

**ATLANTIS NDT**

Magnetic Particle Testing (MT) Level II General Examination — Practice Questions

40 multiple-choice questions with an answer key and explanations

Candidate name	
Date	
Time allowed (suggested)	90 minutes
Score	____ / 40

Reviewed 2026-10-24 · Atlantis Engineering Consultants · atlantisndt.com

Before you start

Forty original questions on magnetism, current types and field direction, magnetizing technique, equipment and particles, process control checks, interpretation of discontinuities and demagnetization. The set includes worked calculations on permeability, field strength, coil ampere-turns, L/D ratio, current selection and bath concentration.

Choose the single best answer for each question. Work without notes first, then check yourself against the answer key at the back. Under ASNT SNT-TC-1A your employer's written practice sets the passing grade and the number of questions in the real examination.

These are original study questions written by Atlantis NDT. They are not taken from, and do not reproduce, any ASNT or employer examination.

- 1. A steel sample carries a flux density of 12,000 gauss when the magnetizing force is 20 oersteds. What is its permeability at that point, in CGS units (air = 1)?**
 - A. 240,000
 - B. 0.0017
 - C. 600
 - D. 12,020
- 2. On a steel's initial magnetization curve, what is the region called where large further increases in magnetizing force produce very little increase in flux density?**
 - A. Saturation
 - B. Coercive force
 - C. Residual magnetism
 - D. Reluctance
- 3. A material that is only weakly attracted by a strong magnet, with a relative permeability slightly greater than 1, is classed as:**
 - A. Diamagnetic
 - B. Ferromagnetic
 - C. Paramagnetic
 - D. Magnetically hard
- 4. Direct current is passed end to end through a solid steel bar. How does the circular field strength vary inside the bar?**
 - A. Zero at the center, rising to a maximum at the surface
 - B. Maximum at the center, falling to zero at the surface
 - C. Uniform from the center out to the surface
 - D. Maximum midway between the center and the surface
- 5. The field strength 50 mm from the center of a long, straight conductor is 2,000 A/m. With the same current and no ferromagnetic material nearby, what is it 100 mm from the center?**
 - A. 4,000 A/m
 - B. 1,000 A/m
 - C. 500 A/m
 - D. 2,000 A/m

6. A solid steel bar and a steel tube have the same outside diameter. Each is magnetized by passing the same current through it end to end. How does the magnetizing force at the outside surface compare?

- A. It is about the same for both
- B. It is higher on the tube, which has less metal
- C. It is higher on the bar, which carries more current
- D. It is zero on the tube

7. If the frequency of the alternating magnetizing current is increased, how does the depth of the effective field in the part change?

- A. It increases
- B. It decreases
- C. It does not change
- D. It increases, but only in high-permeability steel

8. Why is AC a poor choice for the residual method unless the equipment controls where in the cycle the current stops?

- A. AC cannot magnetize ferromagnetic steel
- B. The residual field varies with the point at which current stops
- C. AC leaves a residual field too strong to read
- D. AC heats the part close to its Curie temperature during the shot

9. A long shaft is magnetized in a coil with three-phase full-wave rectified current. What is the purpose of a quick-break (rapid cutoff) circuit?

- A. To demagnetize the shaft after each shot
- B. To convert the field to circular for longitudinal discontinuities
- C. To reduce heating of the coil windings
- D. To improve detection of transverse discontinuities at the ends

10. A steel ring, such as a bearing race, is threaded onto a central conductor and current is passed through the conductor. Which discontinuities are best detected?

- A. Circumferential cracks that run around the ring
- B. Radial and axial cracks, which lie across the circumference
- C. Laminations lying parallel to the ring faces
- D. None, because a closed ring cannot carry a magnetic field at all

11. What is the main advantage of multidirectional (swinging-field) magnetization?

- A. It removes the need to verify field adequacy
- B. It allows nonferromagnetic alloys such as aluminum to be examined
- C. It leaves a permanent residual field for later checks
- D. It finds discontinuities of several orientations in one setup

12. Your procedure gives $NI = 45,000 \div (L/D)$ for a part lying against the inside wall of a low-fill-factor coil. A bar 150 mm long and 50 mm in diameter is placed in a 10-turn coil. What current is required?

- A. 15,000 A
- B. 4,500 A
- C. 1,500 A
- D. 500 A

13. A part 100 mm long and 60 mm in diameter must be magnetized longitudinally in a coil. What is its L/D ratio, and what is a common remedy?

