

CHAPTER: C - Ultrasound Therapy – Production & Technique:

1. A final-year student is preparing for ultrasound therapy on a patient. What is the primary physical principle used in the production of therapeutic ultrasound waves? (one word/phrase)
2. In the production of ultrasound, name the key component in the transducer head that converts electrical energy to mechanical vibrations.
3. The ultrasound machine uses a specific effect to generate waves. State the effect and the typical material used (e.g., crystal type).
4. Production scenario: If the frequency is set to 1 MHz, calculate the wavelength in soft tissue (velocity = 1540 m/s; use formula $\lambda = v/f$).
5. Before any treatment, you must test the machine. Name TWO simple clinical tests to check if the ultrasound head is producing output.
6. Testing the machine: You submerge the head in water and turn it on. What visible sign confirms it's working? (one phenomenon)
7. Technique of application starts with patient prep. List THREE steps in preparing the patient for ultrasound application.
8. Direct contact method: What is the most common coupling agent used, and why is it applied? (one reason)
9. In direct contact, the transducer head is moved in a specific pattern. Describe the movement technique and its purpose (≤ 15 words).
10. Water bath method: Ideal for which body parts? Name TWO irregular areas and one advantage over direct contact.
11. Water bag method: When is this method preferred, and what material is typically used for the bag?
12. Application dilemma: For a hairy area like the forearm, which method (direct, bath, bag) avoids air interface issues best? Justify.
13. Safety in technique: During application, if the patient feels sharp pain, what production or technique fault? (one cause + immediate action)
14. Integrated production-technique: In pulsed mode, how does production differ from continuous, and which application method suits acute injuries?
15. Clinical case: Tennis elbow patient. Outline steps: one production component, machine test, choose method (direct/bath/bag), why, and one parameter.

ANSWER KEY:

1. Piezoelectric effect (reverse piezoelectric for production).
2. Piezoelectric crystal (or transducer crystal).
3. Reverse piezoelectric effect; Quartz or Barium titanate (or PZT - lead zirconate titanate).
4. Wavelength = $1540 / 1,000,000 = 1.54$ mm.
5. Any two: Water fountain test, Tissue paper test, Finger sensation (mild warmth), Schlieren optical test.
6. Streaming or cavitation bubbles (fountain effect).
7. Any three: Explain procedure/consent, Expose area/clean skin, Check sensations, Position comfortably, Remove metals.
8. Ultrasound gel; to eliminate air gaps for better transmission.
9. Slow circular/stroking motions; to prevent hot spots/standing waves.
10. Hands, feet, ankles; advantage: treats irregular surfaces without pressure.
11. Preferred for wounds/ulcers; thin rubber/plastic bag filled with degassed water.
12. Water bath; immerses fully, no air trapped in hair.
13. Cause: Standing waves/poor contact; Action: Stop, check coupling, reduce intensity.
14. Production: Interrupted electrical pulses; suits acute – use pulsed with direct contact for non-thermal effects.
15. Production: Piezoelectric crystal; Test: Water test; Method: Direct contact; Why: Flat area, easy access; Parameter: 1 MHz for depth.