1. CORE PHYSICS & EXPOSURE FORMULAS

Inverse Square (Intensity)	`I1 / I2 = (d2)² / (d1)²`
Direct Square (mAs/SID)	`mAs1 / mAs2 = (d1)² / (d2)²`
15% kVp Rule	`+15% kVp = 2× Exp` (halve mAs) `-15% kVp = ½ Exp` (double mAs)
Magnification (MF)	`MF = SID / SOD` | `SOD = SID - OID`
Geometric Unsharpness	`Ug = (FSS × OID) / SOD`
Heat Units (HU)	`HU = kVp × mAs × C` 1Φ=1.0 | 3Φ6p=1.35 | 3Φ12p=1.41 | HF=1.41
Pixel Size / Nyquist	`Pixel = FOV / Matrix` | `Nyq = 1 / (2×Pitch)`

2. GRID CONVERSION FACTORS (BUCKY FACTOR)

Grid Ratio	GCF	Grid Ratio	GCF
No Grid	1	**8:1 Grid**	4
5:1 Grid	2	**12:1 Grid**	5
6:1 Grid	3	**16:1 Grid**	6

Formula: `mAs2 = mAs1 × (New GCF / Old GCF)`

3. NCRP #116 DOSE LIMITS & QC BENCHMARKS

Category / Test	Limit / Standard
Occupational Annual Effective	**50 mSv** (5 rem)
Occupational Cumulative	**10 mSv × Age** (1 rem × Age)
Lens of Eye / Skin & Extremities	**150 mSv** (Eye) | **500 mSv** (Skin/Hands)
Embryo / Fetus (Declared)	**5 mSv** total | **0.5 mSv / month**
General Public (Freq / Infreq)	**1 mSv** / yr | **5 mSv** / yr
Lead Barriers (Primary / Secondary)	**1/16 in** (1.5 mm) | **1/32 in** (0.8 mm)
Fluoro Tabletop / HLC Boost	**100 mGy/min** (10 R) | **200 mGy/min** HLC
Tube Leakage / Min Filtration	**≤ 100 mR/hr** @ 1m | **≥ 2.5 mm Al** (>70 kVp)
QC "5 - 10 - 5" & Collimation	kVp/Repro **±5%** | Lin **±10%** | PBL/SID **±2%**

4. DIGITAL PROCESSING & DEVIATION INDEX (DI)

- **DI Scale: 0.0** = Target \| **+1.0** = +25% Over \| **-1.0** = -20% Under \| **+3.0** = 2× Exp \| **-3.0** = ½ Exp.
- **Controllers: mAs** = Receptor Exp / Noise (Quantum Mottle) \| **kVp** = Subject Contrast \| **LUT / Window Width** = Display Contrast \| **Rescaling / Window Level** = Display Brightness.
- **Detectors: CR** = BaFBr (Red laser → Blue light) \| **Indirect DR** = CsI + a-Si (Highest DQE) \| **Direct DR** = a-Se (Highest Spatial Res).

5. SKULL, FACIAL & SINUS ANGLES (7° / 8° RULES)

Line Conversions: IOML = OML + 7° \| **GML = OML + 8°** (Sinuses = **Erect**!)

Projection	CR Angle & Line	Petrous Ridges / Anatomy
AP Axial (Townes)	**30° caudad** OML (37° IOML)	Dorsum sellae in foramen magnum
PA Axial (Caldwell)	**15° caudad** OML (0° facial)	Lower 1/3 orbits (Frontal/Ethmoid)
PA Axial (Haas)	**25° cephalad** OML	Alternative to Townes (trauma/large)
Parietoacanthial (Waters)	**37° OML** (MML ⊥ IR)	Below maxillary sinuses (Blowout)
Modified Waters	**55° OML** (LML ⊥ IR)	Lower 1/2 orbits (Orbital floors)
SMV (Schuller)	⊥ IOML (vertex to IR)	Sphenoid sinuses, zygomatic arches
Rhese (Optic Foramen)	**37°** rotation, AML ⊥ IR	Optic canal in lower-outer quadrant
TMJ (Law vs. Schuller)	Law: 15° rot + 15° caud	Schuller: 0° rot + **25°–30° caudad**

6. SPINE, PELVIS & THORAX POSITIONING RULES

Region / View	Position & CR Angle	Anatomy Demonstrated
C-Spine Obliques	45° rot | **15° ceph** (LAO/RAO) **15° caud** (LPO/RPO)	Intervertebral foramina: Ant = **Closest** | Post = **Farthest**
Swimmer's Lateral	0° or **3°–5° caudad**	C7–T1 interspace (depress IR shoulder)
L-Spine Obliques	45° (30° L5-S1) | 0° CR	Zygapophyseal joints: Post = **Closest**
L5–S1 Spot / SI Joints	L5-S1: **30°M / 35°F ceph**	SI (25°–30°): Post = **Farthest** | Ant = Closest
Sacrum vs. Coccyx	Sac: **15° ceph** | Coc: **10° caud**	AP views (opposite angles!)
Pelvis Inlet / Outlet	Inlet: **40° caud**	Outlet: **20°–35°M / 30°–45°F ceph**
Judet Acetabulum	45° Post Obliques	**U-A-P** (Up=Ant Col) | **D-P-A** (Down=Post)
Sternum / Ribs	Sternum: **15°–20° RAO**	Ribs: **Closest** to IR (Ant=Ant, Post=Post)

7. EXTREMITIES, GI/GU & PATIENT CARE MEMORY HOOKS

- **Upper Ext: Stecher** = 20° ceph (scaphoid) \| **Gaynor-Hart** = 25°–30° (carpal canal) \| **Elbow**: Med Obl = Coronoid, Lat Obl = Radial Head \| **Coyle (90°)**: 45° toward shld = Radial Head, 45° away = Coronoid \| **Grashey** = 35°–45° post obl (glenoid).
- **Lower Ext: Ankle Mortise** = 15°–20° int rot \| **45° Int Obl** = Distal tib-fib \| **Lat Knee** = 5°–7° ceph \| **Hip Trauma** = **DO NOT internally rotate** (Danelius-Miller).
- **GI / GU Gravity: Stomach**: RAO = barium in pylorus/bulb; LPO = air in fundus \| **IVU Kidneys**: 30° RPO = Left kidney parallel \| **HSG** = 7–10 days post-menses.
- **Safety & Pharm:** Airborne = **MTV** (Measles, TB, Varicella = N95 + Neg Press) \| **C. diff** = Soap & Water \| **Metformin** = Hold 48 hrs post-contrast if eGFR < 30/AKI \| **Anaphylactoid** = Tachycardia + Epi \| **Vasovagal** = Bradycardia + Trendelenburg \| **Angles**: IM 90°, SubQ 45°, IV 15°–30°, ID 10°–15°.

Exam-Day Strategy: During your 8-minute Pearson VUE tutorial, test the on-screen calculator (or verify your handheld calculator) and jot down Boxes 1, 2, 3, and 5 first before starting Question 1.