



Theory + MCQ's For Radiology Technicians & Imaging Technology

Useful for all Radiographer Competitive Exams

Topic Wise
Notes
for Revision

Covering
5500+
MCQ's with Rationales

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Topic wise
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Radiology Technicians & Imaging Technology Book

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First Edition : July, 2024

Second Edition : December, 2024

Third Edition : July, 2026

Editor : Testpaperlive Publication

Price : ₹1475/-

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PREFACE

This book is designed to help aspiring Radiology Technicians. It is specifically prepared for students pursuing careers in Radiology and Imaging Technology who aim to succeed in various Radiology Technician entrance exams. We created this book based on our own experiences as students, recognizing the need for a comprehensive resource to help future Radiology Technicians gain a strong understanding of Radiography.

This book includes multiple-choice questions (MCQs) on the following topics:

- ☐ Anatomy
- ☐ Physiology and Pathology
- ☐ Dark Room Procedures
- ☐ General Radiography (Radiography-I)
- ☐ Radiological Physics
- ☐ Recent Advances
- ☐ Special Radiography (Radiography-II)
- ☐ Basic Principles of Radiotherapy
- ☐ Radiation Protection
- ☐ Hospital Management and Patient Care

These MCQs are designed to provide authentic knowledge and practical understanding for future Radiology Technicians.

We are grateful to our students for their encouragement in presenting this book. We welcome any suggestions to further improve this book. We are confident that our efforts will benefit our aspiring Radiology Technicians.

— Testpaperlive Publication

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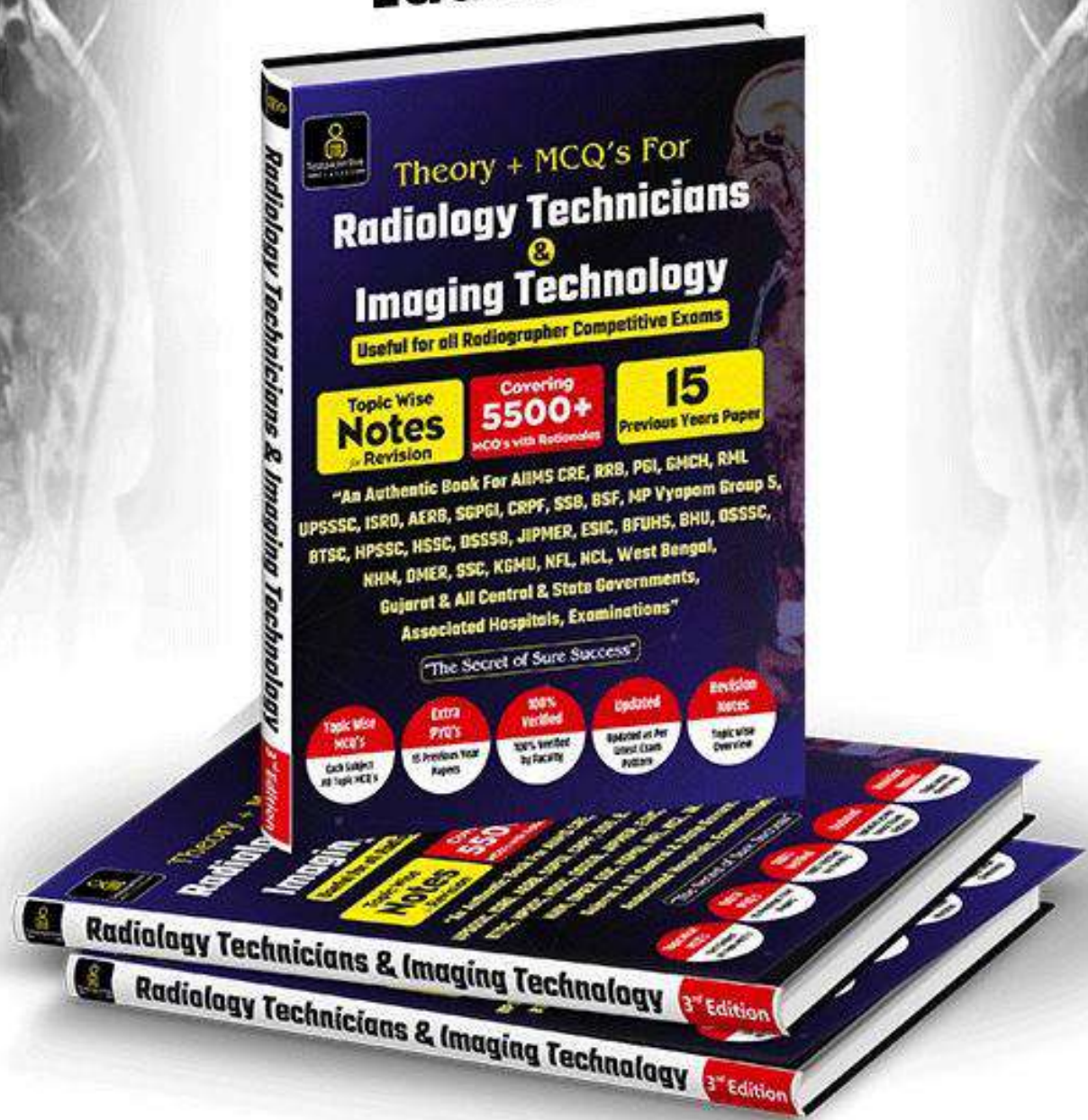
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Launched...



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- Revision Notes**
Topic Wise Overview

Radiology Technicians & Imaging Technology

3rd Edition

Radiology Technicians & Imaging Technology

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Paper-7

AIIMS

(Radiographer)

1. Which ear structure helps maintain balance and spatial orientation?
 - (a) Cochlea
 - (b) Vestibular system
 - (c) Tympanic membrane
 - (d) Eardrum
2. Which cranial nerve is responsible for controlling eye movements?
 - (a) Vestibulocochlear nerve
 - (b) Oculomotor nerve
 - (c) Olfactory nerve
 - (d) Optic nerve
3. What is the purpose of the acronym PET in brain studies? (KSSSCI 2023)
 - (a) Parathyroid Examination Technique
 - (b) Positron Emission Tomography
 - (c) Pituitary Endocrine Test
 - (d) Primary Eye Tracking
4. What does mRNA stand for in cellular processes?
 - (a) Messenger Ribonucleic Acid
 - (b) Microscopic Ribonucleic Assembly
 - (c) Mitochondrial Ribonucleic Assembly
 - (d) Methylated Ribose Acid
5. Which hormone, produced by the adrenal glands, is primarily responsible for regulating the body's response to stress?
 - (a) Thyroxine
 - (b) Cortisol
 - (c) Insulin
 - (d) Melatonin
6. Which disorder is characterized by the progressive degeneration of nerve cells in the brain and spinal cord?
 - (a) Parkinson's disease
 - (b) Amyotrophic lateral sclerosis (ALS)
 - (c) Alzheimer's disease
 - (d) Multiple sclerosis
7. Which part of the ear amplifies sound vibrations before they reach the inner ear?
 - (a) Cochlea
 - (b) Eardrum
 - (c) Ear ossicles
 - (d) Auditory canal
8. What is the purpose of the tear glands in the eye?
 - (a) To produce mucus
 - (b) To keep the eye moist
 - (c) To help with taste
 - (d) To close the eye
9. Which muscle forms the posterior border of the armpit?
 - (a) Sternocostal muscle
 - (b) Latissimus dorsi
 - (c) Pectoralis major
 - (d) Soleus muscle
10. What is the role of the hypothalamus in the brain?
 - (a) Vision processing
 - (b) Regulation of body temperature and hunger
 - (c) Auditory processing
 - (d) Long-term memory storage

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
(b)	(b)	(b)	(a)	(b)	(b)	(c)	(b)	(b)	(b)

Paper-12

RRB (Radiographer)

1. Which of the following is a biodegradable material?
 (a) Plastic bag (b) Wood
 (c) Aluminium (d) Nuclear waste
2. Mass X Velocity (mv) is
 (a) Momentum (b) Force
 (c) Potential energy (d) Kinetic energy
3. The Pong dam is built on which of the following rivers?
 (a) Ravi
 (b) Beas
 (c) Sutlej
 (d) Chenab
4. Regarding ultrasound transducers
 (a) B mode is not possible with phased array probes
 (b) High frequency probes have thin crystals
 (c) The piezo-electric property is a very important property of ultrasound
 (d) 4D probes are not capable of real-time imaging
5. Rotation of the forearm so the palm faces down is called
 (a) Hyperflexion (b) Pronation
 (c) Inversion (d) Supination
6. What is the SI unit of electric field strength?
 (a) Joules / Coulomb
 (b) Henry / Coulomb
 (c) Coulomb / Newton
 (d) Newton / Coulomb
7. Buffers
 (a) Reduces the developing solution oxidation
 (b) Are not used in the developing solution
 (c) Maintain the pH of a solution within close limits
 (d) Are restrainers
8. Superconducting magnets
 (a) Do not use cryogens
 (b) Produce images with less chemical shift artefact
 (c) Provide MR images with high SNR
 (d) Use very high temperature environment to produce strong magnetic field
9. Plane which is at right angles to the median sagittal plane and divides the head / body into anterior and posterior parts is:
 (a) Coronal plane
 (b) Axial plane
 (c) Oblique sagittal plane
 (d) Oblique coronal plane
10. A densitometer is a device that measures
 (a) Optical densities
 (b) Film latitude
 (c) Speed of a film
 (d) Film gamma
11. Tissue compression is used in
 (a) Breast MRI
 (b) Chest X-ray
 (c) X-ray Mammography
 (d) Skull X-ray

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
(b)	(a)	(b)	(c)	(b)	(d)	(c)	(c)	(a)	(a)	(c)

Anatomy and Physiology

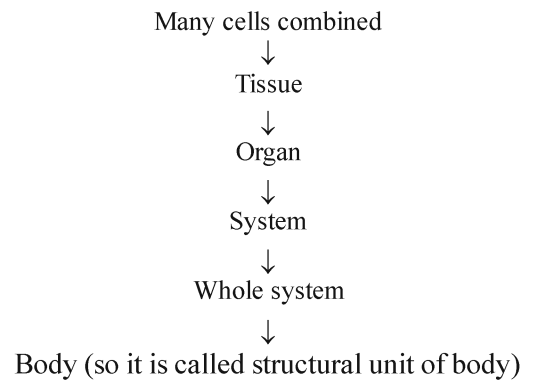
Anatomy : Structural study of human body parts and relationship between other body parts is called anatomy.

Physiology : Functional study of human body part is called physiology.

CELL

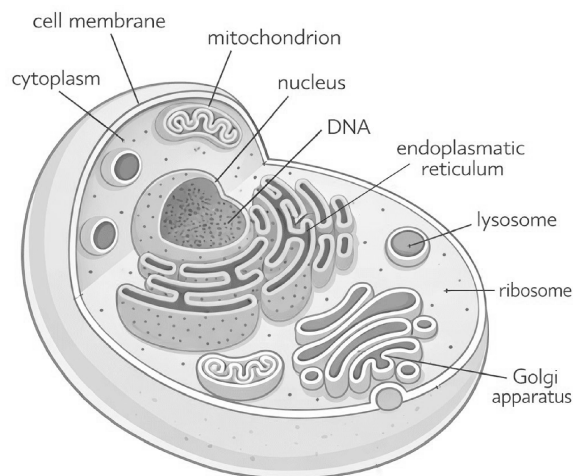
Introduction:-

- Cells is a function & structural unit of body.
- Cells are the microscopic fundamental unit of all living things.
- Some organism are made up of just one cell but animals (human) are multi cellular (made up of many cells)
- Cells are the smallest living unit within our body but play a big role in making our body and play functions properly.

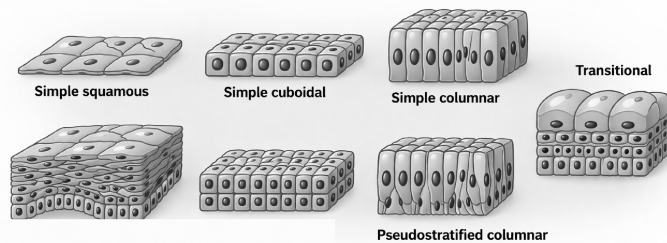


Plasma membrane- A cell consists of plasma membrane enclosing number of organelles suspended in watery fluid called cytosol (cytoplasm).

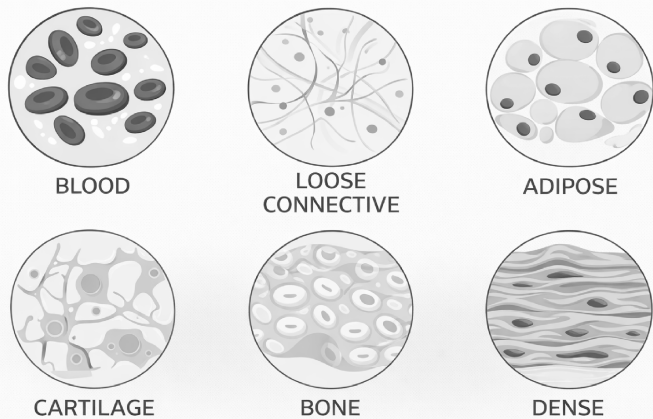
Organelles present in cells are following:-



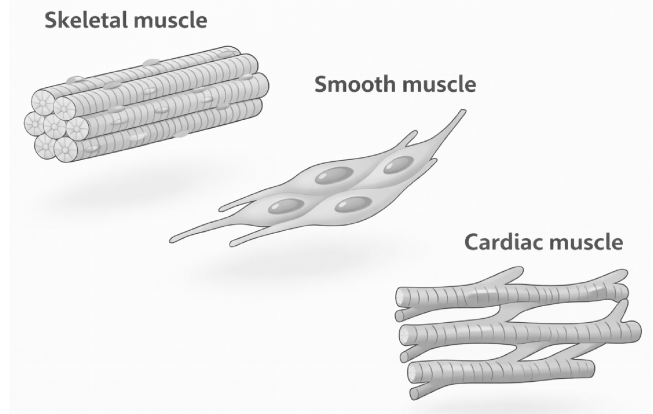
Types of Epithelium



TYPES OF CONNECTIVE TISSUE



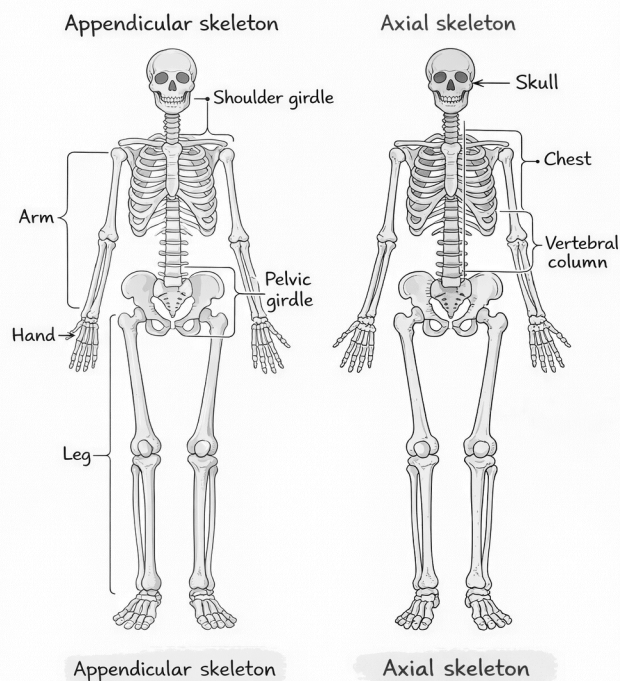
TYPES OF MUSCULAR TISSUE



SKELETAL SYSTEM

Skeletal is the bony frame work of the body.

