

Questions and Answers

Levels I, II, and III

Ultrasonic Testing Method

Supplement to
Recommended Practice
No. SNT-TC-1A
Book C



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ASNT exists to create a safer world by promoting the profession and technologies of nondestructive testing.

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Level III Answers

Ultrasonic Testing Method

- | | | | |
|-------|-------|-------|-------|
| 1. b | 15. b | 29. b | 43. c |
| 2. a | 16. a | 30. c | 44. b |
| 3. c | 17. b | 31. b | 45. d |
| 4. a | 18. b | 32. b | 46. d |
| 5. b | 19. c | 33. d | 47. c |
| 6. b | 20. d | 34. d | 48. a |
| 7. c | 21. b | 35. b | 49. d |
| 8. c | 22. c | 36. d | 50. c |
| 9. b | 23. a | 37. c | 51. d |
| 10. c | 24. d | 38. c | 52. b |
| 11. c | 25. d | 39. b | 53. c |
| 12. d | 26. c | 40. b | 54. a |
| 13. a | 27. a | 41. d | |
| 14. a | 28. a | 42. c | |

54. In general, when a discontinuity is thin it is a poor reflector. The maximum reflection is obtained when the thickness of the discontinuity is equal to at least:

- a. 1/4 wavelength
- b. 1/2 wavelength
- c. 1 wavelength
- d. even multiples of 1/2 wavelength

F.45.22

Recommended Training References

Ultrasonic Testing Method

The following references were used in formulating the questions contained in this book.

A.* *Annual Book of ASTM Standards*, Volume 03.03, *Nondestructive Testing*. Philadelphia, PA: American Society for Testing and Materials. All standards relating to ultrasonic testing. (The reference after the question refers to the specific standard where the correct answer can be found.) Latest edition.

B.* *Nondestructive Testing Handbook*, second edition: Volume 7, *Ultrasonic Testing*. Al Birks, Robert E. Green, Jr., technical eds., Paul McIntire, ed. Columbus, OH: The American Society for Nondestructive Testing, Inc. 1991.

C.* *Ultrasonic Testing, Programmed Instruction Handbook (PI-4-4)*. San Diego, CA: General Dynamics/Convair Division. 1981. (Now published by The American Society for Nondestructive Testing, Inc.)

D.* Krautkramer, J. and H. Krautkramer. *Ultrasonic Testing of Materials*, fourth edition. New York: Springer-Verlag, Inc. 1990.

E.* McGonnagle, W.J. *Nondestructive Testing*, second edition. New York: Gordon & Breach, Science Publishers, Inc. 1975.

F.* McMaster, R.C., ed. *Nondestructive Testing Handbook*, first edition. Columbus, OH: The American Society for Nondestructive Testing. 1959. Sections 43-50.

G.* *Nondestructive Testing Handbook*, second edition: Volume 10, *Nondestructive Testing Overview*, Stanley Ness, Charles E. Sherlock, technical eds., Paul McIntire and Patrick O. Moore, eds. Columbus, OH: The American Society for Nondestructive Testing, Inc. 1996.

H.* *Ultrasonic Testing, Classroom Training Handbook (CT-6-4)*. San Diego, CA: General Dynamics/Convair Division, second edition. 1981. (Now published by The American Society for Nondestructive Testing, Inc.)

I.* *Nondestructive Inspection and Quality Control: ASM Handbook*, Volume 17, ninth edition. Metals Park, OH: ASM International. 1989.

*Available from The American Society for Nondestructive Testing, Inc.

Each question found in this book contains letter(s) and page number(s) in bold type immediately following the answers. For example,

1. The indication on the cathode ray tube (CRT) which represents the far boundary of the material being tested is called:

a. hash

b. the initial pause

c. the main bang

d. the back surface reflection

H.2-8

In this example, the letter “H” refers to Reference H in the list provided above and 2-8 is the specific page in Reference H where the answer to the question can be found.

Reference Usage List

Ultrasonic Testing Method

Reference A: Total = 8
Level I (6)
Level II (2)
Level III (0)

Reference F: Total = 159
Level I (80)
Level II (54)
Level III (25)

Reference B: Total = 21
Level I (7)
Level II (9)
Level III (5)

Reference G: Total = 1
Level I (0)
Level II (1)
Level III (0)

Reference C: Total = 5
Level I (4)
Level II (1)
Level III (0)

Reference H: Total = 189
Level I (80)
Level II (98)
Level III (11)

Reference D: Total = 40
Level I (9)
Level II (13)
Level III (18)

Reference I: Total = 103
Level I (35)
Level II (64)
Level III (5)

Reference E: Total = 30
Level I (22)
Level II (8)
Level III (0)

43. The thickness range of UT resonance thickness gages can be increased by:

- a. using large transducers
- b. operating at the fundamental frequency
- c. operating at a harmonic frequency
- d. increasing the voltage

F.43.37

44. The ability of transducers to detect echoes from small defects is a definition for:

- a. resolution
- b. sensitivity
- c. definition
- d. gain

F.44.5

45. The length of the near field for a 2.5 cm (1 in.) diameter, 5 MHz transducer placed in oil ($V = 1.4 \times 10^5$ cm/s) is approximately:

- a. 0.028 cm (0.01 in.)
- b. 6.25 cm (2.5 in.)
- c. 22.3 cm (8.8 in.)
- d. 55.8 cm (22 in.)

B.197; F.44.13

46. From the equation for the length of the near field, it can be determined that the near field can be minimized by:

- a. decreasing water travel distance
- b. increasing transducer diameter
- c. decreasing the size of reference targets
- d. decreasing test frequency

F.44.13

47. In a water ($V_L = 1.5 \times 10^5$ cm/s) immersion test, ultrasonic energy is transmitted into steel ($V_T = 3.2 \times 10^5$ cm/s) at an incident angle of 14 degrees. What is the refracted shear wave within the material?

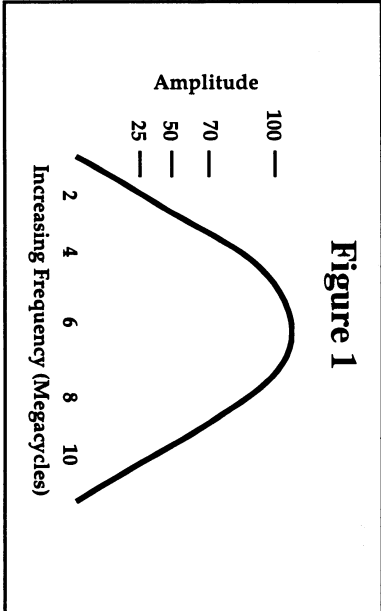
- a. 13 degrees
- b. 35 degrees
- c. 31 degrees
- d. 53 degrees

F.43.15

48. The approximate bandwidth of the transducer with the frequency response shown in Figure 1 (–3 dB) is:

- a. 4 MHz
- b. 8 MHz
- c. 10 MHz
- d. 12 MHz

F.44.4



49. The acoustic impedance for brass ($V = 4.43 \times 10^5$ cm/s, $P = 8.42$ gm/cm³) is:

- a. 0.53×10^5 gm/cm²s
- b. 1.9×10^5 gm/cm²s
- c. 9.4×10^5 gm/cm²s
- d. 37×10^5 gm/cm²s

F.43.12

50. The principal attributes that determine the differences in ultrasonic velocities among materials are:

- a. frequency and wavelength
- b. thickness and travel time
- c. elasticity and density
- d. chemistry and permeability

H.2-17

51. What would be the wavelength of the energy in lead ($V = 2.1 \times 10^5$ cm/s) if it is tested with a 25 MHz transducer?

- a. 119 cm (47 in.)
- b. 0.525 cm (0.21 in.)
- c. 0.0119 cm (0.005 in.)
- d. 0.0084 cm (0.003 in.)

F.43.9

52. What is the transducer half-angle beam spread of a 1.25 cm diameter, 2.25 MHz transducer in water ($V = 1.5 \times 10^5$ cm/s)?

- a. 2.5 degrees
- b. 3.75 degrees
- c. 37.5 degrees
- d. 40.5 degrees

H.2-30

53. The term that is used to determine the relative transmittance and reflectance of ultrasonic energy at an interface is called:

- a. acoustic attenuation
- b. interface refraction
- c. acoustic impedance ratio
- d. acoustic frequency

F.43.12

31. Rough surfaces can cause undesirable effects which are noticeable when parts are tested ultrasonically, including:

a. annular maxima rings

b. an increase in the width of front face echo and consequent loss of resolving power

c. acoustical mismatch

d. asymmetrical modes

F.45.15

32. Rough surfaces cause the echo amplitude from discontinuities within the part to:

a. increase

b. decrease

c. not change

d. change frequency

33. When a sound beam travels from a liquid into a metal through a contoured surface, the sound beam inside the metal will:

a. have the phase velocities of the first symmetrical and asymmetrical modes

b. have the phase velocity of the incident longitudinal wave

c. not be affected by the part geometry

d. be convergent if the surface is concave, and divergent if the surface is convex

F.45.13

34. The resonant frequency of a 2 cm (0.79 in.) thick plate of Naval brass ($V = 4.43 \times 10^5$ cm/s) is:

a. 0.903 MHz

b. 0.443 MHz

c. 0.222 MHz

d. 0.111 MHz

D.128, 233

35. Resonance testing equipment generally utilizes:

a. pulsed longitudinal waves

b. continuous longitudinal waves

c. pulsed shear waves

d. continuous shear waves

F.50.1

36. To eliminate the decrease of sensitivity close to a wall which is parallel to the beam direction, the transducer used should be:

a. as small as possible

b. of as low frequency as possible

c. both a and b

d. large and with a frequency as high as possible

D.191

37. Some information on the shape of a flaw may be given by:

a. the shape of the echo

b. the amplitude of the echo

c. both a and b

d. neither a nor b

D.342; L.245

38. Which of the following transducer materials makes the best transmitter:

a. quartz

b. lithium sulfate

c. barium titanate

d. none of the above

D.117, 119, 123-125; L.255

39. Of the transducer materials listed below, the most efficient receiver is:

a. quartz

b. lithium sulfate

c. barium titanate

d. lead metaniobate

D.119, 123-125; L.255

40. The concentration of energy in the far field of a transducer beam is:

a. greatest at the outer edges of the beam

b. greatest at the center of the beam

c. the same at the outer edges as in the center of the beam

d. directly proportional to beam width

H.2-31

41. A typical application of shear waves in ultrasonic testing is the inspection of:

a. welds

b. plate

c. pipe and tubing

d. all of the above

H.4-10

42. In angle beam shear wave testing, skip distance will _____ as the thickness of the test specimen is increased.

a. decrease

b. not change

c. increase

d. decrease by half with double thickness

D.299-303
- ## Level I Questions

Ultrasonic Testing Method
1. The indication on the instrument display that represents the far boundary of the material being tested is called:

a. hash

b. the initial pause

c. the main bang

d. the back surface reflection

H.2-8

2. In immersion testing, the position of the transducer is often varied to transmit sound into the test part at various angles to the front surface. Such a procedure is referred to as:

a. angulation

b. dispersion

c. reflection testing

d. refraction

F.45.10; H.3-12

3. The cable that connects the ultrasonic instrument to the transducer is specially designed so that one conductor is centered inside another. The technical name for such a cable is:

a. BX cable

b. conduit

c. coaxial cable

d. ultrasonic conductor cable-grade 20

H.3-13, Fig. 3-9

4. The process of comparing an instrument or device with a standard is called:

a. angulation

b. calibration

c. attenuation

d. correlation

F.43.37

5. Another name for a compressional wave is:

a. Lamb wave

b. shear wave

c. longitudinal wave

d. transverse wave

F.43.9; H.2-5

6. Another name for Rayleigh waves is:

a. shear waves

b. longitudinal waves

c. transverse waves

d. surface waves

H.2-32

7. A material used between the face of a transducer and the test surface to permit or improve the transmission of ultrasonic vibrations from the transducer to the material being tested is called:

a. a wetting agent

b. a couplant

c. an acoustic transmitter

d. a lubricant

H.3-21

8. The piezoelectric material in a transducer that vibrates to produce ultrasonic waves is called a:

a. backing material

b. Lucite™ wedge

c. crystal

d. couplant

H.2-7

9. Ultrasonic testing of material where the transducer is in direct contact with the material being tested may be:

a. straight beam testing

b. surface wave testing

c. angle beam testing

d. all of the above

H.4-7

10. An advantage of using lithium sulfate in transducers is that it:

a. is one of the most efficient generators of ultrasonic energy

b. is one of the most efficient receivers of ultrasonic energy

c. is insoluble

d. can withstand temperatures as high as 700 °C (1 260 °F)

F.44.3; H.3-14
- 50
- 7

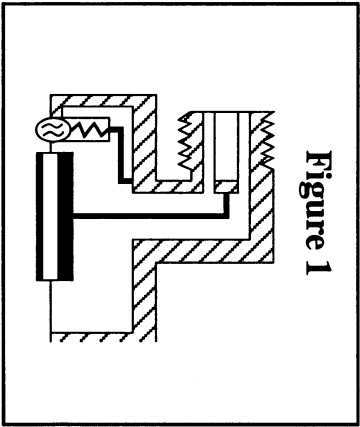
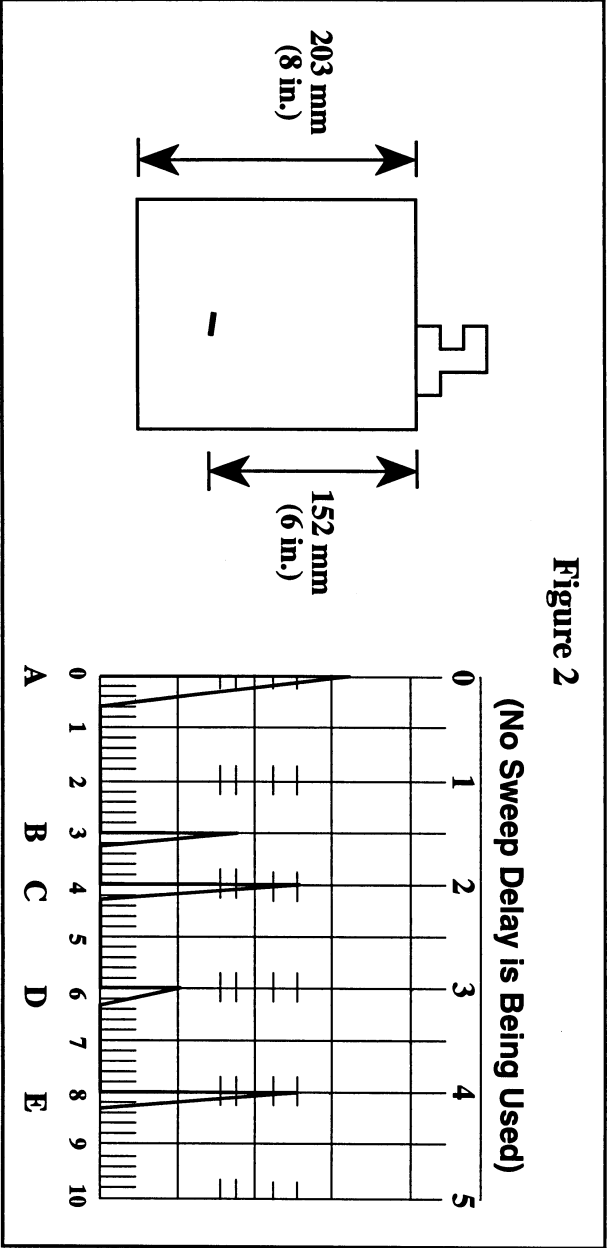


Figure 1

11. The transducer shown in Figure 1 is used for:
- a. surface wave testing
 - b. angle beam testing
 - c. immersion testing
 - d. straight beam testing
- F.43.5; H.3-17
12. The transducer that contains the thinnest piezoelectric crystal is a:
- a. 1 MHz transducer
 - b. 5 MHz transducer
 - c. 15 MHz transducer
 - d. 25 MHz transducer
- B.6; E.223; H.3-20
13. A 25 MHz transducer would most likely be used during:
- a. straight beam contact testing
 - b. immersion testing
 - c. angle beam contact testing
 - d. surface wave contact testing
- F.43.7; H.3-20



14. The amount of beam divergence from a crystal is primarily dependent on the:
- a. type of test
 - b. tightness of crystal backing in the transducer
 - c. frequency and crystal size
 - d. pulse length
- B.54; H.2-30; I.240
15. When an ultrasonic beam passes through the interface between two dissimilar materials at an angle, a new angle of sound travel takes place in the second material due to:
- a. attenuation
 - b. rarefaction
 - c. compression
 - d. refraction
- F.43.15; H.2-19, 2-21; I.236

NOTE: Using Figure 2, answer questions 16 through 20.