- A. About 1.7; add ferromagnetic pole pieces or place parts end to end
- B. About 0.6; add coil turns to raise the flux density
- C. About 1.7; reduce the current because the part will saturate
- D. About 3.3; apply the usual coil formula without change

14. A procedure specifies 1,000 A per 25 mm for head shots and, for noncircular sections, bases the current on the greatest diagonal of the cross-section. What current is required for a rectangular bar 40 mm × 30 mm?

- A. 1,600 A
- B. 2,800 A
- C. 1,200 A
- D. 2,000 A

15. Why is the continuous method generally more sensitive than the residual method?

- A. It uses larger particles that are easier to see
- B. Particles see the full applied field, not the weaker residual one
- C. It can be used only with AC, which is always the more sensitive current
- D. The residual method cannot use fluorescent particles

16. For which part is the residual method most likely to be suitable?

- A. A low-carbon steel plate
- B. An annealed soft-iron pole piece
- C. A hardened high-carbon steel tool part
- D. An austenitic stainless steel fitting

17. Dry magnetic powders are usually a blend of elongated and more rounded particles. Why?

- A. Elongated ones align in leakage fields; rounded ones flow freely
- B. Rounded ones fluoresce; elongated ones give visible contrast
- C. Elongated ones resist moisture; rounded ones resist heat
- D. Rounded ones carry current to discontinuities at the surface

18. Black visible particles are used on a dark, as-welded surface. What is the usual way to improve contrast?

- A. Switch to AC so the black particles appear brighter
- B. Apply a thick primer coat so the particles stand out
- C. Add particles until the whole surface is covered
- D. Apply a thin, even white contrast coating

19. A settling test on a fluorescent wet bath gives 0.05 mL of particles in a 100 mL sample. The procedure range is 0.1 to 0.4 mL. What should be done?

- A. Continue, since a low concentration improves contrast
- B. Add particle concentrate, re-agitate and repeat the settling test
- C. Add carrier to dilute the bath
- D. Raise the UV-A intensity at the surface to make up for the shortfall

20. After a settling test on a used fluorescent bath, the liquid above the settled particles glows noticeably under UV-A. What does this indicate?

- A. The bath is at the ideal concentration
- B. The UV-A lamp is being held too close to the tube
- C. The bath is contaminated or the pigment has separated; replace it
- D. The particles are too coarse and should be replaced with finer ones

21. In wet MT with a water-based carrier, what is a water-break test used for?

- A. To check that the bath wets the surface as a continuous film
- B. To measure the particle concentration of the bath
- C. To verify the UV-A intensity at the surface
- D. To check the carrier's flash point before it is used on hot parts

22. Fluorescent magnetic particles are excited by UV-A. What wavelength band is used, and where is the typical peak?

- A. 200–280 nm, peaking near 254 nm
- B. 320–400 nm, peaking near 365 nm
- C. 400–700 nm, peaking near 550 nm
- D. 700–1,000 nm, peaking near 850 nm

23. On a curved pipe surface, one leg of an electromagnetic yoke makes poor contact and leaves an air gap. What is the effect?

- A. The field becomes circular instead of longitudinal
- B. Sensitivity improves because flux leaks at the gap
- C. There is no effect provided AC is used
- D. The field in the part drops because the gap adds reluctance

24. In a stationary wet unit, a tool-steel ring with small holes drilled at increasing depths below its outside surface is magnetized with a central conductor. What is it used for?

- A. Calibrating the unit's ammeter
- B. Measuring UV-A intensity at the bench
- C. Checking overall system performance
- D. Demagnetizing small parts after examination

25. Prods are placed on either side of a butt weld so that the line between them runs across the weld. Which discontinuities in the weld are best detected at that placement?

- A. Transverse cracks, lying across the weld
- B. Longitudinal cracks, lying along the weld axis
- C. Only subsurface porosity, in any orientation
- D. Discontinuities in all orientations equally

26. In the dry continuous method, how should the powder be applied and the excess removed?

- A. Poured on heavily, then brushed off after the current stops
- B. Dusted on lightly, with excess blown off gently while the field is on
- C. Mixed into a slurry and wiped on with a cloth
- D. Thrown on, with excess removed by strong air after demagnetizing

27. MT must be done on a weld that is still at about 250 °C (480 °F). Which approach is appropriate?

- A. A petroleum-based fluorescent bath, since heat improves mobility
- B. A water-based visible bath applied generously
- C. Dry powder rated by its manufacturer for that temperature
- D. Any particles, since surface temperature does not affect MT

28. Some specifications require MT of welds in high-strength steels to be delayed for a set number of hours after welding. Why?