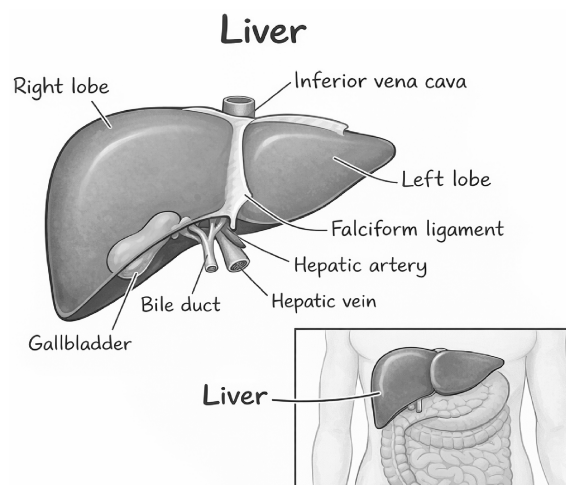
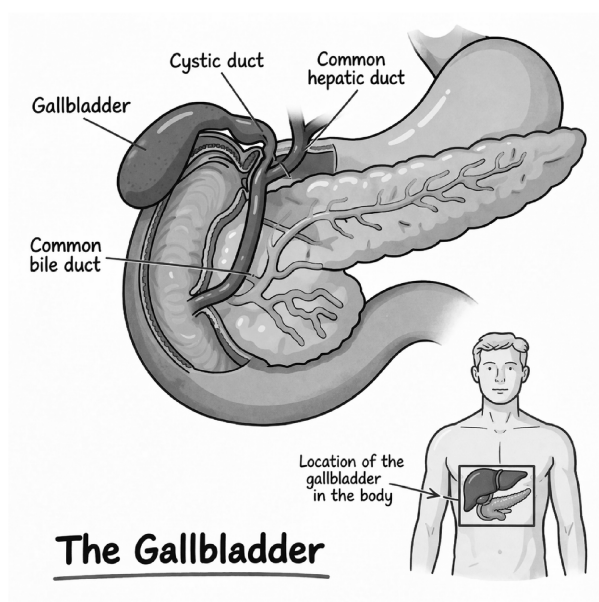
DIVISIONS OF THE SKELETAL SYSTEM



Accessory Digestive Organs

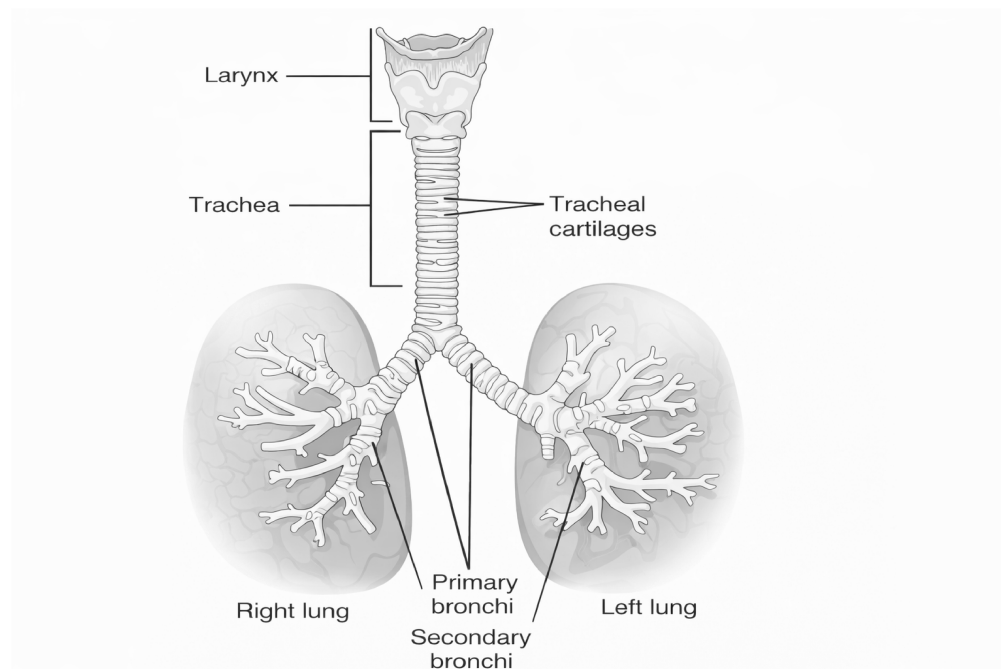
These organs produce secretions that travel through ducts into the tract.

Organ	Primary Secretion	Physiology (Function)
Salivary Glands	Salivary Amylase	Starts breaking down Starch into Maltose.
Liver	Bile	Emulsification of Fats (breaks big fats into small drops).
Gallbladder	Stored/Concentrated Bile.	Releases bile into the Duodenum when fat is present.
Pancreas	Pancreatic Juice	Contains Lipase (fats), Amylase (carbs), & Trypsin (proteins).



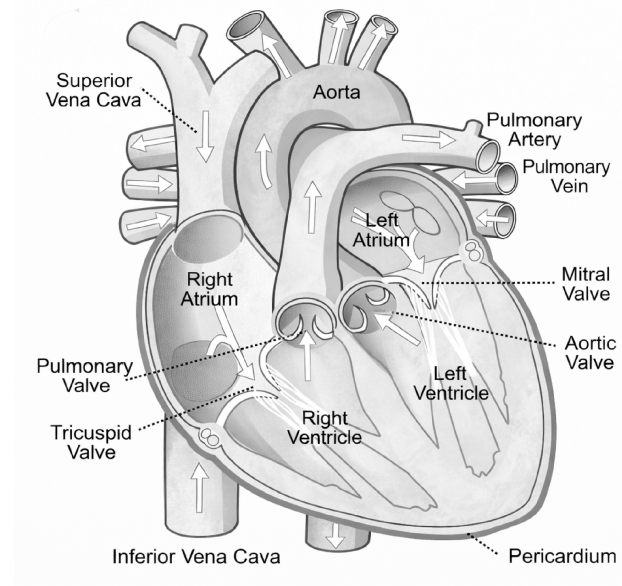
RESPIRATORY SYSTEM

The **respiratory system** is the network of organs and tissues in the body responsible for breathing, which involves taking in oxygen (O_2) and releasing carbon dioxide (CO_2)



CARDIOVASCULAR SYSTEM

The **Circulatory System** (or Cardiovascular System) is a closed network of organs and vessels responsible for transporting oxygen, nutrients, hormones, and waste products throughout the body



Component	Structure	Function
Heart	A four-chambered muscular pump located in the mediastinum.	Generates the pressure needed to propel blood through the body.
Blood Vessels	A 1,00,000 km network of Arteries, Veins, and Capillaries.	Acts as "pipes" or channels for blood distribution.
Blood	Fluid connective tissue (Plasma + Cells).	The medium that carries O ₂ , CO ₂ , nutrients, and waste.

Classification of Blood Vessels

Vessels are classified by their wall structure (three layers: *tunica intima*, *media*, and *externa*) and the direction of flow.

Vessel Type	Structural Feature	Physiology (Direction/Pressure)
Arteries	Thick, elastic walls; no valves (except at heart exit).	Carry blood Away from heart; High pressure.
Veins	Thin walls; contain Valves to prevent backflow.	Carry blood Toward heart; Low pressure.
Capillaries	Microscopic; walls are only one cell thick.	Site of gas and nutrient exchange.

The Human Heart: Chambers & Valves

The heart functions as a dual pump, separating oxygenated and deoxygenated blood.

- **Chambers:**
Atria (Right/Left): Upper receiving chambers; thin-walled.
Ventricles (Right/Left): Lower pumping chambers; thick-walled (especially the Left Ventricle).
- **Valves (Unidirectional Flow):**
Atrioventricular (AV): **Tricuspid** (Right) and **Bicuspid/Mitral** (Left).
Semilunar: **Pulmonary** and **Aortic** valves at the exits.
- **Layers:** **Epicardium** (outer), **Myocardium** (middle muscular), and **Endocardium** (inner lining).

MCQ's with Explanation

Cell

1. What is the primary role of the extracellular matrix (ECM) in tissues?

- (a) To provide structural support to cells
- (b) To facilitate the synthesis of ATP
- (c) To replicate DNA
- (d) To transport lipids across the cell membrane

Ans. (a) To provide structural support to cells

Exp. The extracellular matrix provides structural and biochemical support to the surrounding cells. It is essential for tissue integrity and plays a crucial role in cell communication, differentiation, and proliferation.

2. Which component is NOT typically found in the extracellular matrix?

- (a) Collagen
- (b) Elastin
- (c) Ribosomes
- (d) Fibronectin

Ans. (c) Ribosomes

Exp. Ribosomes are not a part of the extracellular matrix; they are cellular structures involved in protein synthesis found within the cell. The ECM mainly consists of fibrous proteins like collagen, elastin, and fibronectin.

3. Which function is primarily facilitated by the fluids in the extracellular space?

- (a) Energy storage
- (b) Transport of nutrients and waste products
- (c) DNA transcription
- (d) Protein folding

Ans. (b) Transport of nutrients and waste products

Exp. The extracellular space contains interstitial fluid that helps in the transport of nutrients, oxygen, and waste products between cells and blood vessels, facilitating efficient exchange and maintaining homeostasis.

4. What feature of the plasma membrane allows it to selectively regulate the entry and exit of substances?

- (a) Selective permeability
- (b) Fluid mosaic model
- (c) Integral proteins
- (d) Phospholipid bilayer

Ans. (a) Selective permeability

Exp. The plasma membrane is selectively permeable, allowing it to regulate what enters and exits the cell efficiently. This property is crucial for maintaining cellular homeostasis and responding to environmental changes.

5. What role do membrane proteins play in the function of the plasma membrane?

- (a) Energy storage
- (b) Acting as enzymes
- (c) Serving only structural purposes
- (d) DNA replication

Ans. (b) Acting as enzymes

Exp. Membrane proteins play various roles including acting as enzymes to speed up metabolic processes, as receptors for signaling, and as transporters to help substances move across the membrane.

6. Which molecule in the plasma membrane is primarily responsible for the membrane's fluidity?

- (a) Glycolipids
- (b) Cholesterol
- (c) Proteins
- (d) Nucleic acids

Ans. (b) Cholesterol

Exp. Cholesterol plays a critical role in maintaining the fluidity of the plasma membrane. It fits between the phospholipids and prevents them from packing too closely together, thus enhancing membrane fluidity.

7. What is the primary function of the cytoplasm in a cell?

- (a) Storage of genetic material
- (b) Site of cellular respiration
- (c) Medium for metabolic processes
- (d) Protection of the cell nucleus

Ans. (c) Medium for metabolic processes

Exp. The cytoplasm is the jelly-like fluid that fills a cell and is the medium in which the organelles are suspended. It plays a critical role as the site for most cellular processes and metabolic activities.

73. What is a common risk factor for developing a hernia?

- (a) Low body weight
- (b) Excessive physical exertion
- (c) High fiber diet
- (d) Adequate hydration

Ans. (b) Excessive physical exertion

Exp. Excessive physical exertion can increase the risk of developing a hernia, particularly if it involves heavy lifting. The increased pressure can cause an organ or tissue to protrude through a weak spot in the muscle or tissue.

74. What is appendicitis?

- (a) Inflammation of the appendix
- (b) Inflammation of the gallbladder
- (c) Inflammation of the liver
- (d) Infection of the pancreas

Ans. (a) Inflammation of the appendix

Exp. Appendicitis is an inflammation of the appendix, a small, finger-shaped pouch that projects from your colon on the lower right side of your abdomen. It can become inflamed and filled with pus, requiring urgent medical treatment.

75. What is the most common symptom of appendicitis?

- (a) Severe upper abdominal pain
- (b) Painful urination
- (c) Pain in the lower right abdomen
- (d) Severe chest pains

Ans. (c) Pain in the lower right abdomen

Exp. The most common and distinctive symptom of appendicitis is a sudden, sharp pain that begins on the right side of the lower abdomen. This pain may initially start near the belly button and then move. It can become significantly more painful with movement, coughing, or sneezing.

76. What is the standard treatment for appendicitis?

- (a) Antibiotics only
- (b) Dietary changes
- (c) Appendectomy
- (d) Pain management only

Ans. (c) Appendectomy

Exp. The standard treatment for appendicitis is surgical removal of the appendix, known as an appendectomy. This procedure can be performed laparoscopically and is typically urgent to prevent rupture, which can lead to more serious complications.

Excretory System

1. What is the primary function of the excretory system?

- (a) To digest food and absorb nutrients
- (b) To circulate blood throughout the body
- (c) To eliminate waste products of metabolism from the body
- (d) To produce hormones

Ans. (c) To eliminate waste products of metabolism from the body

Exp. The excretory system is responsible for removing waste products from the body, which are produced as a result of metabolic processes. This is essential to maintain homeostasis and prevent damage to the body.

2. Which organs are included in the human excretory system?

- (a) Heart, liver, kidneys
- (b) Lungs, skin, liver
- (c) Kidneys, ureters, bladder, urethra
- (d) Stomach, intestines, colon

Ans. (c) Kidneys, ureters, bladder, urethra

Exp. The excretory system primarily includes the kidneys, ureters, bladder, and urethra. These organs work together to filter blood, create urine, and expel urine from the body.