16. Figure 2 illustrates a contact test on an 203 mm (8 in.) aluminum block. A discontinuity is located 152 mm (6 in.) from the front surface. The display representation for this is shown to the right. What does indication A represent?
- a. The initial pulse or front surface indication.
 - b. The first discontinuity indication.
 - c. The first back surface reflection.
 - d. None of the above.
- E.231; F.43.31, F.47.2, 47.6; I.245

20. Based upon wave theory and ignoring attenuation losses, the echo amplitude is:
- a. directly proportional to the distance to the reflector
 - b. inversely proportional to the distance to the reflector
 - c. directly proportional to the square of the distance to the reflector
 - d. inversely proportional to the square of the distance from the reflector
- F.44.12

21. The rate generator in B-scan equipment will invariably be directly connected to the:
- a. display intensity circuit
 - b. pulser circuit
 - c. RF amplifier circuit
 - d. horizontal sweep circuit
- F.43.34

22. In A-scan equipment, the RF pulser output voltage is normally in the range of:
- a. 1-10 V
 - b. 10-100 V
 - c. 100-1 000 V
 - d. 1 000-3 000 V
- B.123

23. When contact testing, an increase in tightness of a shrink fit to a hollow shaft will cause the ratio of the back reflection to the metal-to-metal interface reflection to:
- a. increase
 - b. decrease
 - c. remain unchanged
 - d. cannot be predicted as the response is material-dependent
- D.475

24. During the inspection of a parallel-sided, machined forging using the straight beam immersion technique, a diminished back reflection in a localized area in the absence of a defect indication would *least* likely represent:
- a. a coarse grain structure
 - b. small nonmetallic stringers
 - c. a defect oriented at a severe angle to the entry surface
 - d. a large inclusion
- F.47.7

25. The frequency that can best distinguish the difference between a large planar defect and 4 stacked (multiple-layered) laminations in rolled plate is:
- a. 0.5 MHz
 - b. 1 MHz
 - c. 2.25 MHz
 - d. 5 MHz
- H.3-20

26. During immersion examination, when evaluating the response from a contoured surface of a part, irrelevant indications due to the contour are most likely to appear as:
- a. sharp spiked signal indications
 - b. irregular signal indications
 - c. broad-based signal indications
 - d. hash
- H.4-32

27. The pulse applied to the electrodes of the ultrasonic transducer is:
- a. electrical
 - b. mechanical
 - c. electro-mechanical
 - d. piezoelectrical
- F.44.5

28. In calibrating an ultrasonic test instrument utilizing the responses from each of the area amplitude type reference blocks, the determination of the:
- a. vertical range is obtained
 - b. pulse range is obtained
 - c. resolving range is obtained
 - d. horizontal range is obtained
- H.5-7

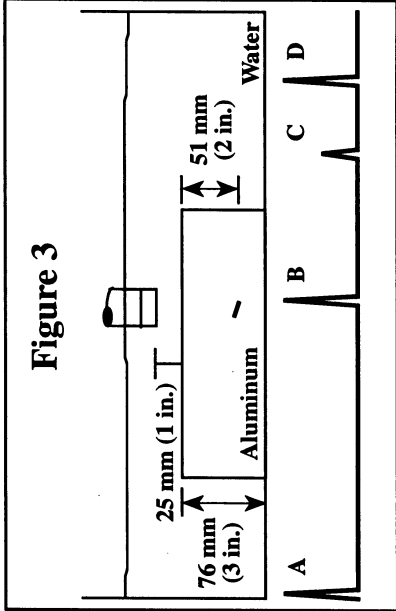
29. Test sensitivity corrections for metal distance and discontinuity area responses are accomplished by using:
- a. an area amplitude set of blocks
 - b. an area amplitude and a distance amplitude set of blocks
 - c. a distance amplitude set of blocks
 - d. steel balls of varying diameter
- H.5-6

30. The time from the start of the ultrasonic pulse until the reverberations completely decay limits the maximum usable:
- a. pulse time-flaw rate
 - b. pulser/receiver rate
 - c. pulse repetition rate
 - d. modified pulse-time rate
- F.43.28

9. The preferred method of ultrasonically inspecting a complex-shaped forging:
- a. is an automated immersion test of the finished forging using an instrument containing a calibrated attenuator in conjunction with a C-scan recorder
 - b. combines thorough inspection of the billet prior to forging with a careful inspection of the finished part in all areas where the shape permits
 - c. is a manual contact test of the finished part
 - d. is an automated immersion test of the billet prior to forging
- I.504**
10. In a long rod that is examined from one end with a longitudinal beam, the most likely effect of longitudinally-oriented discontinuities would be to:
- a. significantly reduce the back surface reflection
 - b. cause echoes between the initial pulse and the first back surface reflection for which the reflector locations cannot be precisely determined
 - c. remove or reduce the amplitude of echoes from refracted beam paths
 - d. cause excessive baseline noise
- F.48.27**
11. When maximum sensitivity is required from a transducer:
- a. a straight-beam unit should be used
 - b. large diameter crystals are required
 - c. the piezoelectric element should be driven at its fundamental resonant frequency
 - d. the band width of the transducer should be as large as possible
- F.43.4**
12. The 1 MHz transducer that should normally have the best time or distance resolution is a:
- a. quartz transducer with air backing
 - b. quartz transducer with phenolic backing
 - c. barium titanate transducer with phenolic backing
 - d. lithium sulfate transducer with epoxy backing
- F.43.5**
13. The sensitivity of an ultrasonic test system:
- a. depends on the transducer, pulser, and amplifier used
 - b. decreases as the frequency is increased
 - c. increases as the resolution increases
 - d. is not related to mechanical damping or the transducer
- F.43.5**
14. The ability of a test system to separate the front-surface echo and the echo from a small discontinuity just below the surface:
- a. depends primarily upon the pulse length generated from the instrument
 - b. is not related to the surface roughness of the part under inspection
 - c. is primarily related to the thickness of the part under inspection
 - d. is usually improved by using a larger diameter transducer
- H.3-13**
15. Transducer sensitivity is most often determined by:
- a. calculations based on frequency and thickness of piezoelectric element
 - b. the amplitude of the response from an artificial discontinuity
 - c. comparing it to a similar transducer made by the same manufacturer
 - d. determining the ringing time of transducer
- H.3-13**
16. Notches are frequently used as reference reflectors for:
- a. distance amplitude calibration for shear waves
 - b. area amplitude calibration
 - c. thickness calibration of plate
 - d. determining near-surface solutions
- H.3-19, 3-22**
17. Notches provide good reference discontinuities when UT examination is conducted to primarily detect defects such as:
- a. porosity in rolled plate
 - b. inadequate penetration at the root of a weld
 - c. weld porosity
 - d. internal inclusions
- F.48.18**
18. The difference between a compression and shear wave is:
- a. quantitative measure
 - b. particle direction
 - c. qualitative measure
 - d. amplitude
- D.7**
19. The particle motion for Rayleigh waves is usually described as:
- a. sinusoidal
 - b. circular
 - c. elliptical
 - d. shear
- B.41**

17. In Figure 2, indication B represents:
- a. the initial pulse or front surface indication
 - b. the first discontinuity indication
 - c. the first back surface reflection
 - d. none of the above
- E.231; F.47.2, 6, 43.31; I.245**
18. In Figure 2, indication C represents the:
- a. second back surface reflection
 - b. first discontinuity indication
 - c. second discontinuity indication
 - d. first back surface reflection
- E.231; F.43.31, 47.2, 6; I.245**
19. In Figure 2, indication D represents the:
- a. first discontinuity indication
 - b. second indication of the discontinuity
 - c. first back surface reflection
 - d. second back surface reflection
- E.231; F.43.31, 47.2, 6; I.245**
20. In Figure 2, indication E represents the:
- a. first discontinuity indication
 - b. second discontinuity indication
 - c. first back surface reflection
 - d. second back surface reflection
- E.231; F.43.31, 47.2, 6; I.245**
21. The velocity of surface waves is approximately _____ the velocity of shear waves in the same material.
- a. two times
 - b. four times
 - c. 1/2
 - d. 9/10
- F.43.8**
22. Figure 3 illustrates an immersion test of a 76 mm (3 in.) block of aluminum with a discontinuity located 51 mm (2 in.) below the surface. The display pattern is shown also. What does indication A represent? Assume no sweep delay is used.
- a. The first front surface indication.
 - b. The initial pulse.
 - c. The first discontinuity indication.
 - d. The first back surface reflection.
- F.43.31, 47.2-4; H.4-6, H.2-9; I.245**
23. In Figure 3, indication B represents the:
- a. first front surface indication
 - b. initial pulse
 - c. first back surface reflection
 - d. first discontinuity reflection
- F.43.31, 47.2-4; H.4-6, 2-9; I.245**
24. In Figure 3, indication C represents the:
- a. first front surface indication
 - b. first discontinuity indication
 - c. first back surface reflection
 - d. second front surface indication
- F.43.31, 47.2-4; H.4-6, 2-9; I.245**
25. In Figure 3, indication D represents the:
- a. first discontinuity indication
 - b. first back surface reflection
 - c. second front surface indication
 - d. second discontinuity indication
- F.43.31, 47.2-4; H.4-6, 2-9; I.245**
26. In Figure 3, the distance between indications A and B represents:
- a. the distance from the front surface of the aluminum block to the discontinuity
 - b. the distance from the front surface of the aluminum block to the back surface of the aluminum block
 - c. the water distance from the transducer to the aluminum block
 - d. none of the above
- F.43.31, F.47.2-4; H.4-6, 2-9; I.245**
27. Under most circumstances, which of the following frequencies would result in the best resolving power?
- a. 1 MHz
 - b. 5 MHz
 - c. 10 MHz
 - d. 25 MHz
- F.43.5; H.3-20**

NOTE: Using Figure 3, answer questions 22 through 26.



Ultrasonic Testing Method, Level I

28. Which of the following materials of the same alloy is most likely to produce the greatest amount of sound attenuation over a given distance?

a. A hand forging.
b. A coarse-grained casting.
c. An extrusion.
d. The attenuation is equal in all materials.

B.377; E.221; F.48.10; H.2-28; I.238

34. When the motion of the particles of a medium is parallel to the direction of propagation, the wave being transmitted is called a:

a. longitudinal wave
b. shear wave
c. surface wave
d. Lamb wave

E.210
29. In contact testing, the entry surface indication is sometimes referred to as:

a. the initial pulse
b. the back reflection
c. the skip distance
d. the scan path

H.2-8

35. When the motion of the particles of a medium is transverse to the direction of propagation, the wave being transmitted is called a:

a. longitudinal wave
b. shear wave
c. surface wave
d. Lamb wave

E.210
30. An ultrasonic instrument display pattern containing a large number of low-level indications (often referred to as "hash") could be caused by:

a. a crack
b. a large inclusion
c. coarse-grained material
d. a gas pocket

E.221; F.47.14; I.238

36. "25 million cycles per second" can also be stated as:

a. 25 kHz
b. 2500 kHz
c. 25 MHz
d. 25 μHz

H.2-5
31. A test method employing two separate transducers on opposite surfaces of the material being tested is called:

a. contact testing
b. surface wave testing
c. through-transmission testing
d. Lamb wave testing

H.4-9

37. Moving a transducer over a test surface either manually or automatically is referred to as:

a. scanning
b. attenuating
c. angulating
d. resonating

E.250
32. The number of complete waves that pass a given point in a given period of time (usually 1 s) is referred to as the:

a. amplitude of a wave motion
b. pulse length of a wave motion
c. frequency of a wave motion
d. wavelength of a wave motion

H.2-5

38. A term used in ultrasonics to express the rate at which sound waves pass through various substances is:

a. frequency
b. velocity
c. wavelength
d. pulse length

F.43.9
33. The boundary between two different materials that are in contact with each other is called:

a. a rarefactor
b. a refractor
c. an interface
d. a marker

E.216

39. When a vertical indication has reached the maximum signal height which can be displayed or viewed on the display of an ultrasonic instrument, the indication is said to have reached its:

a. distance amplitude height
b. absorption level
c. vertical level
d. limit of resolution

A.E-500

Level III Questions
Ultrasonic Testing Method

1. In an ultrasonic test system where signal amplitudes are displayed, an advantage of a frequency-independent attenuator over a continuously variable gain control is that:

a. the pulse shape distortion is less
b. the signal amplitude measured using the attenuator is independent of frequency
c. the dynamic range of the system is decreased
d. the effect of amplification threshold is avoided

B.124

5. The intended purpose of the adjustable calibrated attenuator of an ultrasonic instrument is to:

a. control transducer damping
b. increase the dynamic range of the instrument
c. broaden the frequency range
d. attenuate the voltage applied to the transducer

B.160; D.210
2. An amplifier in which received echo pulses must exceed a certain threshold voltage before they can be indicated might be used to:

a. suppress amplifier noise, unimportant scatter echoes, or small flaw echoes that are of no consequence
b. provide a display with nearly ideal vertical linearity characteristics
c. compensate for the unavoidable effects of material attenuation losses
d. provide distance amplitude correction

