

# South Carolina 4-H Forestry Competition



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4-H is the youth development program of Cooperative Extension Service, a nationwide partnership of federal, state and county governments, and the private sector. The Clemson University Cooperative Extension Service offers its programs to people of all ages, regardless of race, color, sex, religion, national origin, disability, political beliefs, sexual orientation, marital or family status and is an equal opportunity employer.

## I. INTRODUCTION AND PURPOSE

The 4-H Forestry Competition is a competitive event for forestry knowledge and skills. Contestants compete in four areas:

1. Tree Measurements
2. Compass & Pacing
3. Tree Identification
4. Written Examination

The purpose of the Forestry Competition is to provide the opportunity for Forestry contestants to:

- A. Develop leadership talents and to work toward achieving character development and effective citizenship.
- B. Develop appreciation of the need and importance of conserving woodlands as a source of income, raw materials and enjoyment necessary for quality living.
- C. Acquire information and understanding of practical forestry skills in forest management and the use of forest and wood products.

Although competitive in nature, the contest is managed as an extensive forestry educational experience. In addition to meeting these objectives, the event will encourage and promote better forestry knowledge for all youth and adults involved.

## II. GENERAL GUIDELINES AND RULES

1. Dates, times and locations will be announced when available.
2. All South Carolina 4-H youth between the ages of 9 and 18 are welcome to participate. Youth will compete in one of two age levels, 9-13 (Junior 4-H'ers) or 14-19 (Senior 4-H'ers).
3. Ribbons and certificates (and prizes, if available) will be awarded for both of the age groups. The winning Senior Team will have the opportunity to represent SC at the National 4-H Forestry Invitational held at Jackson's Mill State 4-H Camp near Weston, West Virginia. (<http://www.aces.edu/N4HFI/index.html>)
4. The success of each event will hinge on active adult participation and organization. The amount of work that is involved necessitates the distribution of the work load. All adults should come prepared to help where needed.
5. There will be no instructional period at any of the contests. No amount of instruction on the day of the competition will properly prepare the contestant for the knowledge events. Therefore, training must take place prior to the competition for the contestant to be successful.
6. Each contestant must bring their own clipboard, writing board, pencil and calculator as these will not be provided. Contestants are encouraged to wear field clothing.
7. Smoking or chewing tobacco will be not allowed. Rules of the facility where the competition is held will be followed.
8. All knowledge events will be based on 100 points. Therefore, a perfect overall score for the entire contest is 400 points. No more than 100 points will be deducted for each event.
9. Please pre-register at least two weeks in advance.

### III. TREE MEASUREMENTS

#### Objectives

The volume and quality of merchantable wood in a stand of trees is required to determine the value of that stand. It is necessary to know how to measure tree diameter and merchantable height before determining volume.

#### Contest Rules

1. A standard tree scale stick will be used.
2. Ten trees will be selected and designated for use in this competition.
3. Each contestant will estimate diameter, merchantable height and volume of each designated tree. Tree diameters will be taken to the nearest inch. Tree heights will be taken to the nearest full half-log for sawtimber. A half-log is defined as being eight feet long or longer, but less than 16 feet long. The minimum log will be 10 inches D.B.H., one log merchantable length, and have a minimum top diameter of 8 inches. Reference material for "Tree Measurement" can be found on the National 4-H Forestry Invitational website at the following address:  
<http://www.aces.edu/N4HFI/page76.html>
4. Each tree volume will be found in the volume table furnished to contestants. Be sure to use the volume table provided as there are many different kinds of volume tables. Total all sawlog volumes after all designated trees have been measured. References are available on the website listed above.
5. Estimate the board foot volume per acre using the plot size that will be given at the time of the contest. Either a 1/10, 1/5, or 1/4 acre plot will be selected. If a 1/10 acre plot is used, then (10 x plot volume) \_ volume/acre. If a 1/4 acre plot is used, then (4 x plot volume) \_ volume/acre.
6. Calculators may be used.

