Q26. Why is vacuum created in x-ray tube?

Ans. To remove the air to permit electrons to flow from cathode to anode without encountering the gas atoms of the air

Q27. Define heel effect and describe how it can be used to the radiographer's advantage?

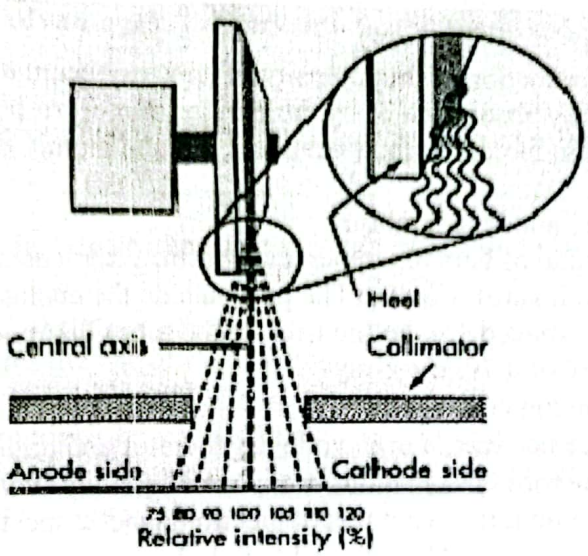
Ans. The anode heel effect is the variation in x-ray intensity along the longitudinal axis of the tube.

It's called the anode heel effect because photons formed deeper in the anode must first pass through the "heel" of the anode which causes that "side" to lose intensity before reaching the object or image receptor.

Anode side- less intensity
Cathode side- more intensity

Think "Fat Cat". The larger part should be toward the cathode side to smooth the uneven densities created by the anode heel effect.

The anode heel effect is most noticeable with a steep bevel, large focal spot, short SID, and a large IR size.



The anode heel effect can be used to advantage when x-raying parts of uneven thickness and/or density, such as the lower leg. By placing the proximal end of the leg under the cathode side of the tube, the finished radiograph would have balanced density. On the other hand, a disadvantage of the heel effect can be experienced when parts of even density and thickness are x-rayed

Factors

- anode angle: by increasing the angle, the amount of target material perpendicular to the anode is decreased resulting in less resorption of x-rays produced.
- target-to-film distance: increase in distance reduces heel effect by allowing more divergence of the beam which produces a more uniform image.
- field size: the field will be more uniform at the centre due to the collimator absorbing the peripheral variations.
- positioning: by aligning higher attenuating material towards the cathode and lower attenuating material towards the anode the resulting field is more uniform

Q28. Discuss the purpose of focusing cup?
Ans.The purpose of focusing cup is to guide the electron stream to the target area on the anode. Because of tremendous amount of heat that is generated at the cathode, the structure is made of tungsten which has excellent thermal properties.
Q29. Why is filament embedded in focusing cup?
Ans.The filament is embedded in focusing cup to electrostatically shape or confines the projectile electron beam to a small area of anode.

Q30.Briefly describe how to use tube rating chart?
Ans. A graph that indicates themaximum exposure values thatmay be made w/o damage to the tube.Each chart contains a family ofcurves representing the varioustube currents.
The X axis and Y axis showscales of the two radiographicparameters of kV and mA.
For a given mA, any combination ofkVp and time that lies below themAs curve is safe.

Q31. What is attenuation?
Ans. **Attenuation** is the reduction of the intensity of an **x-ray** beam as it traverses matter. The reduction may be caused by absorption or by deflection (scatter) of photons from the beam and can be affected by different factors such as beam energy and atomic number of the absorber

Q32.List three parts of the anode assembly?
Ans.i(Rotor(The shaft made of bars of copper and soft iron fabricated into one mass that is located inside the tube enclosure),ii)Stator(The part outside the enclosure that consists of a series of electromagnets equally spaced around the neck of the tube),iii)Anode
Q33.What is the frequency of a 70keV x-ray?
Ans.1.69 x 10e19 Hz by using equation E = h x f
Q34.What is the difference between a high voltage generator and high voltage transformer?
Ans.The high-voltage transformer is just one component of a high-voltage generator.
Q35.Briefly describe three imaging windows of electromagnetic spectrum?
Ans.Radiofrequency by frequency (Hertz), visible light by wavelength (meters), and x-radiation by energy (electron volts).
Q36. Describe inverse square law?
Ans. The intensity of electromagnetic radiation is inversely related to the square of the distance from the source. When light is emitted from a source such as the sun or a light bulb, the intensity decreases rapidly with the distance from the source. This decrease in intensity is inversely proportional to the square of the distance of the object from the source.