D.176

6. Which of the following might result in increased transmission of ultrasound within a coarse-grained material?

a. perform the examination with a smaller diameter transducer
b. perform the examination after a grain refining heat treatment
c. change from a contact examination to an immersion examination
d. change from a longitudinal to a transverse wave

F.48.30
3. The output voltage from a saturated amplifier is:

a. 180 degrees out of phase from the input voltage
b. lower than the input voltage
c. nonlinear with respect to the input voltage
d. below saturation

D.176, 182

7. When material grain size is on the order of _____ wavelength of larger, excessive scattering of the ultrasonic beam may affect test results.

a. 1
b. 1/2
c. 1/10
d. 1/100

I.238
4. The transmitted pulse at the output of the pulser usually has a voltage of 100 to 1 000V, whereas the voltages of the echoes at the input of the amplifier are on the order of:

a. 0.001-1 V
b. 1-5 V
c. 10 V
d. 50 V

D.174-176

8. In a forging, flaws associated with nonmetallic inclusions can most accurately be described as being:

a. oriented parallel to the major axis
b. parallel to the minor axis
c. aligned with forging flow lines
d. oriented at approximately 45 degrees to the forging direction

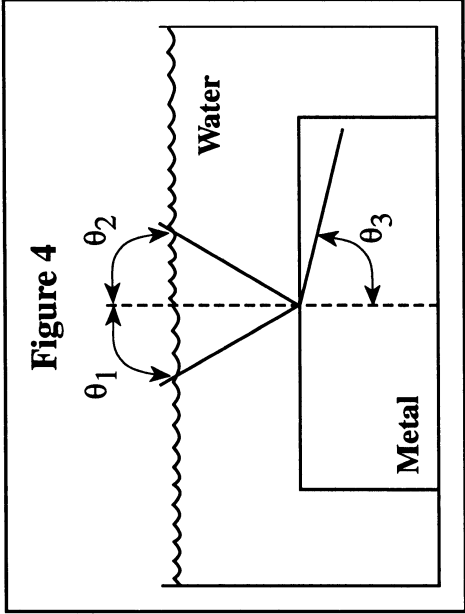
D.340

153. a
154. c
155. a
156. d
157. a
158. b
159. c
160. c
161. b
162. d
163. d
164. b
165. a
179. c
180. b
181. d
182. b
183. a
184. c
185. b
186. c
187. b
188. c
189. b
190. a
191. a
192. b
193. b
194. c
195. d
196. c
197. a
198. d
199. c
200. a
201. d
202. d
203. d

40. An ultrasonic testing technique in which the transducer element is not parallel to the test surface is called:
- a. angle beam testing
b. immersion testing
c. contact testing
d. through-transmission testing

H.4-9

NOTE: Using Figure 4, answer questions 41 through 43.



41. In Figure 4, angle 1 (θ_1) is called:

- a. the angle of incidence
b. the angle of reflection
c. the angle of refraction
d. none of the above

F.43.15

42. In Figure 4, angle 2 (θ_2) is called:

- a. the angle of incidence
b. the angle of reflection
c. the angle of refraction
d. none of the above

F.43.15

43. In Figure 4, angle 3 (θ_3) is called:

- a. the angle of incidence
b. the angle of reflection
c. the angle of refraction
d. none of the above

F.43.15

44. Most commercial ultrasonic testing is accomplished using frequencies between:

- a. 1 and 25 kHz
b. 1 and 1 000 kHz
c. 0.2 and 25 MHz
d. 15 and 100 MHz

F.43.1; H.3-20

45. In an A-scan presentation, the horizontal base line represents:

- a. the amount of reflected ultrasonic sound energy
b. the distance traveled by the transducer
c. the elapsed time or distance
d. none of the above

F.43.29

46. In an A-scan presentation, the amplitude of vertical indications on the display represents the:

- a. amount of ultrasonic sound energy returning to the transducer
b. distance traveled by the transducer
c. thickness of material being tested
d. elapsed time since the ultrasonic pulse was generated

F.43.29

47. Which of the following test frequencies would generally provide the best penetration in a 30 cm (12 in.) thick specimen of coarse-grained steel?

- a. 1 MHz
b. 2.25 MHz
c. 5 MHz
d. 10 MHz

F.48.2

48. In a basic ultrasonic test pattern (A-scan) for contact testing (assuming no sweep delay is used), the initial pulse:

- a. is the high indication on the extreme left side of the display that represents the entry surface of the inspected part
b. is the first pulse that occurs near the right side of the display and represents the opposite boundary of the inspected part
c. is an indication that appears and disappears during screening
d. is always the second pulse from the left on the viewing display

H.2-8; I.242

49. An ultrasonic test using a straight beam contact transducer is being conducted through the thickness of a flat part such as a plate. This test should detect:

- a. laminar-type flaws with major dimensions parallel to the rolled surface
b. transverse-type flaws with major dimensions at right angles to the rolled surface
c. radial flaws with major dimensions along length but radially oriented to the rolled surface
d. none of the above

D.380; F.48.11; H.7-43

Ultrasonic Testing Method, Level I

50. In ultrasonic testing, a liquid coupling medium between the crystal surface and the part surface is necessary because:

a. lubricant is required to minimize wear on the crystal surface

b. an air interface between the crystal surface and the part surface would almost completely reflect the ultrasonic vibrations

c. the crystal will not vibrate if placed directly in contact with the surface of the part being inspected

d. the liquid is necessary to complete the electrical circuit in the transducer

A.E-214; F.48.3; H.3-21

51. Entry surface resolution is a characteristic of an ultrasonic testing system which defines its ability to:

a. detect discontinuities oriented in a direction parallel to the ultrasonic beam

b. detect discontinuities located in the center of a forging containing a fine metallurgic structure

c. detect minute surface scratches

d. detect discontinuities located just beneath the entry surface in the part being tested

A.E-317; F.43.1; H.3-13

52. During ultrasonic testing by the immersion method, it is frequently necessary to angulate the transducer when a discontinuity is located in order to:

a. avoid a large number of back reflections that could interfere with a normal test pattern

b. obtain a maximum response if the discontinuity is not originally oriented perpendicular to the ultrasonic beam

c. obtain the maximum number of entry surface reflections

d. obtain a discontinuity indication of the same height as the indication from the flat bottom hole in a reference block

A.E-214; F.46.17, 46.19, 47.13

53. All other factors being equal, the mode of vibration that has the greatest velocity is the:

a. shear wave

b. transverse wave

c. surface wave

d. longitudinal wave

D.37; F.43.8; H.2-18

54. On the area amplitude ultrasonic standard test blocks, the flat bottom holes in the blocks are:

a. all of the same diameter

b. different in diameter, increasing by 0.4 mm (0.016 in.) increments from the No. "1" block to the No. "8" block

c. largest in the No. "1" block and smallest in the No. "8" block

d. drilled to different depths from the front surface of the test block

A.E-217; H.3-20, 5-4

55. In immersion testing, verification that the transducer is normal to a flat entry surface is indicated by:

a. maximum reflection from the entry surface

b. elimination of water multiples

c. proper wavelength

d. maximum amplitude of the initial pulse

F.46.17

56. A piezoelectric material can:

a. convert a longitudinal beam to a shear wave

b. convert a mechanical energy to electrical energy

c. create ionization in a test specimen

d. produce sound waves in a coaxial cable

F.44.1

57. Sound waves of a frequency beyond the hearing range of the human ear are referred to as ultrasonic waves or vibrations, and the term embraces all vibrational waves of frequency greater than approximately:

a. 2 kHz

b. 200 kHz

c. 20 000 Hz

d. 2 MHz

D.1; H.2-5

58. The velocity of sound waves is primarily dependent on:

a. the pulse length

b. the angle of incidence

c. the material, material thickness, and UT frequency (time between signals on the display)

d. none of the above

B.367; D.38

59. A disadvantage of using natural quartz in a transducer is that:

a. it will dissolve in water

b. it is the least effective generator of ultrasonic energy of all commonly used materials

c. it is mechanically and electrically unstable

d. it easily loses its operating characteristics as it ages

F.44.2; H.3-14
- 12
- Level II Answers
Ultrasonic Testing Method
1. d

2. d

3. b

4. c

5. c

6. d

7. d

8. b

9. d

10. d

11. d

12. b

13. c

14. c

15. b

16. c

17. b

18. a

19. a

20. c

21. a

22. a

23. c

24. a

25. b

26. d

27. a

28. d

29. b

30. c

31. d

32. d

33. a

34. b

35. b

36. c

37. c

38. d

39. c

40. d

41. d

42. c

43. a

44. a

45. c

46. b

47. a

48. c

49. c

50. d

51. b

52. a

53. a

54. d

55. b

56. c

57. b

58. b

59. c

60. d

61. c

62. d

63. a

64. c

65. b

66. d

67. c

68. d

69. b

70. b

71. b

72. c

73. b

74. d

75. b

76. a

77. a

78. c

79. b

80. c

81. b

82. d

83. c

84. b

85. a

86. c

87. d

88. a

89. d

90. a

91. c

92. d

93. a

94. a

95. a

96. b

97. a

98. c

99. b

100. c

101. d

102. d

103. d

104. c

105. d

106. b

107. b

108. a

109. c

110. a

111. a

112. c

113. a

114. a

115. b

116. d

117. b

118. a

119. a

120. d

121. d

122. c

123. a

124. b

125. b

126. d

127. b

128. a

129. d

130. b

131. a

132. b

133. d

134. a

135. c

136. a

137. a

138. c

139. a

140. b

141. b

142. c

143. d

144. b

145. d

146. c

147. c

148. a

149. d

150. b

151. c

152. d
- 45

60. An advantage of using a ceramic transducer in transducers is that it:
- a. is one of the most efficient generators of ultrasonic energy
 - b. is one of the most efficient receivers of ultrasonic energy
 - c. has a very low mechanical impedance
 - d. can withstand temperatures as high as 700 °C (1 260 °F)
66. The angle of incidence is:
- a. greater than the angle of reflection
 - b. less than the angle of reflection
 - c. equal to the angle of reflection
 - d. not related to the angle of reflection

H.A-1

67. On many ultrasonic testing instruments, an operator conducting an immersion test can remove that portion of the display presentation that represents water distance by adjusting a:

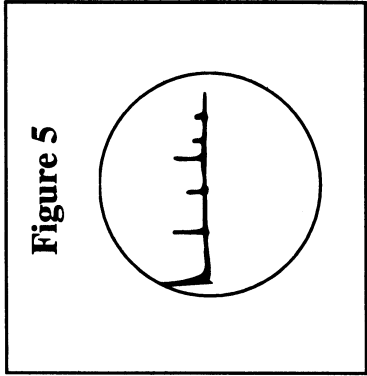
- a. pulse length control
- b. reject control
- c. sweep delay control
- d. sweep length control

H.2-4

68. "100 000 cycles per second" can be written:

- a. 0.1 kHz
- b. 10 kHz
- c. 100 kHz
- d. 100 MHz

H.2-4



69. Figure 5 is an illustration of a typical:

- a. A-scan presentation
- b. B-scan presentation
- c. C-scan presentation
- d. D-scan presentation

F.43.30

61. The primary purpose of reference blocks is to:
- a. aid the operator in obtaining maximum back reflections
 - b. obtain the greatest sensitivity possible from an instrument
 - c. obtain a common reproducible signal
 - d. none of the above
62. When testing by the surface wave method, patches of oil or dirt on the surface may:

F.44.2; H.3-14

63. In immersion testing, the most commonly used couplant is:

- a. water
- b. oil
- c. glycerine
- d. alcohol

H.3-22

64. The piezoelectric material in the transducer:

- a. converts electrical energy into sound
- b. converts electrical energy into mechanical energy
- c. eliminates the signal-to-noise energy
- d. produces high speed electrons in metals

E.222; H.3-22

65. The shortest wavelength pulse is produced by a frequency of:

- a. 1 MHz
- b. 5 MHz
- c. 10 MHz
- d. 25 MHz

H.2-7

66. The angle of incidence is:

- a. greater than the angle of reflection
- b. less than the angle of reflection
- c. equal to the angle of reflection
- d. not related to the angle of reflection

H.2-16

67. On many ultrasonic testing instruments, an operator conducting an immersion test can remove that portion of the display presentation that represents water distance by adjusting a:

- a. pulse length control
- b. reject control
- c. sweep delay control
- d. sweep length control

H.2-4

68. "100 000 cycles per second" can be written:

- a. 0.1 kHz
- b. 10 kHz
- c. 100 kHz
- d. 100 MHz

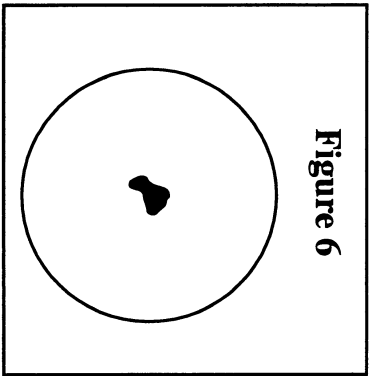
H.2-4

Figure 5

69. Figure 5 is an illustration of a typical:

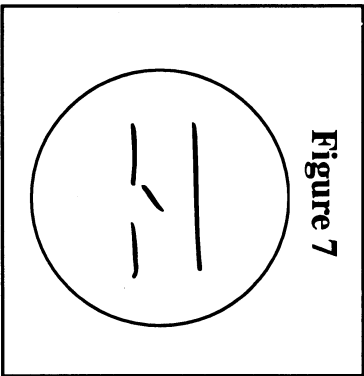
- a. A-scan presentation
- b. B-scan presentation
- c. C-scan presentation
- d. D-scan presentation

F.43.30



70. Figure 6 is an illustration of a typical:
- a. A-scan presentation
 - b. B-scan presentation
 - c. C-scan presentation
 - d. D-scan presentation

E.251; F.46.5; I.242



71. Figure 7 is an illustration of a typical:
- a. A-scan presentation
 - b. B-scan presentation
 - c. C-scan presentation
 - d. D-scan presentation

E.251; F.46.4; I.242

72. A transducer with a frequency greater than 10 MHz will most likely be used during:
- a. a straight beam contact test of aluminum ingot
 - b. an angle beam contact test of a steel pipe
 - c. a surface wave contact test of a metallic plate
 - d. an immersion test
73. The reference holes in standard aluminum area amplitude ultrasonic test blocks contain:
- a. flat bottom holes
 - b. concave-surface holes
 - c. convex-surface holes
 - d. conical-shaped holes

A.E-127; H.5-4

74. The gradual loss of sonic energy as the ultrasonic vibrations travel through the material is referred to as:
- a. reflection
 - b. refraction
 - c. reproducibility
 - d. attenuation

F.43.22; H.2-26; I.238

75. A term used to describe numerous small indications on the instrument display resulting from test part structure, numerous small discontinuities, or both is often referred to as:
- a. multiple back reflections
 - b. multiple front reflections
 - c. hash
 - d. resonance

H.4-33; I.246

76. When testing a plate, increasing the frequency of an ultrasonic longitudinal wave results in:
- a. an increase in its velocity
 - b. a decrease in its velocity
 - c. no change in its velocity
 - d. a reversal in its velocity

