Part II: Questions: Answer in the booklet.

(1) Firms in a competitive constant cost industry have total costs given by $TC=98+4q+2q^2$. A new technology becomes available which has total costs given by $TC_n=72+3q+q^2$. (10 Marks)

A) Before the introduction of the new technology, what is the long-run equilibrium price in this industry? How much output does each firm produce? (5 *Marks*)

B) After the new technology becomes available, what is the long-run equilibrium price in this industry? What happens to firms using the older technology? Explain. (5 *marks*)

(2) Suppose a monopolist with the cost curve

$$C=135+5q$$

produces a good that has no close substitutes. In addition, the demand curve for its product is:

$$P=185-5q$$

What price and quantity will the monopolist set in the market? What will be the firm's total profit? (5 Marks)

(3) For the **Shelf-to-Shed** Corporation**, the relationship between output (q) and the number of hours of specialized manual labour (L) and machine-operation (K) is:**

$$\mathbf{Q=55L+120K-0.55L^2-0.75K^2}$$

The hourly wage of specialised labour is $100, and the hourly wage of machine-operation is $140. The firm can hire as many productive inputs as it wants at these wage rates.

(A) The vice president of manufacturing recommends that the firm hire 65 hours of specialized labour and 25 hours of machine-operation. Evaluate this recommendation. ***(5 marks)***

(B) If the Shelf-to-Shed company decides to spend a total of $100,000 on specialized and machine-operation, how many hours of each type of labour should it hire? *(5 marks)*

(4) **Describe and illustrate the perfectly competitive market structure. Assume a constant cost industry in your discussion. (5 marks)**

Include the primary characteristics that distinguish the market.
Illustrate the demand and supply curves for the industry and the individual firm.
Discuss long-run and short-run profit determination

End of Exam

$$AP_L(L,K^*) = \frac{TP_L(L,K^*)}{L}$$

$$MP_L(L,K^*) = \frac{\Delta TP_L(L,K^*)}{\Delta L}$$

$$MRTS_{KL} = \left.\frac{\Delta K}{\Delta L}\right|_{q=\text{constant}}$$

$$MRTS_{KL} \equiv \frac{\Delta K}{\Delta L} = -\frac{MP_L}{MP_K}$$

$$MRTS_{KL} = -\frac{w}{r}$$

$$K = \frac{C}{r} - \frac{w}{r}L \quad \Leftarrow \text{Isocost Line}$$

$$\frac{MP_L}{w} = \frac{MP_K}{r} \text{ (Minimum Cost Condition) } MRTS_{KL} = -\frac{w}{r}$$

$$AC_L(q) = \frac{C_L(q)}{q} \qquad C_S = C_S(q) = F + V(q)$$

$$AC_S(q) = \frac{C_S(q)}{q} = \frac{F}{q} + \frac{V(q)}{q} = AFC(q) + AVC(q)$$

$$AVC(q) = \frac{V(q)}{q}$$

$$MC_S(q) = \frac{\Delta C_S(q)}{\Delta q} = \frac{\Delta V(q)}{\Delta q}$$

$$\int_{q^0}^{q^1} MC(q)\partial q = \int_{q^0}^{q^1} \frac{\partial V(q)}{\partial q} = V(q^1) - V(q^0)$$

$$MR = \frac{\Delta TR}{\Delta q}$$

$$\pi = TR - TC$$

$$\frac{\partial \pi}{\partial Q} = \frac{\partial TR}{\partial Q} - \frac{\partial TC}{\partial Q}$$

$$\frac{\partial TR}{\partial Q} = \frac{\partial TC}{\partial Q}$$

$$MR = MC$$

$$MR = P\left(1 - \frac{1}{P_E}\right)$$

Part 2:

(1) Firms in a constant cost industry have total costs given by $TC=98+4q+2q^2$, while marginal cost is $MC=4+4q$. A new technology becomes available which has total costs given by $TC_n=72+3q+q^2$, so marginal cost equals $MC_n=3+2q$.

