1) a) We use the Alonso-Muth-Mills model as a framework for this task. This model is a classic monocentric model, meaning we have one central business district (located in the city center, with one employment zone).

Factors that influence where a firm will locate within the city is transportation costs (which is denoted the letter s) and also the Q/f-ratio, which means how much you produce per lot size.

Some firms have high Q/f-ratios, and these firms locate in the city center where the density is higher. I will mention more about this ~~in~~ later in the assignment.

Other general factors can be a firm's profit, their prices, salary, what they make (car vs consulting).

Density also affects the decision, meaning density of development. The form of the land (mountains, flat land) is another factor.

1) b) As mentioned, we use the Alonso-Muth-Mills model.

First off, we have that firms have a higher WTP than households. Firms pay higher rent.
Land is rented to the users paying the highest rent.

To solve this task we have certain assumptions:

- one employment zone in the city
- All goods are imported to and exported from this center
- Distance to city center is d
- Transportation costs are s per km
- All firms produce quantity Q of an identical product, using the same production process
- There is perfect competition is output and input markets
- Free entry into the industry
- Prices are taken as given
- Land rent per m^2 is $r_c(d)$
- Every firm have lot size f
- The structure rent is C (fixed)
- Density of development is fixed

A firm's profit is

$$\rho = Q(P - A - sd) - C - r_c(d)f$$

Q is quantum produced
P is product price
A is wages and material product costs
s is transportation costs per km
d is distance to city center
C is structure rent (fixed)
$r_c(d)$ is land rent per m^2 of land
f is lot size

(Some of these were mentioned on last page, but just to show an overview of the function)

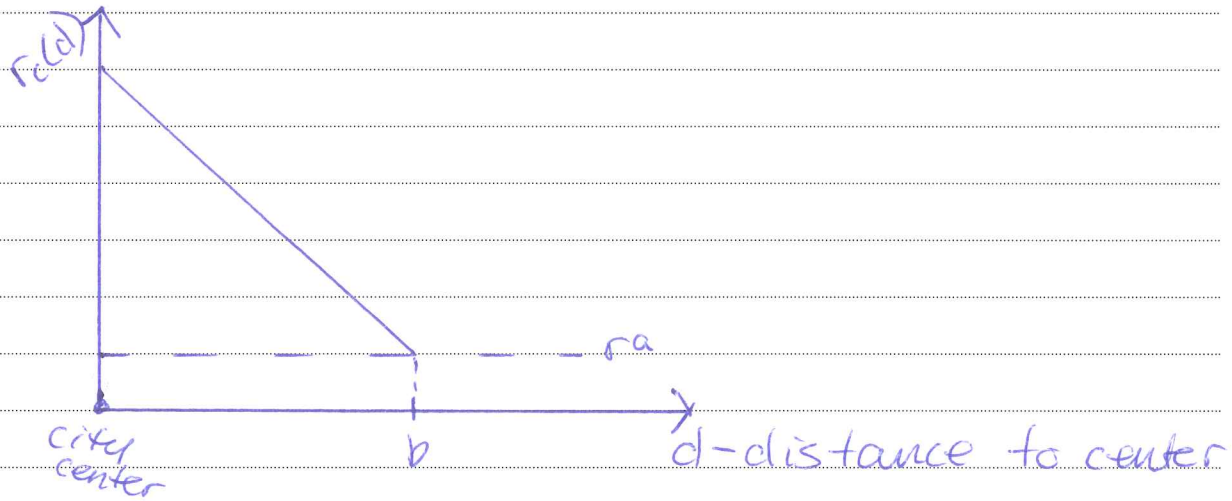
We know that there is perfect competion in the market, and that means zero profit:

$$\rho = Q(P - A - sd) - C - r_c(d)f = 0$$

Then, land rent is (per unit of land):

$$r_c(d) = \frac{Q(P - A - sd) - C}{f}$$

The land rent is affected by sd, which is the transportation cost, given that all other factors are fixed. With longer (commuting) transportation to the city center, the land rent decrease. This is to compensate for higher transportation costs.



As the figure shows, longer away from city center give lower land rent for firms.