E.214

77. Ultrasonic waves transmitted into and received from the test material in the form of repetitive bursts of acoustic energy is called:
- a. pulse echo testing
 - b. continuous wave testing
 - c. resonance testing
 - d. none of the above

F.43.28; I.241

78. Metal blocks, which contain one or more drilled holes to simulate discontinuities, are called:

- a. scrubbers
- b. crystal collimators
- c. single plane angulators
- d. reference blocks

E.273; I.262

79. If the major dimensions of a discontinuity in a 152 mm (6 in.) thick aluminum plate lie parallel to the entry surface at a depth of 76 mm (3 in.), it will be best detected by:
- a. a straight beam test
 - b. an angle beam test
 - c. a surface wave test
 - d. a Lamb wave test

F.48.11

194. Angle beam testing of plate will often miss:

- a. cracks that are perpendicular to the sound wave
- b. inclusions that are randomly oriented
- c. laminations that are parallel to the front surface
- d. a series of small discontinuities

E.262

195. Reducing the extent of the dead zone of a transducer by using a delay tip results in:

- a. improved distance amplitude correction in the near field
- b. reduced frequency of the primary ultrasonic beam
- c. reduced ability to detect flaws in the near field
- d. improved accuracy in thickness measurement of thin plate and sheet
- e. none of the above

I.258

196. In a plate, skip distance can be calculated from which of the following formulas where (t = plate thickness, θ = angle of sound beam refraction, and V = sound velocity):

- a. $S = (2 \times t) / \tan \theta$
- b. $S = 2 \times t \times \sin \theta$
- c. $S = 2 \times t \times \tan \theta$
- d. $S = 2 \times V \times \sin \theta$
- e. none of the above

I.266

197. The technique of examining an ultrasonic reflector from different directions might be used to enable the technician to:

- a. distinguish between different types of flaws
- b. predict the useful service life of the test specimen
- c. distinguish between flaw indications and spurious or false indications
- d. all of the above
- e. none of the above

I.247

198. The principal applications of ultrasonic techniques consist of:

- a. flaw detection
- b. thickness measurements
- c. determination of elastic moduli
- d. all of the above
- e. none of the above

F.43.2

199. Attenuation is the loss of the ultrasonic wave energy during the course of propagation in the material due to:

- a. reflection and refraction
- b. dispersion and diffraction
- c. absorption and scattering
- d. composition and shape
- e. all of the above

D.108

200. When setting up an ultrasonic inspection, the repetition frequency of the ultrasonic instrument should be set:

- a. so that its period is at least as long as the operating time
- b. the same as the transducer resonance frequency
- c. as low as possible to avoid overpulsing and distortion
- d. according to the instruction manual of the instrument
- e. none of the above

D.171-174

201. In immersion shear wave testing, waves are normally generated by angulating the transducer beyond the first critical angle. What is the direction of the material's particle motion?

- a. The same as the wave propagation.
- b. Normal to the material surface.
- c. Parallel to the direction of wave propagation.
- d. Perpendicular to the direction of wave propagation.
- e. Only surface waves existed beyond the first critical angle.

I.233

202. Which of the following modes of vibration are quickly dampened out when testing by the immersion method?

- a. longitudinal waves
- b. shear waves
- c. transverse waves
- d. surface waves

H.2-32

203. The most commonly used method of producing shear waves in a test part when inspecting by the immersion method is:

- a. by transmitting longitudinal waves into a part in a direction perpendicular to its front surface
- b. by using two crystals vibrating at different frequencies
- c. by using Y-cut quartz crystal
- d. by angulating the search tube or manipulator to the proper angle

H.3-12

182. In general, discontinuities in wrought products tend to be oriented:
- a. randomly
 - b. in the direction of grain flow
 - c. at right angles to the entry surface
 - d. at right angles to the grain flow
- H.7-37**
183. In immersion testing, irrelevant or false indications caused by contoured surfaces are likely to result in a:
- a. broad-based indication
 - b. peaked indication
 - c. “hashy” signal
 - d. narrow-based indication
- H.4-24**
184. In contact testing, defects near the entry surface cannot always be detected because of:
- a. the far-field effect
 - b. attenuation
 - c. the dead zone
 - d. refraction
- F.43.31; H.4-20**
185. In cases where the diameter of tubing being inspected is smaller than the diameter of the transducer, what can be used to confine the sound beam to the proper range of angles?
- a. a scrubber
 - b. a collimator
 - c. an angle plane angulator
 - d. a jet-stream unit
- F.47.32**
186. The maximum scanning speed possible is primarily determined by:
- a. the frequency of the transducer
 - b. viscous drag problems
 - c. the pulse repetition rate of the test instrument
 - d. the persistency of the ultrasonic instrument display
- F.48.5**
187. The property of certain materials to transform electrical energy to mechanical energy and vice versa is called:
- a. mode conversion
 - b. piezoelectric effect
 - c. refraction
 - d. impedance matching
- B.66-69; D.117-124; H.2-7**
188. Surface waves are reduced to an energy level of approximately $1/25$ of the original power at a depth of:
- a. 25 mm (1 in.)
 - b. 102 mm (4 in.)
 - c. 1 wavelength
 - d. 4 wavelengths
- H.2-32**
189. To prevent the appearance of the second front surface indication before the first back reflection when inspecting aluminum by the immersion method (water is used as a couplant), it is necessary to have a minimum of at least 25 mm (1 in.) of water for every:
- a. 51 mm (2 in.) of aluminum
 - b. 102 mm (4 in.) of aluminum
 - c. 152 mm (6 in.) of aluminum
 - d. 203 mm (8 in.) of aluminum
- H.4-5**
190. Increasing the length of the pulse used to activate the transducer will:
- a. increase the strength of the ultrasound but decrease the resolving power of the instrument
 - b. increase the resolving power of the instrument
 - c. have no effect on the test
 - d. decrease the penetration of the sound wave
- H.3-13, 4-20**
191. The lack of parallelism between the entry surface and the back surface:
- a. may result in a screen pattern that does not contain back reflection indications
 - b. makes it difficult to locate discontinuities that lie parallel to the entry surface
 - c. usually indicates that a porous condition exists in the metal
 - d. decreases the penetrating power of the test
- H.2-37**
192. A discontinuity with a concave surface will:
- a. diffuse the sound energy throughout the part
 - b. cause the reflected beam to focus at a point determined by the curvature of the discontinuity
 - c. cause mode reinforcement of the ultrasonic wave
 - d. cause none of the above
- F.45.24**
193. Rayleigh waves:
- a. are generated at the first critical angle
 - b. are generated at the second critical angle
 - c. are generated at either critical angle
 - d. travel only in a liquid
 - e. are another name for Lamb waves
- I.233-234**

80. The presence of a discontinuity will not produce a specific discontinuity indication on the ultrasonic instrument display when using the:
- a. straight beam testing method
 - b. surface wave testing method
 - c. angle beam testing method
 - d. through-transmission testing method
- E.232; H.4-9; I.249**
81. The depth of a discontinuity cannot be determined when using the:
- a. straight beam testing method
 - b. through-transmission testing method
 - c. angle beam testing method
 - d. immersion testing method
- E.249; I.249**
82. When inspecting coarse-grained material, a sound wave is most easily scattered by the grain structure by a frequency of:
- a. 1 MHz
 - b. 2.25 MHz
 - c. 5 MHz
 - d. 10 MHz
- F.48.30**
83. The thickest crystal is contained in:
- a. a 1 MHz transducer
 - b. a 5 MHz transducer
 - c. a 15 MHz transducer
 - d. a 25 MHz transducer
- H.3-20**
84. When performing a surface wave test, indications may result from:
- a. improper frequency
 - b. oil on the surface
 - c. a surface discontinuity
 - d. the acoustical velocity of aluminum
- F.45.11**
85. Which of the following discontinuities located 152 mm (6 in.) from the entry surface results in the largest display indication if all factors except discontinuity surface condition and orientation are the same?
- a. A 2 mm (0.08 in.) diameter flat-surfaced discontinuity whose major face is at an angle of 75 degrees from the direction of sound beam propagation.
 - b. A 2 mm (0.08 in.) diameter rough-surfaced discontinuity whose major face is at an angle of 75 degrees from the direction of sound beam propagation.
 - c. A 2 mm (0.08 in.) diameter flat-surfaced discontinuity whose major face is perpendicular to the direction of sound beam propagation.
 - d. A 2 mm (0.08 in.) diameter rough-surfaced discontinuity whose major face is parallel to the direction of sound beam propagation.
- F.45.22**
86. Transducers constructed with a plastic wedge or standoff between the transducer element and the test piece are commonly used for:
- a. for angle beam contact testing
 - b. for immersion testing
 - c. to eliminate the need for a couplant
 - d. to reduce the speed of electrons
- H.3-16, 3-17**
87. A transducer containing three or more individual transducer elements is often referred to as:
- a. a dual transducer
 - b. a sandwich transducer
 - c. a mosaic transducer
 - d. none of the above
- F.44.11**
88. Sound can be focused by means of special curved adapters located in front of the transducer element. These adapters are referred to as:
- a. scrubbers
 - b. acoustic lenses
 - c. angle beam adapters
 - d. single plane adapters
- F.44.6; H.3-17**
89. A test method in which the parts to be inspected are placed in a water bath or some other liquid couplant is called:
- a. contact testing
 - b. immersion testing
 - c. surface wave testing
 - d. through-transmission testing
- F.46.1; H.4-5**

90. A separate time base line imposed on the viewing display of some ultrasonic testing instruments that permits measurement of distances is often referred to as:
- a. an initial pulse
 - b. a time/distance line
 - c. a marker
 - d. a sweep line

H.2-14, 3-6, 4-20; I.242

91. A term used to describe the ability of an ultrasonic testing system to distinguish between the entry surface response and the response of discontinuities near the entry surface is:

- a. sensitivity
- b. penetration
- c. segregation
- d. resolution

F.44.5, F.46.8; H.3-13

92. The phenomenon whereby an ultrasonic wave changes direction when the wave crosses a boundary between materials with different velocities is called:

- a. refraction
- b. reflection
- c. penetration
- d. rarefaction

E.217

93. In a test where the transducer is not perpendicular to the inspection surface, the angle of incidence is equal to:

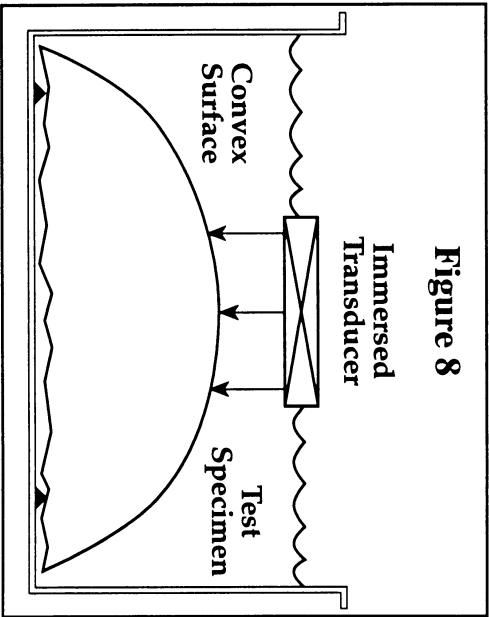
- a. the angle of refraction
- b. the angle of reflection
- c. the shear wave angle
- d. half the shear wave angle

E.217

94. The product of the acoustic velocity of sound in a material and the density of the material is the factor that determines the amount of reflection or transmission of ultrasonic energy when it reaches an interface. This term is called:

- a. acoustic impedance
- b. velocity
- c. wavelength
- d. penetration

E.215



95. In transmitting energy into the part shown in Figure 8, the ultrasonic beam will:

- a. diverge (spread out) through the part
- b. converge (focus in to a point) through the part
- c. transmit straight through the part
- d. not enter the part

H.2-38

96. Ultrasonic waves that travel along the surface of a material and whose particle motion is elliptical are called:

- a. shear waves
- b. transverse waves
- c. longitudinal waves
- d. Rayleigh waves

F.45.11

97. The interference field near the face of a transducer is often referred to as the:

- a. Fresnel zone
- b. acoustic impedance
- c. exponential field
- d. phasing zone

F.44.12

98. When the incident angle is chosen to be between the first and second critical angles, the ultrasonic wave mode within the part will be a:

- a. longitudinal wave
- b. shear wave
- c. surface wave
- d. Lamb wave

H.2-25

172. During a test using A-scan equipment, strong indications that move at varying rates across the screen in the horizontal direction appear. It is impossible to repeat a particular screen pattern by scanning the same area. A possible cause of these indications is:

- a. porosity in the test part
- b. an irregularly shaped crack
- c. a blow hole
- d. electrical interference

I.246

173. In an A-scan presentation, the horizontal line formed by the uniform and repeated movement of an electron beam across the fluorescent screen of a cathode ray tube is called:

- a. a square wave pattern
- b. a sweep line
- c. a marker pattern
- d. none of the above

H.2-11

174. The greatest amount of attenuation losses take place at:

- a. 1 MHz
- b. 2.25 MHz
- c. 5 MHz
- d. 10 MHz

H.4-12

175. Waves that travel around gradual curves with little or no reflection from the curve are called:

- a. transverse waves
- b. surface waves
- c. shear waves
- d. longitudinal waves

H.2-18, 2-28

176. To evaluate and accurately locate discontinuities after scanning a part with a paintbrush transducer, it is generally necessary to use a:

- a. transducer with a smaller crystal
- b. scrubber
- c. grid map
- d. crystal collimator

H.3-15

177. An ultrasonic instrument has been calibrated to obtain a 51 mm (2 in.) indication from a 2 mm (0.08 in.) diameter flat bottom hole located 76 mm (3 in.) from the front surface of an aluminum reference block. When testing an aluminum forging, a 51 mm (2 in.) indication is obtained from a discontinuity located 76 mm (3 in.) from the entry surface. The cross sectional area of this discontinuity is probably:

- a. the same as the area of the 2 mm (0.08 in.) flat bottom hole
- b. greater than the area of the 2 mm (0.08 in.) flat bottom hole
- c. slightly less than the area of the 2 mm (0.08 in.) flat bottom hole
- d. about 1/2 the area of the 2 mm (0.08 in.) flat bottom hole

I.262

178. As the impedance ratio of two dissimilar materials increases, the percentage of sound coupled through an interface of such materials:

- a. decreases
- b. increases
- c. is not changed
- d. may increase or decrease

I.234

179. Low frequency sound waves are not generally used to test thin materials because of:

- a. the rapid attenuation of low frequency sound
- b. incompatible wavelengths
- c. poor near-surface resolution
- d. none of the above will actually limit such a test

I.234

180. When using two separate transducers (one a transmitter, the other a receiver), the most efficient combination would be a:

- a. quartz transmitter and a barium titanate receiver
- b. barium titanate transmitter and a lithium sulfate receiver
- c. lithium sulfate transmitter and a barium titanate receiver
- d. barium titanate transmitter and a quartz receiver

I.257

181. In immersion testing, the accessory equipment to which the search cable and the transducer are attached is called a:

- a. crystal collimator
- b. scrubber
- c. jet-stream unit
- d. search tube or scanning tube

H.3-12

161. Inspection of castings is often impractical because of:

- a. extremely small grain structure
- b. coarse grain structure
- c. uniform flow lines
- d. uniform velocity of sound

H.4-37; I.190

162. Lamb waves may be used to inspect:

- a. forgings
- b. bar stock
- c. ingots
- d. thin sheet

H.2-29

163. The formula used to determine the angle of beam divergence of a quartz crystal is:

- a. $\sin \theta = \text{diameter} \times \text{wavelength}$
- b. $\sin \theta = \text{diameter} \div \text{frequency} \times \text{wavelength}$
- c. $\sin \theta = \text{frequency} \times \text{wavelength}$
- d. $\sin \theta/2 = 1.22 \times \text{wavelength}/\text{diameter}$

H.2-30

164. The resolving power of a transducer is directly proportional to its:

- a. diameter
- b. bandwidth
- c. pulse repetition
- d. none of the above

I.266

165. Acoustic lens elements with which of the following permit focusing the sound energy to enter cylindrical surfaces normally or along a line focus?