#### Scoring

1. Deduct 1 point for each 1 inch error in DBH.
2. Deduct 1 point for each 1/2 log error estimated.
3. Do not deduct more than 4 points for each DBH and for each log estimation.
4. For total volume per acre deduct:
  - 0 points if within 1% of the true value
  - 5 points if within 5% of the true value
  - 10 points if within 10% of the true value
  - 15 points if within 15% of the true value
  - 20 points if more than 15% of the true value

Example: If 4000 bd. ft. is the official volume/acre and the contestant's answer is:

3399 and under	deduct 20 points
3400 to 3599	deduct 15 points
3600 to 3799	deduct 10 points
3800 to 3959	deduct 5 points
3960 to 4040	deduct 0 points
4041 to 4200	deduct 5 points

4201 to 4400	deduct 10 points
4401 to 4600	deduct 15 points
4601 and over	deduct 20 points

## How To Measure Trees

### Introduction

It is essential to estimate the volume of trees in a tract of land so that guidelines can be made for the management of these trees. It is also important to know the volume so that the value of the trees can be determined. This must be done before the trees are sold, cut and sent to the sawmill so that the seller can receive a fair price for the trees.

The basic mathematic formula for finding the volume of a cylinder is (area of the base) x (its height). The area of the base can be determined if the diameter is known. Since a tree has a shape that is similar to a cylinder its volume can be determined by finding two measurements, its diameter and its height.

Once the diameter and the height are known, the volume of a tree is determined by looking it up in a volume table. The most commonly used units of volume are the board foot (bd. ft.) for sawtimber trees and cords for pulpwood trees. One board foot is a piece of wood that has 144 cubic inches. A piece of wood that is 1 inch thick x 12 inches wide x 12 inches long is 1 bd. ft. So is a piece of wood that is 2 inches thick x 6 inches wide x 12 inches long. A cord of wood is the amount of cut trees that can fit in the space of 128 cu. ft. If the trees were cut into 4 foot lengths, one cord would be a stacked pile that was 4 ft. high and 8 ft. long. A cord of wood that is neatly stacked would therefore have more wood in it than a cord of wood that is loosely stacked.

Once the volume of standing trees (called stumpage) is estimated, its value can then be determined. Knowing this is important, especially when selling timber. There are many factors that affect the value of timber such as quantity, quality, location, local demand, competition, logging and hauling conditions, and landowner objectives. A professional forester can help determine its fair market value.

Sawtimber trees are usually sold by the thousand board feet (MBF). For example, if a person had 10 acres of land and the average for each acre was 8,000 board feet, the landowner would have a total of 80,000 board feet (or 80 MBF). If the fair market value for these trees was determined to be \$150 per MBF, all the trees would be worth \$12,000 ( $\$150/\text{MBF} \times 80 \text{ MBF}$ ). By knowing the volume of the timber he proposes to sell, the landowner can make a more intelligent decision.

## How to Measure Diameter

Several instruments may be used to measure the diameter of a tree, such as calipers, diameter tape and a tree scale stick. The tree scale stick (sometimes called Biltmore stick) will be used in the forestry competition. It is an inexpensive tool and accurate enough for general forest management purposes.

The diameter of the tree is always measured at DBH. This stands for diameter at breast height and is defined as the diameter measured at 4.5 feet above the ground. Find a point on your body that is 4.5 feet above the ground and always take diameter measurements opposite that point. If the tree is on land that slopes, measure dbh on the high side of the tree.

Next, hold the tree scale stick firmly against the tree (at dbh) and level with the ground. The stick must also be at a right angle with the tree and 25 inches from your eye. Some sticks are made 25 inches long so that you can easily measure this distance. With one eye closed, line up the left end of the stick (the zero end) with the left side of the tree. Without moving your head, look at the other side of the tree. Read the number on the tree scale stick that lines up with the right hand side of the tree. This is the diameter of the tree in inches.

All trees are not perfectly round, and many times are oval shaped. Therefore, it is best to take two measurements and average the two numbers for a more accurate estimation. You can check your accuracy by taking a tape measure and measuring the circumference of the tree in inches. Dividing the circumference by  $\Pi$  (3.1416) will give the diameter of the tree.

Remember, it is important to hold the stick level, at a right angle to the tree, and 25 inches from the eye, or else you will get incorrect readings. If your arm cannot stretch out 25 inches, it would be a good idea to make an attachment to the stick so that you can.

## How to Measure Height

In measuring the height of a tree (for the purpose of finding the board foot volume of a tree) only what is called merchantable height is measured. This is not the height of the tree to the very top leaf, but it is only that portion of the tree that can be processed at a sawmill. If a tree has no unusual branching or forking, merchantable height would be measured to the point where the diameter of the tree is 8" (referred to as an 8" top). Sometimes a tree branches or forks so unusually that the top part cannot be used. Merchantable height would then be measured to a point right below the fork. It takes some experience before merchantable height can be measured accurately, but a general rule to follow is to measure only that portion of the tree that a sawmill can use to make lumber.

