Current Trends in Ultrasonic Therapy

Scott Benjamin, DDS and Jan Lebeau, RDH

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ABSTRACT
Periodontal disease is prevalent in the US population and globally. A full periodontal examination is required to diagnose and treat plan this disease. Standard initial nonsurgical periodontal therapy requires the removal of all calculus deposits, bacterial toxins, debris, and the disruption and removal of all biofilm. Methods available for the removal of calculus include hand scaling and piezoelectric or magnetostrictive ultrasonic scaling. Selecting appropriate tips and using a safe and effective technique are prerequisites for successful nonsurgical periodontal therapy, as is lifetime re-evaluation of the periodontal patient and regular periodontal maintenance.

EDUCATIONAL OBJECTIVES
The overall goal of this article is to provide the reader with information on the pathogenesis and treatment of periodontal disease. After completing this article the reader will be able to:
1. Describe the prevalence and etiology of periodontal disease;
2. Review the components of a full mouth periodontal examination;
3. Delineate the considerations involved in the use of piezoelectric ultrasonic scalers; and,
4. List and describe the attributes that contribute to time savings, efficacy, safety and ergonomics when using ultrasonic scalers.

ABOUT THE AUTHORS
Scott Benjamin, DDS - Dr. Scott Benjamin is a graduate of SUNY Buffalo, School of Dental Medicine and has been in full-time private practice for over 25 years. He has presented internationally at major dental meetings, universities, workshops, and study clubs, and has published more than 100 articles on dental technology in over a dozen publications on topics ranging from computerization and the internet to micro air abrasion, diagnostic modalities and lasers. AUTHOR DISCLOSURE: Dr. Benjamin has no conflict of interest to declare. He can be reached at: sbenjamin@dentalaim.com.

Jan LeBeau, RDH - Jan LeBeau has been in the practice and education of dental hygiene for over 30 years, joining Pacific Dental Services in 2009 and now serves as the Chair of Hygiene for the PDS Institute. Jan has lectured and published articles on lasers and periodontal disease, the hygienist’s role in implant maintenance, and effective communication for the dental hygienist. Jan is an active member of the Academy of Laser Dentistry and the American Dental Hygiene Association. AUTHOR DISCLOSURE: Ms. LeBeau has no conflict of interest to declare. She can be reached at: lebeaunj@gmail.com.
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untreated, can result in destruction of the tissues supporting
the teeth, tooth loss, masticatory dysfunction and poor
nutrition. It is prevalent throughout the world, ranging from
reversible gingivitis to severe periodontal disease. In the
United States, it has been estimated that 75% of the popula-
tion over the age of 35 experiences some form of periodon-
tal disease, including gingivitis. Environment, genetic and
acquired risk factors all play a role in periodontal disease
(Fig. 1). Tobacco use is a strong risk factor for the develop-
ment, progression and severity of periodontal disease, as
well as impacting the success of managing the disease long
term. Genetic factors are increasingly being investigated.4

Periodontal Disease Progression

Gingivitis occurs due to an inflammatory process asso-
ciated initially with the accumulation of gram-positive
supragingival plaque, and can occur within 2 to 3 days of
the start of dental biofilm formation. By day 7, gram-neg-
ative bacteria migrate and form a subgingival biofilm that
by 12 weeks is well-established, well-differentiated with a
diverse gram-negative flora, and well-structured (Fig. 2). As
biofilm travels deep down the root surface, oral hygiene has
minimal influence on the disruption of subgingival plaque
quantity or its composition, due to an inability to reach the
biofilm with brushing and flossing.6

Periodontal Examination and Diagnosis

A diagnosis of periodontal disease is based on the
patient’s medical history, dental history, clinical and radi-
ographic findings. A comprehensive periodontal examination
includes full mouth pocket charting with 6 sites probed
and recorded per tooth and documentation of bleeding on
probing (BOP), suppuration, gingival recession, mobility,
furcation involvement and other contributing factors such
as overhangs and poor margins (Fig. 3). Radiographs are
essential and permit the assessment of the quantity and pat-
tern of alveolar bone loss, root form, length and proximity,
and the presence of periapical lesions (Fig. 4).7

Adjunctive testing may be performed and can be benefi-
cial in establishing the diagnosis and etiology of the patient’s
condition. These adjunctive tests and techniques include but
are not limited to DNA, enzyme and bacterial testing for spe-
cific pathogens and the bacterial load, as well as assessments
of the levels of prostaglandins, cytokines, tissue-destruction
agents and host-derived enzymes.7 Once a diagnosis has been
made, appropriate periodontal therapy can be instituted.
Periodontal Therapy

