

Radiology

World of Revision

Marrow

© Marrow | sahoosatyajeet000@gmail.com

MARROW

Instructions

- Notes are to be used in conjunction with Marrow videos.

Please note:

- The information in this book has been printed based on the transcript of the Marrow videos. This book has to be used in conjunction with the Marrow videos and not as a standalone material.
- The information contained in this book is for educational purposes only. The content provided is not intended to substitute for professional medical advice, diagnosis or treatment.
- This book cannot be sold separately. It has been made available to only select eligible users who have an active subscription to Marrow videos.
- The text, images, slides, and other materials used in this book have been contributed by the faculty, who are subject matter experts. We have merely reproduced them as video transcripts in this book.
- The notes have been consciously designed in a way that is concise and revisable. To ensure this, we have intentionally added only the most relevant modules and images that are needed for you.
- The notes contain blank spaces primarily for labelling diagrams, completing cycles and more to promote active engagement and reinforce learning.
- Reasonable care has been taken to ensure the accuracy of the information provided in this book. Neither the faculty nor Marrow takes any responsibility for any liability or damages resulting from applying the information provided in this book.

All Rights Reserved

No part of this publication shall be reproduced, copied, transmitted, adapted, modified or stored in any form or by any means, electronic, photocopying, recording or otherwise.

©Marrow

Contents

Radiology

Fundamentals of Radiology	1
X-rays • Effects of radiation • Radiation exposure • Radiation units, Exposure factors and TLD badge • CT scan • Ultrasonography • MRI • Contrast media • Iodinated contrast • MRI and USG contrast agents	
Neurological Imaging	13
Stroke imaging • SAH (Subarachnoid hemorrhage) • CNS spotters • Head trauma CT imaging • Brain tumors CT imaging • Ring enhancing lesions • Other neurological lesions • Circle of willis and ECA • Carotid body tumor/Paraganglioma/Chemodectoma	
Respiratory Imaging	29
Chest x-ray views • Normal CXR findings • Incidental findings on CXR • Silhouette sign • Pulmonary infections • Paediatric imaging • Tuberculosis • Pleural effusion • Pneumothorax • Mediastinal imaging • Lung lesions • Lung tumors • Bronchiectasis and sarcoidosis • Foreign body aspiration • Egg-shell calcification of lymph nodes	
Cardiovascular Imaging	49
Congenital heart diseases • Pericardial effusion • Mitral stenosis • Congestive heart failure • Aortic dissection • Aortic aneurysm • Constrictive pericarditis • Pulmonary embolism	
Gastrointestinal Tract Imaging	57
Acute abdomen : Pneumoperitoneum • Acute abdomen : Bowel obstruction • Bowel obstruction : Differentials • FAST • Barium spotters • Defecography • Hepatic imaging • Gall bladder imaging • Biliary tree imaging • Pancreas imaging & Hydatid cyst	
Genitourinary Tract and Women's Imaging	72
Renal abnormalities • Intravenous urography/Pyelography • Urethral abnormalities • Breast imaging • OBG imaging • Fetal anomalies	
Musculoskeletal Imaging	85
Vitamin deficiencies • Hyperparathyroidism • Bone tumors • Ankylosing spondylitis • Osteomyelitis • Skeletal TB • Sacral insufficiency fractures • Pediatric hip disorders • Spondylolisthesis	
Radiotherapy and Nuclear Medicine	94
Basis of nuclear medicine • Positron emission tomography (PET) scan • Technitium-99m • Applications of radionuclide scans • Components of radiotherapy • Fractionated radiotherapy • Types of radiotherapy • Specialized types of radiotherapy	

FUNDAMENTALS OF RADIOLOGY

----- Active space -----

Founding father of radiology : Wilhelm Röntgen (Discovered X-rays : 8th Nov 1895).