- A. So that residual magnetism left by the welding arc has time to decay
- B. Because particles will not stick to a freshly welded surface
- C. So the weld can cool below its Curie temperature
- D. Because hydrogen cracking can appear hours after the weld cools

29. MT of rolled bar stock shows a straight, sharp, sometimes intermittent indication running lengthwise along the bar. What is it most likely to be?

- A. A seam
- B. A grinding crack
- C. A cold shut
- D. A shrinkage cavity

30. After surface grinding of a hardened part, MT shows a network of fine sharp lines, or a series of fine lines at right angles to the grinding direction. What are they most likely to be?

- A. Nonmetallic inclusions
- B. Magnetic writing
- C. Forging laps
- D. Grinding cracks

31. During in-service MT, a tight, fairly smooth crack is found starting at the corner of a keyway in a rotating shaft. What is its most likely origin?

- A. Fatigue initiated at a stress concentration
- B. A forging lap that was opened up by later machining
- C. Shrinkage left from the original casting
- D. Porosity left from an earlier weld repair

32. MT on the cut bevel of a steel plate before welding shows a straight indication running parallel to the plate surfaces near mid-thickness. What is it most likely to be?

- A. A transverse crack
- B. A crater crack
- C. A lamination
- D. Magnetic writing

33. A broad, fuzzy indication follows the fusion line of a weld between two ferritic steels of different composition. It reappears every time the joint is magnetized and has no sharp edges. What is the most likely cause?

- A. A permeability change at the boundary, to be confirmed as nonrelevant
- B. Lack of fusion, which must be rejected without further checks
- C. Magnetic writing left by contact with another magnetized part
- D. Low bath concentration collecting along the fusion line

34. Which of these is a false indication rather than a nonrelevant one?

- A. Particles held where two steels of different permeability meet
- B. Particles trapped by roughness or drainage, not by leakage
- C. Particles held at a sharp fillet radius by geometric leakage
- D. Particles held along the edge of a press-fit assembly

35. A star-shaped indication is found at the end of a weld bead where the arc was broken. What is it most likely to be?

- A. Undercut
- B. A slag line
- C. A lamination
- D. A crater crack

36. On a steel casting, an MT indication is ragged and branching and lies at a fillet where a thin section joins a thick one. What is it most likely to be?

- A. A seam
- B. A grinding crack
- C. A hot tear
- D. A forging burst

37. What happens when a magnetized steel part is heated above its Curie temperature?

- A. Its retentivity rises once it cools
- B. Its residual field doubles as domains realign
- C. It loses its residual magnetism
- D. Nothing changes unless current is also applied

38. After demagnetizing a bar that had been circularly magnetized, a field indicator held near it shows almost no reading. Why might a residual field still be present?

- A. Field indicators respond only to AC fields
- B. The circular field is contained within the part
- C. The particles absorbed the residual field during the examination
- D. Demagnetization automatically converts the field to longitudinal

39. When demagnetizing with a fixed-current AC coil, how is the gradually decreasing field usually obtained?

- A. Switch the coil off with the part at its center
- B. Pass the part through quickly several times with the coil off
- C. Rotate the part once inside the energized coil
- D. Withdraw it slowly until well clear of the energized coil

40. When demagnetizing a long part, why is it often positioned with its long axis running east-west?

- A. To align it with the earth's field for a stronger effect
- B. Because demagnetizing coils only work in that direction
- C. To keep the demagnetizing coil from overheating
- D. To reduce magnetization picked up from the earth's field

Answer key and explanations

1. C	2. A	3. C	4. A	5. B	6. A	7. B	8. B	9. D	10. B
11. D	12. C	13. A	14. D	15. B	16. C	17. A	18. D	19. B	20. C
21. A	22. B	23. D	24. C	25. A	26. B	27. C	28. D	29. A	30. D
31. A	32. C	33. A	34. B	35. D	36. C	37. C	38. B	39. D	40. D

1. C — Permeability is the ratio of flux density to magnetizing force: $B/H = 12,000 \div 20 = 600$. It is not a fixed property of the steel; it changes along the magnetization curve and falls as the material approaches saturation. [General MT principle (B-H relationship)]

2. A — At saturation nearly all magnetic domains are already aligned, so extra magnetizing force adds little flux. Coercive force is the reverse force needed to bring the flux density back to zero, and residual magnetism is what remains once the force is removed. [General MT principle (magnetization curve)]

3. C — Paramagnetic materials, such as aluminum and austenitic stainless steel, are weakly attracted and cannot be examined by MT. Diamagnetic materials such as copper have a relative permeability slightly below 1 and are weakly repelled, while ferromagnetic materials have a relative permeability far above 1. [General MT principle]