Mathematically, this is called the **inverse square law** and is expressed as follows:

$$I1/I2 = D2^2/D1^2 \quad \text{or} \quad I1/I2 = (D2/D1)^2$$

where $I1$ is the intensity at distance $d1$ from the source and $I2$ is the intensity at distance $d2$ from the source.

The reason for the rapid decrease in intensity with increasing distance is that the total light emitted is spread out over an increasingly larger area. The equivalent of this phenomenon in the water wave analogy is the reduction of wave amplitude with distance from the source. The wavelength remains fixed. If the source of electromagnetic radiation is not a point but rather a line, such as a fluorescent lamp, the inverse square law does not hold at distances close to the source. At great distances from the source, the inverse square law can be applied.
The inverse square law can be applied to distances greater than seven times the longest dimension of the source.

Q37.Explain phenomenon of thermionic emission?
Ans.The process by which free electrons are emitted from the surface of metal when external heat energy is applied. Thermionic emission occur in metals that heated to a very high temperature.
Q38.An x-ray imaging system that draw a current of 80 amperes is supplied with 220Volts.What is power consumed?
Ans.176,000 watts
Q39.Discuss working principle of electric motor?
Ans.
Q40.Discuss the properties and advantages of series and parallel resistance circuits?

Ans.**Parallel connection: Advantages**: 1. Every unit that is connected in a parallel circuit gets equal amount of voltage.

2. It becomes easy to connect or disconnect a new element without affecting the working of other elements.

3. If any fault happened to the circuit, then also the current is able to pass through the circuit through different paths.

Disadvantages: 1. It requires the use of lot of wires.

2. We cannot increase or multiply the voltage in a parallel circuit.
3. Parallel connection fails at the time when it is required to pass exactly same amount of current through **series connection:**

Advantages: 1. Series circuits do not overheat easily. This makes them very useful in the case of something that might be around a potentially flammable source, like dry plants or cloth.

2. Series circuits are easy to learn and to make. Their simple design is easy to understand, and this means that it's simple to conduct repairs .

3. we can add more power devices, they have a higher output in terms of voltage.

4. The current that flows in a series circuit has to flow through every component in the circuit. Therefore, all of the components in a series connection carry the same current.

Disadvantages: 1.If one point breaks in the series circuit, the total circuit will break.

2. As the number of components in a circuit increases ,greater will be the circuit resistance.

Characteristics of parallel circuits: more than 1 path for current

1. current is different in different resistances, but the total current is equal to the sum of the currents in all the branches
   $I_T = I_1 + I_2 + I_3$
2. voltage is the same across all resistances
   $V_T = V_1 = V_2 = V_3$
3. total resistance is less than the sum of the individual resistances
   $V_T/R_T = V_1/R_1 + V_2/R_2 + V_3/R_3$

   $1/R_T = 1/R_1 + 1/R_2 + 1/R_3$
4. a break in the circuit only stops current in the branch where the break occurs

Characteristics of series circuits: 1 path for current

1. current is the same everywhere **(ammeter operation)**
   $I_T = I_1 = I_2 = I_3$
2. voltage is different across different **resistances**
   $V_T = V_1 + V_2 + V_3$ **(voltmeter operation)**
3. total resistance is equal to the sum of the resistances
   $R = R_1 + R_2 + R_3$
4. a break in the circuit stops all current

Q41.How does anode rotate inside a glass encloser with no mechanical connection to the outside?

Ans.By an Induction motor (stator has electrical connections on the outside of the tube; the rotor inside the tube needs no connection.