Nonsurgical periodontal therapy is the standard of care for the initial treatment of periodontal disease. During instrumentation, the goal of nonsurgical periodontal therapy is to disrupt and effectively remove plaque as well as to remove calculus, bacterial toxins and other debris supra- and subgingivally, while minimizing iatrogenic damage to the tooth structure. All root surfaces must be thoroughly debrided to the base of the pocket where periodontal pathogens are most concentrated, and furcation areas and other periodontal niches must be properly-accessed and debrided.

Thorough debridement is essential to control periodontal disease and achieve a satisfactory outcome, and ultrasonic scaling is most frequently the method selected for nonsurgical periodontal therapy. The evidence supports the use of piezoelectric or magnetostrictive ultrasonic scaling which is at the very least as efficacious as manual scalers or a combination of manual and ultrasonic scalers, and in the case of difficult-to-access sites provides for superior instrumentation.

Ultrasonic Scaling

Ultrasonic scaling can be performed using piezoelectric or magnetostrictive scaler units, which are both effective and offer advantages over manual scaling. Piezoelectric ultrasonic scalers provide linear micromovements of the scaler insert, created by current-activated ceramic discs. All surfaces of the insert may be used, with the lateral surfaces the most active. Magnetostrictive ultrasonic scaler inserts move elliptically; again, all surfaces of the insert may be used. In the case of magnetostrictive units, the tips of the inserts are the most active area and the lateral surfaces the least active.

**Efficacy, Efficiency and Patient Comfort**

Selecting an ultrasonic unit and appropriate use of inserts leads to greater efficacy, efficiency, patient comfort and safety than the use of manual scalers. Considerably less time is required to perform ultrasonic scaling than manual scaling, which improves the efficiency of instrumentation. Time savings for ultrasonic scaling versus manual scaling can be up to one-third, a significant increase in efficiency. From the patient’s perspective, increased efficiency improves patient comfort since less time is required per sextant or quadrant, and may enable more treatment to occur in fewer visits, providing convenience without compromising treatment outcomes. It is worth noting that the completion of full-mouth periodontal debridement in one visit has been advocated to reduce recolonization of periodontal sites.
through migration from as-yet-to-be-treated quadrants, although the results of several studies have shown the same outcome whether periodontal therapy is conducted in one or more visits.\textsuperscript{12,13}

For both piezoelectric and magnetostrictive ultrasonic inserts, instrumentation from the coronal rather than the apical aspect of calculus deposits enables their removal efficiently and with less tissue distension than with a manual scaler which is applied from the apical aspect of the deposit. This, together with the application of less force, further contributes to improved patient comfort. In addition, the incorporation of an air polishing option into ultrasonic units may aid the clinician in debriding deep pockets at interdental sites, compared to curettes.\textsuperscript{14} Air polishing is also perceived by patients to cause less discomfort than hand scaling and requires less time and, in one study, no differences were found for microbiological parameters.\textsuperscript{15}

A well-directed flow of lavage improves cooling, and improves patient comfort since the lavage is more easily suctioned away. Nonetheless, since piezoelectric ultrasonic units generate less heat, they require less lavage/coolant in comparison to magnetostrictive units. This further helps to improve visibility and reduces the need for breaks to suction more than the saliva ejector can handle. Moderate requirement for lavage further improves patient comfort by reducing the uncomfortable feeling of a need to swallow or patient gagging. This is very beneficial to the dental hygienist who often works without the aid of an assistant. In the absence of local anesthesia, patients may also experience thermal discomfort from a cool or cold lavage stimulating any exposed dentin and eliciting dentinal hypersensitivity. The ability to use an irrigating solution that can be temperature-controlled, in addition to reducing the volume of irrigating solution, may reduce the potential for sensitivity and discomfort during treatment. Using a chemotherapeutic as the lavage/cooling agent can help reduce bacterial loads in the depths of pockets and periodontal niches that are the most difficult to access. Therefore, a device with the ability to introduce a chemotherapeutic lavage during instrumentation offers antibacterial benefits not available during manual scaling, which would require a separate step for the application of chemotherapeutics. An ultrasonic unit that enables the clinician to easily change between solutions used for irrigation to select the appropriate agents for the patient or even site-specific situation is therefore also beneficial (Table 1).\textsuperscript{16}