A) Before the introduction of the new technology, what is the long-run equilibrium price in this industry? How much output does each firm produce? (5 marks)

Solutions:

Quantity equals 7

The long run equilibrium price is $32.

B) Solution: The price drops to the minimum average total cost of the new technology.

This is found by equating MC_n with ATC_n:

Firms using the older technology equate price with marginal cost:
19.96=4+4q
15.96=4q
q=3.99

$TC=98+4q+2q^2$
Average variable cost is: $AVC=4+2q=4+2(3.99)=\$11.98$

Hence, firms which had previously invested in the older technology continue to produce, though at a lower rate than before.

(2)

Total revenue will be 95*18=1710
Total cost is: 135+5(18)=225
Total profits are 1485.

3 A)
To find the optimal input combinations, choose where:

$$\frac{MP_L}{P_L} = \frac{MP_K}{P_K}$$

Enter in L=65 and K=250 into either equation we see that this is not the optimal input combination.

b) ***(5 marks)***

TC=100,000
Must use 393.81 hours of specialized labour and 432.99 hours of machine-operation.

(4) Describe the perfectly competitive market structure. (5 marks)

Include the primary characteristics that distinguish the market.
Illustrate the demand and supply curves for the industry and the individual firm.
Discuss long-run and short-run profit determination

The Competitive Firm

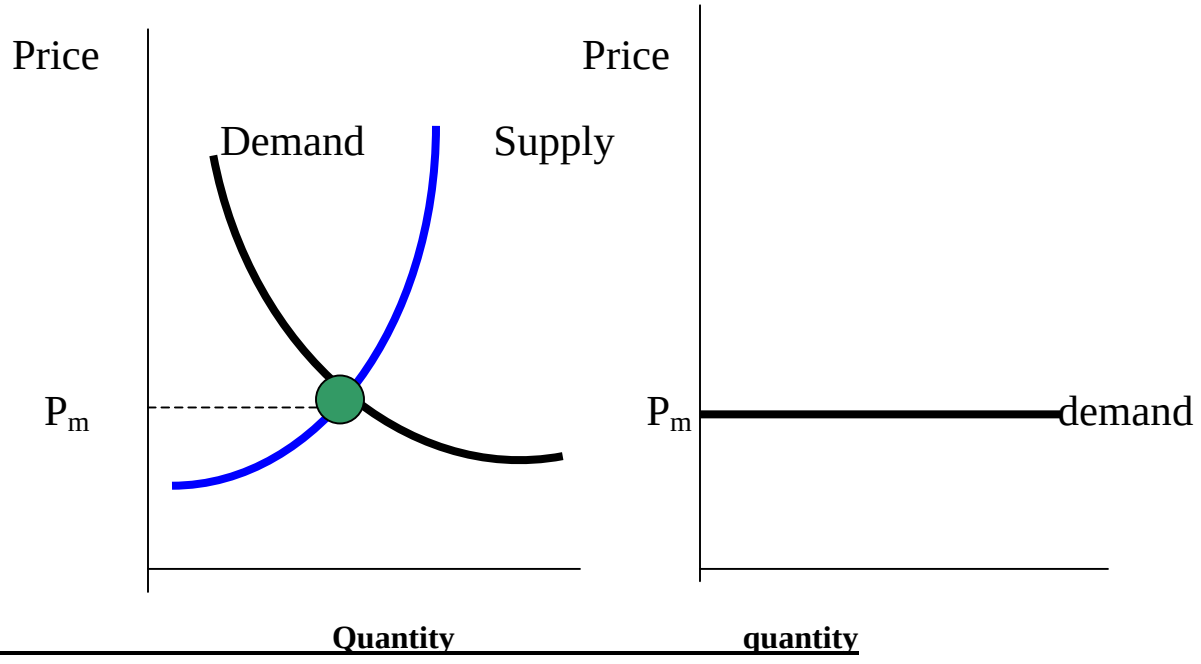
Assumptions:

1)Many firms.

