N}$