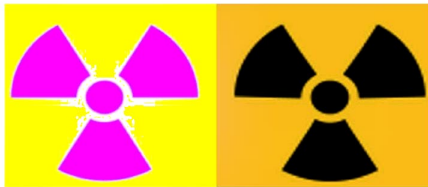


Wilhelm Röntgen



First X-ray image

Symbols :



Trefoil : Radiation hazard



X-ray radiation hazard



Sealed radiation source

Electromagnetic (Em) Spectrum :

- Spectrum of energy components.
- Frequency and energy :

Radio waves < microwaves < infrared < light < UV rays < X-rays < gamma rays
(minimum) (maximum).

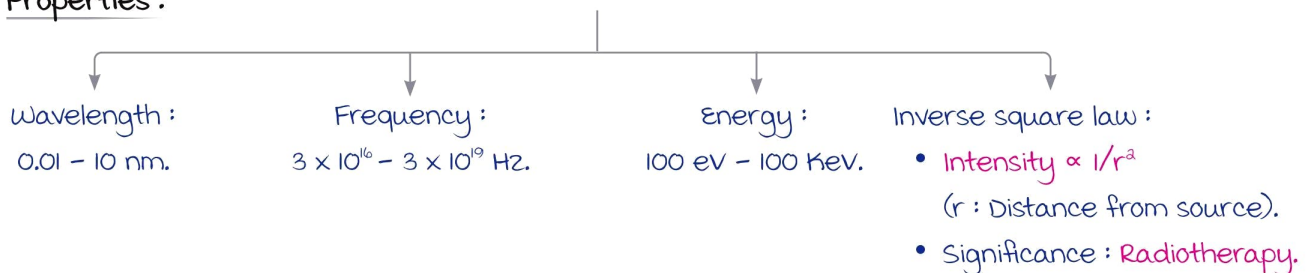
Properties of Em spectrum :

- mass : Absent.
- velocity : 3×10^8 m/s (Speed of light).
- wave type : Crest and trough.

X-Rays

00:06:35

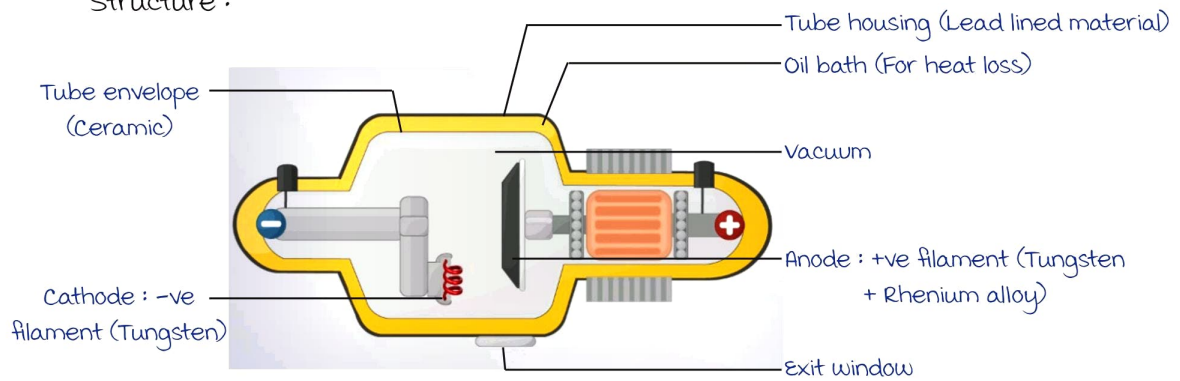
Properties :



----- Active space -----

X-Ray Tube :

Structure :



Functioning :

Electric current → Cathode filament

Thermionic emission
($\Delta T \uparrow$ heat of filament)

