**Introduction to Market Structure**
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**Module 3: Perfectly Competitive Markets**
**Lecture 12**
**Tutorial**

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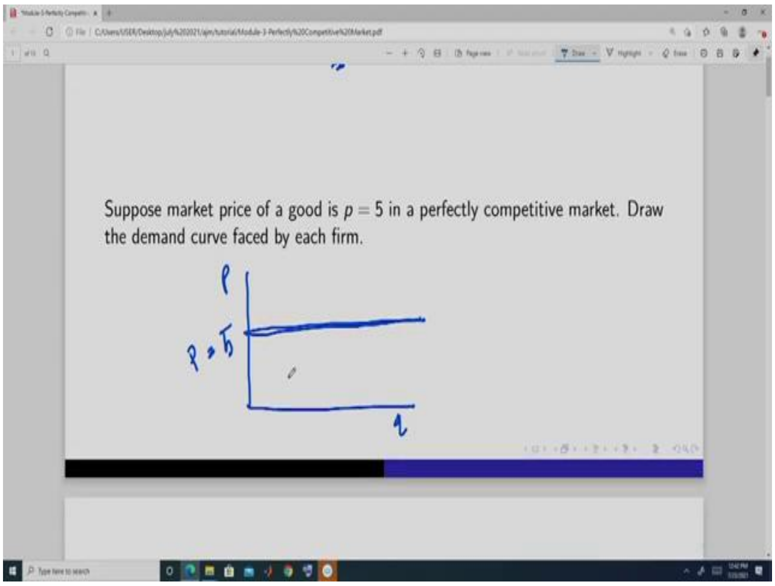


So, let us discuss some problems on module 3 that is Perfectly Competitive Market, okay. Suppose the market price is p is equal to 5. Now, what is the demand curve faced by each firm? So, the demand curve faced by each firm is this horizontal line at price is equal to 5, this is going to be the demand curve faced by each firm because firms are price takers, whatever be the price it cannot determine it, it will take that price as given. So, that is why the demand curve is like this.

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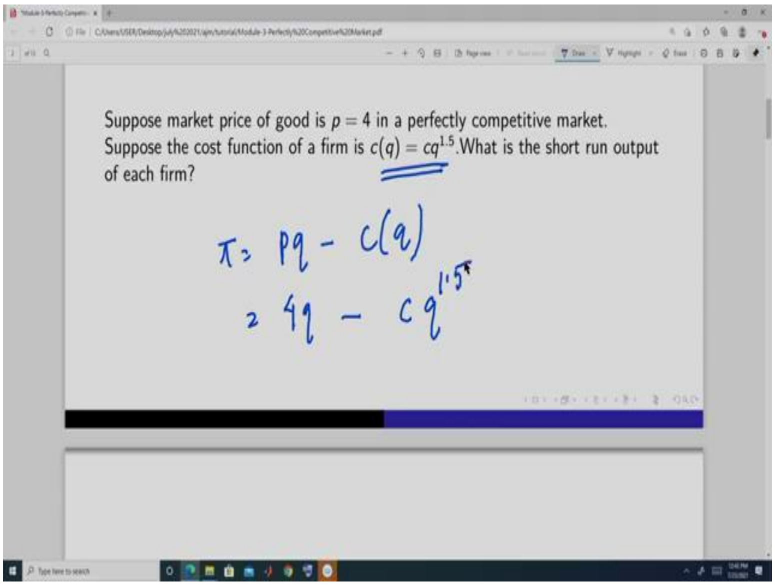


