



Ride the Lightning

A Review of Radiographic Physics

Overview

- .Basic principles of x-ray production
- .Imaging equipment
- .Quality Control
- .Technical Factors
- .Image QA

Preparing for the registry

- .The ARRT just wants to ask you a few questions to find out whether you know what you're talking about or not
- .Questions draw from a very large pool of information
- .Multiple answers that could be construed as correct!
- .Part of what they test is your critical thinking ability

For Example:

.Which of the following is used to reduce the effect of scatter radiation?

- A.Intensifying screen
- B.Compensating filters
- c.Radiographic grids
- D.Compression devices

Answer: C

Section I – Principles of Radiation Physics

.9 questions

X-ray production

- .Where do the electrons come from?
- .kVp as an accelerator
- .Focus – cathode focusing cup
- .Deceleration of the electrons: Target interactions

Target interactions

.Bremsstrahlung

.Characteristic

The X-ray beam

- Frequency vs wavelength – remember these are inverse!
- High frequency = higher energy = more penetration
- Inverse square law
- Properties of x-rays
- Constant velocity (not the same as electrons!)
- Ionizing radiation – damage tissue
- Always travel in a straight line

X-ray beam continued

- Beam characteristics

- Quality

- Quantity (aka intensity)

- Primary beam → Attenuation → Exit (remnant) radiation

- Question: What percent of the primary beam typically exits the patient?

- **Answer: Usually less than 5%!**

Imaging Equipment

.9 more questions

Components

- .The console
- .The tube
- .The AEC
- .Detectors, backup time, plus-or-minus density control
- .Manual exposure controls
- .Beam restriction devices

Example question

.How much would you increase the kVp when using an extension cylinder to cone down on an area of interest?

- A. 5 kVp
- B. 10 kVp
- C. 15 kVp
- D. 20 kVp

The X-ray Generator

- .Really a large transformer plus ancillary equipment
- .Step up
- .Step down
- .Rectification circuit
- .Phase – single or triple
- .Pulse – 100% for single phase, variable for 3 phase

High Frequency

Half wave



100%

Full wave



100%

Three phase,
six pulse



= 14%

Three phase,
twelve pulse



= 4%

High frequency



= < 1%

Mock registry question

Three-phase, six-pulse full wave rectification produces:

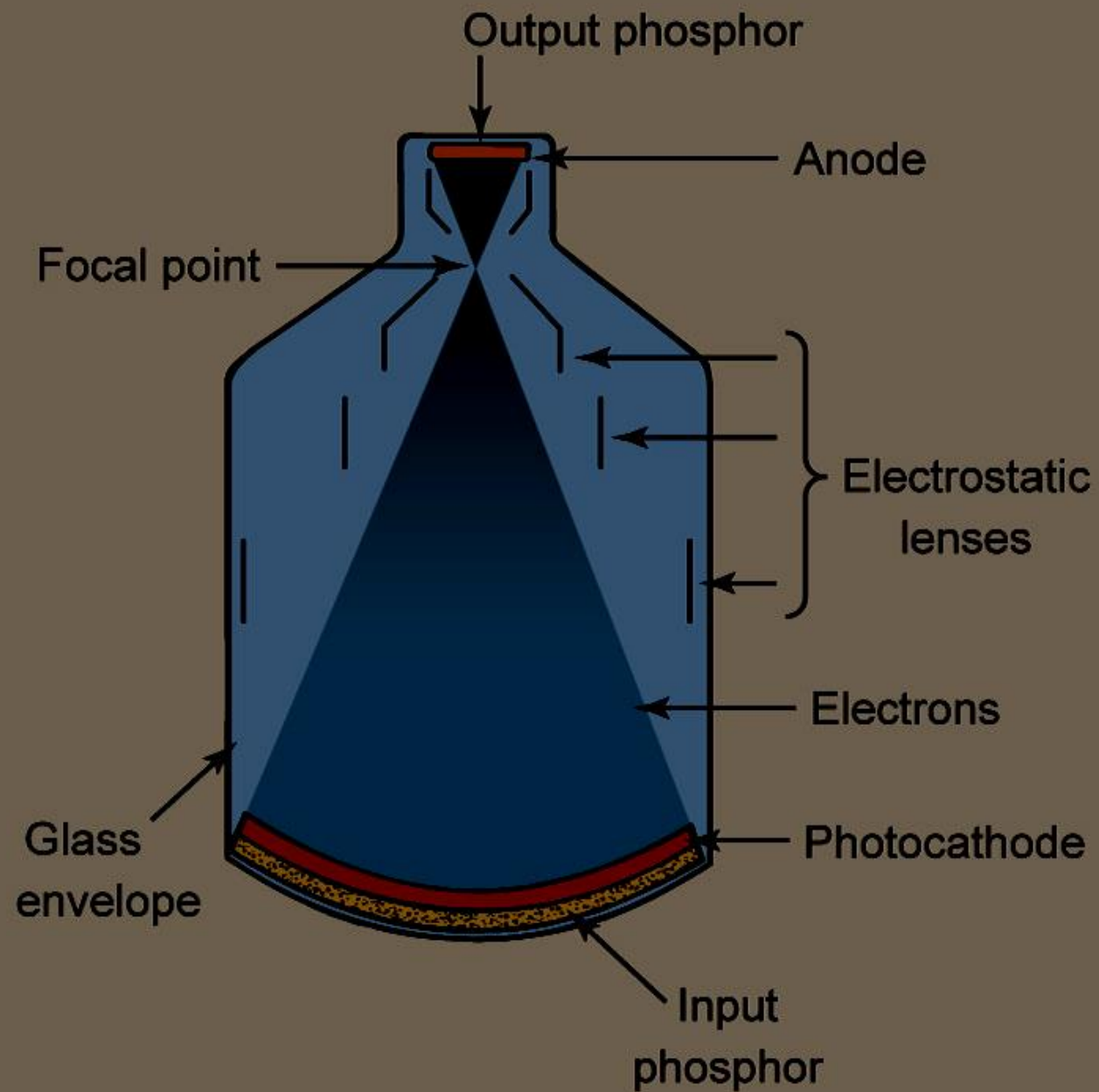
- A. Direct Current with 13% ripple
- B. Direct current with 4% ripple
- C. Direct current with 100% ripple
- D. Alternating current with 13% ripple