1) c) To explain this land rent gradient we can "deriere uttrykket med hensyn på" d:

$$\frac{dr_c(d)}{\partial d} = \frac{-sQ}{f}$$

The land rent is varying with transportation cost(s) and the Q/f-ratio, which shows level of production per lot size.

With increasing distance to city center, the land rent decrease.

If you produce a high quantity per lot size, you will locate closer to the city center.
If you have high transportation costs you will also locate closer to the city center.

1) d) Now, we have that

$$\frac{\partial r_c(d)}{\partial d} = \frac{-sQ}{f}$$

, but if we now expand this model a bit. We now consider firms (i) that are different, in regards to transportation costs (s), quantity produced (Q) and lot size (f).

We then get $\frac{\partial r_c^i(d)}{\partial d} = \frac{-s_i Q_i}{f_i}$

Firms will locate differently because of the factors mentioned.

Industry firms will locate further out because they have a lower Q/f-ratio and maybe also lower transportation costs.

This is logic when thinking about it. Industries use location that are huge and flat (not many levels/floors).
This is because of what they produce - Let us use a car manufacturer as an example here.

A car manufacturer needs a lot of space to produce their cars, but they can't do it in a skyscraper. They need huge, flat buildings.

I will explain more of other types of firms in e).

So, an industry firm will locate further out because they produce less per lot size than commercial firms. They need more space, and also might have lower transportation costs, meaning better transportation technology.

1) e) We assumed that firms pay a higher rent than households do.

This holds true when transportation technology for workers are cheap, workers value of time is low, firm's transportation costs are high, or land when firms have a higher exploitation of land than housing.

We also mentioned the difference in transportation costs(s) and produced quantum per land unit. (Q/f-ratio)

These factors determine where the firms will locate within the city.

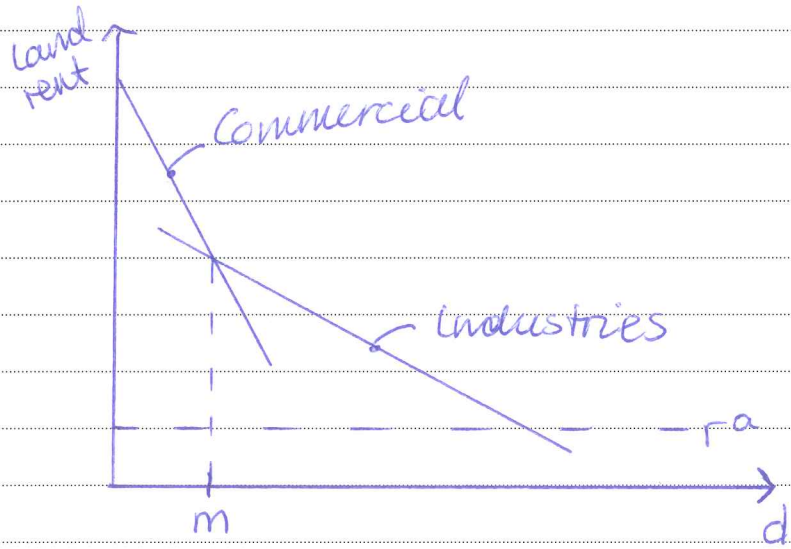
Commercial firms have a higher Q/f-ratio than industry-firms. Why is that?

Let us compare an investment bank with the car manufacturer mentioned earlier.

An investment bank can provide bonds, stocks, derivatives and insurance without using much land to do so.

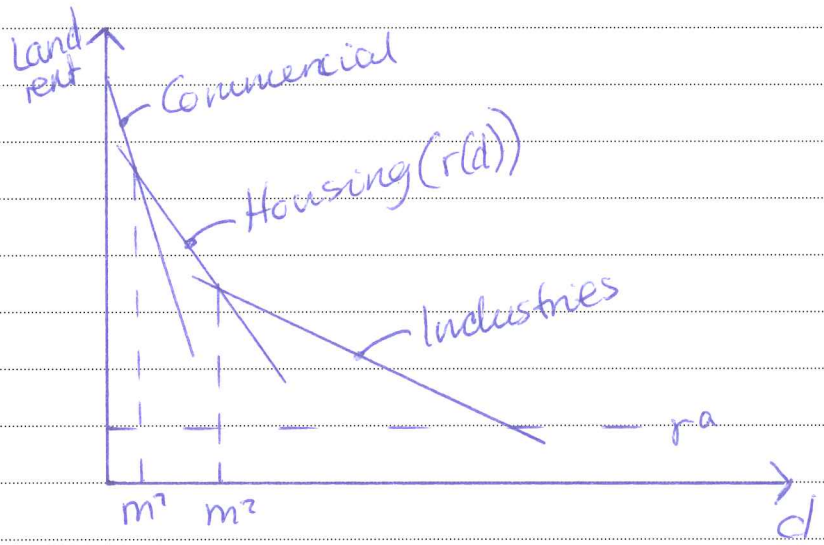
1e) The commercial firms (investment bank for instance) therefore use little land. Their lot size is small compared with industries. They produce a high quantum giving them a high Q/f-ratio.