3. How does the excretory system help regulate blood pressure?

- (a) By controlling the volume of blood
- (b) By producing digestive enzymes
- (c) By secreting insulin
- (d) By absorbing nutrients in the intestines

Ans. (a) By controlling the volume of blood

Exp. The excretory system, particularly through the kidneys, helps regulate blood pressure by controlling the volume of blood (through adjusting fluid balance) and the amount of salts in the blood, which in turn affects the blood pressure.

4. What is the primary role of the kidneys in the excretory system?

- (a) To produce bile
- (b) To filter blood and produce urine
- (c) To digest proteins
- (d) To circulate blood

Exp. Osteomalacia is typically treated by addressing the underlying deficiencies: increasing vitamin D and calcium intake through diet and supplements, as well as increasing exposure to sunlight to boost vitamin D synthesis in the skin.

Muscular System

1. What is the primary function of the muscular system?

- (a) To circulate blood throughout the body
- (b) To protect internal organs and produce blood cells
- (c) To create movement through contraction and relaxation of muscles
- (d) To filter toxins from the blood

Ans. (c) To create movement through contraction and relaxation of muscles

Exp. The primary function of the muscular system is to create movement. Muscles contract and relax to move the body, including not just locomotion but also movement within internal organs, such as the heart and digestive system.

2. How do muscles contribute to heat production in the body?

- (a) By absorbing heat from the environment
- (b) By releasing enzymes that increase body temperature
- (c) Through the metabolic processes involved in muscle contraction
- (d) By insulating the body with fat layers

Ans. (c) Through the metabolic processes involved in muscle contraction

Exp. Muscle contractions produce heat as a byproduct of the energy used in the metabolic processes that fuel muscle activity. This is a significant source of body heat and is crucial for maintaining body temperature.

3. What are the three types of muscle tissue found in the human body?

- (a) Cardiac, smooth, and skeletal
- (b) Bone, smooth, and connective
- (c) Voluntary, involuntary, and cardiac
- (d) Striated, non-striated, and cardiac

Ans. (a) Cardiac, smooth, and skeletal

Exp. The human body contains three types of muscle tissue: skeletal muscle, which is responsible for body movements; smooth muscle, found in the walls of internal organs and responsible for involuntary movements; and cardiac muscle, found only in the heart, also responsible for involuntary movements but with structural differences from smooth muscle.

4. What characterizes skeletal muscle?

- (a) It is controlled involuntarily and found in the heart
- (b) It is composed of spindle-shaped cells and controls organ contractions
- (c) It is under voluntary control and attached to bones
- (d) It forms the lining of the digestive tract

Ans. (c) It is under voluntary control and attached to bones

Exp. Skeletal muscles are under voluntary control, meaning they can be consciously controlled. They are attached to bones by tendons and are responsible for movements of the body in relation to the environment.

5. What is a unique feature of skeletal muscle fibers?

- (a) They are multinucleated
- (b) They lack nuclei
- (c) They contain only one type of protein fiber
- (d) They regenerate quickly after injury

Ans. (a) They are multinucleated

Exp. Skeletal muscle fibers are unique in that they are multinucleated, meaning they contain more than one nucleus per cell. This feature supports their large size and the extensive protein synthesis required for muscle contraction.

6. What is the basic unit of a myofibril within skeletal muscle fibers?

- (a) The mitochondrion
- (b) The sarcomere
- (c) The lipid droplet
- (d) The glycogen granule

Ans. (b) The sarcomere

Exp. The sarcomere is the basic contractile unit of muscle fiber in a myofibril. It is defined by the area between two Z lines (or Z discs), and it is where muscle contraction occurs through the interaction of actin and myosin filaments.

7. What is the primary role of the sarcomere in muscle contraction?

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Radiation Physics

DISCOVERY OF X-RAYS

In 1895, German physicist **Wilhelm Conrad Roentgen** discovered X-rays while experimenting with cathode ray tubes in a dark lab. Discovered while experimenting with **Crookes tubes**.

He noticed a **barium platinocyanide** screen glowing despite no direct exposure, leading him to conclude a new invisible radiation existed.

Because this radiation was unknown, he named it “X-rays,” using “X” to represent an unknown quantity.

Roentgen found these rays could penetrate materials to image human bones, producing the first radiograph of his wife’s hand and ring.

This discovery revolutionized medicine by allowing internal observation without surgery, earning Roentgen the first Nobel Prize in Physics in 1901.

Properties of X-Rays

1. X-rays have strong penetrating ability.
2. X-rays can ionize atoms and molecules by removing electrons from them.
3. X-rays can blacken photographic film. This property forms the basis of **radiographic imaging**.
4. Certain materials emit visible light when exposed to X-rays. This phenomenon is known as fluorescence and is used in **fluoroscopy and intensifying screens**.
5. X-rays cannot be detected by human senses. They require special detectors such as film, digital detectors, or scintillation devices.
6. X-rays propagate in straight lines and obey the inverse square law. They travel in straight lines at the speed of light, which is $3 \times 10^8 \text{ m/s}$
7. Exposure to X-rays may cause biological damage such as tissue injury or genetic mutations.
8. X-rays are a form of **electromagnetic radiation** similar to visible light but with much shorter wavelength and higher energy

Production of X-Rays

X-rays are produced when **high-speed electrons interact with a target material** inside an X-ray tube. The kinetic energy of electrons is converted into electromagnetic radiation.

The process occurs inside a **vacuum tube**, where electrons emitted from the cathode travel toward the anode due to high voltage applied across the tube.

The main steps of X-ray production are:

1. Electrons are produced at the **cathode filament** through thermionic emission.
2. A high potential difference (kVp) accelerates these electrons toward the anode.

3. When electrons strike the target (usually tungsten), their kinetic energy is converted into:

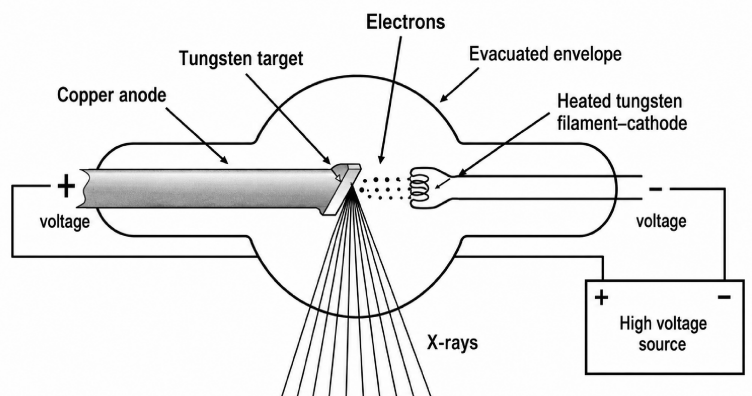
- **X-ray photons**
- **Heat energy**

Approximately **99% of electron energy becomes heat**, while only about **1% is converted into X-rays**.

This interaction produces two types of radiation:

1. **Bremsstrahlung radiation: braking radiation**
2. **Characteristic radiation**

These two processes form the **X-ray spectrum**.



Bremsstrahlung vs. Characteristic Radiation

Feature	Bremsstrahlung (Braking)	Characteristic Radiation
Origin	Electron slows down near the nucleus.	Electron knocks out an inner-shell electron.
Mechanism	Energy is lost as the electron "brakes" or swerves.	Energy is released when an outer electron fills the "hole."
Energy Level	Continuous spectrum (range of many energies).	Discrete energy (fixed, specific peaks).
Occurrence	Makes up 80–90% of the X-ray beam.	Makes up 10–20% of the X-ray beam.
Requirement	Occurs at any voltage setting.	Only occurs if voltage exceeds the "binding energy."
Target Material	Independent of the target type for its shape.	Depends entirely on the target material (e.g., Tungsten).

X-Ray Tube Design

Component	Material	Primary Function
Cathode (-)	Tungsten Filament	Source of electrons; uses thermionic emission to create an electron cloud.
Anode (+)	Tungsten Target	The "stop" for electrons; converts kinetic energy into X-rays (1%) and Heat (99%).
Glass/Metal Envelope	Pyrex or Metal	Creates a vacuum so electrons can travel without hitting air molecules.
Tube Housing	Lead-lined Steel	Prevents leakage radiation and protects the tube from physical damage.
Focusing Cup	Nickel or Molybdenum	Negatively charged cup that pushes the electron cloud into a narrow beam.
Insulating Oil	Dielectric Oil	Surrounds the tube to provide electrical insulation and help cool it down.
Window	Beryllium OR Thin Glass	A thin area where the useful X-ray beam exits the tube with minimal absorption.

MCQ's with Explanation

X-Ray Discovery And X-Ray Properties, Production Of X-Ray, X Ray Tube, Thermoionic Emission Principle And Anode Heel Effect, X-Ray Tube Design, Focal Spot Area And Line Focus Principle

1. Who discovered X-rays?

- (a) Isaac Newton
- (b) Wilhelm Conrad Roentgen
- (c) Marie Curie
- (d) Albert Einstein

Ans. (b) Wilhelm Conrad Roentgen

Exp. Wilhelm Conrad Roentgen discovered X-rays in 1895.

2. What is the primary mechanism for X-ray production?

- (a) Photoelectric effect
- (b) Bremsstrahlung
- (c) Compton scattering
- (d) Pair production

Ans. (b) Bremsstrahlung

Exp. Bremsstrahlung is the primary mechanism for X-ray production in an .

3. What is the function of the cathode in an X-ray tube ?

- (a) To accelerate electrons
- (b) To produce electrons
- (c) To focus electrons
- (d) To decelerate electrons

Ans. (b) To produce electrons

Exp. The cathode's primary function is to produce electrons through thermionic emission.

4. What is the principle behind thermionic emission?

- (a) Photoelectric effect
- (b) Heating of the cathode
- (c) Magnetic field
- (d) Electric field

Ans. (b) Heating of the cathode

Exp. Thermionic emission occurs when the cathode is heated, causing it to emit electrons.

5. What does the result in heel effect ?

- (a) Uniform X-ray intensity
- (b) Increased X-ray intensity at the cathode end
- (c) Increased X-ray intensity at the anode end
- (d) Decreased X-ray intensity at both ends

Ans. (b) Increased X-ray intensity at the cathode end

Exp. The results in increased X-ray intensity at the cathode end due to the geometry of the anode.

6. What is the advantage of a smaller focal spot in an radiography ?

- (a) Increased tube life
- (b) Increased spatial resolution
- (c) Increased penetration
- (d) Reduced patient dose

Ans. (b) Increased spatial resolution

Exp. A smaller focal spot leads to increased spatial resolution, providing clearer images.

7. What is the aim of angled anode?

- (a) Increase tube life
- (b) Reduce patient dose
- (c) Improve spatial resolution
- (d) Balance spatial resolution and heat capacity

Ans. (d) Balance spatial resolution and heat capacity

Exp. The aims to balance spatial resolution and heat capacity by using an angled anode.

8. What is the unit of dose equivalent?

- (a) Gray
- (b) Sievert
- (c) Becquerel
- (d) Curie

Ans. (b) Sievert

Exp. The unit of dose equivalent is Sievert, which takes into account the biological effect of radiation.

9. What is the purpose of a collimator in an radiography ?

- (a) To focus electrons
- (b) To limit the X-ray beam size
- (c) To accelerate electrons
- (d) To produce electrons

Ans. (b) To limit the X-ray beam size

Exp. A collimator is used to limit the X-ray beam size, reducing patient exposure.

Temperature & Heat

1. Which of the following temperature scales does not have negative values?

- (a) Celsius (b) Fahrenheit
(c) Kelvin (d) Reaumur

Ans. (c) Kelvin

Exp. The Kelvin scale starts at absolute zero (0K), the theoretical lowest possible temperature where molecular motion ceases

2. The transfer of heat by the bulk movement of molecules in a fluid (liquid or gas) is called:

- (a) Conduction (b) Convection
(c) Radiation (d) Induction

Ans. (b) Convection

Exp. Convection occurs when heated particles actually move from one place to another, common in boiling water or sea breezes.

3. The heat energy required to change the state of a substance without a change in temperature is:

- (a) Specific heat (b) Latent heat
(c) Molar heat (d) Sensible heat

Ans. (b) Latent heat

Exp. Latent heat is the “hidden” energy used to break molecular bonds during phase changes, like melting ice into water.

4. The SI unit of heat is:

- (a) Calorie (b) Joule
(c) Watt (d) Kelvin

Ans. (b) Joule

Exp. While calories are often used for food, the official International System of Units (SI) unit for all forms of energy, including heat, is the Joule.

5. Which of the following is the best absorber and emitter of thermal radiation?

- (a) Shiny silver surface
(b) White surface
(c) Dull black surface
(d) Transparent glass

Ans. (c) Dull black surface

Exp. Dark, matte surfaces are highly efficient at both absorbing radiant heat and emitting it.

6. Which of the following substances has the highest specific heat capacity?

- (a) Copper (b) Iron
(c) Water (d) Mercury

Ans. (c) Water

Exp. Water requires more energy (4,184 J/kg·K) to raise its temperature than almost any other common substance, which is why it's a great coolant.

7. When a metal ring is heated, what happens to the size of the hole in the middle?

- (a) It decreases (b) It increases
(c) It stays the same (d) It becomes oval

Ans. (b) It increases

Exp. Thermal expansion acts like a photographic enlargement; every dimension of the object, including the hole, expands outward.

8. The “Zeroth Law of Thermodynamics” helps define the concept of:

- (a) Internal Energy
(b) Entropy
(c) Temperature
(d) Work

Ans. (c) Temperature

Exp. It states that if two systems are each in thermal equilibrium with a third system, they are in equilibrium with each other, establishing temperature as a measurable property.

9. Which mode of heat transfer can happen in a complete vacuum?

- (a) Conduction (b) Convection
(c) Radiation (d) All of the above

Ans. (c) Radiation

Exp. Radiation uses electromagnetic waves and does not require a physical medium (like air or metal) to travel.

10. What is the value of Absolute Zero in the Fahrenheit scale?

- (a) -273.15°F (b) 0°F
(c) -459.67°F (d) -32°F

Ans. (c) -459.67°F

16. Which logic gate produces an “ON” output only when BOTH inputs are “ON”?

- (a) OR Gate
- (b) NOT Gate
- (c) AND Gate
- (d) NAND Gate

Ans. (c) AND Gate

Exp. An AND gate is a digital circuit that requires a high signal (1) on all of its inputs to produce a high output. If even one input is “OFF,” the resulting output will remain “OFF.”