The merchantable height of a sawtimber tree is usually measured in units called logs. One log is equal to a section of tree that is 16 feet long. So, if the merchantable height of a tree was 32 feet, the height of the tree would be 2 logs. The height is always measured in  $\frac{1}{2}$  logs, therefore a tree with a merchantable height of 40 feet is the same as a height of  $2\frac{1}{2}$  logs. A 47 ft. tree is also  $2\frac{1}{2}$  logs. A 48 ft. tree would be 3 logs high. The reason for this "strange" measurement is that a 16 foot section of tree is a convenient length for a logger and sawmill to cut. Most walls in houses are 8 feet tall, and therefore you could get 2x4's of the proper length from each  $\frac{1}{2}$  log.

To measure the merchantable height of a tree, stand 66 feet from the tree. You will want to learn how many paces you have in 66 feet so you don't have to measure it with a tape each time. Hold the tree scale stick vertical to the ground and 25 inches from your eye. Line up the bottom of the stick with stump height. (Stump height is defined as the point where the logger will cut the tree down, which is about one foot above the ground.) Without moving your head, look up the tree scale stick. Read the number of logs on the stick that lines up with the merchantable height on the tree. Make sure you hold the stick correctly or else you will get incorrect readings.

## Exercises for Tree Measurements

1. Define board foot, cords, sawtimber, pulpwood, stump height, minimum top diameter, merchantable height, logs (why do you think logs are 16' long?), stumpage, dbh, and tree scale stick.
2. Determine and understand how a tree scale stick is used to measure the height and diameter of a tree. How can you measure the height of trees using shadows?
3. How do you use a volume table? Discuss why it is necessary to know the volume of a tree and the volume of your forest (value). Why is this important for the forester and for the landowner.
4. What other equipment is available to foresters to measure height and diameter? Ask a forester for a demonstration of this equipment.
5. What does it mean to cruise timber?
6. What is a log scale and a form class?
7. Have a forester mark and measure practice trees. Practice estimating the heights and diameters of these trees. Demonstrate the impact of pacing improper distances from the tree. Show what happens when you hold the tree scale stick less than 25" from your eye. Show what happens if you do not hold the stick straight up or down.
8. How many board feet in a 2x4 that is 8 feet long?
9. How many board feet in a 2x10 that is 16 feet long?
10. How many cords are in a pile of neatly stacked firewood if the pieces are 18 inches long, stack 6 feet high and in a space 10 feet long.
11. A shed has the following dimensions: 8 feet high x 10 feet wide x 12 feet long. How many cords can be stacked inside the shed?
12. How many cords can fit in a pickup truck that has a bed of the following size: 6' x 6' x 20" (stack the wood so that it is even with the top of the bed).

13. Make a tree scale stick using the following information. First find a suitable stick. A thin and narrow piece of wood that is 25 inches long and resembling a yard stick is ideal. Make DBH marks on the stick at the appropriate distance from the zero end using the chart below.

<u>Tree Size</u> (DBH)	<u>Distance of Mark</u> <u>From End of Stick</u> (Inches)	<u>Tree Size</u> (DBH)	<u>Distance of Mark</u> <u>From End of Stick</u> (Inches)
4	3.70	21	15.40
5	4.55	22	15.95
6	5.36	23	16.52
7	6.17	24	17.07
8	6.95	25	17.59
9	7.70	26	18.12
10	8.43	27	18.63
11	9.15	28	19.15
12	9.85	29	19.63
13	10.52	30	20.12
14	11.18	31	20.61
15	11.84	32	21.10
16	12.44	33	21.57
17	13.07	34	22.03
18	13.66	35	22.48
19	14.25	36	22.93
20	14.83		

You will notice that as you place DBH marks on your stick, the intervals will decrease as the tree diameters increase.

On the other side of the stick, make the tree height marks. On standard 25-inch cruiser sticks, one 16-foot log is represented by an interval of approximately 6.05 inches. Unlike DBH mark intervals, the distance between consecutive 16-foot log marks on cruiser sticks is constant.

Contestant Number \_\_\_\_\_

Score \_\_\_\_\_

SOUTH CAROLINA  
4-H FORESTRY COMPETITION

Tree Measurements

Instructions:

1. Measure and record DBH (to the nearest inch) and number of logs (to the nearest ½ log) for each numbered tree.
2. Determine individual tree volume from the volume table provided.
3. Determine total volume for all numbered trees and the total volume per acre. Plot size will be given at the time of the contest.
4. Calculators may be used.