- a. Cylindrical curvatures.
- b. Spherical lens curvatures.
- c. Convex shapes.
- d. Concave shapes.

I.259

166. In the basic pulse echo instrument, the synchronizer, clock, or timer circuit determines the:

- a. pulse length
- b. gain
- c. pulse repetition rate
- d. sweep length

I.170

167. The primary requirement of a paintbrush transducer is that:

- a. all crystals be mounted equidistant from each other
- b. the intensity of the beam pattern not vary greatly over the entire length of the transducer
- c. the fundamental frequency of the crystals not vary more than 0.01%
- d. the overall length not exceed 76 mm (3 in.)

I.258

168. Heat conduction, viscous friction, elastic hysteresis, and scattering are four different mechanisms which lead to:

- a. attenuation
- b. refraction
- c. beam spreading
- d. saturation

I.238

169. Because the velocity of sound in aluminum is approximately 245 000 in./s, for sound to travel through 25 mm (1 in.) of aluminum, it takes:

- a. $1/8$ s
- b. 4 μ s
- c. 4 ms
- d. $1/4 \times 10^4$ s

I.163, 233

170. When testing a part with a rough surface, it is generally advisable to use:

- a. a lower frequency transducer and a more viscous couplant than is used on parts with a smooth surface
- b. a higher frequency transducer and a more viscous couplant than is used on parts with a smooth surface
- c. a higher frequency transducer and a less viscous couplant than is used on parts with a smooth surface
- d. a lower frequency transducer and a less viscous couplant than is used on parts with a smooth surface

H.3-22

171. Reflection indications from a weld area being inspected by the angle beam technique may represent:

- a. porosity
- b. cracks
- c. weld bead
- d. all of the above

H.4-35

99. The formula used to calculate the angle of refraction within a material is called:

- a. Fresnel's law
- b. Fraunhofer's law
- c. Snell's law
- d. Lamb's law

H.2-24

100. In a material with a given velocity, when frequency is increased, the wavelength will:

- a. not be affected
- b. increase
- c. decrease
- d. double

F.43.9

101. Circuits that electronically amplify return signals from the receiving transducer and often modify the signals into a form suitable for display are called:

- a. pulser circuits
- b. marker circuits
- c. timer circuits
- d. receiver-amplifier circuits

I.242

102. The most common type of data display used for ultrasonic examination of welds is:

- a. an A-scan display
- b. a B-scan display
- c. a C-scan display
- d. an X-Y plot

F.43.29

103. The display that plots signal amplitude versus time is called:

- a. an A-scan display
- b. a B-scan display
- c. a C-scan display
- d. none of the above

I.241

104. A circuit that modifies the return signal from the receiving transducer into a form suitable for display on an oscilloscope or other output device is called a:

- a. pulser
- b. receiver-amplifier
- c. clock
- d. sweep

I.242

105. A circuit that generates a burst of alternating voltage that is applied to the sending transducer is called a:

- a. pulser
- b. receiver-amplifier
- c. damping
- d. clock

I.242

106. A circuit that coordinates electronic operation of the entire ultrasonic instrument system is called:

- a. damping
- b. a receiver-amplifier
- c. a clock
- d. a power supply

I.242

107. A plan view display or recording of a part under examination is called:

- a. a C-scan display
- b. an A-scan display
- c. an X-axis plot
- d. a strip chart recording

F.43.34

108. Ultrasonic data, which is presented in a form representative of the cross section of the test specimen, is called:

- a. an A-scan presentation
- b. a B-scan presentation
- c. a C-scan presentation
- d. an X-Y plot

H.3-8

109. What type of ultrasonic examination uses wheel-type transducers that eliminate the use of a tank?

- a. through-transmission testing
- b. contact testing
- c. resonance testing
- d. immersion testing

I.258

110. In addition to other functions, a transducer manipulator in a mechanical immersion-scanning unit permits:

- a. use of the through-transmission technique
- b. use of high scanning speeds
- c. detection of obliquely-oriented discontinuities
- d. utilization of less skilled operators

D.391

Ultrasonic Testing Method, Level I

111. A type of data presentation most likely to be used with a high speed automatic scanning system is:

a. an A-scan presentation

b. a velocity versus amplitude plot

c. a C-scan presentation

d. a plot of echo height versus depth

H.3-7

112. The component in a conventional immersion system that spans the width of the immersion tank is called:

a. an articulator

b. a bridge

c. a manipulator

d. a search tube

H.3-12

113. The component in an ultrasonic immersion system that is used to adjust and maintain a known transducer angle is called:

a. a carriage

b. a manipulator

c. a search tube

d. an index system

F.46.1

114. An amplitude type gate is necessary for all:

a. shear wave examinations

b. longitudinal wave examinations

c. automatic examinations

d. manual examinations

F.43.35

115. When a C-scan recording is used to produce a permanent record of an ultrasonic test, the information displayed is typically the discontinuity's:

a. depth and size

b. depth, orientation, and size

c. location and depth

d. location and size (plan view)

H.3-8

116. Rough entry surface conditions can result in:

a. a loss of echo amplitude from discontinuities

b. an increase in the width of the front surface echo

c. both a and b

d. none of the above

F.45.15

117. As the grain size increases in a material, its principal effect in ultrasonic testing is on the:

a. velocity of sound

b. attenuation

c. acoustic impedance

d. angle of refraction

F.45.3
118. In straight beam pulse echo testing, a discontinuity with a rough reflecting surface perpendicular to the incident wave has what effect on the detected signal in comparison to a smooth flat bottom hole of the same size?

a. It increases the detected signal.

b. It decreases the detected signal.

c. It has no effect on the detected signal.

d. It decreases the width of the pulse of the detected signal.

F.45.22

119. Ultrasonic vibrations can be propagated only in the longitudinal mode in:

a. machine oil

b. aluminum

c. ice

d. beryllium

H.2-6

120. If the velocity of a longitudinal mode wave in a given homogeneous material is 0.625 cm/us at 13 mm (0.5 in.) below the surface, what is the velocity at 51 mm (2 in.) below the surface?

a. 1/4 the velocity at 13 mm (0.5 in.)

b. 1/2 the velocity at 13 mm (0.5 in.)

c. the same as the velocity at 13 mm (0.5 in.)

d. none of the above

H.2-17

121. If a 5 MHz transducer is substituted for a 2.25 MHz transducer, the effect on the wavelength of a longitudinal mode wave produced in the test specimen is that:

a. the wavelength would be longer

b. the wavelength would remain constant

c. the wavelength would be shorter

d. the wavelength would vary directly with the acoustic impedance

H.2-5

122. What can cause nonrelevant indications on the cathode ray tube?

a. contoured surfaces

b. edge effects

c. surface conditions

d. all of the above

F.47.11

Ultrasonic Testing Method, Level II

151. The equation describing wavelength in terms of velocity and frequency is:

a. wavelength = velocity × frequency

b. wavelength = z (frequency × velocity)

c. wavelength = velocity + frequency

d. wavelength = frequency + velocity

H.2-5
152. When an ultrasonic beam reaches the interface of two dissimilar materials it is:

a. reflected

b. refracted

c. mode converted

d. all of the above

H.2-21
153. When inspecting aluminum by the immersion method using water for a couplant, the following information is known:

velocity of sound in water = 1.49×10^5 cm/s,

velocity of longitudinal waves in aluminum = 6.32×10^5 cm/s, and angle of incidence = 5 degrees.

The angle of refraction for longitudinal waves is approximately:

a. 22 degrees

b. 18 degrees

c. 26 degrees

d. 16 degrees

H.2-24
154. Of the piezoelectric materials listed below, the most efficient sound transmitter is:

a. lithium sulfate

b. quartz

c. barium titanate

d. silver oxide

I.255
155. Of the piezoelectric materials listed below, the most efficient sound receiver is:

a. lithium sulfate

b. quartz

c. barium titanate

d. silver oxide

I.255
156. The most commonly used method of producing shear waves in a test part when inspecting by the immersion method is:

a. by transmitting longitudinal waves into a part in a direction perpendicular to its front surface

b. by using two crystals vibrating at different frequencies

c. by using a Y-cut quartz crystal

d. by angulating the search tube to the proper angle

I.258
157. Beam divergence is a function of the dimensions of the crystal and the wavelength of the beam transmitted through a medium, and it:

a. increases if the frequency or crystal diameter decreases

b. decreases if the frequency or crystal diameter decreases

c. increases if the frequency increases and crystal diameter decreases

d. decreases if the frequency is increases and crystal diameter decreases

H.2-30
158. The wavelength of an ultrasonic wave is:

a. directly proportional to velocity and frequency

b. directly proportional to velocity and inversely proportional to frequency

c. inversely proportional to velocity and directly proportional to frequency

d. equal to the product of velocity and frequency

C.233
159. The fundamental frequency of a piezoelectric crystal is primarily a function of:

a. the length of the applied voltage pulse

b. the amplifying characteristics of the pulse amplifier in the instrument

c. the thickness of the crystal

d. none of the above

E.223; H.6-11
160. Acoustic velocities of materials are primarily due to the material's:

a. density

b. elasticity

c. both a and b

d. acoustic impedance

H.2-17

139. In steel, the velocity of sound is greatest in:
a. longitudinal waves
b. shear waves
c. surface waves
d. none of the above — sound velocity is identical in all modes, in a given material
H.2-18; I.235

140. The acoustic impedance is:
a. used to calculate the angle of reflection
b. the product of the density of the material and the velocity of sound in the material
c. found by Snell's law
d. used to determine resonance values
H.2-35; I.235

141. Thin sheet may be inspected with the ultrasonic wave directed normal to the surface by observing:
a. the amplitude of the front surface reflection
b. the multiple reflection pattern
c. all front surface reflections
d. none of the above
D.391-399

142. A diagram in which the entire circuit stage or sections are shown by geometric figures and the path of the signal or energy by lines and/or arrows is called a:
a. schematic diagram
b. blueprint
c. block diagram
d. none of the above
H.2-16

143. A hole produced during the solidification of metal due to escaping gases is called:
a. a burst
b. a cold shut
c. flaking
d. a blow hole
I.514

144. A discontinuity that occurs during the casting of molten metal which may be caused by the splashing, surging, interrupted pouring, or the meeting of two streams of metal coming from different directions is called:
a. a burst
b. a cold shut
c. flaking
d. a blow hole
H.7-10

145. The ratio between the wave speed in one material and the wave speed in a second material is called:
a. the acoustic impedance of the interface
b. Young's modulus
c. Poisson's ratio
d. the index of refraction
D.48

146. The expansion and contraction of a magnetic material under the influence of a changing magnetic field is referred to as:
a. piezoelectricity
b. refraction
c. magnetostriction
d. rarefaction
D.150-153

147. The ratio of stress to strain in a material within the elastic limit is called:
a. Young's modulus
b. the modulus of elasticity
c. both a and b
d. the index of refraction
F.43.10

148. A point, line, or surface of a vibrating body marked by absolute or relative freedom from vibratory motion is referred to as:
a. a node
b. an antinode
c. rarefaction
d. compression
B.856; D.9; F.51.2

149. The factor that determines the amount of reflection at the interface of two dissimilar materials is:
a. the index of rarefaction
b. the frequency of the ultrasonic wave
c. Young's modulus
d. the acoustic impedance
H.2-36

150. A quartz crystal cut so that its major faces are parallel to the Z and Y axes and perpendicular to the X axis is called:
a. a Y-cut crystal
b. an X-cut crystal
c. a Z-cut crystal
d. a ZY-cut crystal
H.3-14

123. The proper interpretation and evaluation of the presented defect signals are essential to any nondestructive test. A common method for the estimation of defect size is the use of:
a. a double transducer test
b. a piezoelectric standard
c. mode conversion
d. a reference standard
F.47.31

129. An A-scan display, which shows a signal both above and below the sweep line, is called:
a. a video display
b. a RF display
c. an audio display
d. a frequency modulated display
B.857; D.178

130. A B-scan display shows the relative:
a. distance a discontinuity is from the transducer and its through-dimension thickness
b. distance a discontinuity is from the transducer and its length in the direction of transducer travel
c. cross sectional area of a discontinuity above a predetermined amplitude
d. none of the above
F.44.12

124. Another name for Fresnel zone is:
a. Fraunhofer zone
b. near field
c. far field
d. Torrid zone
F.44.12

125. Attenuation is a:
a. test display characteristic
b. test material parameter
c. transducer characteristic
d. form of testing
F.43.22

126. For discontinuity geometries other than flat, the echo amplitude is usually _____ from that observed for a flat defect, of similar orientation perpendicular to the sound beams.
a. identical
b. increased
c. decreased
d. elongated
F.45.24

127. To evaluate discontinuities that are oriented at an angle to the entry surface so that the sound beam strikes the plane of the discontinuity at right angles, the operator must:
a. change the frequency
b. grind the surface
c. angulate the transducer
d. increase the gain
F.47.13

128. The pulser circuit in an ultrasonic instrument is used to:
a. control the horizontal and vertical sweep
b. activate the transducer
c. control transducer timing between transmit and sweep
d. generate markers that appear on horizontal sweep
F.43.38

131. Surface (Rayleigh) waves traveling on the top face of a block:
a. are not reflected from a sharp edge corner
b. are reflected from a sharp edge corner
c. travel through the sharp edge corner and are reflected from the lower edge
d. are absorbed by a sharp edge corner
H.2-29

132. Surface (Rayleigh) waves are more highly attenuated by:
a. a curved surface
b. a heavy couplant
c. a thin couplant
d. both a and b
H.2-32

133. The velocity of sound in a material is dependent upon the:
a. frequency of the wave
b. wavelength
c. material properties
d. vibration cycle
F.43.16