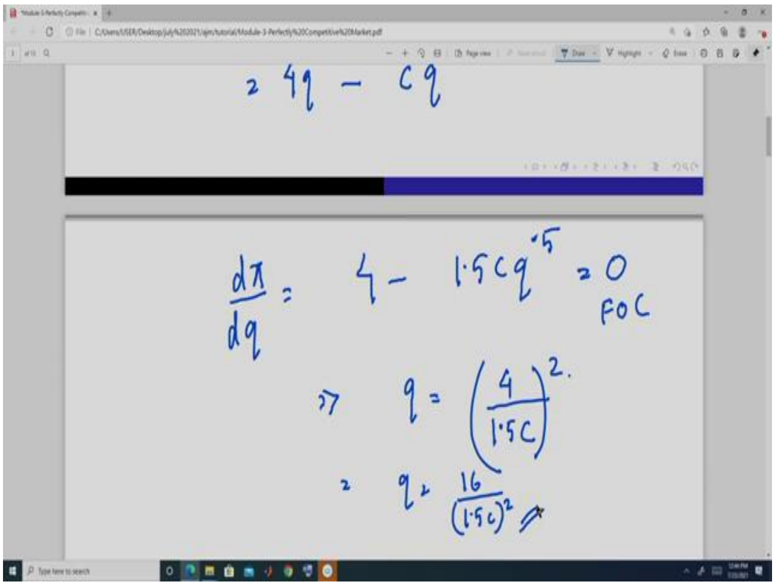


Now suppose the price is this, p=4 and the cost function of a firm is this- $c(q) = cq^{1.5}$ and there are supposed many firms what is the short run, and they are similar in terms of the cost and what is the short run output of each firm? So the profit of any firm is this price into q into this cost function- $\pi = pq - c(q)$, which we can write price is fixed at 4, so this into q cost is this- $\pi = 4q - cq^{1.5}$.

Now we take the derivative of this with respect to output because we want to maximize this, so we get this- $\frac{d\pi}{dq} = 4 - 1.5$ cq, first order condition gives this is equal to 0, so we get equal to this, sorry, this is the output of each firm c takes, some positive number, okay, here, so we get this- $q = \frac{16}{(1.5c)^2}$.

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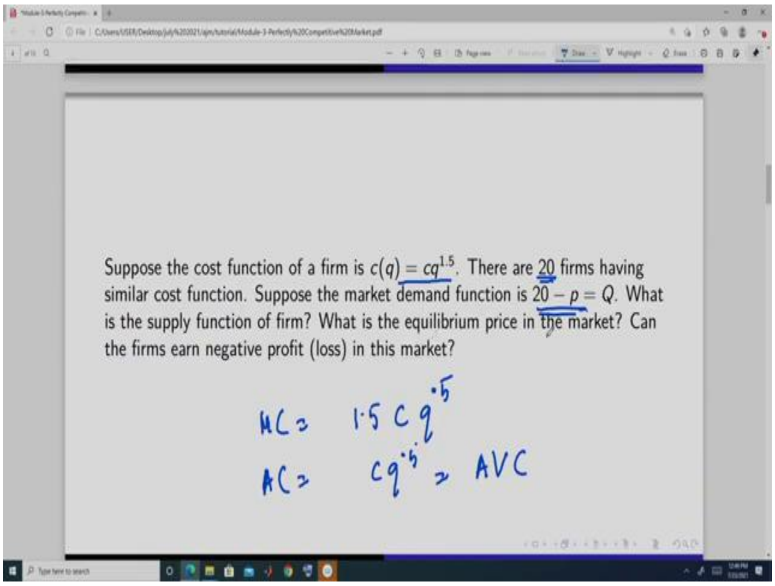