2)Each produces a homogeneous product.

3)Firm is a price taker (market price is independent of the number of units sold by each firm).

4)Firm's demand function is a horizontal line at the market price.



Market Demand and Supply

Demand Function for the firm.

Since the market price is determined by the market, a competitive firm's total revenue will increase proportionally with the quantity sold. Total revenue is linear function from the origin.

Marginal Revenue:

For a competitive firm, each additional unit of its good sold adds an amount equal to the market price to its total revenue. $$MR = \frac{\Delta R}{\Delta q} = P$$

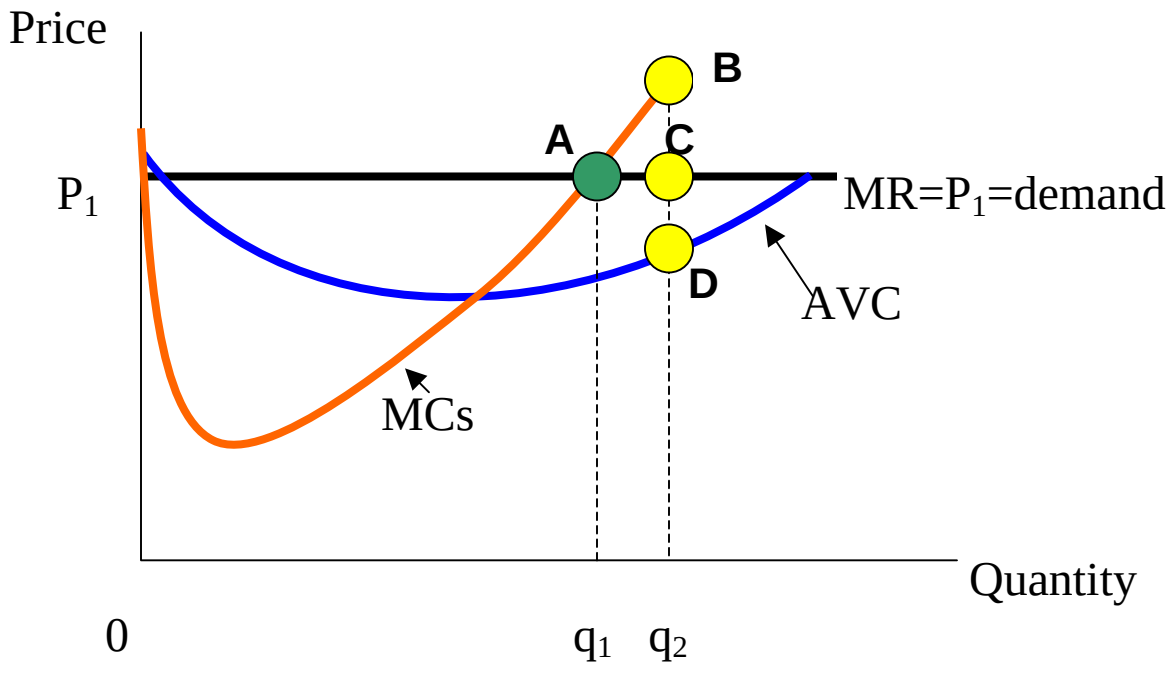
MR also equals average revenue, since: $$AR = \frac{TR}{q} = P$$

Deriving The Output That Maximizes Total Short-Run Profits

In the short run, we will assume that capital is fixed. To maximize short run profits, the firm selects a level of output where marginal revenue, MR, equals short-run marginal cost.

$$MR = P = MCs(q)$$

"A competitive firm produces a quantity where price equals short-run marginal cost, and marginal cost is rising."



The firm's horizontal demand function is located at the market price P_1.

The firm maximizes short-run profits by producing q_1 units where $MR=P_1=MCs$.

Total profit will fall if the firm produces a larger or smaller output than q_1.