Selecting a unit that offers a well-directed flow of the solution being used with bright illumination from an LED light incorporated into it results in improved visibility of the site (Fig. 5). Using optimal illumination, the tissue can be gently retracted and the light positioned to illuminate deep into the pocket. This has the potential to reduce the time required for instrumentation and to improve outcomes by enhancing accuracy of instrumentation. Bright and properly-aimed illumination can enhance the clinician’s ability to visualize the treatment site to assist in

<table>
<thead>
<tr>
<th>TABLE 1. Partial list of the benefits of piezoelectric ultrasonic instrumentation</th>
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<tr>
<td>Slimmer tips result in less tissue distension</td>
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<td>Reduced force required</td>
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<td>Calculus can be instrumented from the coronal aspect</td>
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<td>Coronal insert application reduces tissue distension</td>
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<td>Less potential for gagging due to limited lavage requirements</td>
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<td>Limited coolant requirements reduces stimuli reaching exposed dentin</td>
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<td>Reduced chairside time</td>
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<td>Ability to control the temperature of the solutions irrigating and lavaging the treatment area</td>
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<td>Ability to deliver appropriate antimicrobial agents while debriding the root/tooth structure</td>
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<td>Enhanced visualization with the ability to illuminate the area being treated</td>
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</table>
enabling the appropriate amount of scaling of the treatment area and reduce the chances of either over- or under-instrumenting the root surface. Enabling the correct amount of instrumentation will enhance the patient’s comfort both during the procedure and postoperatively, and help ensure improved outcomes.

Additionally, the ability to control and adjust the power and irrigation flow during the procedure without interruption improves the practitioner’s efficiency and augments his/her ability to stay focused on the patient’s care and treatment, rather than on the instrument. This control can easily be obtained in utilizing quality piezoelectric ultrasonic units with foot pedals that control the power and water vs. devices that require the clinician to stop and turn to adjust knobs which interrupts the treatment process workflow.

**Ergonomic Considerations**

Ultrasonic scaling minimizes the need for the clinician to place his/her fingers and thumb in positions that cause strain and fatigue. Given the prevalence of musculoskeletal occupational injuries (including carpal tunnel syndrome) that are related to dental and dental hygiene procedures, attention to ergonomics is essential. By having and utilizing appropriate tips and techniques, pivoting of the wrist can be minimized with ultrasonic scaling. Less force, movement and muscle activity are also required than with manual scalers, further reducing the risk of occupational injury. An appropriate posture with use of loupes further improves ergonomics and reduces the risk of occupational injury (Fig. 6). Carefully assessing the anatomy and access when selecting the most appropriate tips optimizes the number required, by ensuring that the inserts offering the easiest safe and effective access at a given clinical site are used. This reduces the time required since fewer stops are necessary to change out tip designs, reducing fatigue. Typically, at least three different tips are required when treating a quadrant or more. Ultrasonic inserts with silicone grips or dimpled grips that are placed over the handpiece area are available for magnetostrictive and piezoelectric ultrasonic inserts – these make holding the scaler insert more comfortable and reduce pinch force and vibration, resulting in less fatigue. As mentioned before, having LED lights incorporated into ultrasonic scaling also improve ergonomics by providing excellent visualization where it is needed – the clinician is less likely to bend in awkward positions in an effort to adequately see the site. Using a foot pedal to vary the power as well as the

<table>
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<th>Table 2. Attributes of ultrasonic scaling contributing to improved ergonomics</th>
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<tr>
<td>Less time required than hand scaling</td>
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<td>Less force required than hand scaling</td>
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<td>Built-in LED lighting</td>
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<td>Foot controls</td>
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<tr>
<td>Insert selection</td>
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<tr>
<td>Removes need for awkward thumb/finger grips</td>
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<td>Silicone and dimpled grips</td>
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lavage used lets the clinician focus, again without the need for the clinician to change his/her body position to adjust knobs or dials as would be the case with the device having the controls on the countertop (Table 2). Since considerably less time is required with ultrasonic scaling,\textsuperscript{10} this results in ergonomic benefits for the clinician. A more ergonomic procedure is also likely to result in less fatigue and reduced treatment time (a benefit to the practice and the patient).