<u>Tree</u>	<u>D.B.H.</u>	<u>Logs</u>	<u>Tree Volume</u>
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
7	_____	_____	_____
8	_____	_____	_____
9	_____	_____	_____
10	_____	_____	_____
		Total Plot Volume	_____
		Plot Size	_____
		Volume Per Acre	_____

#### IV. PACING AND COMPASS

##### Objectives

It is often required to estimate distance by the pacing method and to determine direction of travel using a compass. This exercise is designed to emphasize these two skills.

##### Contest Rules

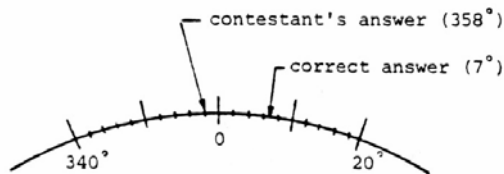
1. Contestants will be required to determine the bearing and distance between a series of marked points in the allotted time. Ground line distances will be used. Compass declinations will not be used.
2. The contestant will start at point "A" and record the bearing to point "B". Then pace to point "B" and record the distance to the nearest foot. The contestant will then measure the bearing and distance from point "B" to point "C". Repeat these steps until all the lines are measured.
3. The course will consist of five bearings and five distances.
4. Calculators will be allowed.
5. The contestant must use the compass provided at the Invitational. Personal compasses may not be used.

##### Scoring

1. Deduct 1 point for each 2 degrees in error.
2. Deduct 1 point for each 2 feet in error.
3. Do not deduct more than 16 points for each bearing and for each distance.

##### Example 1

If contestant is off by  $9^\circ$ .  $9/2 = 4\frac{1}{2}$  points. Round down to nearest whole number. Deduct 4 points from score. Caution: Do not subtract  $358^\circ - 7^\circ = 351^\circ$  and deduct maximum number of points for being  $351^\circ$  off.



##### Example 2

If the contestant determines that the distance between point A and point B is 97 feet and the correct distance is 92 feet:

$$\text{Subtract: } 97' - 92' = 5'$$

$$\text{Then divide: } 5/2 = 2\frac{1}{2}$$

Round down to nearest whole number. Deduct 2 points from score.

## How to Pace and Use a Compass

### Introduction

A compass is an important tool in finding and marking boundary lines and property corners. Knowing this is important because you don't want to cut down your neighbor's trees. When cruising timber (measuring the total volume of timber on a tract of land), a compass is used to keep on a straight path so that the appropriate trees are measured. A map and a compass can help you find your way out of the woods should you get lost or turned around. Also, it can show you the fastest and most direct way back to your vehicle.

### Pacing

It is often too cumbersome and time consuming to use a tape measure when finding your way in the forest. A quick and easy way to measure distance is by pacing. Every two steps that you take is the same as one pace. If you lead off with your left foot, then every time your right foot touches the ground you have gone one pace. It is better to use the number of paces than the number of steps because you won't have to count as high and you will be less likely to lose count.

If you want to measure the distance from point A to point B, you will need two pieces of information. First, you need to know the number of paces between the two points, and that is easily found by counting your paces. Second, you need to know how many feet you have in your pace. This is determined by placing two stakes in the ground exactly 100 feet apart. Count the number of paces that you have between the two stakes. Dividing 100 feet by the number of paces in 100 feet will give you the number of feet in your pace. For example, if you paced 17.5 paces between the stakes, each time you take one pace you have gone 5.7 feet ( $100 \text{ feet} \div 17.5 \text{ paces} = 5.7 \text{ feet/pace}$ ). This number will be different for each person, and therefore you should memorize your number.

Now you are ready to measure distances by pacing. Use the following equation to determine distance:

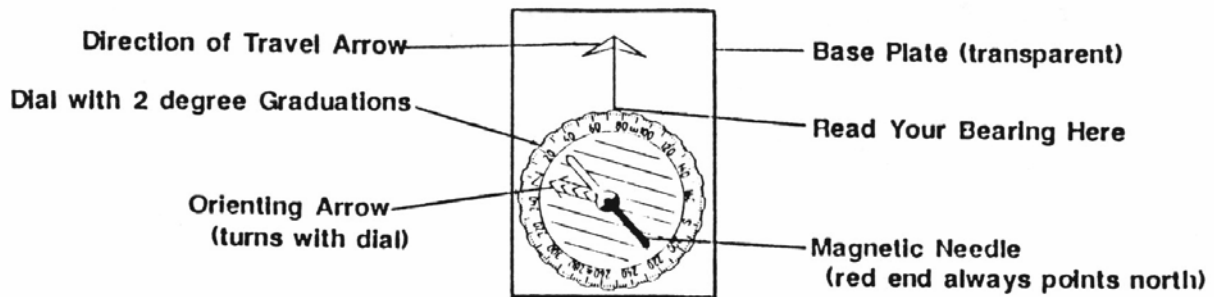
$$\text{distance traveled} = (\text{number of paces} \times \text{number of feet in my pace}).$$