For example, suppose the firm was producing an amount that was more than q_1, (q_2). At this higher amount, the MR will be less than the MCs. The firm's total profits will decrease.

MR from selling q_2-q_1 = ACq_2q_1
MC from producing q_2-q_1 = ABq_2q_1
Total Revenue falls when producing q_2 units from q_1 units.

The Short-Run Supply Function of A Competitive Firm

By applying the MR=P=MCs rule, we have derived one point on the firm's short-run supply function. I.e. At price P_1, the firm should supply q_1 units.

The quantity the firm supplies at any price can also be found by using this rule for profit maximization.

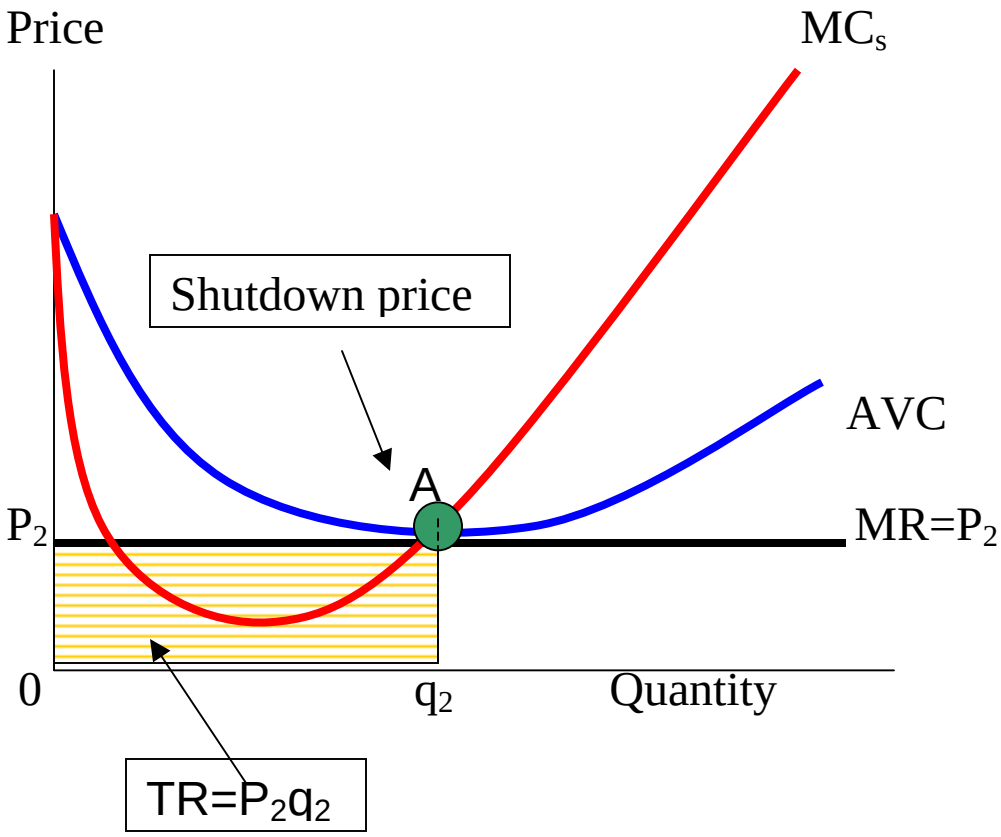
Consequently, the firm's short-run marginal cost function is the firm's short-run supply function where total revenue equals or is greater than total variable cost.

The firm's short-run marginal cost function is the firm's short-run supply function as long as total revenue $\geq$ total variable cost.

Note:

You need to know the position of the SAC curve in order to determine whether the firm's is making a profit or a loss in the short-run. But the firm can determine its short-run profit maximizing output without knowing whether it is earning a profit or a loss. If a firm sets output where price equals short-run marginal cost, it is operating as well as it can at the given price level.

When the price is equal or greater than minimum average variable cost, the firm will maximize its profit by producing where MC=MR.