Answer: A

Source: Mosby's Comprehensive Review of Radiography

Fluro Units

- .Image intensifier
- .CRT or flat screen monitor
- .Recording – now all digital
- .ABC (automatic brightness control)



Sample Question

Total brightness gain achieved using an image intensifier equals:

- A. Flux gain times minification gain
- B. Diameter of input phosphor times diameter of output phosphor
- C. Intensification factor: brightness without an image intensifier divided by brightness with an image intensifier
- D. Total light emitted at the photocathode

Digital components

- .PSP imaging plates
- .Flat panels – Direct and indirect
- .CR plate erasure
- .Cleaning CR plates – must be anhydrous!

Other units

.Dedicated chest stand

.Tomographic system

Accessories

- .Grids – must know about all types and conversion factors!
- .Bucky – how does it work?
- .Image receptors
 - Film-screen speed
 - CR imaging plate
 - DR receptor – Indirect and direct capture

Quality Control (4 questions)

- .Beam Restriction
- .9-penny test (light field – x-ray field congruency)
- .Central ray alignment
- .CR must be within 1 degree of perpendicular to the IR
- .CR must be within 1% of the center of the Bucky tray
- .Tube angulation indicator must be within +/- 5 degrees
- .Reporting of malfunctions
- .Digital receptor systems
- .Digital artifacts
- .Maintenance (erase plates after a period of disuse)

Shields

- .Lead aprons and shields should be tested for damage
- .TJC says test every 6 months
- .Keep a log of these inspections in case TJC checks up on you

Technical factors (20 questions)

.Anatomical programming

.Calipers

.Fixed vs Variable kVp

.Casts

.Anatomy and pathology (Ex: emphysema and osteoporosis)

.Pediatric imaging

.Contrast media

AEC

- .Effects of changing exposure factors
- .Remember, AEC only controls time
- .Detector configuration
- .Anatomic alignment with cell
- .Density control (plus or minus)

Digital considerations

- .Spatial resolution vs contrast resolution
- .Sampling frequency, pixels per mm
- .DEL – Detector element size
- .Receptor size and matrix size

Digital image signal

- .Quantum mottle
- .Other sources of noise
- .Signal to noise ratio (SNR)
- .Contrast to noise ratio (CNR)

Whew!!!

.That's a lot of information to remember, but keep in mind that the ARRT wants to know if you really understand what you're doing.

.There's no way to tell exactly what questions you'll be asked, but if you have a good working knowledge of radiographic equipment, you can FIGURE OUT 90% of the questions they ask.

.Take your time on the exam (you'll have plenty), and remember to read carefully all of the choices, then choose the BEST one you are given.

.Good Luck to you!