Accumulation of electrons around cathode

Acceleration of electrons towards anode

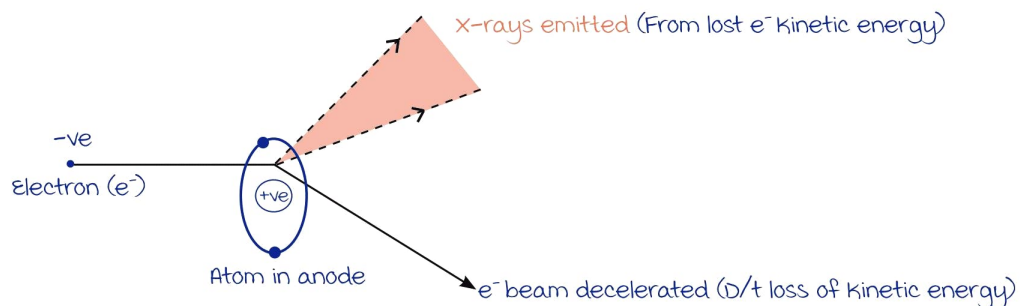
Accelerated electron hit anode

Production of X-rays.

Mechanisms of X-Ray Production :

I. Continuous spectrum :

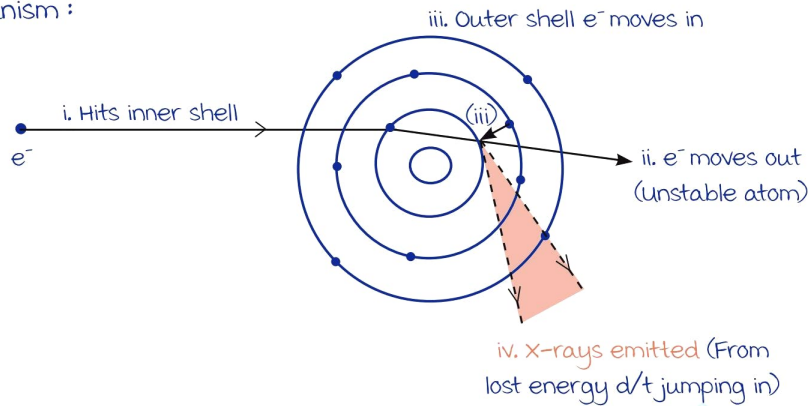
- $m/c : 70 - 80 \%$.
- AKA **Bremsstrahlung**/white radiation/braking radiation.
- mechanism :



2. Characteristic spectrum :

----- Active space -----

- Less common : 20 - 30%.
- Significance : used in mammography.
- mechanism :

Interactions of X-Rays (In Patient's Body) :

- Compton effect : m/c overall.
 - Photoelectric effect : 2^{nd} m/c .
 - Coherent scattering
 - Photo-disintegration
 - Pair production
- Not seen in diagnostic radiology
(High energy X-ray beams not used).

	Compton effect/ mid-energy phenomenon	Photoelectric effect/ low energy phenomenon
Cause	Interaction b/w X-ray photon and outer shell e^-	Interaction b/w X-ray photon and inner shell e^-
X-ray beam deviation (Scatter radiation)	⊕	⊖
Image distortion	⊕	⊖ (Image quality improved)
Desired levels	↓	↑

----- Active space -----

Effects of Radiation

00:18:26

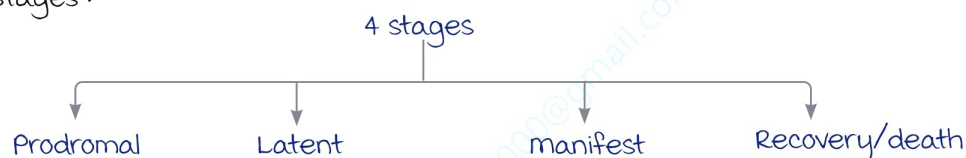
Law of Radiobiology/Law of Bergonie & Tribondeau ☢ :

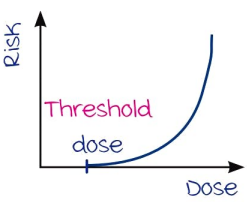
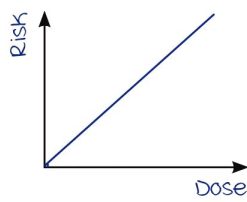
- Radiosensitivity \propto Amount of undifferentiated cells/ cells in active mitosis in tissue.
- maximum radiosensitivity : Bone marrow.