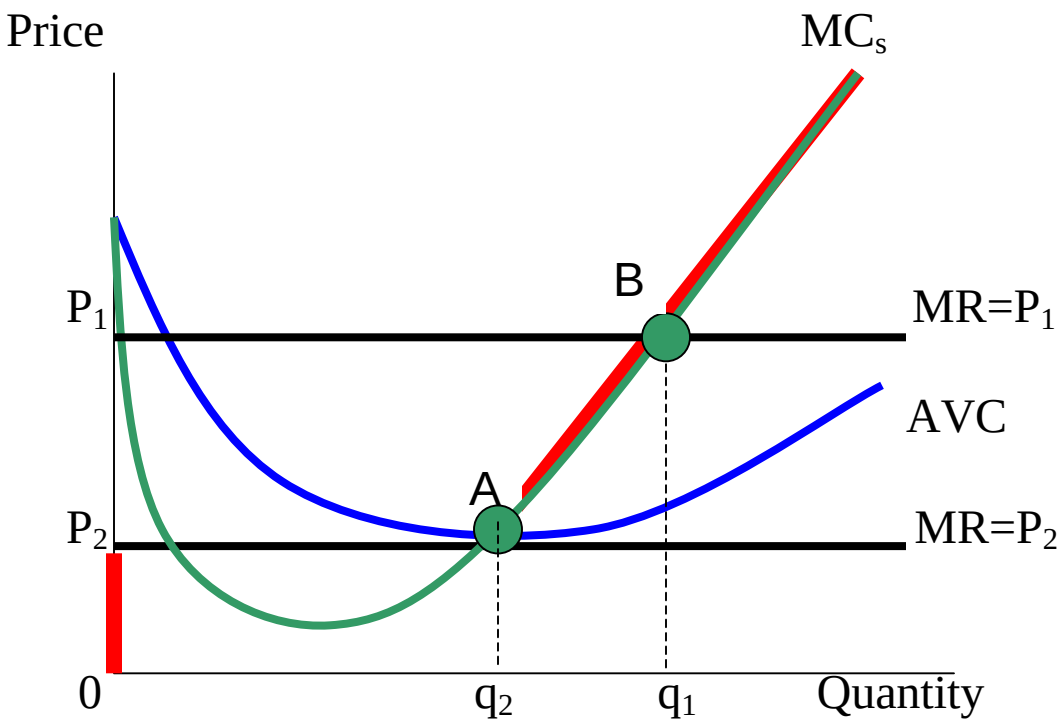
Suppose the market price is P_2. The firm supplies q_2 units.

In this instance, the market price P_2 equals the short-run marginal cost and minimum average variable cost.

Total revenue= total variable cost.

If the market price is less than P_2, total revenue is less than total variable cost. The firm will supply nothing and incur the loss equal to fixed cost, rather than incur a larger loss.

P_2 is referred to as the **shutdown price**.



The firm's short-run supply function consists of two parts:

- The red vertical line from 0 to P_2.
- The red line/ short-run marginal cost curve for price above P_2.

The Long-Run Supply Function of A Competitive Firm

In the long run all factors of production are variable.

The competitive firm remains a price taker and is motivated to maximize its profit.

The firm will select the combination of factor inputs that will produce the quantity that will maximize profit at each market price, and will produce that quantity at the lowest total cost.