Ultrasonic Testing Method, Level I

135. Ultrasonic vibrations are commonly used to:

a. examine materials for discontinuities

b. examine materials for thickness

c. examine materials for mechanical properties

d. all of the above

D.2
136. Which of the following has the longest Fresnel zone?

a. 13 mm (0.5 in.) diameter 1 MHz

b. 13 mm (0.5 in.) diameter 2.25 MHz

c. 28.5 mm (1.125 in.) diameter 1 MHz

d. 38 mm (1.5 in.) diameter 2 MHz

B.197
137. When contact testing, if the ultrasonic instrument is set with an excessively high pulse repetition frequency:

a. the screen trace becomes too light to see

b. the time-base line becomes distorted

c. the initial pulse disappears

d. interference of UT signals and undesirable fluctuations in signal amplitude result

B.106
138. The advantages of immersion testing include:

a. increased inspection speed

b. the ability to control and direct sound beams

c. adaptability for automated scanning

d. all of the above

I.258
139. Longitudinal wave velocity in water is approximately 1/4 the velocity in aluminum or steel. Therefore, the minimum water path should be:

a. four times the test piece thickness

b. 1/2 the test piece thickness

c. 1/4 the test piece thickness plus 6 mm (0.25 in.)

d. none of the above

H.4-5; I.258
140. In immersion testing, a wetting agent is added to the water to:

a. adjust the viscosity

b. help eliminate the formation of air bubbles

c. prevent cloudiness

d. none of the above

H.3-22
141. The formula used to determine the fundamental resonant frequency is:

a. $F = VT$

b. $F = V/2T$

c. $F = TV$

d. $F = VT$

F.43.36, F.50.1
142. If frequency is increased, wavelength:

a. decreases (becomes shorter)

b. increases (becomes longer)

c. remain the same but velocity increases

d. remains the same but velocity decreases

F.43.9; H.3-19
143. The variable in distance amplitude calibration block construction is the:

a. drilled hole size

b. drilled hole point angle

c. metal distance above the drilled hole

d. angle of the drilled hole to block longitudinal axis

H.5-7; I.264
144. When setting up a distance amplitude correction curve using 3 flat bottom holes, sometimes the hole closest to the transducer gives less of a response than one or both of the other two. This could be caused by:

a. a hole that is too large

b. near field effects

c. impedance mismatch

d. the acoustic velocity

I.239, 263
145. Most ferrous and nonferrous welds may be ultrasonically tested using a frequency range of:

a. 25-100 KHz

b. 200-500 KHz

c. 1-2.25 MHz

d. 3-6 MHz

e. 10-20 MHz

F.48.1
146. The product of the material density and the velocity of sound within that material is referred to as:

a. acoustic impedance

b. near field

c. acoustic attenuation

d. ultrasonic beam distribution

e. vibrational index

F.45.1; H.2-35
147. A straight beam contact transducer consists of:

a. a case, a crystal, a mount, and backing

b. a case, a crystal, backing, and a plastic wedge

c. a case, a crystal, backing, and acoustic lenses

d. a case, a crystal, a mount, backing, a plastic wedge, and acoustic lenses

F.43.6

Ultrasonic Testing Method, Level II

127. The incident angles at which 90 degrees refraction of longitudinal and shear waves occurs are called:

a. the normal angles of incidence

b. the critical angles

c. the angles of maximum reflection

d. none of the above

E.217; I.236
128. Compression waves whose particle displacement is parallel to the direction of propagation are called:

a. longitudinal waves

b. shear waves

c. Lamb waves

d. Rayleigh waves

H.2-17; I.233
129. The mode of vibration that is quickly damped out when testing by the immersion method is:

a. longitudinal waves

b. shear waves

c. transverse waves

d. surface waves

H.2-23; I.234
130. The motion of particles in a shear wave is:

a. parallel to the direction of propagation of the ultrasonic beam

b. transverse to the direction of beam propagation

c. limited to the material surface and elliptical in motion

d. polarized in a plane at 45 degrees to the direction of beam propagation

H.2-18; I.233
131. An ultrasonic longitudinal wave travels in aluminum with a velocity of 635 000 cm/s and has a frequency of 1 MHz. The wavelength of this ultrasonic wave is:

a. 6.35 mm (0.25 in.)

b. 78 mm (3.1 in.)

c. 1.9 m (6.35 ft)

d. 30 000 Å

F.43.9; I.233
132. The refraction angle of longitudinal ultrasonic waves passing from water into a metallic material at angles other than normal to the interface is primarily a function of:

a. the impedance ratio ($r = Z_w/Z_m$) of water to metal

b. the relative velocities of sound in water and metal

c. the frequency of the ultrasonic beam

d. the density ratio of water to metal

H.2-24; I.236
133. In contact testing, shear waves can be induced in the test material by:

a. placing an X-cut crystal directly on the surface of the materials, and coupling through a film of oil

b. using two transducers on opposite sides of the test specimen

c. placing a spherical acoustic lens on the face of the transducer

d. using a transducer mounted on a plastic wedge so that sound enters the part at an angle

H.2-20
134. As frequency increases in ultrasonic testing, the angle of beam divergence of a given diameter crystal:

a. decreases

b. remains unchanged

c. increases

d. varies uniformly through each wavelength

E.214; F.48.3; I.240
135. Which of the following is *not* an advantage of contact ultrasonic transducers (probes) adapted with lucite shoes?

a. Most of the crystal wear is eliminated.

b. Adaptation to curved surfaces is permitted.

c. Sensitivity is increased.

d. Ultrasound is allowed to enter a part's surface at oblique angles.

F.48.1-48.24
136. The velocity of sound is the lowest in:

a. air

b. water

c. aluminum

d. plastic

H.2-18; I.235
137. A longitudinal ultrasonic wave is transmitted from water into steel at an angle of 5 degrees from the normal. In such a case, the refracted angle of the transverse wave is:

a. less than the refracted angle of the longitudinal wave

b. equal to the refracted angle of the longitudinal wave

c. greater than the refracted angle of the longitudinal wave

d. not present at all

H.2-20; I.236
138. The velocity of longitudinal waves is the highest in:

a. water

b. air

c. aluminum

d. plastic

H.2-18; I.235

Ultrasonic Testing Method, Level II

115. Significant errors in ultrasonic thickness measurement can occur if:
- a. the test frequency is varying at a constant rate
 - b. the velocity of propagation deviates substantially from an assumed constant value for a given material
 - c. water is employed as a couplant between the transducer and the part being measured
 - d. none of the above should cause errors
- F.43.27, 50.5**
116. Generally, the best ultrasonic testing method for detecting discontinuities oriented along the fusion zone in a welded plate is:
- a. an angle beam contact method using surface waves
 - b. a contact test using a straight longitudinal wave
 - c. an immersion test using surface waves
 - d. an angle beam method using shear waves
- F.48.12; I.270**
117. An ultrasonic testing instrument that displays pulses representing the magnitude of reflected ultrasound as a function of time or depth of metal is said to contain:
- a. a continuous wave display
 - b. an A-scan presentation
 - c. a B-scan presentation
 - d. a C-scan presentation
- F.43.29; H.3-6, 3-7; I.241**
118. At a water-steel interface the angle of incidence in water is 7 degrees. The principal mode of vibration that exists in the steel is:
- a. longitudinal
 - b. shear
 - c. both a and b
 - d. surface
- H.2-26**
119. In a liquid medium, the only mode of vibration that can exist is:
- a. longitudinal
 - b. shear
 - c. both a and b
 - d. surface
- H.2-21; I.233**
120. In an ultrasonic instrument, the number of pulses produced by an instrument in a given period of time is known as the:
- a. pulse length of the instrument
 - b. pulse recovery time
 - c. frequency
 - d. pulse repetition rate
- F.43.29; I.252**

Ultrasonic Testing Method, Level I

148. In immersion testing, to remove the second water reflection from between the entry surface signal and the first back reflection, you should:
- a. increase the repetition rate
 - b. decrease the frequency
 - c. decrease the sweep length
 - d. increase the water path
- F.46.10**
149. For a given incident angle, as the frequency of the transducer increases, the refracted angle:
- a. increases
 - b. decreases
 - c. stays the same
 - d. cannot be determined
- H.2-24**
150. Both longitudinal and shear waves may be simultaneously generated in a second medium when the angle of incidence is:
- a. between normal and the first critical angle
 - b. between the first and second critical angles
 - c. past the second critical angle
 - d. only at the second critical angle
- H.2-25**
151. In immersion testing, when the sound beam strikes a concave surface, the sound beam tends to:
- a. converge
 - b. diverge
 - c. stay the same
 - d. mode convert
- H.2-38**
152. Penetration of ultrasonic waves in a material is normally the function of test frequency used. The greatest depth of penetration is provided by a frequency of:
- a. 1 MHz
 - b. 2.25 MHz
 - c. 5 MHz
 - d. 10 MHz
- H.3-21**
153. Generally speaking, certain piezoelectric materials exhibit better properties than others. The following material that is considered to be the most efficient receiver of ultrasonic energy is:
- a. quartz
 - b. ceramic
 - c. barium titanate
 - d. lithium sulfate
- H.3-14**
154. Refracted energy assumes a new direction of propagation when the _____ is changed.
- a. principle angle
 - b. reflected angle
 - c. critical angle
 - d. incident angle
- F.43.15**
155. The loss of energy as it propagates through material is the result of beam:
- a. interference
 - b. attenuation
 - c. absorption
 - d. reflection
- F.43.22**
156. In selecting a suitable couplant, which of the following characteristics would not affect the selection?
- a. Mode of propagation desired.
 - b. Material surface finish and temperature.
 - c. Operating frequency of the transducer.
 - d. Chemical properties of the couplant.
- I.179**
157. Excessive surface roughness of the material being tested can cause:
- a. a loss of echo amplitude from discontinuities within the material
 - b. impedance mismatch
 - c. increased acoustic velocity
 - d. increased back surface response
- F.45.15**
158. Reference or calibration standards are used for:
- a. determining phase shift analysis
 - b. providing a method for standardizing the test system
 - c. determining tensile strength
 - d. measuring vibrations
- H.5-3**
159. The change in direction of an ultrasonic beam when it passes from one material to another material in which elasticity and density differ is called:
- a. refraction
 - b. rarefaction
 - c. angulation
 - d. reflection
- H.2-21**

Ultrasonic Testing Method, Level I

160. If a discontinuity is oriented at an angle other than 90 degrees to the sound beam, the results may be a:

- a. loss of signal linearity
- b. loss or lack of signal reflected from the discontinuity
- c. focusing of the sound beam
- d. loss of interference phenomena

H.4-33

161. A device that transforms electrical pulses into mechanical and vice versa utilizes:

- a. Snell's law
- b. piezoelectric principles
- c. mode conversion principles
- d. none of the above

H.2-7

162. Whenever an ultrasonic incident angle is set at 5 degrees from normal:

- a. the refracted wave is mode converted
- b. the refracted wave is the same mode as the incident wave
- c. the refracted wave has two components, one of which will be the same mode as the incident wave
- d. it is impossible to determine mode(s) of refracted wave without more information

C.3-28

163. If a discontinuity is located in the Fresnel or near field region of a sound beam:

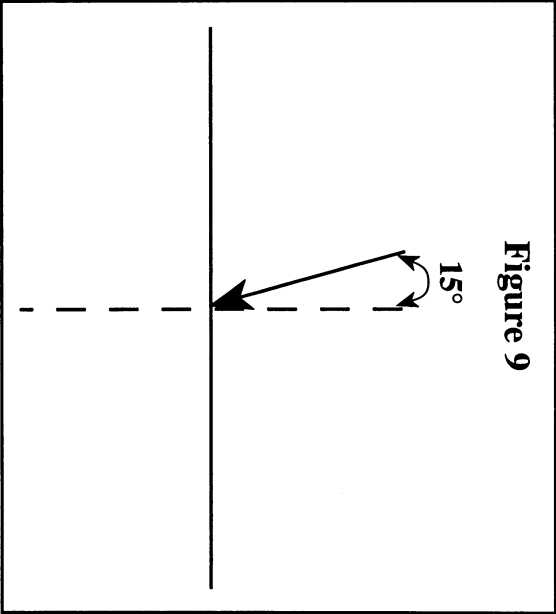
- a. the larger the discontinuity, the larger the amplitude of the reflected signal
- b. the closer to the surface the discontinuity is located, the larger will be the amplitude of reflected signal
- c. in immersion testing, the amplitude of signal increases as the water path decreases
- d. in immersion testing, the amplitude of reflected signal may increase or decrease as water path decreases

C.2-12

164. If a transducer is vibrating at a frequency and injecting ultrasonic energy through water into a steel specimen:

- a. the sound wavelength is the same in both the water and the steel
- b. the sound frequency in the water is less than the sound frequency in steel
- c. the sound wavelength is not the same in both the water and the steel
- d. the sound frequency in the water is greater than the sound frequency in steel

C.1-53



165. When a longitudinal sound wave strikes a water-steel interface at an angle of incidence of 15°, (see Figure 9):

- a. all the sound energy is reflected back into the water at an angle of 15°
- b. part of the sound energy is reflected at 15° and part is refracted into the steel at an angle of less than 15°
- c. part of the sound energy is reflected at 15° and part is refracted along the water-steel interface
- d. part of the sound energy is reflected at 15° and part is refracted into the steel at an angle greater than 15°

C.3-30

Ultrasonic Testing Method, Level II

104. If an ultrasonic wave is transmitted through an interface of two materials in which the first material has a higher acoustic impedance value but the same velocity value as the second material, the angle of refraction will be:

- a. greater than the angle of incidence
- b. less than the angle of incidence
- c. the same as the angle of incidence
- d. beyond the critical angle

F.43.15; I.236

105. Which of the following frequencies would probably result in the greatest ultrasonic attenuation losses?

- a. 1 MHz
- b. 2.25 MHz
- c. 10 MHz
- d. 25 MHz

F.43.26, 48.30

106. The product of the sound velocity and the density of a material is known as the:

- a. refraction value of the material
- b. acoustic impedance of the material
- c. elastic constant of the material
- d. Poisson's ratio of the material

F.43.12; I.235

107. The amplifier range over which the unsaturated signal response increases in amplitude in proportion to the discontinuity surface area is the:

- a. sensitivity range
- b. vertical linearity range
- c. selectivity range
- d. horizontal linearity range

H.5-5

108. When inspecting a rolled or forged surface with a thin scale that is generally tightly adhering to the part, before testing the part:

- a. clean the surface of loose scale
- b. have all scale removed
- c. rough machine the surface
- d. caustic etch the surface

F.47.23-25

109. The angle of reflection of an ultrasonic beam at an aluminum-water interface is:

- a. 0.256 times the angle of incidence
- b. approximately 1/2 the angle of incidence
- c. equal to the angle of incidence
- d. approximately 4 times the angle of incidence

F.43.14-15

110. What kind of waves travel at a velocity slightly less than shear waves and their mode of propagation is both longitudinal and transverse with respect to the surface?

- a. Rayleigh waves.
- b. Transverse waves.
- c. L-waves.
- d. Longitudinal waves.