Suppose you wanted to know the distance between your house and a tree in your back yard. You find that it is 15.5 paces long and you have 5.2 feet/pace. The total distance between the house and the tree is simply ( $15.5 \text{ paces} \times 5.2 \text{ feet/pace}$ ) or 80.6 ft (81 feet when rounded).

The key to measuring distances by pacing is consistency, and to be consistent you need to practice. You should walk at a speed that is comfortable for you. When you pace, walk like you always walk. It is not necessary to exaggerate. When determining how many paces you have in 100 feet, pace it over and over and over again until you consistently come up with the same answer. Check yourself from time to time to make sure that this number stays the same. Pace the 100 feet when you are tired and when you are energetic to see if there is a difference. Check yourself on the day of the contest. If you are going to multiply 5.2 times each pace, you will want to be certain that you are indeed going 5.2 feet for each pace.

## Compass

### A. Parts of a Compass



### B. How to Use a Compass

1. Hold the compass in your hand, keeping it in front of your body but away from belt buckles or other metal objects. Turn your body and point to where you are going with the direction-of-travel arrow. Make sure to keep the compass level so that the needle will move freely.
2. Turn the dial until the orienting arrow is directly underneath the red portion of the magnetic needle.
3. Read the bearing (read the number where the direction-of-travel arrow and the dial intersect).

### C. More About Compasses

Suppose that you found that the bearing from point A to point B is  $45^\circ$ . After pacing to point B you decide that you need to double check your bearing to see if it is correct. You could walk all the way back to point A, but that would not be necessary. You can simply point the compass back to A from point B. This time put the orienting arrow underneath the white end of the magnetic arrow. Read the degrees at the same place as before. If you had the correct bearing the first time, you should also read  $45^\circ$  the second time. Sometimes it will be necessary to follow a certain bearing. In this case, set the compass by turning the dial until the desired degree is lined up with the direction-of-travel arrow. While holding the compass correctly, turn your body around until the orienting arrow is directly underneath the red end (the north end) of the magnetic needle. When everything is lined up, find an object in the distance (such as a tree) that the direction-of-travel arrow is pointing at. Walking directly to that object will keep you on your desired bearing.

### Exercises for Pacing and Compass

1. How many feet are in each of your paces? Do you have this number memorized? If you measure 23 paces between your back door and a tree in your back yard, what is the distance between them? (This answer will be different for each person.) Practice your pacing until you consistently get the same answer.
2. Determine the number of paces that you have in 66 feet and memorize this number (66 feet = 1 chain). This will be helpful in tree measurement. Why do foresters use chains when measuring distances?
3. What are the principles of how a compass works? Determine the difference between an azimuth compass and a quadrant compass. What is declination?
4. How is compass used to determine-the direction of travel? How are a map and a compass used together to determine the direction of travel?
5. Lay out a practice course and allow participants to develop these skills. Have somebody hide an object under a rock or behind a tree. See if you can find it given a certain bearing and distance.
6. Use your pacing skills to estimate the number of acres in a field or tract of land. First, pace a line which you feel represents the average width. Pace another line which represents the average length of the field. When pacing these distances use the number of chains as your unit of measurement (see exercise 2). Multiply these two numbers to get the approximate number of square chains in the field. Dividing square chains by 10 will give you the number of acres.

Contestant Number \_\_\_\_\_

Score \_\_\_\_\_

SOUTH CAROLINA  
4-H FORESTRY COMPETITION  
Pacing and Compass

Instructions

1. Start at point "A" and record bearing to point "B".
2. Pace the distance to point "B" and record to the nearest foot.
3. Repeat steps 1 and 2 for each line.
4. Calculators will be allowed.