**Selecting and Using Ultrasonic Tips**

Selecting multiple ultrasonic insert tips improves instrumentation and efficacy – units with more choice give the clinician the ability to customize insert use for a given site. Typically, wider diameter inserts are used first for the removal of gross calculus deposits, followed by instrumentation with narrower inserts. Narrow, slim ultrasonic inserts enable access to furcations and other periodontal regions that would otherwise be difficult or impossible to access. Deep pockets harbor the highest load of periodontal pathogens yet, paradoxically, manual scalers are wider than the base of many periodontal pockets and the slimmest Gracey curette is still wider than the access to some furcation sites and therefore not able to adequately instrument the site.\textsuperscript{18} Narrow ultrasonic inserts enable deeper instrumentation, more consistently access to the base of deep pockets, and improve debridement of deep pockets which can be expected to improve treatment outcomes.\textsuperscript{9,19,20} Slimmer ultrasonic inserts minimize tissue distension and associated patient discomfort.

**Safe Use**

When used incorrectly, manual and ultrasonic scalers can cause iatrogenic root damage including gouging, riffeling and rough surfaces that then provide rough sites encouraging recolonization and growth of biofilm following periodontal therapy. Choosing appropriate ultrasonic inserts and using the correct technique minimizes the potential for root damage – care should be taken to avoid using excess force, and slimmer inserts are gentler on root surfaces than wider inserts.\textsuperscript{21,22} Inserts must also be aligned correctly against the tooth surface to avoid damage to the root surface (Fig. 7); piezoelectric units will sound different if they are incorrectly aligned, alerting the clinician to adjust the tip’s angulation. Care should always be taken to avoid using the tip of inserts pointed at the tooth surface, and inserts should be replaced when they show signs of wear as their efficacy then decreases and there is an increased risk of root surface damage. Adequate lavage...
for cooling and irrigation is essential to avoid heat-related pulpal and periodontal damage – piezoelectric units result in less temperature change and therefore require less coolant than magnetostrictive scalers, thereby also reducing the potential amount of bacterial aerosol produced during the procedure (Table 3).

### TABLE 3. Attributes of ultrasonic scaling benefitting instrumentation and safety

<table>
<thead>
<tr>
<th>Attribute</th>
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<tr>
<td>Narrow, slim inserts aid access to pocket depths and furcations</td>
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<tr>
<td>Slimmer tips preserve tooth tissue</td>
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<td>All surfaces of ultrasonic inserts may be used</td>
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<td>More efficient than hand scaling</td>
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<tr>
<td>Inserts provide for cavitation and lavage</td>
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<tr>
<td>Require for less coolant with piezoelectric increases visibility and reduces the potential for bacterial aerosol</td>
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<tr>
<td>Timely replacement of worn tips</td>
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<td>Piezoelectric units alert the user to incorrect insert alignment</td>
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Response to Treatment and Periodontal Maintenance

Following standard nonsurgical periodontal therapy, the patient must return for re-evaluation and life-long periodontal maintenance visits which are typically every 3 to 4 months. Just as the host response and host factors influence the onset and progression of periodontal disease, they also influence an individual patient’s response to treatment. Recurrent periodontitis varies depending upon risk factors, the level of home care (oral hygiene) and professional maintenance following initial therapy. In moderate to severe cases of periodontal disease, adjunctive therapy may be required and surgical intervention may be indicated.

### Summary

The need for efficiency and improved treatment outcomes is paramount for practice success, as well as the patients we serve. Incorporating the appropriate treatment modalities, such as piezoelectric ultrasonic scalers, into a clinician’s armamentarium enables the practitioners to be highly effective in the initial phase of treatment in the management of periodontal disease. By incorporating minimally invasive and effective procedures with minimal discomfort into the practice should lead to higher case acceptance and enhanced care, but more importantly better overall health for patients with this extremely common oral health condition.

### References

8. Drisko CL, Cochran DL, Blieden T, Bouwsma OJ, Cohen...


Webliography


Acknowledgement
The authors would like to acknowledge and thank Dr. Chris Salierno for the images in Figures 2-4, and Elizabeth Nies, RDH for the images in Figures 5-7.
CE Quiz

1. The overall goal of initial nonsurgical periodontal therapy is to _________.
   a. disrupt and remove biofilm
   b. remove calculus
   c. remove debris and bacterial toxins
   d. all of the above

2. ________ risk factors play a role in periodontal disease.
   a. Environmental
   b. Acquired
   c. Genetic
   d. all of the above

3. As biofilm travels deep down the root surface, ________ has minimal influence on the disruption of subgingival plaque quantity or its composition.
   a. oral hygiene
   b. nonsurgical periodontal therapy
   c. the use of curettes
   d. all of the above