H.2-20; I.234

111. Which ultrasonic test frequency would probably provide the best penetration in a 30 cm (12 in.) thick specimen of coarse-grained steel?

- a. 1 MHz
- b. 2.25 MHz
- c. 5 MHz
- d. 10 MHz

H.3-21

112. During immersion testing of an ASTM Ultrasonic Standard Reference Block, a B-scan presentation system will show a:

- a. "plan" view of the block, showing the area and position of the hole bottom as seen from the entry surface
- b. basic test pattern showing the height of indication from the hold bottom and its location in depth from the entry surface
- c. cross section of the reference block, showing the top and bottom surfaces of the block and the location of the hole bottom in the block
- d. none of the above

F.47.3

113. Properties of shear or transverse waves used for ultrasonic testing include:

- a. particle motion normal to propagation direction, and a propagation velocity that is about 1/2 the longitudinal wave velocity in the same material
- b. exceptionally high sensitivity due to low attenuation resulting from longer wavelengths when propagating through water
- c. high coupling efficiency because shear waves are less sensitive to surface variables when traveling from a coupling liquid to the part
- d. none of the above statements apply to shear waves

H.2-18; I.233

114. One of the most common applications of ultrasonic tests employing shear waves is for the:

- a. detection of discontinuities in welds, tube, and pipe
 - b. determination of elastic properties of metallic products
 - c. detection of laminar discontinuities in heavy plate
 - d. measurement of thickness of thin plate
- A.ASTM E-164, Para. 1, 2; H.4-11; I.270

92. Which of the following modes of vibration exhibits the shortest wavelength at a given frequency and in a given material?
- a. A longitudinal wave.
 - b. A compression wave.
 - c. A shear wave.
 - d. A surface wave.

E.210, E.214

93. In general, shear waves are more sensitive to small discontinuities than longitudinal waves for a given frequency and in a given material because:
- a. the wavelength of shear waves is shorter than the wavelength of longitudinal waves
 - b. shear waves are not as easily dispersed in the material
 - c. the direction of particle vibration for shear waves is more sensitive to discontinuities
 - d. the wavelength of shear waves is longer than the wavelength of longitudinal waves
- D.296-304; F.45.21

94. In general, which of the following modes of vibration would have the greatest penetrating power in a coarse-grained material if the frequency of the waves are the same?
- a. Longitudinal waves.
 - b. Shear waves.
 - c. Transverse waves.
 - d. All of the above modes would have the same penetrating power
- F.45.5

95. A testing technique in which the crystal or transducer is parallel to the test surface and ultrasonic waves enter the material being testing in a direction perpendicular to the test surface is:
- a. straight beam testing
 - b. angle beam testing
 - c. surface wave testing
 - d. none of the above
- H.4-8; I.233

96. The distance from a given point on an ultrasonic wave to the next corresponding point is referred to as:
- a. frequency
 - b. wavelength
 - c. velocity
 - d. pulse length
- H.2-5; I.233

97. The speed with which ultrasonic waves travel through a material is known as its:
- a. velocity
 - b. pulse repetition rate
 - c. pulse recovery rate
 - d. ultrasonic response
- F.43.9, H.2-5

98. A substance that reduces the surface tension of a liquid is referred to as:
- a. a couplant
 - b. an ultrasonic dampener
 - c. a wetting agent
 - d. none of the above
- F.47.31

99. The ultrasonic transducers most commonly used for discontinuity testing utilize:
- a. magnetostriction principles
 - b. piezoelectric principles
 - c. mode conversion principles
 - d. none of the above
- B.66-68; D.117; F.43.4

100. Mechanical and electrical stability, insolubility in liquids, and resistance to aging are three advantages of transducers made of:
- a. lithium sulfate
 - b. barium titanate
 - c. quartz
 - d. Rochelle salts
- F.44.2; I.254

101. The formula $\frac{\sin \theta_1}{V_1} = \frac{\sin \theta_2}{V_2}$ is referred to as:
- a. the acoustical impedance ratio formula
 - b. the phase conversion formula
 - c. the Fresnel zone formula
 - d. Snell's law
- F.43.15; I.166

102. The formula $\frac{\sin \theta_1}{V_1} = \frac{\sin \theta_2}{V_2}$ is used to determine:
- a. angular relationships
 - b. phase velocities
 - c. amount of reflected sound energy
 - d. acoustic impedance
- F.43.15; I.236

103. The amount of energy reflected from a discontinuity is dependent on:
- a. the size of the discontinuity
 - b. the orientation of the discontinuity
 - c. the type of discontinuity
 - d. all of the above
- F.45.24

Level I Answers

Ultrasonic Testing Method

1. d 2. a 3. c 4. b 5. c 6. d 7. b 8. c 9. d 10. b 11. d 12. d 13. b 14. c 15. d 16. a 17. b 18. d 19. b 20. d 21. d 22. b 23. a 24. b 25. b 26. c 27. d 28. b 29. a 30. c 31. c 32. c 33. c 34. a 35. b 36. c
37. a 38. b 39. c 40. a 41. a 42. b 43. c 44. c 45. c 46. a 47. a 48. a 49. a 50. b 51. d 52. b 53. d 54. b 55. a 56. b 57. c 58. c 59. b 60. a 61. c 62. d 63. a 64. b 65. d 66. c 67. c 68. c 69. a 70. c 71. b 72. d
73. a 74. d 75. c 76. c 77. a 78. d 79. a 80. d 81. b 82. d 83. a 84. c 85. c 86. a 87. c 88. b 89. b 90. c 91. d 92. a 93. b 94. a 95. a 96. d 97. a 98. b 99. c 100. c 101. d 102. a 103. a 104. b 105. a 106. c 107. a 108. b
109. d 110. c 111. c 112. b 113. b 114. c 115. d 116. c 117. b 118. b 119. a 120. c 121. c 122. d 123. d 124. b 125. b 126. c 127. c 128. b 129. b 130. b 131. b 132. b 133. c 134. a 135. d 136. d 137. d 138. d 139. c 140. b 141. b 142. a 143. c 144. b

Ultrasonic Testing Method, Level II

- | | | | |
|--------|--------|--------|--------|
| 145. c | 151. a | 157. a | 163. d |
| 146. a | 152. a | 158. b | 164. c |
| 147. a | 153. d | 159. a | 165. d |
| 148. d | 154. d | 160. b | |
| 149. c | 155. b | 161. b | |
| 150. a | 156. c | 162. c | |

80. In an immersion inspection of raw material, the water travel distance should be:
 - a. exactly 76 mm (3 in.)
 - b. equal to 76 mm (3 in.) $\pm$ 13 mm ($\pm$ 0.5 in.)
 - c. equal to the water travel distance used in setting up on the reference standards
 - d. equal to the thickness of a material

F.46.26
 81. The angle formed by an ultrasonic wave as it enters a medium of different velocity than the one from which it came and a line drawn perpendicular to the interface between the two media is called the angle of:
 - a. incidence
 - b. refraction
 - c. rarefaction
 - d. reflection

H.2-21
 82. The process of adjusting an instrument or device to a reference standard is referred to as:
 - a. angulation
 - b. scanning
 - c. correcting for distance amplitude variations
 - d. calibration

H.5-3
 83. An electron tube in which a beam of electrons from the cathode is used to reproduce an image on a display at the end of the tube is referred to as:
 - a. an amplifier tube
 - b. a pulser tube
 - c. a cathode ray tube
 - d. a sweep tube

H.2-10
 84. A grouping of a number of crystals in one transducer, with all contact surfaces in the same plane, and vibrating in phase with each other to act as a single transducer is called a:
 - a. focusing crystal
 - b. crystal mosaic
 - c. scrubber
 - d. single plane manipulator

H.3-13
 85. The angle of reflection is:
 - a. equal to the angle of incidence
 - b. dependent on the couplant used
 - c. dependent on the frequency used
 - d. equal to the angle of refraction

H.2-10
 86. The angular position of the reflecting surface of a planar discontinuity with respect to the entry surface is referred to as:
 - a. the angle of incidence
 - b. the angle of refraction
 - c. the orientation of the discontinuity
 - d. none of the above

H.2-40
 87. A short burst of alternating electrical energy is called:
 - a. a continuous wave
 - b. a peaked DC voltage
 - c. an ultrasonic wave
 - d. a pulse

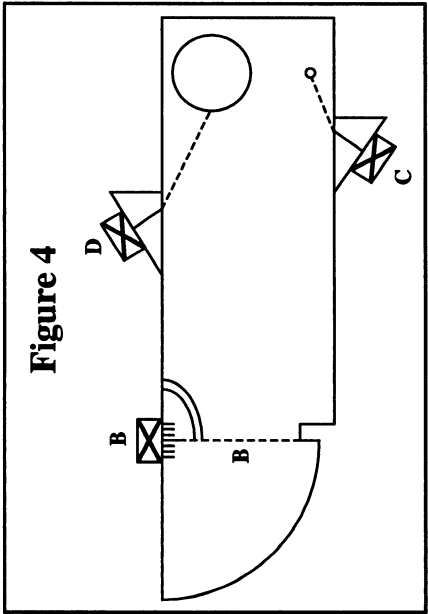
H.3-3
 88. In ultrasonic testing, the time duration of the transmitted pulse is referred to as:
 - a. the pulse length or pulse width
 - b. the pulse amplitude
 - c. the pulse shape
 - d. none of the above

H.3-4, 3-5
 89. The phenomenon by which a wave strikes a boundary and changes the direction of its propagation within the same medium is referred to as:
 - a. divergence
 - b. impedance
 - c. angulation
 - d. reflection

E.215
 90. The change in direction of an ultrasonic beam when it passes from one medium to another whose velocity differs from that of the first medium is called:
 - a. refraction
 - b. rarefaction
 - c. angulation
 - d. reflection

D.23
 91. The coated inside surface of the large end of a cathode ray tube which becomes luminous when struck by an electron beam is called:
 - a. an electron gun
 - b. an electron amplifier
 - c. an ultrasonic instrument display
 - d. an electron counter

H.2-10



72. In a water immersion test, ultrasonic energy is transmitted into steel at an incident angle of 14 degrees. What is the angle of the refracted shear wave within the material?

$$\begin{aligned} V_s &= 3.2 \times 10^5 \text{ cm/s} \\ V_w &= 1.5 \times 10^5 \text{ cm/s} \end{aligned}$$

(Trigonometry Tables Required)

- a. 45 degrees
- b. 23 degrees
- c. 31 degrees
- d. 13 degrees

H.2-24

73. If you were requested to design a plastic shoe to generate a Rayleigh wave in aluminum, what would be the incident angle of the ultrasonic energy?

$$\begin{aligned} V_A &= 3.1 \times 10^5 \text{ cm/s} \\ V_P &= 2.6 \times 10^5 \text{ cm/s} \end{aligned}$$

(Trigonometry Tables Required)

- a. 37 degrees
- b. 57 degrees
- c. 75 degrees
- d. 48 degrees

H.2-24

74. Compute the wavelength of ultrasonic energy in lead at 1 MHz.

$$\begin{aligned} V_L &= 2.1 \times 10^5 \text{ cm/s} \\ V &= \lambda \times F \end{aligned}$$

- a. 0.21 cm
- b. 21 cm
- c. 0.48 cm
- d. 4.8×10^{-5} cm

H.2-5

75. For aluminum and steel, the longitudinal velocity is approximately _____ the shear velocity.

- a. equal to
- b. twice
- c. half of
- d. four times

H.2-22

76. Water travel distance for immersion inspections should be:

- a. such that the second front reflection does not appear between the first front and back reflections
- b. exactly 76 mm (3 in.)
- c. less than 76 mm (3 in.)
- d. always equal to the thickness of the material being inspected

F.46.10

77. The electronic circuitry that allows selection and processing of only those signals relating to discontinuities that occur in specific zones of a part is called:

- a. an electronic gate
- b. an electronic attenuator
- c. a distance amplitude correction circuit
- d. a fixed marker

H.3-6

78. When conducting a contact ultrasonic test, the "hash" or irregular signals that appear in the CRT display of the area being inspected could be caused by:

- a. fine grains in the structure
- b. dirt in the water couplant
- c. coarse grains in the structure
- d. a thick but tapered back surface

F.48.30

79. In inspecting a 102 mm (4 in.) diameter threaded steel cylinder for radial cracks extending from the root of the threads, it would be preferable to transmit:

- a. shear waves at an angle to the threads
- b. longitudinal waves from the end of the cylinder and perpendicular to the direction of the thread roots
- c. surface waves perpendicular to the thread roots
- d. shear waves around the circumference of the cylinder

D.347

Level II Questions

Ultrasonic Testing Method

- The wave mode that has multiple or varying wave velocities is:
 - a. longitudinal waves
 - b. shear waves
 - c. transverse waves
 - d. Lamb wavesF.43.9
- Which of the following would be considered application(s) of ultrasonic techniques?
 - a. Determination of a material's elastic modulus.
 - b. Study of a material's metallurgical structure.
 - c. Measurement of a material's thickness.
 - d. All of the above.F.43.2
- The only significant sound wave mode that travels through a liquid is a:
 - a. shear wave
 - b. longitudinal wave
 - c. surface wave
 - d. Rayleigh waveF.45.6
- The acoustic impedance of a material is used to determine the:
 - a. angle of refraction at an interface
 - b. attenuation within the material
 - c. relative amounts of sound energy coupled through and reflected at an interface
 - d. beam spread within the materialF.43.12
- When angle beam contact testing a test piece, increasing the incident angle until the second critical angle is reached results in:
 - a. total reflection of a surface wave
 - b. 45 degree refraction of the shear wave
 - c. production of a surface wave
 - d. none of the aboveH.2-27
- The wave mode that has multiple or varying wave velocities is:
 - a. longitudinal wave.
 - b. A shear wave.
 - c. A surface wave.
 - d. All of the above.H.2-5
- Acoustic energy propagates in different modes. Which of the following represent a mode?
 - a. A longitudinal wave.
 - b. A shear wave.
 - c. A surface wave.
 - d. All of the above.H.2-5
- The simple experiment where a stick in a glass of water appears disjointed at the water surface illustrates the phenomenon of:
 - a. reflection
 - b. magnification
 - c. refraction
 - d. diffractionI.232
- The crystal thickness and transducer frequency are related. The thinner the crystal:
 - a. the lower the frequency
 - b. the higher the frequency
 - c. there is no appreciable affect
 - d. none of the aboveH.3-20
- The random distribution of crystallographic direction in alloys with large crystalline structures is a factor in determining:
 - a. acoustic noise levels
 - b. selection of test frequency
 - c. scattering of sound
 - d. all of the aboveF.45.6
- The length of the zone adjacent to a transducer in which fluctuations in sound pressure occur is mostly affected by:
 - a. the frequency of the transducer
 - b. the diameter of the transducer
 - c. the length of transducer cable
 - d. both a and bD.191