Output That Maximizes Long-Run Profits

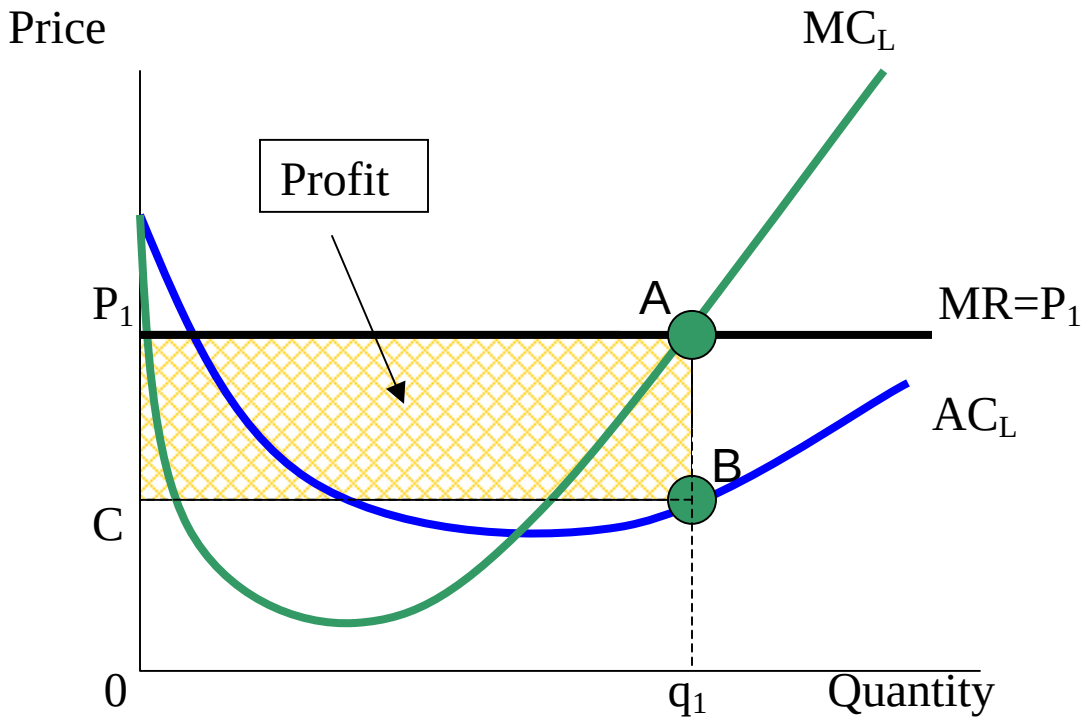
A price taking firm will maximize profit by producing the quantity of output where MR equals long-run marginal cost.

Since marginal revenue equals price:

$$MR = P = MC_L(q)$$

[Determination of Quantity in the long run]

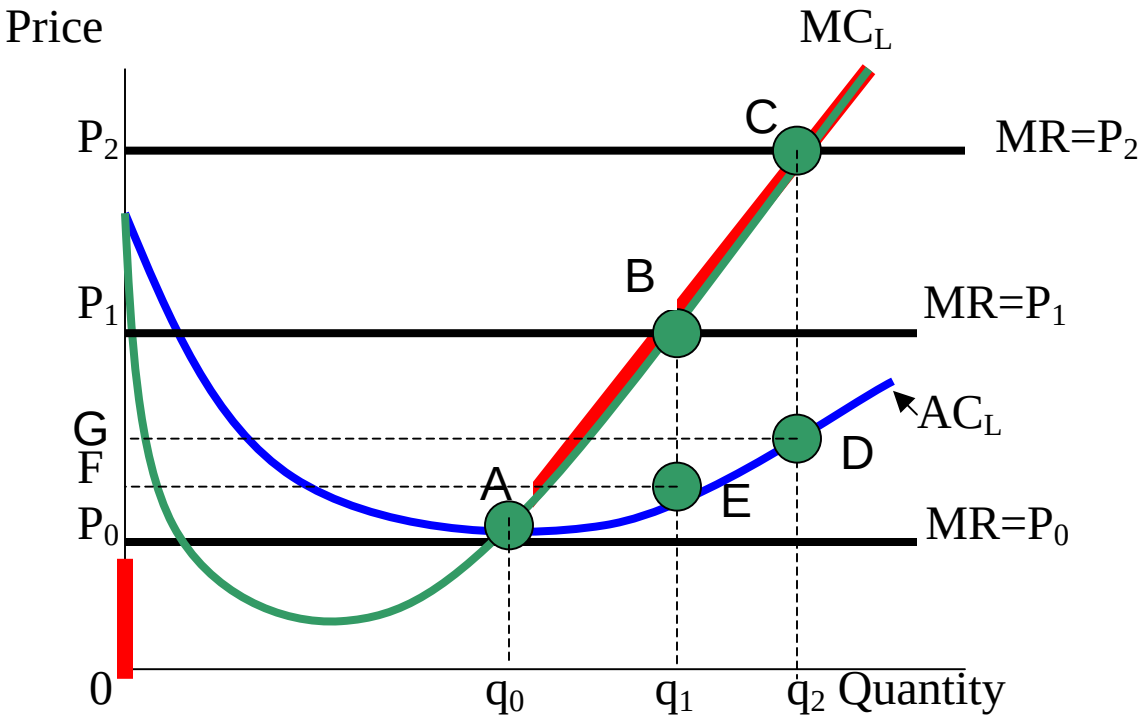
If the firm is producing a quantity where price is greater than marginal cost, it should produce more units. This will produce more revenue than it costs to produce, and profits will increase.