17. In a Triode, if the Control Grid is made highly negative, what happens to the plate (anode) current?

- (a) It increases significantly.
- (b) It stays the same.
- (c) It is “cut off” or stopped.
- (d) It reverses direction.

Ans. (c) It is “cut off” or stopped.

Exp. A negative grid repels electrons back toward the cathode, preventing them from reaching the anode. This is how a triode acts as a switch.

18. Which digital component is responsible for converting the continuous analog signal from an X-ray detector into discrete numerical data?

- (a) CPU
- (b) DAC (Digital-to-Analog Converter)
- (c) ADC (Analog-to-Digital Converter)
- (d) Logic Gate

Ans. (c) ADC (Analog-to-Digital Converter)

Exp. The ADC is the “bridge” that turns electrical voltages into the 0s and 1s used by computers.

19. In digital logic, a NAND gate is often called a “Universal Gate” because:

- (a) It can only be used in space.
- (b) Any other logic gate (AND, OR, NOT) can be created using only NAND gates.
- (c) It works with both AC and DC current.
- (d) It is made of both vacuum tubes and transistors.

Ans. (b) Any other logic gate (AND, OR, NOT) can be created using only NAND gates.

Exp. The NAND gate is considered “universal” because complex combinations of them can replicate the function of any other fundamental logic gate. This versatility makes them the primary building block for modern computer processors.

20. Which of the following has the highest electrical conductivity?

- (a) Silicon
- (b) Glass
- (c) Silver
- (d) Air

Ans. (c) Silver

Exp. While copper is used for wiring due to cost, silver is actually the most conductive element.

Mammography

1. What is the typical range of kVp used in mammography?

- (a) 18-26 kVp
- (b) 22-30 kVp
- (c) 25-35 kVp
- (d) 30-40 kVp

Ans. (b) 22-30 kVp

Exp. The typical range of kVp used in mammography is 22-30 kVp to ensure optimal contrast and image quality.

2. Which of the following is NOT a common anode material in mammography?

- (a) Molybdenum
- (b) Tungsten
- (c) Rhodium
- (d) Aluminum

Ans. (d) Aluminum

Exp. Aluminum is not commonly used as an anode material in mammography. Molybdenum, tungsten, and rhodium are more common.

3. What is the primary purpose of using a grid in mammography?

- (a) To increase contrast
- (b) To reduce patient dose
- (c) To improve spatial resolution
- (d) To increase brightness

Ans. (a) To increase contrast

Exp. The primary purpose of using a grid in mammography is to increase contrast by reducing scatter radiation.

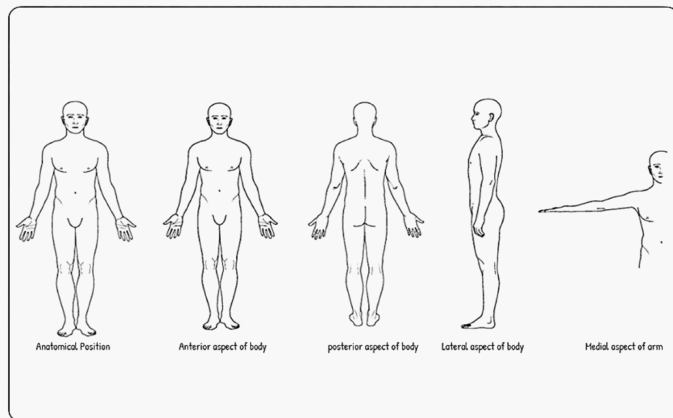
4. Which of the following is the most sensitive phase for detecting breast cancer?

Radiography 1st General

TERMINOLOGY IN RADIOGRAPHY

All the basic terminology descriptions below refer to the patient in the standard reference position, known as the anatomical position.

Directional terms:



Anterior (Ventral): Toward the **front**.

Posterior (Dorsal): Toward the **back**.

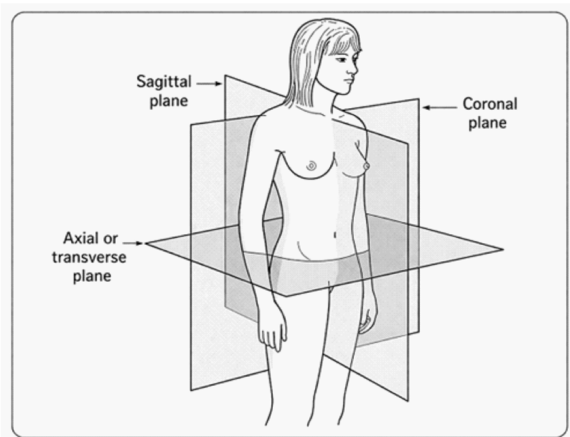
Medial: Toward the **midline** (inner).

Lateral: Away from the **midline** (outer).

PLANES OF BODY

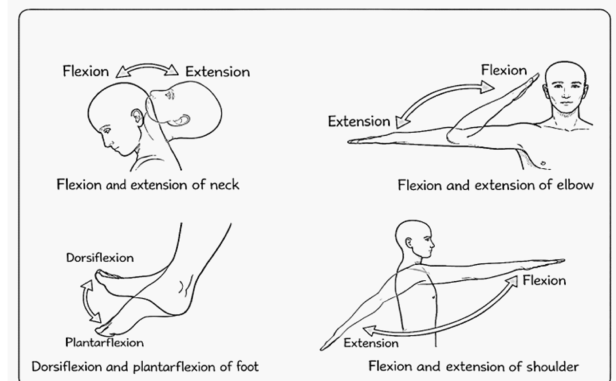
Body planes are imaginary flat surfaces that divide the body into sections.

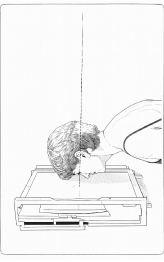
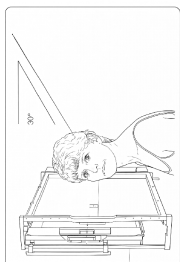
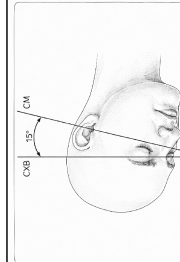
- **Sagittal:** Divides into **Left & Right**.
- **Midsagittal:** Equal halves.
- **Parasagittal:** Unequal halves.
- **Coronal (Frontal):** Divides into **Front & Back**.
- **Transverse (Axial):** Divides into **Top & Bottom**.



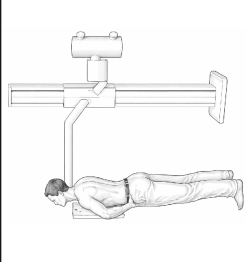
BODY ROTATION TERMS

- Internal rotation- turn toward midline
- External rotation- turn away from midline
- Flexion- bend joint
- Extension- straighten joint
- Abduction- move away from midline
- Adduction- move toward midline
- Pronation – palm down/ back
- Supination- palm up/ front
- Inversion- Turning the sole of the foot inward
- Eversion- Turning the sole of the foot outward



Mandible – PA	Patient prone or erect facing IR , forehead on IR, nose off slightly as needed; MSP perpendicular .	CR perpendicular to mandible , exiting at level of lips/mentum region. SID: 100 cm. 70–80 kVp, 16–25 mAs. Cassette size- 24*30 cm	Shows mandibular body and rami with reduced magnification compared with AP.	
Mandible – Axio Lateral Oblique	Patient erect or supine , head rotated toward side of interest depending on body/ramus/condyle being demonstrated.	CR angled 20–25° cephalad , centered to mandibular region of interest. SID: 100 cm. 70–80 kVp, 10–16 mAs. Cassette size- 18*24 or 24*30 cm	Shows body, ramus, or condylar process of mandible without superimposition. Good in fractures.	
TMJ – Lateral (Law Method)	Patient in lateral position , head rotated about 15° toward IR to place TMJ of interest close to detector. Open and closed mouth views usually taken.	CR 15° caudal , centered about 4 cm superior to EAM of upside. SID: 100 cm. 65–75 kVp, 8–12 mAs. Cassette size- 18*24 cm	Demonstrates TM joint space and mandibular condyle ; compares open and closed mouth function.	
Nasal Bone – Lateral	Patient erect or supine , side of nose against IR; head in true lateral.	CR perpendicular to nasal bones. SID: 100 cm. 55–65 kVp, 5–10 mAs. Cassette size- 18*24 cm	Best for nasal bone fractures , displacement, and profile of nasal bridge.	
Rhese View (Orbit)	Patient prone or erect facing IR , head rotated so AML perpendicular ; chin, cheek, and nose touch IR.	CR perpendicular , centered to downside orbit. SID: 100 cm. 65–75 kVp, 8–12 mAs. Cassette size- 18*24 cm	Demonstrates optic canal in the lower outer quadrant of orbit . Used for orbital/optic foramen evaluation.	

2. CHEST (THORAX)

VIEW / PROJECTION	POSITION (Patient Position)	CENTRAL RAY / EXPOSURE FACTOR	IMPORTANT USE / STRUCTURE SEEN	IMAGE
PA	Patient erect facing IR , chin elevated, hands on hips with shoulders rolled forward so scapulae move laterally. MSP perpendicular to IR.	CR perpendicular to T7 (inferior angle of scapula). SID: 180 cm. 110–125 kVp, 2–5 mAs. Cassette size- 35*43 cm	Standard chest view showing lungs, heart, mediastinum, ribs, costophrenic angles . Best for lung pathology detection.	

MCQ's with Explanation

Chest Radiography

1. What is the standard projection for a chest X-ray?

- (a) AP view (b) PA view
(c) Oblique view (d) Lateral view

Ans. (b) PA view

Exp. The standard projection for a chest X-ray is the posteroanterior (PA) view. It offers better anatomical detail and less magnification of the heart compared to the anteroposterior (AP) view.

2. Which pathology is identified by a “boot-shaped” heart in a chest X-ray?

- (a) Pleural effusion (b) Aortic aneurysm
(c) Pneumothorax (d) Tetralogy of Fallot

Ans. (d) Tetralogy of Fallot

Exp. A “boot-shaped” heart is characteristic of Tetralogy of Fallot, a congenital heart disease. This shape is due to right ventricular hypertrophy and overriding aorta.

3. What is the primary purpose of a Lordotic view?

- (a) To visualize the apices
(b) To visualize the diaphragm
(c) To visualize the heart
(d) To visualize the ribs

Ans. (a) To visualize the apices

Exp. The Lordotic view is primarily used to visualize the lung apices, which are otherwise superimposed by the clavicles in standard views. This view is helpful in detecting apical pathology like tuberculosis.

4. What does “Silhouette Sign” indicate?

- (a) Air in pleural space
(b) Loss of normal borders
(c) Calcification
(d) Fluid accumulation

Ans. (b) Loss of normal borders

Exp. The “Silhouette Sign” refers to the loss of normal borders between thoracic structures. It is indicative of pathological conditions such as masses, consolidation, or pleural effusion.

5. A widened mediastinum suggests:

- (a) Pulmonary edema
(b) Pneumothorax
(c) Aortic dissection
(d) Pleural effusion

Ans. (c) Aortic dissection

Exp. A widened mediastinum on a chest X-ray is highly suggestive of an aortic dissection, a life-threatening condition that requires immediate intervention.

6. In an AP view, the heart appears:

- (a) Smaller than in PA view
(b) Magnified
(c) More detailed
(d) Completely obscured

Ans. (b) Magnified

Exp. In the anteroposterior (AP) view, the heart appears magnified because the X-ray beam has to pass through more tissue, distorting the anatomical structures and size.

7. Hyperlucent lung fields are indicative of:

- (a) Consolidation (b) Emphysema
(c) Pneumonia (d) Pleural effusion

Ans. (b) Emphysema

Exp. Hyperlucent lung fields typically indicate emphysema, a chronic obstructive pulmonary disease that causes destruction of the alveoli and air trapping.

8. The “Air Bronchogram Sign” is commonly associated with:

- (a) Pneumothorax (b) Pleural effusion
(c) Consolidation (d) Atelectasis

Ans. (c) Consolidation

Exp. The Air Bronchogram Sign is commonly seen in consolidation conditions like pneumonia, where alveoli are filled with fluid or pus but the bronchi remain air-filled.

9. A lateral decubitus position is used to detect:

- (a) Pneumothorax (b) Pulmonary edema
(c) Pleural effusion (d) Lung collapse

Ans. (c) Pleural effusion

46. In pediatric patients, which type of hip dislocation is most common?

- (a) Posterior
- (b) Anterior
- (c) Superior
- (d) Inferior

Ans. (a) Posterior

Exp. In pediatric patients, posterior hip dislocations are most commonly observed. Immediate radiographic evaluation is critical for diagnosis and treatment.

47. For evaluating the sacroiliac joints, what is the typical degree of obliquity for an oblique view?

- (a) 10-15 degrees
- (b) 25-30 degrees
- (c) 35-40 degrees
- (d) 45-50 degrees

Ans. (b) 25-30 degrees

Exp. A typical degree of obliquity for evaluating the sacroiliac joints in an oblique view is 25-30 degrees. This angle allows for optimal visualization of the SI joints.

48. Which pathological condition is best diagnosed using the “Fleming view”?

- (a) SI joint dysfunction
- (b) Acetabular fracture
- (c) Pubic symphysis separation
- (d) Sacral insufficiency fractures

Ans. (a) SI joint dysfunction

Exp. The “Fleming view” is particularly useful for diagnosing SI joint dysfunction, as it involves stress-loading the joint and provides a functional assessment.

49. What is the primary focus of the AP axial “Outlet” view in pelvic radiography?

- (a) Coccyx and sacrum
- (b) Ischial spines
- (c) Pubic and ischial bones
- (d) Hip joints

Ans. (c) Pubic and ischial bones

Exp. The primary focus of the AP axial “Outlet” view is to visualize the pubic and ischial bones in relation to each other. This view is essential for diagnosing conditions like pelvic ring fractures.

Knee Joint, Ankle

1. What is the primary purpose of the Schatzker classification system in knee radiography?

- (a) To categorize the severity of knee infections
- (b) To classify tibial plateau fractures
- (c) To analyze ligament tears
- (d) To evaluate arthritis severity

Ans. (b) To classify tibial plateau fractures

Exp. The Schatzker classification system is primarily used for classifying tibial plateau fractures. It helps clinicians determine the severity and type of fracture, which in turn aids in deciding the best treatment approach.