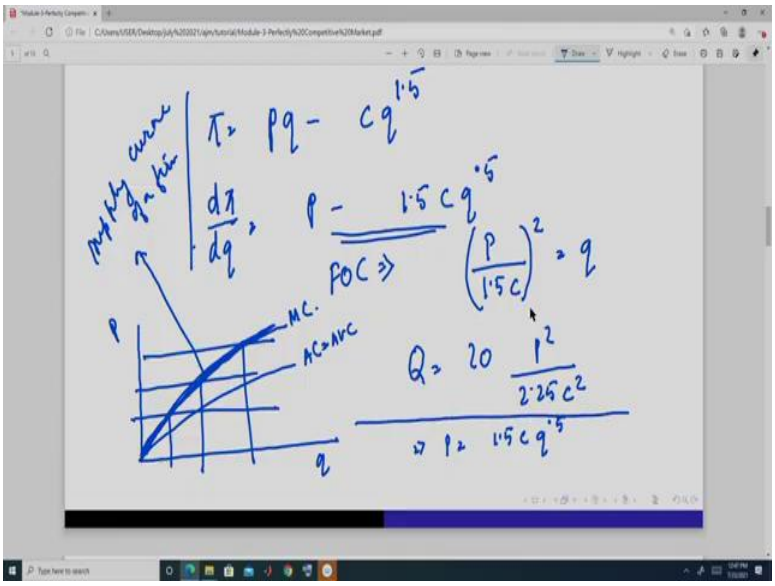


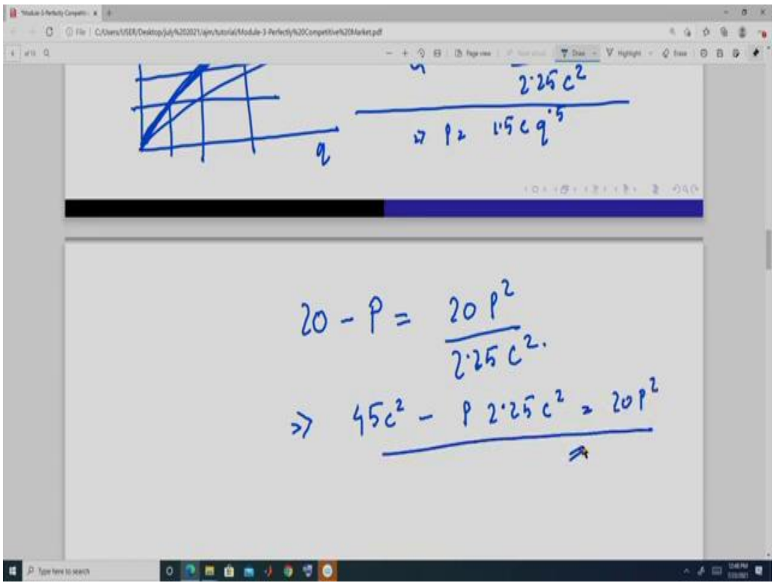

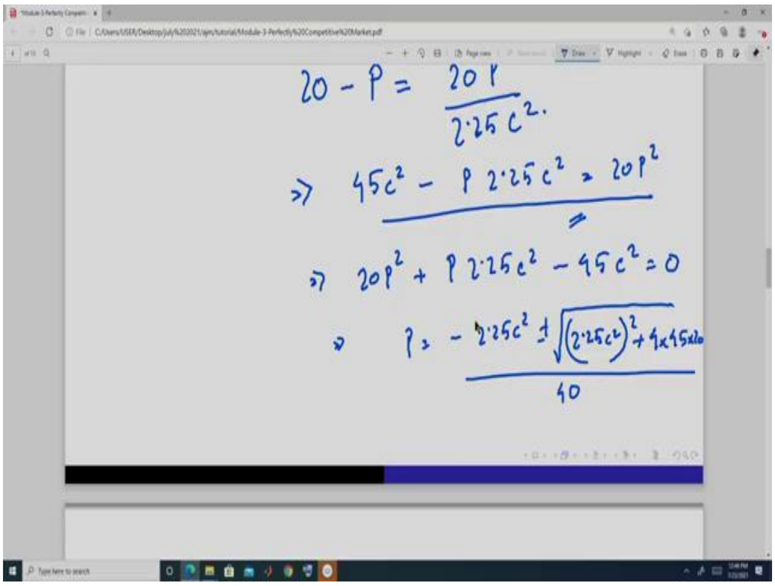

Next suppose, suppose the cost function of a firm is this- $c(q) = cq^{1.5}$, same as the previous one and now we have 20 firms, okay, having similar cost function, 20 firms, earlier we have not specified the number of firms, now we have specified and suppose the market demand function is this- 20-p=Q, what is the supply function of the firm and what is the equilibrium price in the market and can the firms earn negative profit or loss in this market.

If you look at this cost function, what is the marginal cost? Marginal cost is-.$MC = 1.5\ cq^{.5}$, is this, what is the average cost, average cost is c- AC= $cq^{.5}$, which is same as average variable cost because, so this is the case of strict decreasing returns to scale kind of thing, okay. Now, what is the profit of the firm**s**, of any firm, this is the profit function- $\pi = cq - cq^{1.5}$., first order condition implies it is this- $\left(\frac{P}{1.5c}\right)^2 = q$, right? Now, we have 20 firms, so the total supply at price p is 20 into p square.

This you can write this- $Q = 20\ P^2/2.25c^2$. What is the market, so this is the supply, supply of each firm is this- $P - 1.5\ cq^{.5}$, price is equal to this, if we take this output ,price here, marginal cost is this, so it is something like this average cost and average, it is this, so this whole you take any price here, this is going to be the optimal price, if the price is here, it is going to be this, if the price is this, so this whole this line is the supply curve of a firm, right?.

So, supply curve of a form is p is equal to 1.5 c, this- $P = 1.5\ cq^{.5}$. So, but the market supply is this, when there are 20 firms. Now, market demand is 20 minus p is, this is the market demand- 20-P and this is equal to this 20, i.e $20 - P = \frac{20P^2}{2.25c^2}$, this. So this should be equal to this- $45c^2 - P\,2.25c^2 = 20P^2$, we solve this quadratic equation and we will get a price and with that price is going to be the market equilibrium price.