Acute Radiation Syndrome ☢ :

- Appearance order ↓
- i. Acute hematological syndromes : 1 - 2 Gy
 - ii. Acute GIT syndrome : 6 - 10 Gy
 - iii. Acute CNS syndrome : 20 - 30 Gy
- } Threshold dose.

Stages :

**Deterministic & Stochastic Effects :**

	Deterministic effect	Stochastic effect
Onset	Acute - subacute	Chronic
Threshold dose	⊕	⊖
Severity	\propto dose (↑Dose → Erythema, necrosis, ulceration of skin)	Not dose related
Risk-dose relationship	Non-linear : 	Linear : 
Examples	<ul style="list-style-type: none"> • Acute radiation syndromes • Cataract • Skin effects • Sterility 	<ul style="list-style-type: none"> • Carcinogenesis • Mutations • Chromosomal aberrations

Radiation Exposure

00:29:41

----- Active space -----

Radiation Exposure Values :

	Types	Scans	Exposure values (mSv)
Danger	CT/PET/radionuclide studies (Highest exposure)	PET scan	25
		CT abdomen	10
		CT thorax	8
		Bone scan	-
		CT head/brain	3.5
Warning	Diagnostic procedures (multiple exposure)	Barium enema	7
		Intravenous urogram	-
		Barium meal follow through	-
		Barium meal	-
		Barium swallow	-
		micturating cystourethrography (MCU)	1.2
Safe	Spot radiographs (Exposure once/ twice)	Lumbar spine	1.0
		Abdomen X-ray	-
		Hip X-ray	-
		Skull X-ray	-
		Chest X-ray	0.02
		Limb/joint X-ray	0.01 (least)

ICRP/ICRU Radiation Exposure Guidelines :

- ICRP : International Commission on Radiological Protection.
- ICRU : International Commission on Radiation Units.

		Public exposure	Occupational exposure
Effective dose		1 mSv/year	<ul style="list-style-type: none"> • 20 mSv/yr averaged over 5 years OR • 50 mSv in any one year provided that total dose over 5 years is <100 mSv
Annual equivalent dose	Lens of eye	15 mSv	150 mSv
	Skin	50 mSv	500 mSv
Pregnant females		< 1 mSv	

AERB Guidelines (India Specific) :

- AERB : Atomic Energy Regulatory Board.
- Similar to international guidelines except :
 effective dose in occupational exposure : 30mSv in any 1 year
 (< 100 mSv in 5 years).

----- Active space -----

Radiation Units, Exposure Factors and TLD Badge

00:38:05

Radiation Units :

	Conventional unit	S.I. unit
Radiation exposure	Roentgen	Coulomb/kg (Charge/weight)
Radiation absorbed	Radiation absorbed dose (RAD)	Gray (Gy)
Absorbed dose equivalent	Radiation equivalent in man (REM)	Sievert (Sv)
Radioactivity	Curie	Becquerel

X-Ray Exposure Factors :

	Tube potential	Tube current
AKA	Kilovoltage peak (kvp)	milli-ampere second (mAs)
Determines	<ul style="list-style-type: none"> \propto Penetration $\propto \frac{1}{\text{Image contrast}}$ 	\propto Image contrast

Thermoluminescent Dosimeter (TLD) Badge ☢ :

Use : monitors radiation exposure (Range : 0.01 mGy - 10 Gy).

Composition : Phosphor crystals (Lithium fluoride, lithium borate, beryllium oxide).

Assessment : Every 3 months at AERB/BARC (Bhabha atomic research centre)/
Renentech labs.

Mechanism :

Radiation exposure \rightarrow Absorbed by crystals \rightarrow Electron elevated to high energy state

Trapped in high energy state
(electron energy)

Heating of badge (In laboratory)

Releases trapped energy as visible light.



TLD badge