The commercial firms build their buildings vertically, they use sky scrapers. So their FAR is high, which make them locate in center. Industries locate in the outskirts, as mentioned. They have a low Q/f-ratio and need more land to produce their goods.
This can be illustrated:



1e) The slope of land rent gradients for commercial firms are steeper than for industries.

Just to show, if households are includes it would look like this:



Commercial firms closest to center, then housing, and the industries locate in the city outskirts.

1f) In a spatial equilibrium no firms or households have an incencive to move given their utily of land, wages and income. In the spatial equilibrium every one is located at the location giving most utily for them, and demand equals supply of land.

2) Taking short answers into concideration when answering following questions:

a) The housing wealth effect happens when an asset increase in value, in this case the house. Increase in value leads to increased spending because people feel richer, but they have not ~~the~~ received any more money. Increased house value causes also people to lend more, with house as collateral. They then use this money for items that do not generate value (bonds, etc) but on consumer products. When housing prices fall they are worse off because of it, and have less savings and more debt.

2) b) Many people lend more when interest rates are low, as of now. If you then buy a house, and rates again increase you might not afford the ~~rent~~ increased payments.
An increased supply of housing may lead housing prices to fall, as can a housing bubble* (mention more in next task).
Increased tax rates on your property may also be a risk because of higher tax payments.

~~* After~~

2) c) A housing bubble may occur when increase in prices can not be justified by fundamentals, such as income levels and savings. Prices increase because people expect higher prices tomorrow than they are today. This drives prices more up.
A housing bubble first form with increased financial flows into the economy or cheap credit. This money is invested in an asset group (here: housing), and what is mentioned above occurs.

Signs such as rapid price increases, price-to-income ratio (meaning housing prices are alot higher than the income levels), price-to-replacement cost ratio (in equilibrium these are equal, meaning a lot higher price is due to much larger demand than supply). Low construction levels are another factor leading to a housing bubble. Hysteria one might call it, is a sign also of a bubble happening.

2) d) With people discovering that housing prices can not be sustained in the longer term, a bubble start to burts.
Cheap credit is blown into the economy, and with increasing rates more people are defaulting on their payments.

These two factors and other signs (mentioned earlier) lead to the bubble bursting.
When people fail on their payments eventually supply of housing increase (+ construction increase when prices increase). This drives prices down.
Investors sell because they notice factors are pointing in a negative directions.

This keeps going until prices drop a lot. A housing bubble was the main reason for financial problems in 2008.

A housing bubble is problematic because it creates more debt in the society, people have less money to spend. This means people save more. Demand decrease, prices fall, and it might trigger a recession and possibly deflation.

2) e) The burden of a land value tax will be carried by the landowner. Tax on housing will be carried by the tenant. If you owe a property and live there yourself you have to pay both taxes.

The reason is because if the tax on land is transferred to the tenant, increasing rent, the tenant choose to move, meaning it is more attractive relatively to own the property. They, tenants, will move over to the asset market.

3) a) The density is no longer fixed, and land is for residential use only. Landowners are profit maximizing.

There is a trade-off here when considering and deciding on the optimal density. With higher density (measured as FAR*) the WTP for a property decrease, but with the increasing density you also fit more units on the site.

*FAR is Floor Area Ratio, and is

$$\frac{\text{Housing Floor Area}}{\text{Total Land Area}}$$

FAR = BOA / TOA

We assume no external effects, meaning neighborhood density effects, but if considering these effects, these also have to be evaluated.