Q42. At 80 kVp what is the energy in joules of the electron arriving at X-ray tube target?

Ans.1.28 x 10^(-14) J

Q43.Define Automatic exposure control (AEC), Focusing Cup, X-ray quality,Mutual induction, Bremsstrahlung X-rays

Ans. AEC:a device that measures the quantity of radiation that reaches the image receptor and automatically terminates the exposure when the image receptor has received the required radiation intensity.

Bremsstrahlung: X-rays that are produced when a projectile electron is slowed by the electric field of a target atom nucleus.

Focusing Cup: Shroud inside the x-ray tube surrounding the cathode to concentrate the electrons on the target focal spot.

Q44.Enlist film used in radiography with their size?

Ans. Types of Film Used in Medical Imaging

Types	Emulsion	**Characteristics**	Applications
Intensifying screen	Two	Blue or green sensitive	General radiography
Copy or duplicating	Single with antihalation backing	Pre-exposed	Duplicating radiographs
Dental	Two packed in sealed envelope	Has lead foil to reduce back scatter	Dentistry
Radiation monitoring	Two packed in sealed envelope	One emulsion can be sloughed off to increase OD scale	Radiation monitoring
Dry transfer	One	Thermally sensitive	"Dry" printers

Standard Film Sizes

English Units (in)	**SI Units (cm)**
7 x 7	18 x 18
8 x 10	20 x 25
10 x 12	24 x 30

14 x 14	35 x 35
14 x 17	35 x 43

Q45.What is working principle of electric generator?
Ans.
Q46.What is film? What types of films are used in radiography?Write procedure for developing the film?
Ans.**X-ray films** for general **radiography** consist of an emulsion-gelatin containing radiation sensitive silver halide crystals, such as silver bromide or silver chloride, and a flexible, transparent, blue-tinted base. ... Usually, the emulsion is coated on both sides of the base in layers about 0.0005 inch thick.
Standard film: Standard X-ray cassettes with intensifying screens have limited use, as they are too big for most uses except extra-oral views.

Types

- screen type films: faster when used with intensifying screen
  - conventional
  - orthochromatic (green sensitive)
- direct exposure type: used for dental exposures

1. Wetting/Developing
2. Stop Bath/Fix
3. Washing
4. Drying

Q47. What is the usual voltage range for diagnostic x-ray systems?
Ans. 25 to 150 kVp
25 to 150kVp

Q48. Name 3 things the operating console controls:

Ans. the voltage applied to the x-ray tube, the current through the x-ray tube *the exposure time or
On/off control, kVp selection, mA selection, time (mAs) selection, and automatic-exposure controls

Q48.What precautions are necessary when using and storing radiographic film?
Ans.i) Should be stored according to manufactures instructions: ii) protection from heat or light iii) store in clean, dry location iv) store away from chemical fumes v) store at temperature of 70^0 Fahrenheit and 40-60% humidity

Q49.What are the three functions of the anode serves in an x-ray tube?

Ans.i) It serves as target surface for the high voltage electrons from the filament(x-ray photon source) ,ii) It conducts the high voltage from the cathode back into x-ray generator circuitry, iii) Its serve as primary thermal conductor .

Q50.Describe the factors which affect the x-ray quantity and quality?

Quality refers to the overall energy of the beam

As the X-ray beam is polyenergetic, any factors that increase or decrease the average energy of photons in the beam affect x-ray beam quality.

Quality is directly affected by: i. Changes in **kVP**ii.Changes in the material (atomic number Z) of thetarget material.iii. Changes in the filtration.iv. The type of waveform used (i.e., 1φ, 3φ, or highfrequency).

Quantity refers to the number of X-ray photons in the beam .

As the number of photons increases, the beam intensity increases & any factors that affect the number of x-ray photons in the beam influence x-ray beam quantity.

Quantity is affected by, i. Changes in **mA** (tube current). ii. Changes in the filtration. iii. Changes in the material (Z number) of target. iv. Changes in **kVP**

v. Changes in type of waveform used. vi. Changes in distance from the tube (FFD).

Q51.Discuss how changing in KVP changes x-ray quantity, x-ray quality and contrast and