So, this is going to be this one- $20c^2 + P\,2.25c^2 - 45c^2 = 0$, this, so this term is going to be definitely greater than this, so we will get a positive price, okay. Now, here question is what is the market equilibrium price? So, by one will be the negative price, another will be a positive, negative price is not possible so the positive one is going to there.

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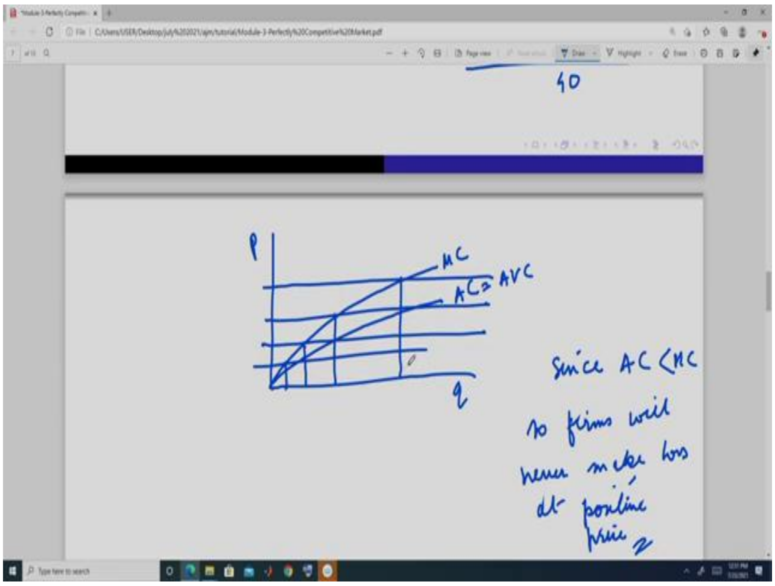


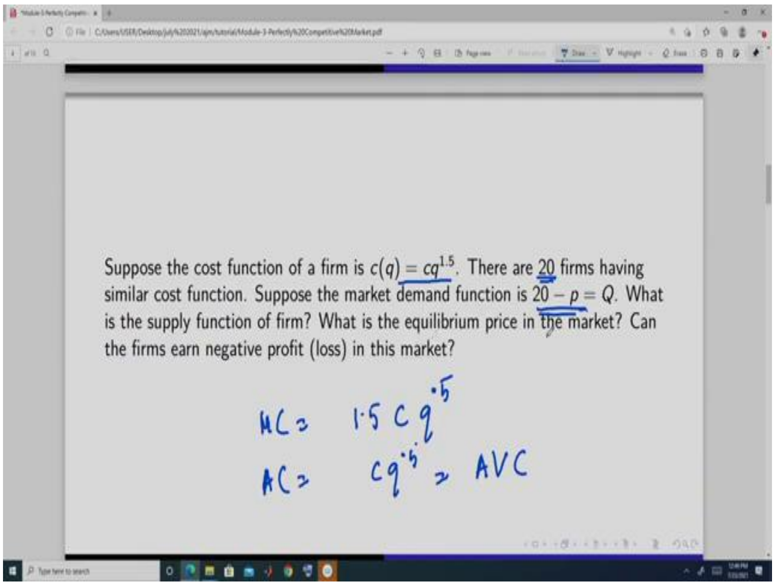


Next, the question is whether can the firms earn negative profit in this market? Now, see this is an interesting part. Marginal cost is this, average cost is this which is equal to average variable cost, you take any price, market price, this is the output, this is the optimal output, this is, so since average cost, since AC is always less than MC so firms will never make loss at positive price, okay, we get this.