11. The differences in signals received from identical reflectors at different material distances from a transducer may be caused by:
- material attenuation
 - beam divergence
 - near field effects
 - all of the above
- B.197-198**
12. It is possible for a discontinuity smaller than the transducer to produce indications of fluctuating amplitude as the transducer is moved laterally if testing is being performed in the:
- Fraunhofer zone
 - near field
 - Snell field
 - shadow zone
- B.197**
13. In immersion testing, the near field effects of a transducer may be eliminated by:
- increasing transducer frequency
 - using a larger diameter transducer
 - using an appropriate water path
 - using a focused transducer
- F.44.14**
14. In Figure 1, assuming a uniform beam pattern, what relationship would you expect to exist between the amplitudes of the reflected laminar signals at positions A and B?
- 12 dB difference
 - equal amplitudes
 - 2 to 1
 - 3 to 1
- B.197**
15. In the far field of a uniform ultrasonic beam, sound intensity is _____ the beam centerline.
- minimum at
 - maximum at
 - maximum throughout twice the angle ($\sin \gamma = \frac{C}{Df}$) where C is acoustic velocity, D is crystal diameter, and f is frequency at
 - not related to orientation of
- B.52-53, 198; H.2-31**
16. Which of the following may result in a long narrow rod if the beam divergence results in a reflection from a side of the test piece before the sound wave reaches the back surface?
- Multiple indications before the first back reflection.
 - Indications from multiple surface reflections.
 - Conversion from the longitudinal mode to shear mode.
 - Loss of front surface indications.
- H.2-39**
17. Where does beam divergence occur?
- near field
 - far field
 - at the crystal
 - none of the above
- I.239**
18. As frequency increases in ultrasonic testing, the angle of beam divergence of a given diameter crystal:
- decreases
 - remains unchanged
 - increases
 - varies uniformly through each wavelength
- H.2-31**

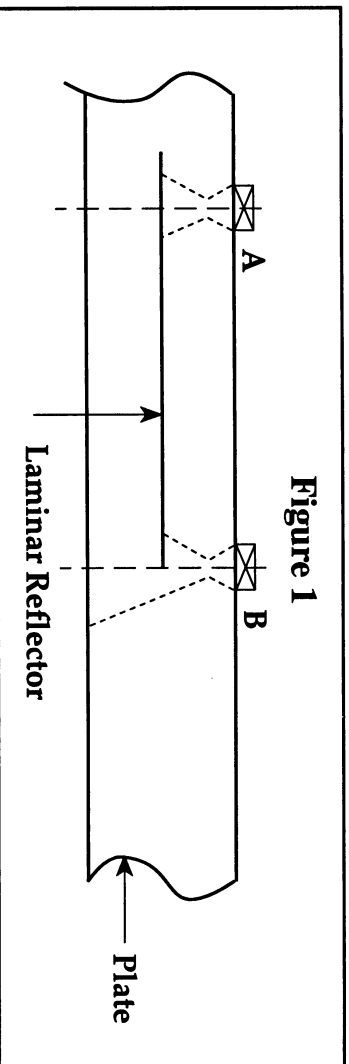


Figure 1

61. The vertical linear range of a test instrument may be determined by obtaining ultrasonic responses from:
- a set of distance amplitude reference blocks
 - steel balls located at several different water path distances
 - a set of area amplitude reference blocks
 - all of the above
- H.5-5**
62. Large grains in a metallic test specimen usually result in:
- a decrease or loss of back surface reflection
 - large "hash" or noise indications
 - a decrease in penetration
 - all of the above
- H.4-19**
63. The total energy losses occurring in all materials is called:
- attenuation
 - scatter
 - beam spread
 - interface
- B.377**
64. Delay-tip (stand-off) type contact transducers are primarily used for:
- defect detection
 - sound wave characterization
 - thickness measurement or flaw detection in thin materials
 - attenuation measurements
- I.258**
65. Acoustical lenses are commonly used for contour correction. When scanning the inside of a pipe section by the immersion method, use a:
- focused cup lens
 - convex lens
 - concave lens
 - variable pitch lens
- F.44.9**
66. In Figure 3, transducer A is being used to establish:
- verification of wedge angle
 - sensitivity calibration
 - resolution
 - an index point
- I.266**
67. In Figure 3, transducer C is being used to check:
- distance calibration
 - resolution
 - sensitivity calibration
 - verification of wedge angle
- I.267**
68. In Figure 3, transducer D is being used to check:
- sensitivity calibration
 - distance calibration
 - resolution
 - verification of wedge angle
- I.266**
69. When the incident angle is chosen to be between the first and second critical angles, the ultrasonic wave generated within the part will be:
- longitudinal
 - shear
 - surface
 - Lamb
- H.2-23**
70. In Figure 4, transducer B is being used to check:
- the verification of wedge angle
 - resolution
 - sensitivity calibration
 - distance calibration
- I.266**
71. The angle at which 90 degrees refraction of the shear wave mode occurs is called the:
- first critical angle
 - second critical angle
 - third critical angle
 - angle of reflection
- H.2-25**

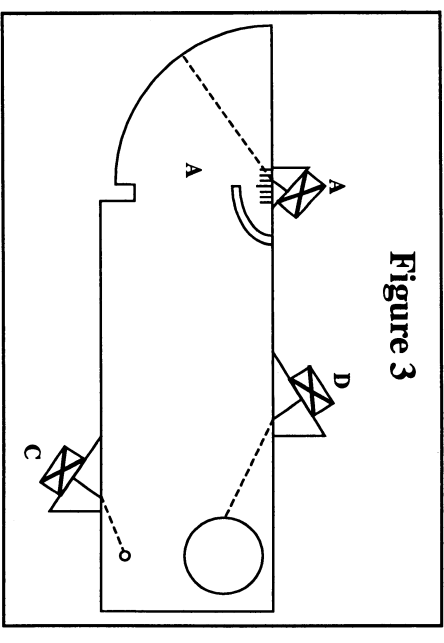


Figure 3

50. During a straight beam ultrasonic test, a discontinuity indication is detected that is small in amplitude compared to the loss in amplitude of back reflection. The orientation of this discontinuity is probably:

- parallel to the test surface
- perpendicular to the sound beam
- parallel to the sound beam
- at an angle to the test surface

H.2-40

51. A discontinuity is located having an orientation such that its long axis is parallel to the sound beam. The indication from such a discontinuity will be:

- large in proportion to the length of the discontinuity
- small in proportion to the length of the discontinuity
- representative of the length of the discontinuity
- such that complete loss of back reflection will result

H.2-40

52. Gas discontinuities are reduced to flat discs or other shapes parallel to the surface by:

- rolling
- machining
- casting
- welding

F.45.22

53. In which zone does the amplitude of an indication from a given discontinuity diminish exponentially as the distance increases?

- The far field zone.
- The near field zone.
- The dead zone.
- The Fresnel zone.

H.2-41

54. A smooth flat discontinuity whose major plane is not perpendicular to the direction of sound propagation may be indicated by:

- an echo amplitude comparable in magnitude to the back surface reflection
- a complete loss of back surface reflection
- an echo amplitude larger in magnitude than the back surface reflection
- all of the above

H.2-40

55. Using a pulse echo technique, if the major plane of a flat discontinuity is oriented at some angle other than perpendicular to the direction of sound propagation, the result may be:

- loss of signal linearity
- loss or lack of a received discontinuity echo
- focusing of the sound beam
- loss of interference phenomena

H.2-40

56. As transducer diameter decreases, the beam spread:

- decreases
- remains the same
- increases
- becomes conical in shape

H.2-30

57. A set of standard reference blocks with the same geometrical configuration and dimensions other than the size of the calibration reflectors, e.g., flat bottom holes, is called a set of:

- distance amplitude standards
- area amplitude standards
- variable frequency blocks
- beam spread measuring blocks

H.5-5

58. The angle at which 90 degrees refraction of a longitudinal sound wave is reached is called:

- the angle of incidence
- the first critical angle
- the angle of maximum reflection
- the second critical angle

H.2-25

59. The control of voltage supplied to the vertical deflection plates of the instrument display in an A-scan UT setup is performed by the:

- sweep generator
- pulser
- amplifier circuit
- clock timer

E.238

60. Attenuation is a difficult quantity to measure accurately, particularly in solid materials, at the test frequencies normally used. The overall result usually observed includes other loss mechanisms which can include:

- beam spread
- couplant mismatch
- test piece geometry
- all of the above

F.43.23

19. As the radius of curvature of a curved lens is increased, the focal length of the lens:

- increases
- decreases
- remains the same
- cannot be determined unless the frequency is known

F.44.7

20. When examining materials for planar flaws oriented parallel to the part surface, what testing method is most often used?

- angle beam
- through-transmission
- straight beam
- dual crystal

I.268

21. If a contact angle beam transducer produces a 45 degrees shear wave in steel, the angle produced by the same transducer in an aluminum specimen would be: ($V_{steel} = 0.323 \text{ cm}/\mu\text{s}$; $V_{AL} = 0.310 \text{ cm}/\mu\text{s}$)

- less than 45 degrees
- greater than 45 degrees
- 45 degrees
- unknown: more information is required

H.2-24

22. Rayleigh waves are influenced most by defects located:

- close to or on the surface
- 1 wavelength below the surface
- 3 wavelengths below the surface
- 6 wavelengths below the surface

D.306

23. The ultrasonic testing technique in which finger damping is most effective in locating a discontinuity is the:

- shear wave technique
- longitudinal wave technique
- surface wave technique
- compressional wave technique

F.45.11; H.2-32

24. Lamb waves can be used to detect:

- laminar-type defects near the surface of a thin material
- lack of fusion in the center of a thick weldment
- internal voids in diffusion bonds
- thickness changes in heavy plate material

F.45.12

25. The ratio of the velocity of sound in water compared to that for aluminum or steel is approximately:

- 1:8
- 1:4
- 1:3
- 1:2

H.2-18

26. Which of the following scanning methods could be classified as an immersion type test?

- Tank in which the transducer and test piece are immersed.
- Squirter bubbler method in which the sound is transmitted in a column of flowing water.
- Scanning with a wheel-type transducer with the transducer inside a liquid filled tire.
- All of the above.

I.258-259

27. In an immersion test of a piece of steel or aluminum, the water distance appears on the display as a fairly wide space between the initial pulse and the front surface reflection because of:

- reduced velocity of sound in water as compared to test specimen
- increased velocity of sound in water as compared to test specimen
- temperature of the water
- all of the above

H.4-5; I.245

28. Using the immersion method, a distance amplitude curve (DAC) for a 19 mm (0.75 in.) diameter, 5 MHz transducer shows the high point of the DAC at the B/51 mm (2 in.) block. One day later, the high point of the DAC for the same transducer is at the J/102 mm (4 in.) block. Assuming that calibration has not changed, this would indicate that the transducer:

- is improving in resolution
- is becoming defective
- has the beam of a smaller transducer
- both b and c

F.44.13

29. What law can be used to calculate the angle of refraction within a metal for both longitudinal and shear waves?

- Poisson's ratio law
- Snell's law
- Fresnel's field law
- Charles' law

F.45.10

Ultrasonic Testing Method, Level II

30. At an interface between two different materials, an impedance difference results in:
 - a. reflection of the entire incident energy at the interface
 - b. absorption of sound
 - c. division of sound energy into transmitted and reflected modes
 - d. none of the above

F.45.9
 31. When using focused transducers, nonsymmetry in a propagated sound beam may be caused by:
 - a. backing material variations
 - b. lens centering or misalignment
 - c. porosity in lenses
 - d. all of the above

H.6-13
 32. Ultrasonic wheel units may be used for which of the following types of examination?
 - a. straight or longitudinal examination
 - b. angle beam or shear wave examination
 - c. surface wave or Rayleigh wave examination
 - d. all of the above

H.4-7
 33. During straight beam testing, test specimens with non-parallel front and back surfaces can cause:
 - a. partial or total loss of back reflection
 - b. no loss in back reflection
 - c. a widened (broad) back reflection indication
 - d. a focused (narrow) back reflection indication

H.2-37
 34. In the immersion technique, the distance between the face of the transducer and the test surface (water path) is usually adjusted so that the time required to send the sound beam through the water:
 - a. is equal to the time required for the sound to travel through the test piece
 - b. is greater than the time required for the sound to travel through the test piece
 - c. is less than the time required for the sound to travel through the test piece
 - d. none of the above

H.4-6
 35. In a B-scan display, the length of a screen indication from a discontinuity is related to:
 - a. a discontinuity's thickness as measured parallel to the ultrasonic beam
 - b. the discontinuity's length in the direction of the transducer travel
 - c. both a and b
 - d. none of the above

F.43.41
 36. Which circuit triggers the pulser and sweep circuits in an A-scan display?
 - a. receiver-amplifier
 - b. power supply
 - c. clock
 - d. damping

I.242
 37. On an A-scan display, the "dead zone," refers to:
 - a. the distance contained within the near field
 - b. the area outside the beam spread
 - c. the distance covered by the front surface pulse width and recovery time
 - d. the area between the near field and the far field

I.267
 38. On an A-scan display, what represents the intensity of a reflected beam?
 - a. echo pulse width
 - b. horizontal screen location
 - c. signal brightness
 - d. signal amplitude

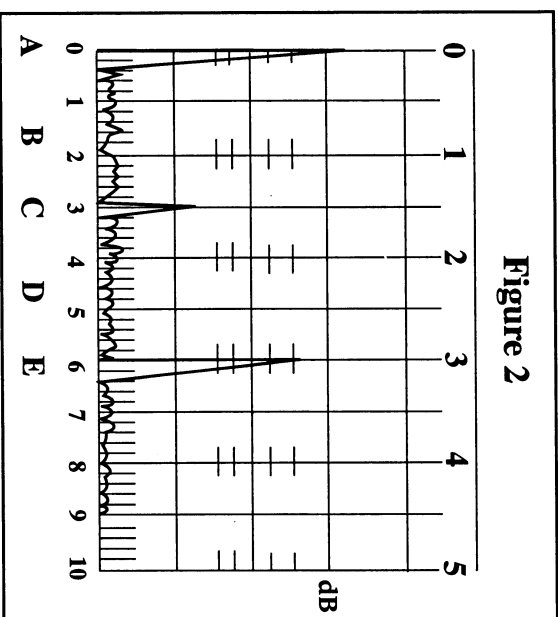
F.43.29
 39. Of the following scan types, which one can be used to produce a recording of flaw areas superimposed over a plan view of the test piece?
 - a. A-scan
 - b. B-scan
 - c. C-scan
 - d. D-scan

I.242
 40. In immersion testing in a small tank, a manually operated manipulator is used to:
 - a. set the proper water path
 - b. set the proper transducer angle
 - c. set the proper index function
 - d. complete both a and b

F.46.1
 41. In straight (normal) beam contact testing, a reduction in the back surface reflection amplitude could indicate:
 - a. inadequate coupling
 - b. a flaw which is not normal to the beam
 - c. a near surface defect that cannot be resolved from the main bang (initial pulse)
 - d. all of the above

F.43.41

Ultrasonic Testing Method, Level II



- Figure 2**