<u>Line</u>	<u>Bearing</u>	<u>Distance</u>
A – B	_____	_____
B – C	_____	_____
C – D	_____	_____
D – E	_____	_____
E – F	_____	_____

## V. TREE IDENTIFICATION

### Objectives

Different species of trees have different requirements for good growth. They also differ in merchantability. Therefore, it is important to properly identify the trees found in the forests to be managed.

### Contest Rules

1. The contestant will match the number of the contest tree or specimen with its name on the score sheet.
2. The contestant will be given a specific amount of time to identify the specimen and record the information on the score sheet.
3. The contestant may carefully touch or feel the specimen.
4. Twenty (20) specimens will be used from the 60 species listed in the Familiar Trees Of South Carolina Publication (Clemson Extension Bul. 117) and may consist of trees in their natural habitat, freshly cut branches, pictures, or pressed herbarium leaf mounts. Bulletin 117 can be found at the following URL:  
<http://www.clemson.edu/extfor/publications/bul117/>  
or in PDF at <http://www.clemson.edu/extfor/publications/bul117/bul117.pdf>

### Scoring

1. Five points will be awarded for each correct match.

## Exercises

1. The key to identification of trees is observation. The better you can observe the better you will know your trees. Tracing or drawing leaves will help you remember. Pay attention to the details.
2. What are the different parts of a tree (leaves, bark, winter twigs, flowers, seeds, fruit, roots, etc.). How and when can each of these help you to identify trees?
3. What are some other tree characteristics that can help you identify trees (tree shape, leaf color, branching patterns, smell, feel, taste, etc.)? How and when can you use these characteristics?
4. Learn the different leaf margins, leaf forms, leaf arrangements and leaf compositions. (See Familiar Trees of South Carolina, Bulletin 117.) You should be able to classify all trees into the following categories: leaves that are needles, scale like, simple opposite, compound opposite, simple alternate, compound alternate and whorled. What groups of trees belong in each category (such as oak and maple)?
5. What is a leaf key? Learn how to use one.
6. Write a report on an individual tree. Include in your report identification characteristics, its uses to man, where and how it grows, its value for wildlife and historical aspects.
7. Discuss the importance of trees in an urban environment. Discuss the importance of trees to wildlife and wildlife management.
8. Imagine you are a tree. Write a poem or a story about how you feel about people, where you live, birds and animals, the weather or anything else you would like to talk about.

# *SAMPLE ANSWER SHEET*

Contestant Number \_\_\_\_\_

Score \_\_\_\_\_

## SOUTH CAROLINA 4-H FORESTRY COMPETITION

### Tree Identification

Instructions: Match the number of the contest tree or specimen with its name on the list.

- |                          |                          |
|--------------------------|--------------------------|
| _____ white ash          | _____ southern red oak   |
| _____ bald cypress       | _____ water oak          |
| _____ American beech     | _____ white oak          |
| _____ river birch        | _____ cabbage palmetto   |
| _____ box elder          | _____ common persimmon   |
| _____ black cherry       | _____ eastern white pine |
| _____ American elm       | _____ loblolly pine      |
| _____ eastern hemlock    | _____ longleaf pine      |
| _____ mocker nut hickory | _____ shortleaf pine     |
| _____ pignut hickory     | _____ eastern red cedar  |
| _____ black locust       | _____ sassafras          |
| _____ southern magnolia  | _____ sweet gum          |
| _____ red maple          | _____ American sycamore  |
| _____ chestnut oak       | _____ black tupelo       |
| _____ live oak           | _____ black walnut       |
| _____ post oak           | _____ yellow-poplar      |

## VI. FORESTRY WRITTEN EXAMINATION

### Objectives

An objective written examination will be given to provide participants an opportunity to demonstrate their knowledge of forestry information.

### Contest Rules

1. The exam will consist of 20 questions. Sample questions can be found on the National 4-H Forestry Invitational (<http://www.aces.edu/N4HFI/index.html>). They may be either multiple choice, true/false, or matching questions.
1. A different exam will be given for each of two age levels, 9-13 (Junior 4-H) and 14-19 (Senior 4-H).
2. The reference materials for the 9-13 age group will be the "National 4-H Forestry Manual, Unit A-Trees," and "Familiar Trees of South Carolina,". The reference materials for the 14-19 age group will be the "National 4-H Forestry Manuals Units A,B, & C" and "Familiar Trees of South Carolina." The National Forestry Manuals can be downloaded form the National 4-H Forestry Invitational website at <http://www.aces.edu/N4HFI/page83.html>.

### Scoring

1. Five points will be deducted for each incorrect answer.