2. Which of the following projection angles best visualizes the intercondylar fossa?

- (a) AP view
- (b) Lateral view at 30-degree flexion
- (c) Holmblad view
- (d) Camp-Coventry Method

Ans. (d) Camp-Coventry Method

Exp. The Camp-Coventry Method involves a PA axial projection with the patient in a prone position and the knee flexed at 40-50 degrees. It's one of the most effective methods for visualizing the intercondylar fossa.

3. Which ligament is most commonly injured in ankle sprains?

- (a) Posterior talofibular ligament
- (b) Calcaneofibular ligament
- (c) Anterior talofibular ligament
- (d) Deltoid ligament

Ans. (c) Anterior talofibular ligament

Exp. The anterior talofibular ligament is the most frequently injured ligament in ankle sprains, often due to inversion-type mechanisms.

4. In an AP view of the ankle, which of the following structures should be visualized?

- (a) Medial and lateral malleoli in one plane
- (b) Talus fully superimposed over the tibia
- (c) Tarsal bones fully superimposed over the fibula
- (d) Deltoid ligament fully outlined

Ans. (a) Medial and lateral malleoli in one plane

Bed Side X-ray, Basic Radiographic Landmarks, Radiographic Positioning

1. Which projection is most suitable for detecting free air in the abdominal cavity in bedridden patients?

(a) Supine AP (b) Erect PA
(c) Lateral decubitus (d) Lateral chest

Ans. (c) Lateral decubitus

Exp. The lateral decubitus position is best for detecting free air in the abdominal cavity when the patient is bedridden. In this position, free air rises and can be easily distinguished from other structures, which is critical for diagnoses like pneumoperitoneum.

2. What landmark serves as the primary centering point for a lateral chest X-ray?

(a) Xiphoid Process (b) mid coronal plane
(c) C7 Vertebra (d) Iliac Crest

Ans. (b) mid coronal plane

Exp. The mid coronal plane is generally used as the primary centering point for lateral chest X-rays. This ensures that the thoracic structures are adequately displayed without rotation, offering the most diagnostic information.

3. Which radiographic view is most appropriate for identifying the axillary region?

(a) PA (b) Lateral
(c) AP oblique (d) Transthoracic lateral

Ans. (c) AP oblique

Exp. The AP oblique view is specifically designed for better visualization of the axillary region. This positioning allows for a clearer image of the axilla, which may be necessary for certain diagnostic requirements.

4. When conducting a bed-side abdominal X-ray, what is the primary concern?

(a) Time (b) Image Quality
(c) Patient Comfort (d) Radiation Safety

Ans. (d) Radiation Safety

Exp. While all options are important, radiation safety remains the primary concern when conducting a bedside abdominal X-ray. Ensuring minimal exposure to both the patient and healthcare providers is essential for responsible radiographic practice.

5. What is the key factor for choosing a posterior-anterior (PA) over an anterior-posterior (AP) chest X-ray?

(a) Patient mobility (b) Radiation dose
(c) Image clarity (d) All of the above

Ans. (d) All of the above

Exp. PA chest X-rays are generally preferred due to multiple reasons: they provide better image quality, lower radiation dose to sensitive tissues (like breast tissue), and are usually feasible for mobile patients. Therefore, all the given options are key factors for choosing PA over AP.

6. In bedside radiography, what is the minimum source-to-skin distance (SSD) typically recommended?

(a) 12 inches (b) 18 inches
(c) 30 inches (d) 40 inches

Ans. (c) 30 inches

Exp. A minimum SSD of 30 inches is typically recommended in bedside radiography to minimize the radiation dose to the skin and improve image quality.

7. What radiographic landmark corresponds with the level of L4-L5 interspace?

(a) Iliac Crest
(b) Xiphoid Process
(c) Ischial Tuberosity
(d) Symphysis Pubis

Ans. (a) Iliac Crest

Exp. The iliac crest serves as a landmark corresponding to the L4-L5 interspace. It is commonly used as a centering point for various lumbar and abdominal radiographs.

8. Which of these factors affect the quality of a bedside chest X-ray?

(a) Patient Position (b) Image Receptor Size
(c) Tube Angulation (d) All of the Above

Ans. (d) All of the Above

Exp. The quality of a bedside chest X-ray can be influenced by multiple factors including patient position, image receptor size, and tube angulation. Correctly managing these variables is crucial for diagnostic accuracy.

9. For a lateral humerus X-ray, the patient's arm should be in what position?

(a) Fully extended (b) 90-degree flexion
(c) Slightly flexed (d) 45-degree flexion

Ans. (b) 90-degree flexion

Darkroom Procedure

DARK ROOM

A **dark room** is a **light-proof room** used in radiology departments for handling and processing X-ray films without exposing them to white light.

X-ray films are **very sensitive to light**, so all work like **loading, unloading, and processing films** must be done in a controlled lighting environment.

The dark room should be located very close to the radiographic room as it saves lot of time.

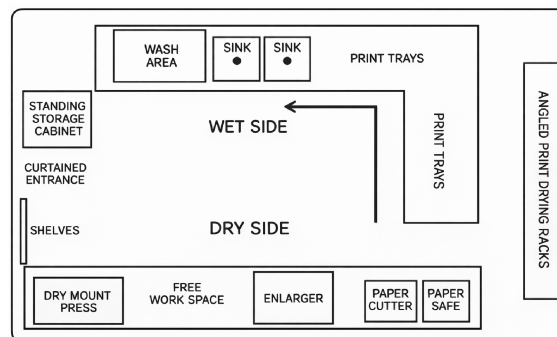
A dark room must be large enough (ideal is 100 square feet floor space and 11 feet ceiling height. The room must be **large enough to separate dry and wet areas**.

Dark Room Construction Requirements

A dark room must be **completely light-proof** and designed to allow safe film handling.

Feature	Requirement	Purpose
Walls	Painted with dark matte paint (lined with lead sheet with 1.5 mm thickness)	Reduce light reflection
Ceiling	Light-proof and non-reflective	Prevent stray light
Door	Light-tight door	Prevent light leakage
Floor	Non-slippery waterproof floor	Easy cleaning
Ventilation	Exhaust fan or ventilation ducts	Remove chemical fumes

Dark Room Layout



DARK ROOM ENTRANCE SYSTEM

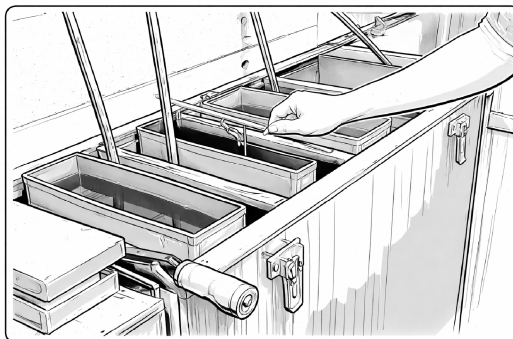
The entrance must prevent white light from entering the dark room.

MANUAL FILM PROCESSING:

Film processing is the **chemical process used to convert the latent (invisible) image on X-ray film into a visible permanent image.**

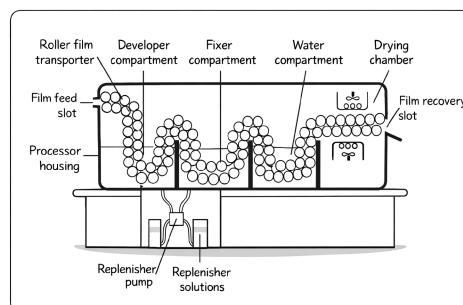
The film is processed in the **wet side of the dark room** using chemicals.

The Latent Image- When X-rays hit the film, they cause a physical change in the silver halide crystals that is **invisible** to the human eye. This is called the **Latent Image**. It only becomes a **Manifest Image** (visible) after going through the chemical processing



AUTOMATIC FILM PROCESSING

Automatic film processing is a high-speed, mechanical method used to develop, fix, wash, and dry radiographic or photographic film. It relies on a **roller transport system** and precise **temperature control** to produce a finished image in **90 seconds to 8 minutes**.



Compounds of Developer and Their Functions

Manual Processing

Component	Chemical	Functions
1. Developing agent	Metol (phenidone in auto)	Reducing agent; produces shades of gray at early stage; rapidly acting (responsible for low contrast).
	Hydroquinone	Reducing agent; produces blackest shades; acts slowly and requires a strongly alkaline medium.
2. Preservative	Sodium sulphite	Controls aerial oxidation; maintains balance among developing components.
3. Accelerator (activator)	Sodium carbonate or Sodium hydroxide	Helps swell gelatine; produces alkalinity; controls pH level.
4. Restrainer	Potassium bromide	Antifogging agent; protects unexposed crystals from the action of the developing agent.
5. Solvent	Water	Dissolves chemicals for use.

MCQ's with Explanation

Darkroom Layout

1. What is the primary reason for having a proper darkroom layout in a radiography facility?

- (a) Aesthetics
- (b) Radiation Protection
- (c) Optimizing Workflow
- (d) Equipment Storage

Ans. (c) Optimizing Workflow

Exp. A well-designed darkroom layout is essential for optimizing workflow. This allows for the quick and efficient processing of radiographic films, thereby reducing the time required to get accurate diagnostic images.

2. What should be the maximum allowable distance between the workbench and the processing unit?

- (a) 2 feet
- (b) 6 feet
- (c) 10 feet
- (d) 15 feet

Ans. (b) 6 feet

Exp. Ideally, the workbench and the processing unit should not be more than 6 feet apart. This minimizes unnecessary movement and promotes better work efficiency in the darkroom.

3. Which of the following lighting conditions is most suitable for a darkroom?

- (a) White light
- (b) Red light
- (c) Yellow light
- (d) Green light

Ans. (b) Red light

Exp. Red light is most suitable for a darkroom because it minimizes the risk of film fogging while allowing enough visibility for technicians to work efficiently adequate wavelength. short adequate wavelength

4. What is the recommended temperature for a darkroom?

- (a) 50-60°F
- (b) 60-70°F
- (c) 70-80°F
- (d) 80-90°F

Ans. (b) 60-70°F (68°F)

Exp. The recommended temperature for a darkroom is 60-70°F (68°F). Proper temperature control is vital for ensuring that the films and chemicals used in the darkroom function optimally.

5. Which of the following materials is best suited for darkroom walls?

- (a) Glass
- (b) Concrete
- (c) Wood
- (d) Plastic

Ans. (b) Concrete

Exp. Concrete walls are best suited for a darkroom as they offer superior radiation shielding. They are also less prone to degradation from chemicals used in film processing.

6. What is the ideal humidity level for a radiography darkroom?

- (a) 20-30%
- (b) 30-40%
- (c) 40-60%
- (d) 60-80%

Ans. (c) 40-60%

Exp. The ideal relative humidity level for a darkroom is between 40-60%. This range helps to maintain the quality of the radiographic film and ensures the longevity and effectiveness of the processing chemicals.

7. What is the primary purpose of a safelight in a darkroom?

- (a) To check for film fogging
- (b) To view radiographs
- (c) To illuminate without affecting film
- (d) To sterilize equipment

Ans. (c) To illuminate without affecting film

Exp. The primary purpose of a safelight is to provide enough light for technicians to work without affecting the sensitive radiographic film, thus preventing film fogging.

8. Which area of the darkroom should be most illuminated?

- (a) Washing Area
- (b) Drying Area
- (c) Viewing Area
- (d) Film Storage Area

Ans. (c) Viewing Area

Exp. Silver recovery primarily serves to reduce water pollution. Properly treating the waste from radiographic operations can prevent silver from contaminating water sources.

20. Which chemical would NOT be suitable for silver recovery due to safety concerns?

- (a) Sodium sulfide
- (b) Iron filings
- (c) Cyanide
- (d) Sodium thiosulfate

Ans. (c) Cyanide

Exp. Cyanide is highly toxic and poses significant safety risks, making it unsuitable for use in silver recovery processes.

Artifacts, Hanger, Automatic Film Processor Solutions

1. Which of the following is NOT a common cause of artifact

- (a) Hair on the film
- (b) Dust particles
- (c) High kVp
- (d) Static electricity

Ans. (c) High kVp

Exp. High kVp is generally not a cause of in radiographic images. are often due to foreign substances like hair, dust, or static electricity affecting the film.

2. What is the purpose of the radiographic hanger?

- (a) To cut film
- (b) To hold film during processing
- (c) To project X-rays
- (d) To focus light beams

Ans. (b) To hold film during processing

Exp. The radiographic hanger is designed to hold the film securely during the chemical processing stages. It ensures uniform treatment of the film.

3. What component of the automatic film processor neutralizes the developer solution?

- (a) Rinse
- (b) Drying
- (c) Activator
- (d) Stop bath

Ans. (d) Stop bath

Exp. The stop bath is the component that neutralizes the developer solution. It effectively halts the developing process, ensuring that the image remains stable.

4. How can 'fog' be minimized?

- (a) By using higher kVp
- (b) By avoiding light leaks
- (c) By increasing exposure time
- (d) By using less mA

Ans. (b) By avoiding light leaks

Exp. 'Fog' are generally caused by unintended exposure of the film to light. Avoiding light leaks in the darkroom minimizes the occurrence of these .

5. What could happen if a henger is not properly cleaned?

- (a) Film may not get developed
- (b) chemical appear on the film
- (c) X-ray machine could malfunction
- (d) Film speed increases

Ans. (b) chemical appear on the film

Exp. A dirty henger can lead to the deposition of chemical residues on the film, which may produce on the radiographic images.

6. What is the primary role of the developer solution in an automatic film processor?

- (a) To fix the image
- (b) To reduce exposure time
- (c) To convert latent image to visible image
- (d) To rinse off chemicals

Ans. (c) To convert latent image to visible image

Exp. The developer solution's primary role is to convert the latent image on the film into a visible image by chemically reducing the exposed silver halides.

7. A "crescent-shaped" artifact is likely due to what?*

- (a) Electrical interference
- (b) Bending of the film
- (c) Static electricity
- (d) Light leakage

Ans. (b) Bending of the film

Exp. A crescent-shaped artifact usually occurs due to bending of the film, often caused by improper handling. The shape signifies stress applied to the film.

