

*Instructions:* Complete each of the following, which are based on your lecture notes or the textbook. When asked to draw graphs, use a different graph for each problem.

1. Define 'short-run' and 'long-run' production, based on the variability of inputs. Also define 'variable' and 'fixed' inputs to production.
2. Draw a production function and label the regions of the function that represent returns to labor (i) increasing at an increasing rate, (ii) increasing at a decreasing rate, and (iii) decreasing.
3. Based on the production function (aka 'total product' curve) from (2), derive the  $MP_L$  and  $AP_L$  curves. Explain how you derive the MP and AP curves. Is this problem dealing with short run or long run? How do you know?
4. Using the TP curve, show how to derive the 'labor requirements' curve. Next explain how we go from this to the VC curve. Finally, draw a new graph that illustrates TC, VC, and FC curves. Explain the relationships between the curves.
5. Using the VC curve, draw a new graph that illustrates the related MC and AVC curves. Explain how this is done graphically.
6. Recalling that  $MRTS = \text{slope of isoquant} = \frac{\Delta K}{\Delta L}$ , show your work to find  $MC = \frac{w}{MP_L}$ , and that  $AVC = \frac{w}{AP_L}$ .
7. Re-create Frank's Figure 9.5 on p. 271 (in the 9<sup>th</sup> edition, it's Fig. 9.5 on p. 288). Do it in two steps: (i) Plot VC on the upper graph, then find MC and AVC on the lower graph; (ii) Plot FC then TC on the upper graph, then find ATC and AFC on the lower graph. Is this problem dealing with the short run or long run? How do you know?
8. What is the slope of the isocost line? Illustrate with a graph and explain.
9. What is the 'golden rule of cost minimization'? What is the implication if the two terms aren't equal to each other? Give an example to illustrate.
10. Draw a graph showing an expansion path. Explain what it means.
11. Define and give an example for each of the following: economies of scale, diseconomies of scale, economies of scope, diseconomies of scope.