1. (a) The present value of a tree tomorrow (TT) is

$$PV(TT) = \frac{\$60}{1+r} = \frac{\$60}{1.1} = \$54.5 \quad (1)$$

The present value of a tree tomorrow exceeds the present value of a tree today (\$50), so you should wait until next year.

(b) The "cost" in this case is the opportunity cost of not cutting the trees today (that is, I could cut the trees today and earn \$50 per tree). The payoff is the value of trees tomorrow. The rate of return of waiting until next year is therefore

$$\rho = \frac{60 - 50}{50} = 0.2 \quad (2)$$

(c) The easiest approach to this problem is to think of it as a year-to-year problem. Namely, I want to cut the trees today if the interest I earn on the proceeds is equal to the amount by which the value of the tree will grow in an additional year. In the first year, for example, I would earn \$5 in interest per tree next year if I cut them down today and put the proceeds in the bank. This is less than the \$10 I earn by letting a tree grow another year. So it is not optimal to cut down the trees in the first year.

When is it optimal? When, if x is the sales price of a tree,

$$(0.1)x = \$10 \rightarrow x = \$100 \quad (3)$$

When I can sell the trees for \$100, the return to cutting them down and putting the money in the bank equals the return from letting the trees grow another year. The trees sell for \$100 when they are 10 feet tall, so this is the optimal height at which to harvest them. Note that when the trees are 10 feet tall, the firm is indifferent between cutting them and letting them grow another year (i.e., both actions yield the same benefit). Thus, cutting the trees when they are 11 feet tall is also optimal.

2. (a) A technology shows decreasing returns to scale if an equal proportional increase in both inputs leads to a proportionally smaller increase in output (e.g., if doubling both inputs produces less than a doubling of output).

The law of diminishing returns states that in the presence of a fixed input, *after some point*, equal increments of the variable input lead to ever decreasing increments of output.

The LODR is a short run concept (remember, one input is fixed) while DRS is a long run concept.

(b) See figure 1. The marginal cost curve slopes upwards due to the law of diminishing returns. To increase output by equal increments, firms have to hire an ever-increasing number of workers who must all be paid the wage rate w. Thus, each increment of output is more expensive than the last one.

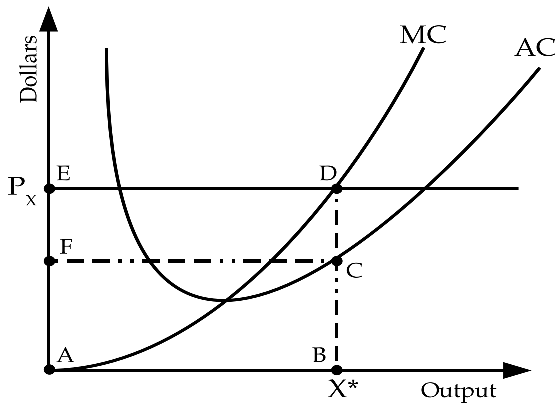

Figure 1: Marginal and Average Cost

The average cost curve slopes downwards initially because fixed costs are spread out over more units of output while marginal cost grows slowly. As output rises though, spreading fixed cost out has less and less of an effect, and ever rising marginal cost (which increases average variable cost) makes average cost rise. This accounts for the U-shape of the average cost curve.

(c) See figure 1. The optimal output level is X^*, the output level at which marginal revenue (i.e., price) equals marginal csot. Profit is given by the box $CDEF$.

(d) When the supply of labor shifts to the left the equilibrium wage rate w^* increases. This increases a firm's variable cost since it's variable cost is its quantity of labor times w^*. This shifts both the short run marginal cost curve and the short run average cost curve upwards, raising minimum average cost. In the long run, entry and exit of firms insures that price equals marginal cost equals minimum average cost. Thus, in the long run, the output price rises due to the increase in minimum average cost.

(e) Profit is maximized at the output level at which marginal revenue equals marginal cost. In this case marginal revenue is the price, \$100. As the table below shows, marginal cost equals \$100 when output equals 5. (Note: because of the discrete nature of this problem, profit is also maximized when output equals 4; this was an acceptable answer.)

Output	**Total Cost**	**Marginal Cost**
1	50	
2	100	50
3	170	70
4	250	80
5	350	100
6	470	120
7	600	130