8. How should a radiographic film be dried after washing?

- (a) By wiping it with a cloth
- (b) By air drying
- (c) By using a blow dryer
- (d) By placing it in direct sunlight

Ans. (b) By air drying

Radiography 2nd (Special)

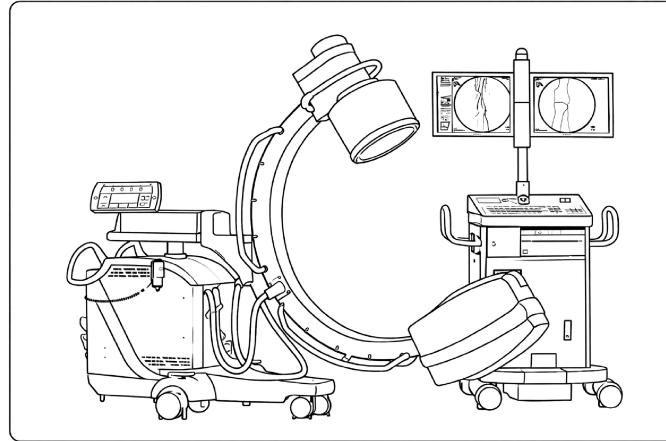
RADIOLOGICAL PROCEDURES

Name	Indication	Contrast Media	Contra-indication	Access & Procedure	Radiography Views	Patient Preparation & Post Care	Sign & significance
IVP (Intravenous Pyelography)	Evaluation of kidneys, ureters and bladder; urinary calculi; obstruction; congenital anomalies; hematuria	Water-soluble iodinated contrast (e.g., Urografin, Iohexol)	Renal failure, iodine allergy, dehydration, pregnancy	IV injection of contrast through peripheral vein → contrast filtered by kidneys → opacifies pelvicalyceal system, ureters and bladder	Scout film KUB → 5 min nephrogram → 10–15 min pyelogram → delayed films if needed → post-void film	Patient fasting 6–8 hrs; bowel preparation; check renal function; hydration after procedure; observe for contrast reaction	Nephrogram / Renal Blush(Normal Kidney Perfusion) Filling Defect(Stones, Tumors, or Blood Clots) Flower-Vase / Maiden Hair(Horseshoe Kidney) Paintbrush Sign(Medullary Sponge Kidney) Cobra Head / Spring Sign(Ureterocele) Fish-Hook / J-Shaped Ureter(Retrocaval Ureter) Beaded / Corkscrew Ureter(Tuberculosis)
RGU (Retrograde Urethrography)	Urethral stricture, urethral injury, trauma, fistula	Water-soluble iodinated contrast (e.g., Urografin, Iohexol)	Acute urinary infection, urethral injury with severe bleeding	Catheter inserted into urethral meatus → contrast injected retrograde → urethra filled and imaged	Oblique view of urethra (usually 30–45° oblique)	Patient explained procedure; aseptic catheterization; after study encourage urination and monitor discomfort	Stricture (Post-inflammatory scarring) Extravasation (Urethral Rupture) Step-off Sign (Complete Urethral Transection) Filling Defects (Urethral Polyps, Stones, or Air Bubbles) Moth-eaten Appearance (Urethritis or Chronic Tuberculosis) Beaded Appearance (Multiple Urethral Strictures) Jet Sign (Urethral Fistula)
MCU (Micturating Cystourethrogram)	Vesicoureteric reflux, bladder dysfunction, urethral abnormalities	Water-soluble iodinated contrast diluted with saline(e.g., Urografin, Iohexol)	Acute urinary infection, contrast allergy	Bladder catheterized → bladder filled with contrast → radiographs taken during filling and micturition	AP bladder → oblique views → micturition films	Bladder catheterization; aseptic technique; patient asked to void during imaging; observe after procedure	Keyhole Sign (PUV) Christmas Tree / Pinecone Bladder (Neurogenic Bladder / Trabeculation) Spinning Top Urethra (Distal Urethral Stenosis in girls) Dog-Ear Sign (Bladder Diverticula) Pear-Shaped Bladder (Pelvic Lipomatosis or Hematoma) Hourglass Bladder (Urachal Cyst) Step-off Sign (Complete Urethral Transection)

C-ARM

A **C-Arm** is a mobile fluoroscopic X-ray imaging system used in operating rooms for real-time imaging during surgical procedures.

The name comes from the **C-shaped arm that connects the X-ray tube and image detector.**

**Components of C-Arm**

A C-arm is made of four functional systems that work together to produce live X-ray “movies” during surgery.

1. X-Ray Generator

Mounted on one end of the “C,” it produces the radiation.

- **X-Ray Tube:** The source that emits X-rays through high-voltage stimulation.
- **Collimator:** A device that narrows the X-ray beam to the specific area of interest, which lowers the radiation dose to the patient and sharpens the image.

2. Imaging System (The Detector)

Mounted on the opposite end, it captures the X-rays after they pass through the patient.

- **Image Intensifier (II):** An older, bulkier cone-shaped technology that converts X-rays into light photons, then electrons, and back to bright light to create an image.
- **Flat Panel Detector (FPD):** A newer, “flat” digital technology that converts X-rays directly into digital data. It provides clearer images, a wider field of view, and requires roughly half the radiation dose of an II.

3. Workstation Unit

The “brain” of the machine, usually a separate cart on wheels.

- **Monitors:** Typically dual screens used to view a “live” image on one side and a “last held” reference image on the other.
- **Image Processing:** Software that clears up the image in real-time, removing digital “noise” and adjusting brightness/contrast.

4. Mechanical & Control System

The physical parts that allow the machine to be used safely and accurately.

- **C-Arm Frame:** Allows for orbital, horizontal, and vertical movements around the patient without moving them.
- **Exposure Switch:** A hand or foot pedal that the surgeon uses to trigger the X-ray beam.
- **Brakes & Locks:** Essential for keeping the heavy arm perfectly still once the correct angle is found.

MCQ's with Explanation

IVP-Intravenous Pyelogram, Special Radiography RGU, Special Radiography MCU

1. What is the primary purpose of administering contrast media in IVP?

- (a) To visualize the kidneys
- (b) To enhance liver function
- (c) To visualize the gallbladder
- (d) To enhance lung opacity

Ans. (a) To visualize the kidneys

Exp. In IVP, contrast media is administered to enhance the visualization of the kidneys, ureters, and bladder. It helps in outlining these structures clearly on the X-ray images.

Special Radiography RGU

2. Which anatomical structure is primarily visualized in Retrograde Urethrography (RGU)?

- (a) Kidneys
- (b) Ureters
- (c) Urethra
- (d) Bladder

Ans. (c) Urethra

Exp. RGU is specifically designed to visualize the urethra. It is used to diagnose strictures, obstructions, or other abnormalities within the urethral tract.

Special Radiography MCU

3. What does MCU stand for in the context of radiography?

- (a) Magnetic Capture Urography
- (b) Micturating Cysto-Urethrography
- (c) Magnetic Cysto-Urethrography
- (d) Micturating Capture Urography

Ans. (b) Micturating Cysto-Urethrography

Exp. MCU stands for Micturating Cysto-Urethrography. It is a study that visualizes the bladder and urethra while the patient is urinating, often used to diagnose vesicoureteral reflux.

4. In an IVP study, what is the typical time for the first image after contrast injection?

- (a) 1 minute
- (b) 5 minutes
- (c) 10 minutes
- (d) 20 minutes

Ans. (a) 1 minutes

Exp. The first image in an IVP study is typically taken about 1 minutes after the injection of contrast media. This allows sufficient time for the kidneys to filter the contrast and for it to appear in the urinary system. If contrast media is delayed then first film is take after 5 minutes. which is called delayed nephrogram

5. Which of the following is NOT a contraindication for RGU?

- (a) Acute urinary tract infection
- (b) Urethral trauma
- (c) Pregnancy
- (d) Renal failure

Ans. (d) Renal failure

Exp. Renal failure is not a contraindication for RGU as this procedure primarily focuses on the urethra and not the kidneys. However, acute urinary tract infection, urethral trauma, and pregnancy are generally considered contraindications.

IVP - Intravenous Pyelogram

6. What is the most common side effect of iodinated contrast media in IVP?

- (a) Nausea
- (b) Metallic taste
- (c) Allergic reaction
- (d) Hypertension

Ans. (a) Nausea

Exp. A Nausea taste is the most common side effect experienced after the administration of iodinated contrast media in IVP. It is generally harmless and temporary. Little overdose of contrast can cause metallic taste.

7. What is the primary contraindication for performing an IVP?

- (a) Diabetes
- (b) Renal failure
- (c) Hypertension
- (d) Asthma

Ans. (b) Renal failure

Exp. Renal failure is the primary contraindication for performing an IVP, as the kidneys are responsible for filtering out the contrast media. In renal failure, this process is compromised.

Special Radiography RGU

- (a) To reduce radiation exposure
- (b) To obtain high-resolution images
- (c) To visualize soft tissues
- (d) To shorten procedure time

Ans. (b) To obtain high-resolution images

Exp. A “spot film” is used during myelography to obtain high-resolution images of specific areas of interest, enhancing diagnostic accuracy.

47. What is the primary reason for using a “swimmer’s view” in thoracic myelography?

- (a) To visualize the upper thoracic vertebrae
- (b) To visualize the lower thoracic vertebrae
- (c) To visualize the thoracic nerve roots
- (d) To visualize the thoracic discs

Ans. (a) To visualize the upper thoracic vertebrae

Exp. A “swimmer’s view” in thoracic myelography is primarily used to visualize the upper thoracic vertebrae, which are often difficult to see with standard views.

48. Which of the following is NOT a typical contraindication for myelography?

- (a) Recent lumbar puncture
- (b) Active spinal infection
- (c) Multiple sclerosis
- (d) Allergy to contrast medium

Ans. (c) Multiple sclerosis

Exp. Multiple sclerosis is not a typical contraindication for myelography. The primary contraindications include recent lumbar puncture, active spinal infection, and allergy to contrast medium.

49. What is the primary reason for using a “lateral decubitus view” in lumbar myelography?

- (a) To visualize the lumbar nerve roots
- (b) To visualize the lumbar discs
- (c) To visualize the lumbar vertebrae
- (d) To visualize the cauda equina

Ans. (a) To visualize the lumbar nerve roots

Exp. A “lateral decubitus view” in lumbar myelography is primarily used to visualize the lumbar nerve roots, providing valuable diagnostic information.

50. What is the primary reason for using “digital tomosynthesis” in myelography?

- (a) To obtain 3D images
- (b) To reduce radiation exposure
- (c) To visualize soft tissues
- (d) To shorten procedure time

Ans. (a) To obtain 3D images

Exp. Digital tomosynthesis is used in myelography to obtain 3D images, which provide more detailed information and improve diagnostic accuracy compared to 2D images.

Angiography, Coronary Angiography, Cerebral Angiography

1. What is the primary contrast medium used in angiography?

- (a) Barium sulfate (b) Iodine-based
- (c) Gadolinium (d) Air

Ans. (b) Iodine-based

Exp. Iodine-based contrast agents are primarily used in angiography because they provide high radiopacity and are less toxic compared to other contrast agents like barium.

2. Which artery is most commonly accessed for coronary angiography?

- (a) Radial artery
- (b) Femoral artery
- (c) Brachial artery
- (d) Carotid artery

Ans. (b) Femoral artery

Exp. The femoral artery is most commonly accessed for coronary angiography because it allows for easier catheter manipulation and has a lower risk of complications compared to other access points.

3. What is the primary risk associated with cerebral angiography?

- (a) Infection (b) Stroke
- (c) Hemorrhage (d) Allergic reaction

Ans. (b) Stroke

Exp. The primary risk associated with cerebral angiography is stroke. This can occur due to dislodgement of plaque or thrombus, leading to cerebral ischemia.

4. What is the purpose of a “run-off” study in angiography?

Recent Advances

PET (POSITRON EMISSION TOMOGRAPHY)

Positron Emission Tomography (PET) is a **nuclear medicine imaging technique that produces three-dimensional images of metabolic processes in the body.**

Unlike conventional imaging which shows structure, PET mainly shows **functional activity of tissues.**

PET is commonly combined with **CT or MRI** to produce **PET-CT or PET-MRI scans.**

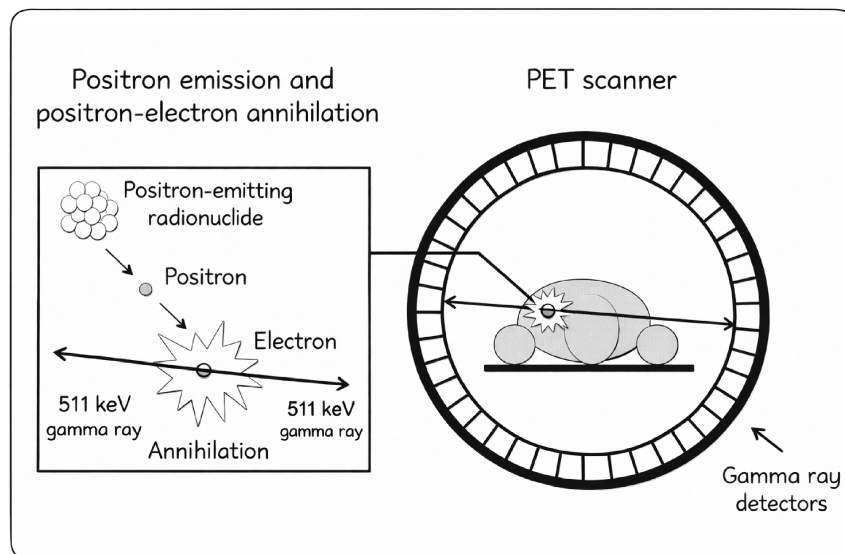
Principle of PET

PET works on the principle of **positron emission and annihilation radiation.**

1. **Emission:** A tracer injected into the body emits **positrons.**
2. **Annihilation:** A positron hits an electron, causing them to “explode” and disappear.
3. **Gamma Rays:** This explosion sends **two gamma rays** flying in exactly opposite directions.
4. **Coincidence:** The ring of detectors catches both rays at the same time.
5. **Mapping:** The computer draws a line between the two hits to pinpoint the exact source of metabolic activity.

Line of Response:

The **Line of Response (LOR)** is the straight path connecting two opposite detectors that simultaneously catch a pair of gamma rays from an annihilation event. It tells the computer that the radioactive source must be located somewhere along that specific line to create the final 3D map.

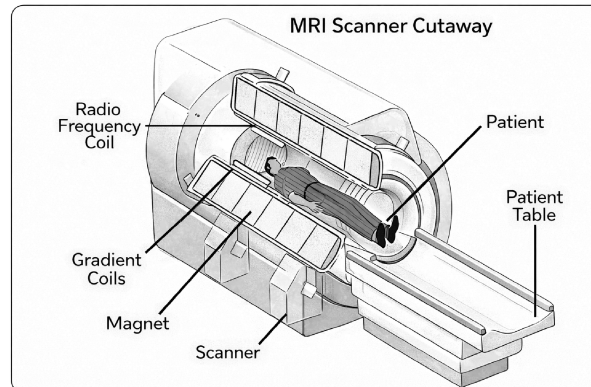


Principle

MRI works on the principle of **nuclear magnetic resonance (NMR)**.