Profit = P_1ABC
$TR=P_1q$
Market price is P_1; cost =C; Firm produces q_1 at an AC of C.

The Long-Run Supply Function Of A Competitive Firm

The firm's supply function can be generated by repeatedly finding the point where price equals long run marginal cost.



When the firm produces q_0 units, long-run MC equals long-run average cost, and long-run average cost is at a minimum.
Profits are zero. Equilibrium in the long-run.
The firm's **long-run supply function** has two parts:

1) The vertical line for prices less than P_0.
2. The firm's long-run MC function for higher prices ($\geq P_0$.)

*"**The firm's long-run marginal cost function is the firm's long-run supply function for prices above the minimum of the long-run average cost function."***

Hence from these two assumptions, a **constant cost** industry has a long-run industry supply function that is ***horizontal*** at the market price.

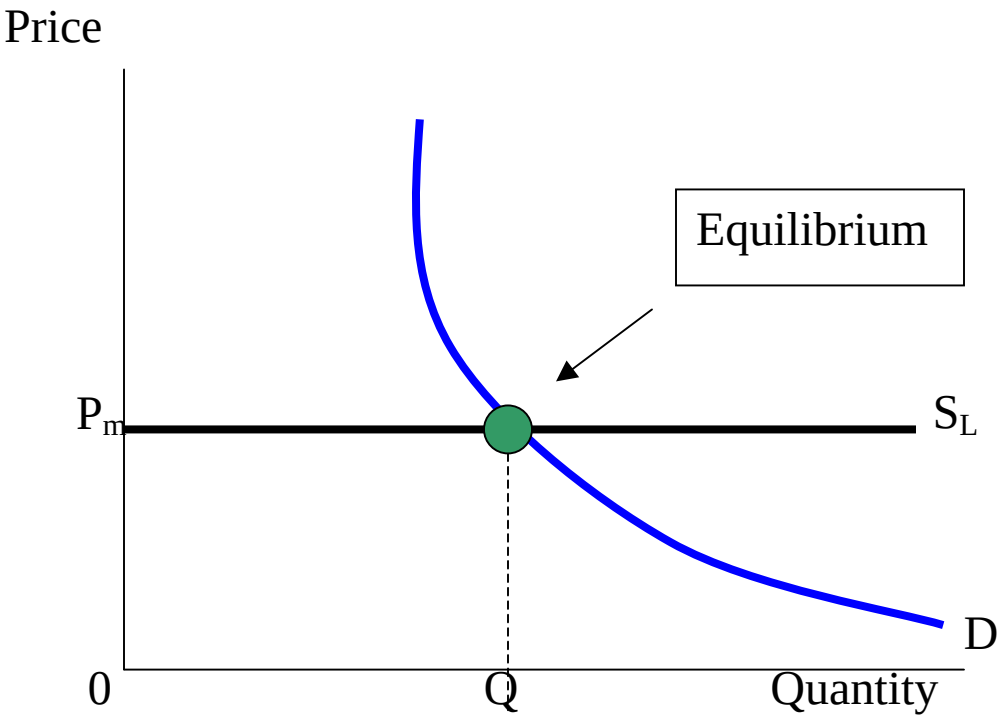
The LAC and MC Functions of the Firm

The red lines show the long-run supply function of a competitive firm.