4. During full mouth pocket charting as part of a comprehensive periodontal examination, ________ must be probed and recorded.
   a. 2 sites per tooth
   b. 4 sites per tooth
   c. 6 sites per tooth
   d. any of the above

5. Radiographs ________.
   a. are an essential component of the periodontal examination
   b. enable assessment of alveolar bone loss
   c. permit assessment of roots and the periapical region
   d. all of the above

6. If incorrectly aligned, piezoelectric scalers will _________.
   a. stall
   b. sound different
   c. cause a beeping sound from the unit
   d. all of the above

7. In the United States, it has been estimated that ________ of the population over the age of 35 experiences some form of periodontal disease.
   a. 55%
   b. 65%
   c. 75%
   d. 85%

8. All ________ must be thoroughly debrided during nonsurgical periodontal therapy.
   a. root surfaces, including to the base of the pocket
   b. furcation areas
   c. periodontal niches
   d. all of the above

9. Piezoelectric ultrasonic scalers provide for ________ movement of the scaler insert.
   a. elliptical
   b. circular
   c. linear
   d. directionally random

10. The results of several studies have shown ________ outcomes when periodontal therapy is conducted in one versus more visits.
    a. poorer
    b. the same
    c. improved
    d. none of the above
### CEQuiz

11. Patient comfort may be improved using a piezoelectric scaler due to _________.
   a. reduced chairside time compared to manual scaling
   b. the use of narrow, slim tips, which result in less tissue distension
   c. lower requirements for lavage, which may reduce gagging
   d. all of the above

12. Incorrect use of manual and ultrasonic scalers can cause _________.
   a. gouging of the root surface
   b. riffeling
   c. a rough surface
   d. all of the above

13. Silicone grips that fit over the handpiece portion of ultrasonic scalers _________.
   a. reduce vibration
   b. provide a fat grip for the clinician
   c. are ergonomically friendly
   d. all of the above

14. The availability of ________ helps the clinician reach difficult-to-access areas.
   a. ultrasonic scaler slim tips
   b. periodontal curettes
   c. universal hand scalers
   d. all of the above

15. Air polishing _________.
   a. may aid the clinician in debriding deep pockets at interdental sites
   b. is perceived by patients to cause less discomfort than hand scaling
   c. requires less time than hand scaling
   d. all of the above

16. After standard nonsurgical periodontal therapy, patients must return for re-evaluation and life-long periodontal maintenance visits, which are typically every _________.
   a. 2 to 3 months
   b. 3 to 4 months
   c. 4 to 6 months
   d. year

17. With piezoelectric scalers, ________ of the tips may be used.
   a. all surfaces
   b. only the lateral surfaces
   c. only the middle area
   d. none of the above

18. Moderate requirement for lavage/coolant _________.
   a. helps to improve visibility
   b. reduces the need for breaks to suction more than the saliva ejector can handle
   c. improves patient comfort
   d. all of the above

19. Time savings for ultrasonic scaling versus manual scaling can be up to _________.
   a. one-half
   b. one-third
   c. three-quarters
   d. none of the above

20. The ergonomics of ultrasonic scaler units is improved by _________.
   a. foot pedals rather than manually adjusted knobs
   b. the incorporation of LED lighting
   c. the ability to scale without awkward thumb and finger grips
   d. all of the above
### Educational Objectives

1. Describe the prevalence and etiology of periodontal disease;
2. Review the components of a full mouth periodontal examination;
3. Delineate the considerations involved in the use of piezoelectric ultrasonic scalers; and
4. List and describe the attributes that contribute to time savings, efficacy, safety, and ergonomics.

### Course Evaluation

Please evaluate this course using a scale of 3 to 1, where 3 is excellent and 1 is poor.

<table>
<thead>
<tr>
<th>Objective</th>
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<td>Clarity of objectives</td>
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<td>Benefit to your clinical practice</td>
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<td>Quality of illustrations</td>
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<td>Clarity of quiz questions</td>
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<td>Rate your overall satisfaction with this course</td>
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<td>Did this lesson achieve its educational objectives?</td>
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### Quiz Answers

Fill in the circle of the appropriate answer that corresponds to the question on previous pages.

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<th>Question</th>
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### Course Submission

1. Read the entire course.
2. Complete this entire answer sheet in either pen or pencil.
3. Mark only one answer for each question.
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### Price

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