The principle of **MRI** is based on the behavior of **Hydrogen protons** in a strong magnetic field. It follows a specific four-step process:

Step	Process in Short
1. Alignment	The main magnet (B_0) forces all random hydrogen protons to line up in one direction.
2. Excitation	An RF pulse is fired, "knocking" the protons out of alignment so they absorb energy.
3. Relaxation	The pulse stops; protons "relax" back to start and release a radio signal (T_1/T_2).
4. Detection	Receiver coils catch these radio signals, and a computer reconstructs the 3D image.



Components of MRI System

Component	Role in the Imaging Chain
Main Magnet (B_0)	Provides the strong, constant magnetic field to align the body's protons.
Gradient Coils	Smaller magnets that create field variations to locate exactly where a slice is.
RF Transmit Coil	Sends the Radiofrequency pulse into the patient to "excite" the protons.
RF Receiver Coil	Acts as an antenna to catch the radio signals (echoes) emitted by the body.
Shim Coils	Used to make the main magnetic field perfectly uniform (homogeneous).
Computer System	Performs the Fourier Transform math to turn radio waves into a 3D image.
Patient Table	A non-magnetic bed that moves the patient precisely into the Isocentre (middle).

Types of MRI Magnets

The main magnet (B_0) is the most expensive part of the system. There are three primary technologies used to create the magnetic field.

Magnet Type	How it Works	Key Characteristic
Permanent	Uses large blocks of naturally magnetic material (like bricks).	Always On; very heavy but uses no electricity or cooling.
Resistive	Uses standard copper coils with a large electric current running through them.	Can be turned off; generates a lot of heat and uses massive electricity.
Superconducting	Uses special coils cooled by Liquid Helium to near absolute zero.	Modern Standard; provides the strongest and most stable field (1.5T - 3T).

MCQ's with Explanation

PET

1. What is the primary radiopharmaceutical used in PET imaging?

- (a) Technetium-99m (b) Fluorine-18 FDG
(c) Iodine-131 (d) Barium-137

Ans. (b) Fluorine-18 FDG

Exp. Fluorine-18 FDG (Fluorodeoxyglucose) is the most commonly used radiopharmaceutical in PET imaging. It mimics glucose and is taken up by cells with high metabolic activity, making it ideal for detecting tumors and assessing tissue function.

2. What is the main advantage of PET over CT?

- (a) Higher resolution
(b) Functional imaging
(c) Lower radiation dose
(d) Faster scan time

Ans. (b) Functional imaging

Exp. Unlike CT, which primarily provides anatomical details, PET offers functional imaging. It allows for the assessment of metabolic activity, blood flow, and other physiological processes, making it more suitable for certain diagnostic applications like cancer staging.

3. Which of the following is NOT a common application of PET?

- (a) Cardiac imaging
(b) Bone density measurement
(c) Oncology
(d) Neurological studies

Ans. (b) Bone density measurement

Exp. PET is not typically used for measuring bone density. It is primarily used for assessing metabolic activity, making it more suitable for applications like cardiac imaging, oncology, and neurological studies.

4. What is the typical half-life of Fluorine-18?

- (a) 2 minutes (b) 110 minutes
(c) 6 hours (d) 24 hours

Ans. (b) 110 minutes

Exp. The half-life of Fluorine-18 is approximately 110 minutes. This relatively short half-life allows for rapid decay and lower radiation exposure to the patient, but it also requires quick imaging procedures.

5. In PET imaging, what does "attenuation correction" refer to?

- (a) Reducing noise in the image
(b) Compensating for tissue absorption of the emitted photons
(c) Enhancing the contrast
(d) Correcting for patient movement

Ans. (b) Compensating for tissue absorption of the emitted photons

Exp. Attenuation correction in PET imaging is the process of compensating for the absorption of emitted photons by various tissues in the body. This is crucial for obtaining accurate quantitative measurements and high-quality images.

6. What is the principle behind PET imaging?

- (a) X-ray absorption
(b) Magnetic resonance
(c) Annihilation reaction
(d) Sound wave reflection

Ans. (c) Annihilation reaction

Exp. PET imaging is based on the principle of the annihilation reaction. When a positron emitted from a radiopharmaceutical collides with an electron, they annihilate each other, producing two 511 keV gamma photons that travel in opposite directions. These are detected to create the image.

7. Which of the following is NOT a limitation of PET imaging?

- (a) High cost
(b) Limited spatial resolution
(c) Inability to detect metabolic activity
(d) Radiation exposure

Ans. (c) Inability to detect metabolic activity

Exp. One of the main advantages of PET imaging is its ability to detect metabolic activity. Limitations include high cost, limited spatial resolution, and radiation exposure to the patient.

Ans. (b) Affected by spinal degeneration

Exp. DEXA measurements of the spine can be affected by spinal degeneration or arthritis, which may lead to inaccurately high bone density readings.

45. What is the primary advantage of using MRS for brain applications?

- (a) High resolution (b) Biochemical information
- (c) Short scan time (d) Low cost

Ans. (b) Biochemical information

Exp. MRS provides valuable biochemical information about brain tissues, which can be crucial for the diagnosis and monitoring of various neurological conditions.

46. What is the primary disadvantage of using DEXA for renal patients?

- (a) High radiation dose
- (b) Inaccurate results
- (c) Expensive
- (d) Time-consuming

Ans. (b) Inaccurate results

Exp. DEXA may provide inaccurate bone density measurements for renal patients due to altered mineral metabolism, which can affect the X-ray attenuation.

47. What is the primary advantage of using MRS for prostate applications?

- (a) High resolution
- (b) Biochemical information
- (c) Short scan time
- (d) Low cost

Ans. (b) Biochemical information

Exp. MRS can provide valuable biochemical information about prostate tissues, such as the concentration of citrate and choline, which can be useful for diagnosis and monitoring.

48. What is the primary limitation of using DEXA for postmenopausal women?

- (a) High radiation dose
- (b) Inaccurate results
- (c) Expensive
- (d) Time-consuming

Ans. (b) Inaccurate results

Exp. DEXA may provide inaccurate bone density measurements for postmenopausal women due to hormonal changes, which can affect bone density.

49. What is the primary advantage of using MRS for breast applications?

- (a) High resolution (b) Biochemical information
- (c) Short scan time (d) Low cost

Ans. (b) Biochemical information

Exp. MRS can provide valuable biochemical information about breast tissues, such as the concentration of choline, which can be useful for diagnosis and monitoring.

50. What is the primary limitation of using DEXA for pediatric applications?

- (a) High radiation dose
- (b) Inaccurate results
- (c) Expensive
- (d) Time-consuming

Ans. (b) Inaccurate results

Exp. DEXA may provide inaccurate bone density measurements for pediatric patients due to their growing bones, which can affect the X-ray attenuation.

PACS

1. What does the acronym PACS stand for in radiography?

- (a) Picture And Computer Systems
- (b) Picture Archiving and Communication System
- (c) Patient Archiving and Clinical System
- (d) Picture Analysis and Communication Standard

Ans: (b) Picture Archiving and Communication System

2. What is the primary purpose of a PACS system in a medical imaging department?

- (a) To perform MR scans
- (b) To generate hard-copy X-ray films
- (c) To store, retrieve, and distribute digital images
- (d) To fix broken imaging equipment

Ans: (c) To store, retrieve, and distribute digital images

Exp. PACS functions as a digital library that allows healthcare providers to **access** scans instantly from any connected computer. This eliminates the need to manually transport physical files between departments

Radiation Therapy

INTRODUCTION TO RADIATION

Radiation is the emission and propagation of **energy through space or matter in the form of waves or particles**. Radiation plays an important role in both **diagnostic imaging and radiation therapy**.

In medical radiology, radiation is mainly used for:

- **Diagnosis** (X-ray, CT scan)
- **Treatment of cancer** (Radiotherapy)

Radiation used in medical applications is usually **ionizing radiation**. Ionizing radiation has enough energy to remove electrons from atoms and create ions.

Radiation therapy uses **high-energy radiation to destroy cancer cells** by damaging their DNA. The goal of radiotherapy is to deliver a sufficient radiation dose to tumor tissues while minimizing damage to surrounding normal tissues.

Types of Radiation

Radiation can be classified into two main types.

1. Non-Ionizing Radiation

This type of radiation does not have enough energy to ionize atoms.

Examples:

- Radio waves
- Microwaves
- Infrared radiation
- Visible light

These are generally used in communication and heating applications.

2. Ionizing Radiation

Ionizing radiation has sufficient energy to remove electrons from atoms.

Examples:

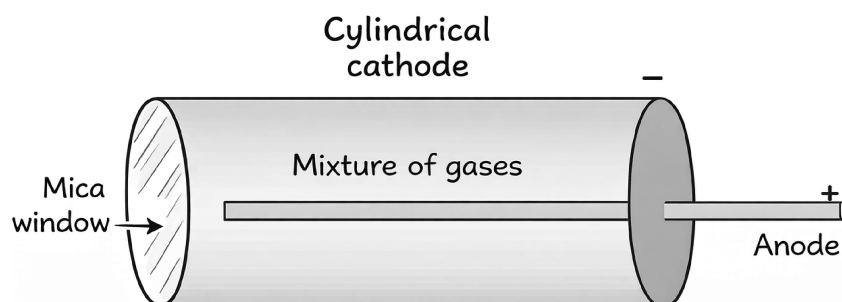
- X-rays
- Gamma rays
- Alpha particles
- Beta particles
- Neutrons

Ionizing radiation is used in **radiotherapy and nuclear medicine**.

A **chamber** is the physical, gas-filled enclosure or container where radiation interacts with matter to create detectable ions

Feature	Ionization Chamber	Proportional Counter	Geiger-Müller (GM) Counter
Voltage Level	Low	Medium	High
Signal Output	Very small current	Pulse proportional to energy	Large, uniform pulse
Sensitivity	Low (needs high radiation)	Medium	Very High (detects single particles)
Energy Resolution	None	Good (can identify types)	None (all pulses look the same)
Primary Use	High-dose rate monitoring	Alpha/Beta lab counting	Finding contamination/leaks
"Dead Time"	Minimal	Short	Long (sensor "blinds" briefly)
Analogy	A steady rain gauge	A scale that weighs each drop	A hair-trigger alarm

Geiger muller counter:



2. Scintillation detector:

A **scintillation detector** is a device that identifies radiation by catching the tiny flashes of light produced when radioactive particles hit specific materials.

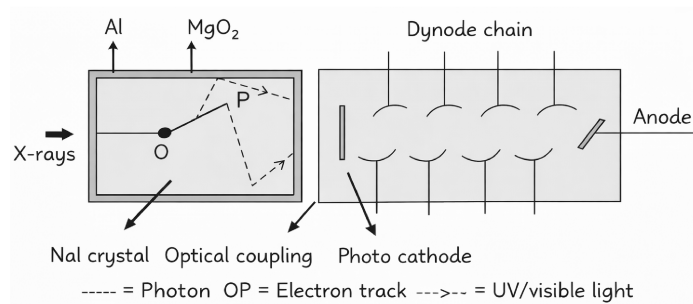
While gas-filled detectors use **ionization** (creating electrical charges), scintillation detectors use **excitation** (creating light).

Working principle:

The working principle of a **scintillation detector** follows a 4-step energy conversion:

- Absorption:** Radiation hits a crystal (scintillator) and "excites" its atoms.
- Scintillation:** The excited atoms release energy as a tiny **flash of light** (photons).
- Conversion:** This light hits a **photocathode**, which converts the light into a few electrons.
- Multiplication:** A **Photomultiplier Tube (PMT)** multiplies those few electrons into a massive electrical pulse large enough to measure.

The **brighter** the light flash, the **stronger** the electrical pulse, which tells you the **energy level** of the radiation.



Components:

The goal of radiation therapy is to **maximize the therapeutic ratio**.

Several factors influence the therapeutic ratio, including:

- Radiation dose distribution
- Tumor radiosensitivity
- Normal tissue tolerance
- Fractionation of radiation dose
- Use of advanced treatment techniques

Modern radiotherapy techniques such as IMRT, IGRT, and stereotactic radiotherapy help improve the therapeutic ratio by delivering radiation more precisely to tumors.

BEAM MODIFYING DEVICES

Beam modifying devices are used in radiotherapy to alter the shape, intensity, or distribution of the radiation beam so that it conforms to the tumor volume.

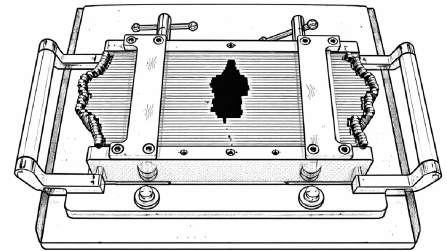
These devices help deliver radiation more effectively while protecting surrounding healthy tissues.

Types of Beam Modifiers

A. Collimators

Collimators are devices that restrict the size and shape of the radiation beam. They are usually made of high-density materials such as tungsten or lead.

Collimators ensure that radiation is delivered only to the intended treatment area.



B. Multi-Leaf Collimator (MLC)

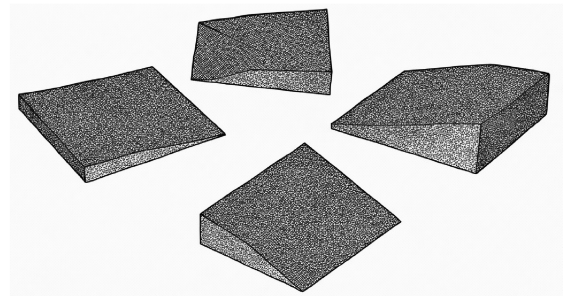
MLCs consist of many thin metal leaves that move independently to shape the radiation beam according to the tumor shape.

MLCs are widely used in modern radiotherapy techniques like IMRT.

C. Wedge Filters

Wedge filters are beam modifiers used to create a **gradual variation in radiation intensity across the treatment field**.

They are used when tumors have irregular shapes or when dose distribution needs adjustment.



D. Compensators

Compensators are devices used to correct dose variations caused by uneven patient body surfaces.

They help ensure that the radiation dose is distributed uniformly throughout the treatment area.