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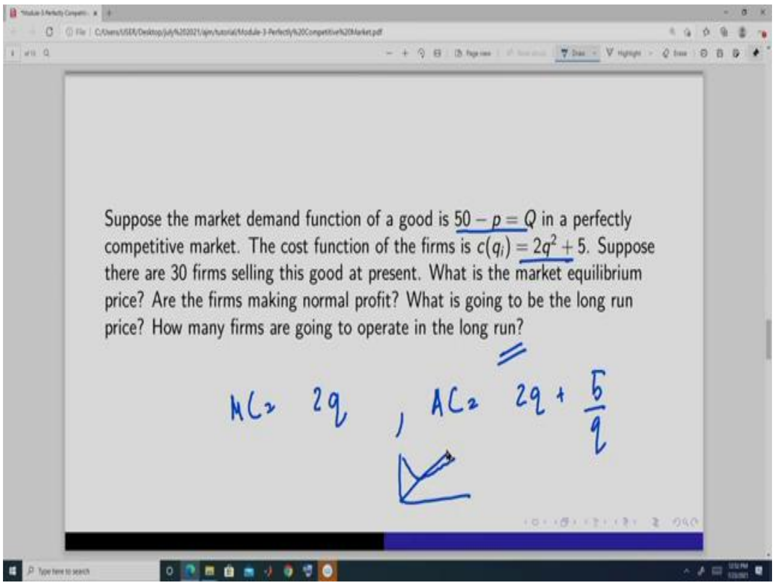


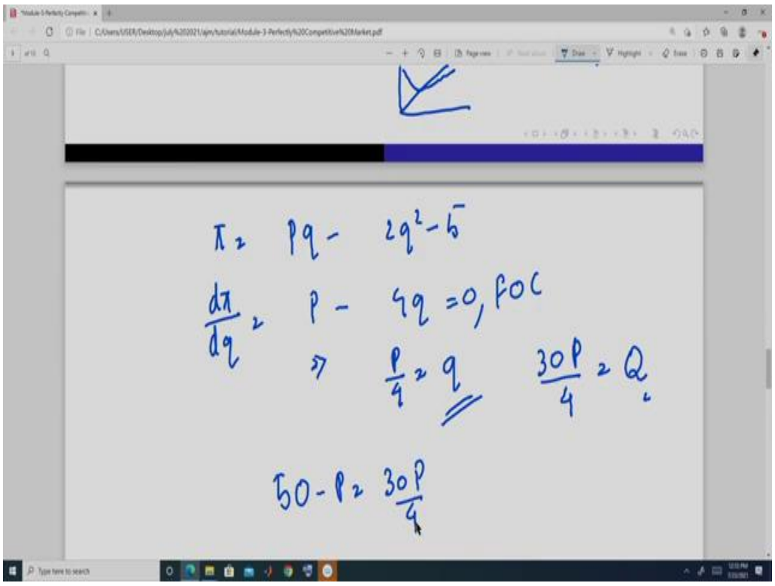


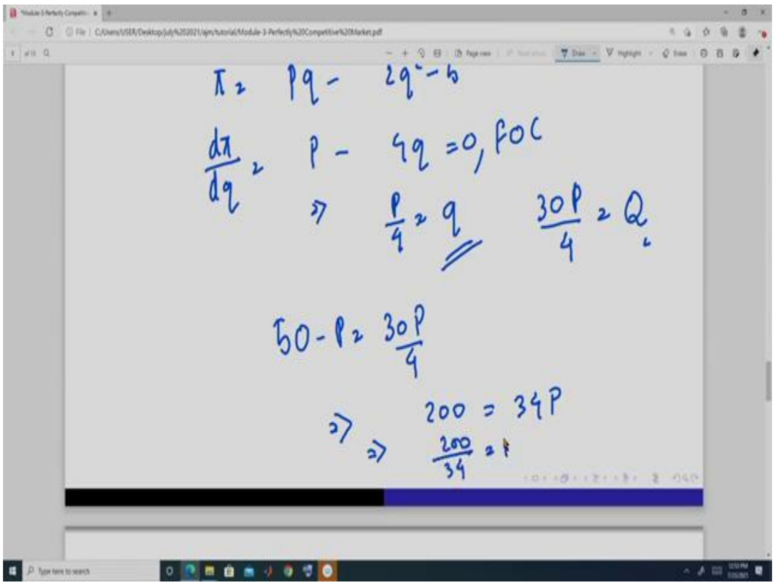

$$\Rightarrow \frac{100}{17} = p$$

$$\pi = \frac{100}{17}\cdot\frac{25}{17} - 2\left(\frac{25}{17}\right)^2 - 5$$

$$\frac{p}{4} = q \Rightarrow \frac{100}{4\cdot 17} = q \Rightarrow \frac{25}{17} = q$$