3) b) We build on the knowledge from a)

~~The land a~~
The WTP per m^2 of floor area is
$P = \alpha - \beta F$
P = price per m^2 of floor area
β → Marginal change in value due to change in density
α → Sum of value from all attributes of the property, except own ~~FAR~~
F → density (FAR)

The cost of construction per m^2 floor area is
$C = \mu + \tau F$
C → cost of constructing per m^2 area
μ → sum of all other costs (labor, start-up, etc)
τ → Marginal ~~loss~~ increase in cost due to increasing density. Higher density is more expensive

We assume no external effects in this task.

3b) The profit per m^2 area is

$$\pi^{BOA} = P - C$$

The landowner wishes to maximize the profit from land:

$$\pi^{TOA} = (P-C)F$$

$$= (\alpha - \beta F - \mu - \tau F)F$$

$$= \alpha F - \beta F^2 - \mu F - \tau F^2$$

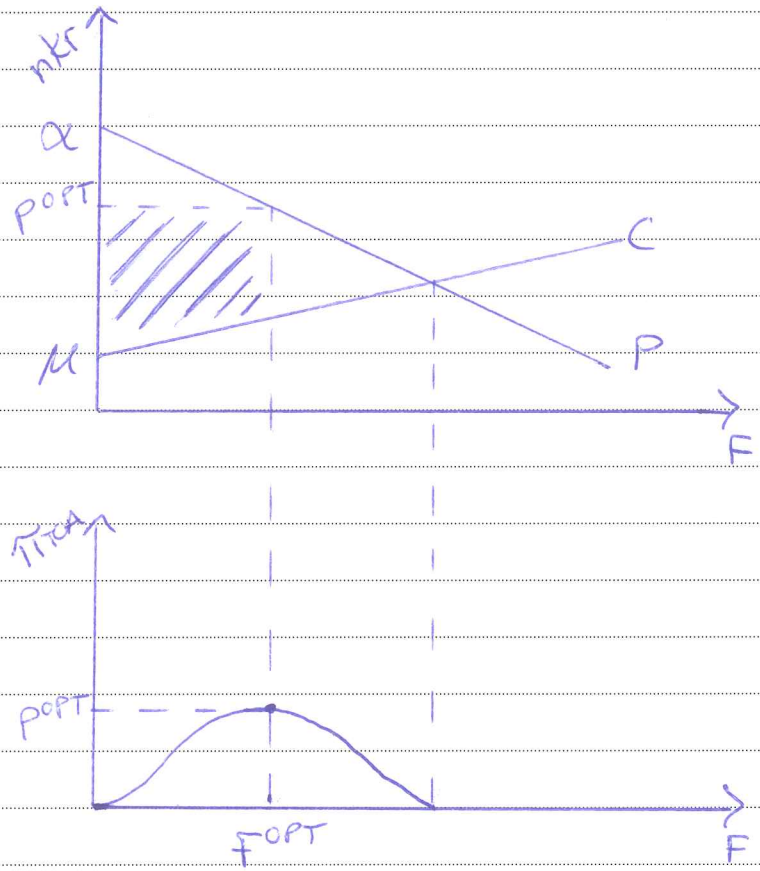
$$= (\alpha - \mu)F - (\beta + \tau)F^2$$

We now wish to find an expression for the optimal F:

$$\frac{\partial \pi^{TOA}}{\partial F} = \alpha - \mu - 2F(\beta + \tau) = 0$$

$$F^{OPT} = \frac{\alpha - \mu}{2(\beta + \tau)} \Rightarrow P^{OPT} = \frac{(\alpha - \mu)^2}{4(\beta + \tau)}$$

3b) So, we've found the optimal density and the profit at this level of density. This can be shown in a figure as well:



The figure shows the optimal level of F at F^{OPT}. This is, as seen, at the top of the curve (the top point) in the lower figure. This level of F gives a profit of p^{OPT}. The striped area in the upper figure is the illustrated profit. This means that the price in the market, given F^{OPT}, gives the mentioned profit.