E. Bolus

A bolus is a tissue-equivalent material placed on the patient's skin surface to increase the radiation dose at shallow depths.

It is often used for **superficial tumors**



MCQ's with Explanation

Radiation Units

1. The unit used to measure the biological effect of ionizing radiation is:

- (a) Gray (Gy) (b) Sievert (Sv)
(c) Becquerel (Bq) (d) Roentgen (R)

Ans. (b) Sievert (Sv)

Exp. The Sievert (Sv) is the unit used to measure the biological effect of ionizing radiation on human tissue. It takes into account the type of radiation and its impact on different organs and tissues.

2. Which unit is used to measure absorbed dose of radiation?

- (a) Gray (Gy)
(b) Sievert (Sv)
(c) Becquerel (Bq)
(d) Curie (Ci)

Ans. (a) Gray (Gy)

Exp. The Gray (Gy) is the SI unit of absorbed radiation dose, representing the absorption of one joule of radiation energy per kilogram of matter.

3. One Becquerel (Bq) is defined as:

- (a) One disintegration per minute
(b) One disintegration per second
(c) One disintegration per hour
(d) One disintegration per day

Ans. (b) One disintegration per second

Exp. The Becquerel (Bq) is the SI unit of radioactivity and is defined as one disintegration per second.

4. Which unit is commonly used to measure the exposure of X-rays and gamma rays?

- (a) Gray (Gy) (b) Sievert (Sv)
(c) Roentgen (R) (d) Rad

Ans. (c) Roentgen (R)

Exp. The Roentgen (R) is a unit of exposure for X-rays and gamma rays and measures the amount of ionization produced in the air.

5. The traditional unit of absorbed dose, which has been replaced by the Gray in the SI system, is:

- (a) Sievert (Sv) (b) Rad
(c) Roentgen (R) (d) Becquerel (Bq)

Ans. (b) Rad

Exp. The Rad is the traditional unit of absorbed dose, where 1 Rad is equivalent to 0.01 Gray (Gy).

6. What is the unit of measurement for radioactivity used before the Becquerel (Bq)?

- (a) Curie (Ci) (b) Rad
(c) Roentgen (R) (d) Sievert (Sv)

Ans. (a) Curie (Ci)

Exp. The Curie (Ci) is a non-SI unit of radioactivity that was used before the Becquerel (Bq). One Curie is equivalent to 3.7×10^{10} disintegrations per second.

7. The unit used to measure the potential biological impact of different types of radiation is:

- (a) Roentgen (R) (b) Gray (Gy)
(c) Sievert (Sv) (d) Rad

Ans. (c) Sievert (Sv)

Exp. The Sievert (Sv) accounts for the biological effects of radiation, factoring in the type and energy of radiation, which allows for comparison of different types of exposure.

8. Which unit is defined as 1 joule of energy absorbed per kilogram of tissue?

- (a) Roentgen (R) (b) Rad
(c) Gray (Gy) (d) Sievert (Sv)

Ans. (c) Gray (Gy)

Exp. The Gray (Gy) is defined as the absorption of one joule of radiation energy per kilogram of tissue.

9. What is the relationship between the Rad and the Gray?

- (a) 1 Rad = 1 Gray
(b) 1 Rad = 0.01 Gray
(c) 1 Rad = 100 Gray
(d) 1 Rad = 10 Gray

Ans. (b) 1 Rad = 0.01 Gray

Exp. The Rad is an older unit of absorbed dose, where 1 Rad is equivalent to 0.01 Gray (Gy).

Ans. (b) To convert light photons into an electrical signal and amplify it '

Exp. The photomultiplier tube (PMT) detects the light flashes from the scintillator and turns them into a measurable electrical current.

12. Which device is specifically used to monitor an individual's cumulative radiation exposure over time?

- (a) Geiger-Muller Counter
- (b) Film Badge
- (c) Proportional Counter
- (d) Scintillation Spectrometer

Ans. (b) Film Badge

Exp. A film badge is a passive dosimeter designed to be worn by a person to track their total radiation dose over a set period (usually a month).

13. A "Survey Meter" is primarily used as a:

- (a) Personal dose record
- (b) Rate measuring instrument
- (c) Permanent record of exposure
- (d) Particle accelerator

Ans. (b) Rate measuring instrument

Exp. Survey meters provide immediate, real-time readings of radiation levels (mR/hr or counts per minute) rather than a historical cumulative dose.

14. Which of the following is the main disadvantage of solid state semiconductor detector?

- (a) Low accuracy
- (b) Low sensitivity
- (c) It should be maintained at low temperature
- (d) High pressure has to be produced

Ans. (c) It should be maintained at low temperature

Exp. High-purity semiconductor detectors (like HPGe) must be cooled with liquid nitrogen to reduce thermal noise and function correctly.

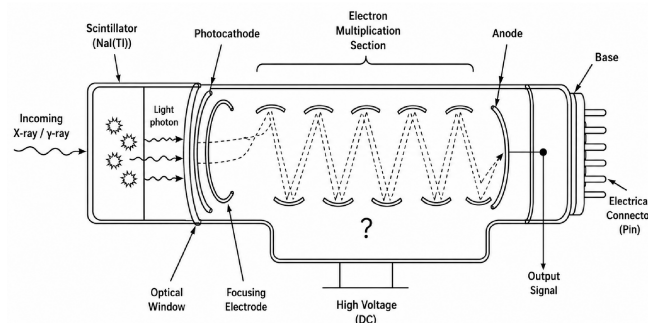
15. Scintillation detector is a large flat crystal of which of the following materials?

- (a) Sodium chloride
- (b) Sodium iodide
- (c) Sodium sulphate
- (d) Sodium carbonate

Ans. (b) Sodium iodide

Exp. Sodium iodide (thallium-activate(d), or **NaI(Tl)**), is the most common crystal used in scintillation detectors due to its high light output and efficiency. (Note: Your prompt provided "A" as the answer, but Sodium Iodide is the correct material).

16. Given below is a diagram of Scintillation detector. Identify the unmarked component.



- (a) Lens
- (b) Collimator
- (c) Dynodes
- (d) Focussing cup

Ans. (c) Dynodes

Exp. In a **Photomultiplier Tube (PMT)**, the **dynodes** are a series of electrodes that multiply the initial photoelectrons through **secondary emission**, creating a large, measurable electrical pulse from a faint flash of light.

17. If an ion chamber collects 2×10^{-8} C in 0.01 kg of air, exposure is:

- (a) 2×10^{-6} C/kg
- (b) 2×10^{-7} C/kg
- (c) 2×10^{-5} C/kg
- (d) 2×10^{-9} C/kg

Ans. (a) 2×10^{-6} C/kg

Exp. Exposure = $Q/m = (2 \times 10^{-8}) / 0.01 = 2 \times 10^{-6}$ C/kg.

18. Film badges measure radiation based on:

- (a) Ionization in air
- (b) Photographic blackening
- (c) Gas multiplication
- (d) Thermal emission

Ans. (b) Photographic blackening

Exp. Radiation darkens photographic film; degree of blackening correlates with dose.

19. Pocket dosimeters operate based on:

- (a) Thermoluminescence
- (b) Electroscop principle
- (c) Gas multiplication
- (d) Semiconductor junction

Ans. (b) Electroscop principle

Patient Care & Safety

LEGAL & REGULATORY ASPECTS IN RADIOLOGY

1. PCPNDT ACT (Pre-Conception and Pre-Natal Diagnostic Techniques Act)

The PCPNDT Act is a very important law in India that was implemented to prevent female foeticide and misuse of ultrasound techniques for sex determination. This act strictly prohibits the determination and disclosure of fetal sex during pregnancy.

Radiology departments, especially ultrasound centers, must be registered under this act. Every procedure performed must be documented properly in prescribed forms such as Form F. Failure to maintain records or illegal disclosure of fetal sex can result in severe penalties including imprisonment, cancellation of license, and heavy fines.

Radiographers and technicians must ensure that:

- No communication regarding fetal sex is given
- Proper documentation is maintained
- Equipment is registered and monitored
- Ethical practice is followed strictly

2. ELORA (eLORA – e-Licensing of Radiation Applications)

ELORA is an online system developed by AERB (Atomic Energy Regulatory Board) for licensing and regulation of radiation equipment such as X-ray machines, CT scanners, and radiotherapy units.

All radiology centers must register their equipment and obtain licenses through ELORA. It ensures radiation safety and regulatory compliance.

Responsibilities include:

- Equipment registration and approval
- Periodic quality assurance
- Radiation safety officer (RSO) compliance
- Reporting of incidents

3. ATOMIC ENERGY ACT

The Atomic Energy Act governs the use of radiation in India. It ensures safe handling, use, and disposal of radioactive materials.

Under this act:

- Radiation exposure must be kept **ALARA (As Low As Reasonably Achievable)**
- Workers must wear dosimeters
- Shielding and protection measures are mandatory
- Unauthorized use of radiation is punishable

Radiographers must follow all safety guidelines to prevent radiation hazards.

MCQ's with Explanation

BMW

1. What is the color of the container used for storing cytotoxic waste?

- (a) Yellow (b) Blue
(c) Black (d) Red

Ans. (a) Yellow

Exp. Yellow containers are specifically used for storing cytotoxic waste, which includes waste like cancer drugs, genotoxic chemicals, etc. This color coding is crucial for safe and efficient waste management.

2. Which act regulates the management of biomedical waste in India?

- (a) Water Act, 1974
(b) Air Act, 1981
(c) Biomedical Waste Management Rules, 2016
(d) E-Waste Management Rules, 2016

Ans. (c) Biomedical Waste Management Rules, 2016

Exp. The Biomedical Waste Management Rules, 2016, specifically address the regulation and management of biomedical waste in India. It is an essential framework for healthcare facilities for the effective management of biomedical waste.

3. Which is the most appropriate method to treat microbiological and biotechnological waste?

- (a) Autoclaving (b) Incineration
(c) Microwaving (d) Chemical treatment

Ans. (a) Autoclaving

Exp. Autoclaving is the most effective method to treat microbiological and biotechnological waste. It employs steam sterilization to kill or deactivate all forms of life and biological agents.

4. What is the primary purpose of pre-treatment of BMW?

- (a) Aesthetic Appeal (b) Decrease volume
(c) Increase volume (d) Color Coding

Ans. (b) Decrease volume

Exp. Pre-treatment of biomedical waste is primarily done to decrease its volume, thereby making it easier to handle, transport, and treat. This can include processes like shredding or compacting the waste.

5. Which of the following is considered as General Waste in a healthcare setting?

- (a) Infected Gloves (b) Food wrappers
(c) Used Needles (d) Amputated Body Parts

Ans. (b) Food wrappers

Exp. Food wrappers fall under the category of general waste in a healthcare setting. These items are non-hazardous and do not pose a risk of infection. They can be disposed of as ordinary waste.

6. What is the first step in the waste management hierarchy?

- (a) Disposal (b) Recycling
(c) Reduction (d) Treatment

Ans. (c) Reduction

Exp. The first step in the waste management hierarchy is "Reduction." This involves minimizing the amount of waste generated, which is essential for sustainable waste management practices.

7. Which of the following diseases is most likely to be transmitted through improper disposal of sharps?

- (a) Tuberculosis (b) Hepatitis B
(c) Dengue (d) Malaria

Ans. (b) Hepatitis B

Exp. Hepatitis B is most likely to be transmitted through improper disposal of sharps, such as needles. Sharps contaminated with blood can be a potent source of Hepatitis B virus.

8. Who is responsible for the proper disposal of BMW in a healthcare facility?

- (a) Only nurses
(b) Only janitorial staff
(c) Only doctors
(d) All healthcare personnel

Ans. (d) All healthcare personnel

- (a) Ensures consistent supply chain
- (b) Facilitates telemedicine consultations
- (c) Minimizes medication errors
- (d) Improves hospital billing accuracy

Ans. (c) Minimizes medication errors

Exp. A Closed-Loop Medication Administration System aims to minimize medication errors by integrating various phases of medication administration, including prescribing, dispensing, and documenting, into a single, coherent system.

29. What is the main advantage of using a digital scribe in updating electronic patient charts?

- (a) Reduces paper waste
- (b) Enables real-time updates
- (c) Automates diagnostic procedures
- (d) Enhances patient-physician interaction

Ans. (d) Enhances patient-physician interaction

Exp. The main advantage of using a digital scribe is that it allows the physician to focus on the patient rather than on charting. This enhances the quality of the patient-physician interaction, as the scribe takes care of updating the electronic patient charts.

30. Which of the following does NOT qualify as PHI (Personal Health Information) in a patient chart?

- (a) Social Security Number
- (b) Blood Type
- (c) Zip Code
- (d) Patient Satisfaction Survey

Ans. (d) Patient Satisfaction Survey

Exp. Personal Health Information (PHI) comprises data that could identify a patient and relate to their health status, provision of healthcare, or payment for healthcare. A patient satisfaction survey, while related to healthcare, does not contain identifiable health information and therefore is not considered PHI.

Patient Dignity And Storage Of Film

1. What is the primary ethical principle behind maintaining patient dignity?

- (a) Beneficence
- (b) Autonomy
- (c) Justice
- (d) Nonmaleficence

Ans. (b) Autonomy

Exp. Autonomy refers to the patient's right to make choices, hold views, and take actions according to their values and beliefs. Respecting autonomy is fundamental to maintaining patient dignity.

2. Which document should be completed to safeguard the privacy and dignity of a patient?

- (a) Incident report
- (b) Discharge summary
- (c) Consent form
- (d) Medical record

Ans. (c) Consent form

Exp. A consent form is crucial in safeguarding the privacy and dignity of a patient. It specifies what procedures are to be performed and ensures the patient understands and agrees.

Storage of Film

1. What is the recommended temperature for storing X-ray films?

- (a) 10-15°C
- (b) 18-24°C
- (c) 25-30°C
- (d) 35-40°C

Ans. (b) 18-24°C

Exp. The optimal temperature for storing X-ray films is 18-24°C. Storing films at this temperature range helps in preserving the image quality and shelf-life of the films.

2. What type of container is NOT suitable for storing X-ray films?

- (a) Plastic containers
- (b) Wooden boxes
- (c) Metallic containers
- (d) Acid-free paper envelopes

Ans. (c) Metallic containers

Exp. Metallic containers may cause artifacts and degrade the image quality of the X-ray films. It is advisable to use non-reactive storage solutions like acid-free paper envelopes.

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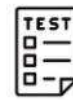
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