$$= 4\cdot\left(\frac{25}{17}\right)^2 - 2\left(\frac{25}{17}\right)^2 - 5$$

$$= 2\left(\frac{25}{17}\right)^2 - 5 < 0$$

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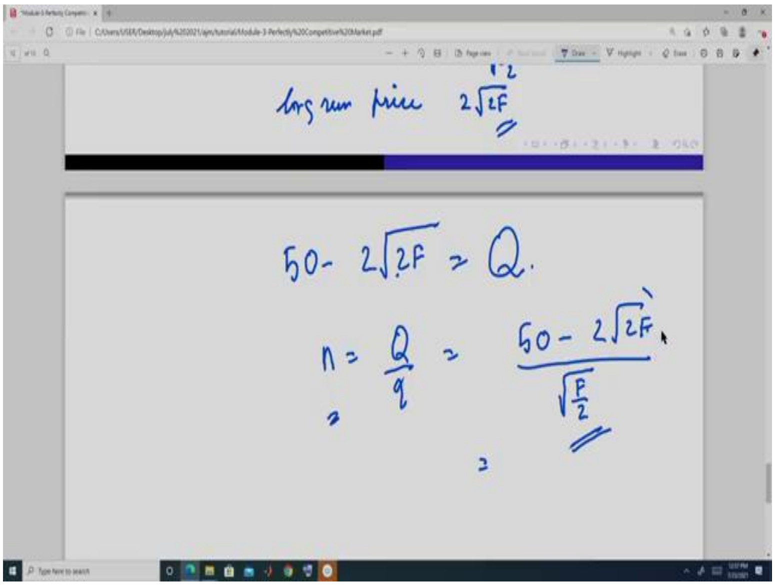
$$AC = 2\cdot\frac{\sqrt{F}}{\sqrt{2}} + \frac{F}{\sqrt{\frac{F}{2}}} = 2\sqrt{2F}$$

long run price $2\sqrt{2F}$




Now, let us solve another problem that is suppose the market demand function is this- 50-p=Q and the cost function is of this nature- $c(q_i) = 2q^2 + 5$. Now, we have a fixed component, fixed cost component and suppose there are 30 firms selling this good. What is the market equilibrium price? Are the firms making normal profit? What is going to be the long run price and how many firms are going to operate in the long run?

Now, here if you look at this marginal cost is 2q, okay, average cost is this- $AC = 2q + \frac{5}{q}$, okay? so marginal cost is this, average cost is something, it is something like this, okay. Now, the profit of any firm is this, it takes the price as given, so we get this profit function- $\pi = pq - 2q^2 - 5$, so this is equal to first order condition- $\frac{d\pi}{dq} = p - 4q = 0$, cost function is this so p by 4 is equal to, this- p/4=q is the output of each firm, there are 30 firms, so 30, i.e- 30p/4=Q.

This is the, market demand curve is this- 50–p=Q, get this- 50–P= 30P/4, this- 200=34P, so 100 by 17 is the price, right? Now, are the firms making normal profit? So, this is the price- 100/17=P, so profit is this, output of each firm p by 4, so this is the profit- $\pi = \frac{100}{17} . \frac{25}{17} - 2\left(\frac{25}{17}\right)^2 - 5$, this- $\pi = 4.\left(\frac{25}{17}\right)^2 - 2\left(\frac{25}{17}\right)^2 - 5$so this you can write it is something like this- $\pi = 2\left(\frac{25}{17}\right)^2 - 5$ . Now, this number is less than 2, so this is- $\pi = 2\left(\frac{25}{17}\right)^2 - 5 < 0$ . So, firms are making loss. So, some firms are going to leave or exit. So, in the long run what is the average cost?

Average cost is going to be the minimum of this which is we get this by taking derivative of this with respect to output, which is equal to this- $\frac{dAC}{dq} = 2 - \frac{F}{q^2}$ so minimum point is this. So, if this is the a, so what is the AC? So, this is equal to two times… So, the long run price is this-$2\sqrt{2F}$. Now, what is going to be the number of firms? So, this- $50 – 2\sqrt{2F} = Q$, is going to be the aggregate output when we plug in the price, right? What is the output of each firm?

Output of each firm is this-$\sqrt{F}/2$, so n is this divided by this-$n = Q/q$, so this is 50 this-$\frac{50 – 2\sqrt{2F}}{\frac{\sqrt{F}}{2}}$

, so this is the number of, so we take the closest integer of this and we get the number of firms which are going to be there in the market in the long run. This is the number, okay. So, because the number of firms are always going to be integer, so we take the integer which is lower than this real number and this is definitely a positive number if F is not that big, okay. So, these are some of the problems that we discuss in module 3. Thank you.