4. A — The field at any radius inside the bar depends on the current enclosed within that radius, so it is zero at the center and greatest at the surface; outside the bar it falls off with distance. With AC, the skin effect concentrates the field even more toward the surface. [General MT principle (circular magnetization)]

5. B — Outside a straight conductor $H = I \div (2 \times \pi \times r)$, so field strength is inversely proportional to distance, not to its square: $2,000 \times 50/100 = 1,000$ A/m. The 500 A/m option wrongly applies an inverse-square law. [General MT principle (field around a conductor)]

6. A — At the outside surface $H = I \div (2 \times \pi \times r)$, which depends only on the current and the radius, not on whether the part is hollow. What differs is the inside surface of the tube, where current passed through the wall produces almost no field. [General MT principle (circular magnetization)]

7. B — Alternating current is confined near the surface by the skin effect, and the effective depth becomes shallower as frequency and permeability increase. This is why line-frequency AC suits surface cracks, while DC magnetizes deeper. [General MT principle (skin effect)]

8. B — Depending on where in the cycle the current happens to stop, the part can be left with anything from very little residual field to nearly its full retained value, so results vary from shot to shot. Equipment intended for AC residual work controls the cutoff point; otherwise DC or rectified current is used for the residual method. [General MT principle; ASTM E709]

9. D — With full-wave rectified current the field collapses slowly, and the ends of a longitudinally magnetized part can be left weakly magnetized. A rapid cutoff induces a current pulse in the part that strengthens magnetization near the ends, where transverse discontinuities would otherwise be missed. [General MT principle; ASTM E1444]

10. B — Current through the conductor produces a circular field that follows the ring's circumference, so it crosses radial cracks on the faces and axial cracks on the bore and outside surface. Circumferential discontinuities lie parallel to this field and need a different technique, such as induced-current magnetization, which drives current around the ring. [General MT principle; ASTM E709]

11. D — Two or more fields are applied in rapid succession, so the resultant field sweeps through many directions and discontinuities of different orientations can be revealed in one setup. Field adequacy must still be shown in each direction, usually with artificial flaw shims. [General MT principle; ASTM

E1444]

12. C — $L/D = 150 \div 50 = 3$, so $NI = 45,000 \div 3 = 15,000$ ampere-turns, and dividing by the 10 turns gives $15,000 \div 10 = 1,500$ A. The 15,000 A option forgets to divide by the number of turns, 4,500 A forgets to divide by L/D, and 500 A divides by L/D twice. [General MT practice (coil ampere-turns, formula as stated in the procedure); ASTM E1444]
13. A — $L/D = 100 \div 60$, about 1.7. A short part has a strong self-demagnetizing effect from its own poles, and the usual coil formulas do not apply below an L/D of about 2, so pole pieces or a string of parts end to end are used to lengthen the effective part. [General MT principle (L/D ratio); ASTM E1444]
14. D — The diagonal is 50 mm ($40^2 + 30^2 = 1,600 + 900 = 2,500 = 50^2$), so the current is $50 \div 25 \times 1,000 = 2,000$ A. Using the longer side gives 1,600 A and adding the two sides gives 2,800 A, both of which misapply the rule. [General MT practice (current from cross-section, rule as stated in the procedure)]
15. B — The field present while the particles are mobile is the full applied field, which is always stronger than the residual field left after the current stops. The residual method also depends on the steel's retentivity, so it suits only magnetically hard materials. [General MT principle; ASTM E709]
16. C — The residual method needs high retentivity, which hardened high-carbon and tool steels have. Low-carbon steel and soft iron retain too little field, and austenitic stainless steel is not ferromagnetic. [General MT principle]
17. A — Elongated particles form stronger poles and line up in leakage fields, building clear indications. Rounded particles flow and spread more freely over the surface, so a blend gives both mobility and indication-forming ability. [General MT principle (dry particles)]
18. D — A thin white contrast coating makes dark particles easy to see. It must be kept thin, because any coating holds particles away from the leakage field, and a procedure that uses one should show that indications can still be detected through it. [General MT practice]
19. B — A reading of 0.05 mL is half the 0.1 mL minimum, so indications may be too weak to see. The bath is corrected by adding concentrate, agitated and retested before use; adding carrier would lower the concentration further. [General MT practice; ASTM E709]
20. C — The carrier itself should not fluoresce. A glowing carrier means contamination or fluorescent pigment that has separated from the particles, which raises background fluorescence and reduces contrast, so the bath should be replaced. [General MT practice; ASTM E709]
21. A — Water-based baths rely on wetting agents. If the film breaks into beads or patches instead of covering the surface evenly, the surface is not adequately wetted, often because of oil or too little wetting agent, and particle coverage will be poor. [General MT practice; ASTM E1444]
22. B — UV-A is the long-wave ultraviolet band, about 320–400 nm, and lamps for MT peak near 365 nm. The particles absorb it and emit visible yellow-green light; 254 nm is UV-C, which is hazardous and not used. [General MT principle (fluorescence)]
23. D — Air has far higher reluctance than steel, so even a small gap reduces the flux driven into the part between the legs. Articulated legs should be adjusted so both poles stay in firm contact. [General MT principle (magnetic circuit)]
24. C — The ring is magnetized at the specified currents and the number of hole indications is compared with the required minimum. It checks the equipment, particles and technique together, but it does not replace calibration of the ammeter. [General MT practice; ASTM E1444]
25. A — Current flows along the line between the prods and the field circles that current path, so it crosses discontinuities lying parallel to the line between the prods, here across the weld. Longitudinal