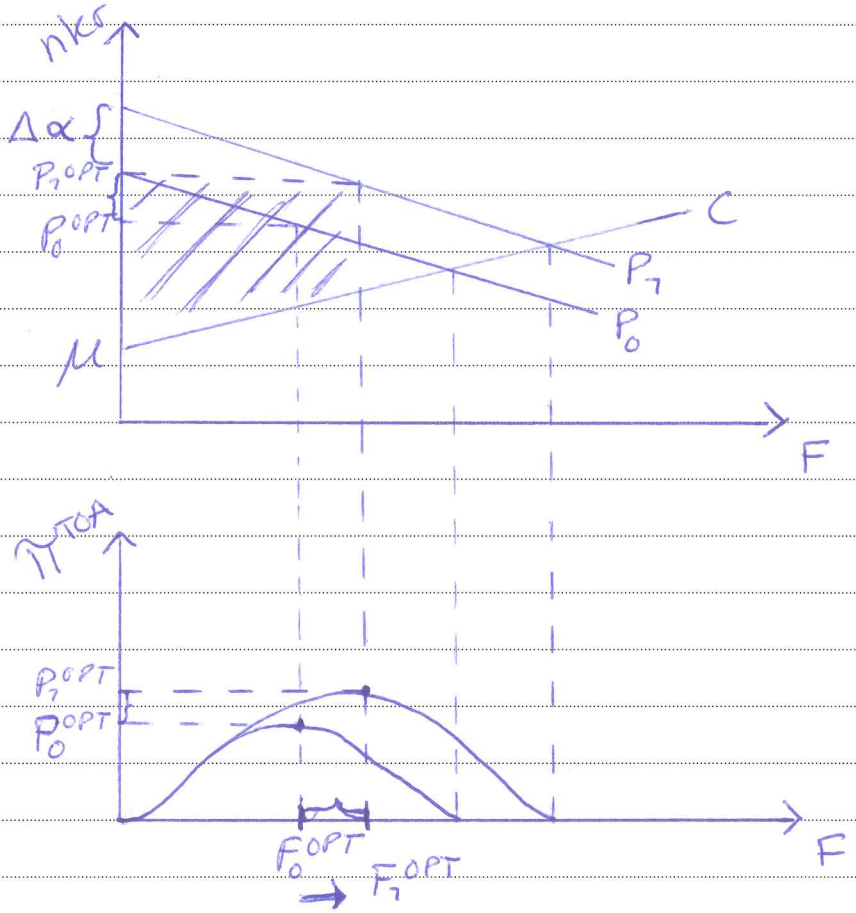
3) c) With the landowners site being more desirable, this means that the WTP increase, which again affects the α. The α increase, and this can be illustrated.

We still have the same expressions for F^{OPT} and p^{OPT}:

$$F^{OPT} = \frac{\uparrow \alpha - \mu}{2(\beta+\tau)} \quad \text{and} \quad p^{OPT} = \frac{(\uparrow \alpha - \mu)^2}{4(\beta+\tau)}$$

As we can see from the expression, when α increase both F^{OPT} and p^{OPT} will increase (optimal density and profit).

3c)



As the figure shows:
With increased α the willingness to pay increase, and therefore a shift occurs from P^0 to P^1.
This gives a higher optimal density of development and a higher profit.
The new profit is shown in the upper figure → the striped area.

3) d) With higher demand for land the value of land and housing prices will increase.
Higher prices will lead to more construction in the long term, ~~but it~~ and this again will lead to increased density.

With increased density the WTP will eventually fall again, and we will reach an equilibrium between the price per m^2 and the cost of m^2, which will give $P=f(c)$. This means that the price equals the replacement cost.

3) e) A condition for redevelopment is:

Net value of new construction − demolition cost > gross value of existing structure

We assume that construction cost of existing structure are sunk cost.

The gross value of existing structure is

$$p^0 = (\alpha^0 - \beta F^0) F^0$$

The net value of new construction is

$$p^* - c^* = (\alpha - \beta F^*) F^* - (\mu + \tau F^*) F^*$$

Demolition cost is δF^0

So, we will choose to redevelop if:

$$(\alpha - \beta F^*) F^* - (\mu + \tau F^*) F^* - (\alpha^0 - \beta F^0) F^0 > \delta F^0$$

With larger WTP (for new structure) compared to existing, more likely is demolition.

If $\alpha > \alpha^0$, then demolition is also more likely.