At point A, the firm is operating at minimum long run average cost.

Produce where $MC_L=MR=P_m$

Profit is zero.



Long Run Industry Equilibrium

The market price is P_m and the quantity produced is Q. At this price, no existing firm will change the amount produced and no new firms want to enter the industry.

The long run industry supply function is S_L.

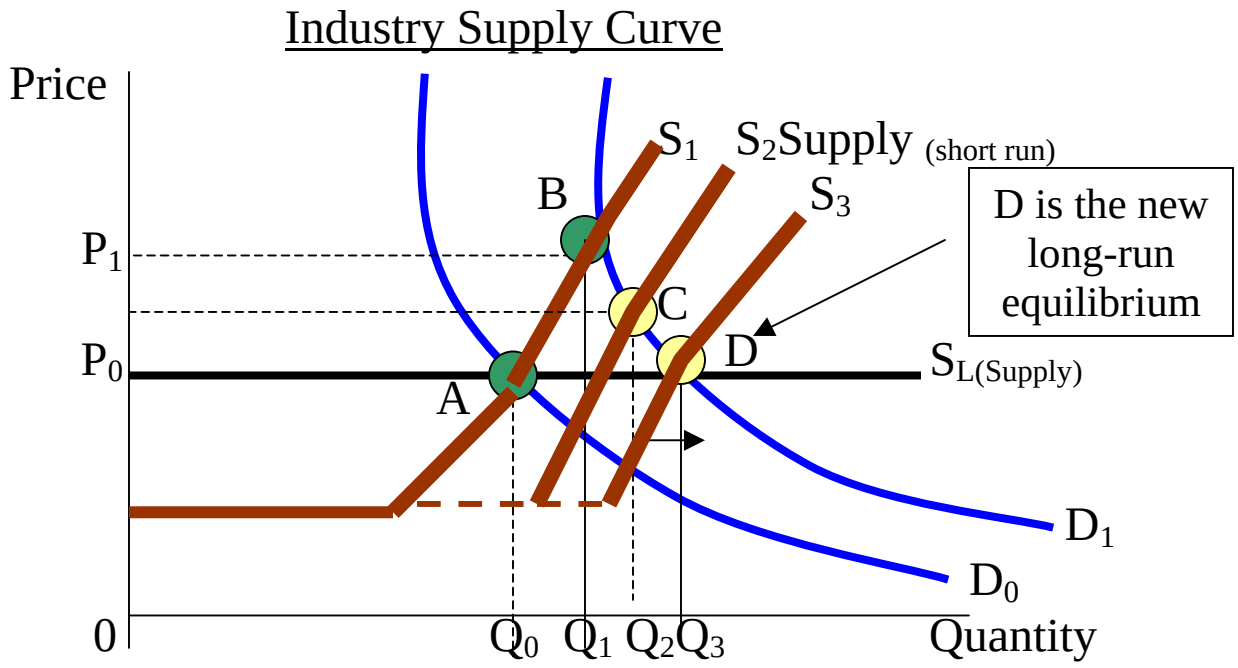
The market demand function is D.

The long run equilibrium price is P_M.

Equilibrium quantity is Q units.

Since P_M is the market price, each competitive firm maximizes profits by producing q units, the level of output where $P_M=MR=MC_L=AC_L$.

When the price is P_M, no firm earns a profit in the long run. The number of firms in the industry will equal N=Q/q.



An increase in market demand causes equilibrium industry output to increase but does not change the long-run equilibrium price in a constant cost industry.