cracks need the prods placed along the weld axis, which is why each area is examined with two placements about 90° apart. [General MT principle (prod technique)]

26. B — A light, even cloud lets particles drift to leakage fields, and removing the excess with gentle air while the part is magnetized keeps indications in place. Heavy application masks indications, and strong air or removing excess after the field is gone can strip off weakly held indications. [General MT practice; ASTM E709]

27. C — Wet carriers evaporate on hot surfaces, petroleum carriers add a fire risk, and fluorescent pigments degrade with heat. Dry powders are made for elevated temperatures, but only within the manufacturer's stated range unless the procedure has been qualified at that temperature. [General MT practice]

28. D — Hydrogen absorbed during welding can cause delayed cracking in the weld or heat-affected zone, sometimes hours after the joint has cooled. Examining too early can miss cracks that form later, so high-strength and quenched-and-tempered steels often carry a waiting period. [General welding and MT practice]

29. A — Seams form when surface discontinuities in the original billet are elongated by rolling, so they appear as straight lines parallel to the rolling direction. Cold shuts and shrinkage are casting discontinuities, and grinding cracks follow a finishing operation. [General MT interpretation]

30. D — Local overheating during grinding sets up thermal stresses that crack hardened surfaces, typically in a network or as lines perpendicular to the grinding direction. They are shallow but sharp, and they are relevant indications. [General MT interpretation]

31. A — Fatigue cracks are service-induced and start where cyclic stress is concentrated, such as keyways, fillets, threads and holes. Laps and shrinkage are manufacturing discontinuities and would not typically start at a machined keyway corner. [General MT interpretation]

32. C — A lamination is a planar discontinuity parallel to the plate surfaces, so it breaks the surface only at edges and bevels, where it shows as a line along the edge. It cannot be found by MT on the plate face; ultrasonic testing is used for that. [General MT interpretation]

33. A — Abrupt changes in permeability, at dissimilar-metal boundaries, heat-affected zones or cold-worked areas, create leakage fields that give diffuse indications. They are nonrelevant only once confirmed, for example by another method or light surface conditioning; magnetic writing would not return after demagnetization. [General MT interpretation]

34. B — A false indication is not caused by a magnetic leakage field; the particles are held mechanically or left behind by drainage. Nonrelevant indications are real leakage fields from geometry, permeability changes or fits, but not from discontinuities. [General MT interpretation]

35. D — Crater cracks form in the weld pool at the end of a bead as it shrinks on solidifying, and often look star-shaped. Undercut runs along the weld toe, and slag lines are usually elongated and parallel to the weld axis. [General MT interpretation (weld discontinuities)]

36. C — Hot tears form during solidification when contraction is restrained, typically at changes in section, and give ragged, branched indications. Seams and forging bursts belong to wrought products, not castings. [General MT interpretation (casting discontinuities)]

37. C — Above the Curie temperature (about 770 °C for iron) the steel stops being ferromagnetic and its domains lose alignment, so it cools essentially demagnetized. It is the most complete method but rarely practical, because the heating can change the part's metallurgical properties. [General MT principle (demagnetization)]

38. B — A circular field in a part without discontinuities closes on itself, so there is little external field for an indicator to read. A common practice is to apply a longitudinal field at least as strong and then demagnetize, so that the remaining field can be measured. [General MT principle; ASTM E709]

39. D — Moving the part slowly away from the energized coil exposes it to a reversing field that weakens with distance, which is what demagnetization needs. Switching the coil off with the part inside can leave a residual field. [General MT practice (demagnetization)]

40. D — The horizontal component of the earth's field runs roughly north-south, so a long part lying north-south can pick up a small longitudinal field from it. Laying the part east-west keeps the earth's field across the part, where it has little effect. [General MT practice (demagnetization)]

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