1. Using the material from lecture on the demand curve, do the following:

*a. Assuming unskilled labor and capital are gross substitutes and skilled labor and capital are gross complements, show and explain how an investment tax credit will affect these two labor markets. Explain how the skill composition of employment changes.

Figure 6: Effect of ITC on Skilled and Unskilled Labor Markets

An investment tax credit of 10% means that an employer making a $1m investment today will be able to reduce his tax payments to the government by $100,000. In effect, a $1m piece of capital equipment only costs $900,000 which is a fall in the price of capital. This change in the price of capital will affect both the skilled and the unskilled labor markets.

In the skilled labor market, a reduction in the price of capital will cause the demand for skilled labor to increase when skilled labor and capital are **gross complements**—the scale effect dominates the substitution effect. More precisely, a fall in the price of capital will decrease the cost of production and hence increase output (the supply of output
increases) which causes the demand for skilled labor to increase. When the relative price of capital falls, more capital is gradually substituted for skilled labor causing the demand for skilled labor to decrease. Since the scale effect dominates the substitution effect (which should be relatively small in any case), demand for skilled labor ultimately increases.

In the unskilled labor market, a reduction in the price of capital will cause the demand for unskilled labor to decrease because unskilled labor and capital are gross substitutes. More precisely, a fall in the price of capital will decrease the cost of production and hence increase output (the supply of output increases) which causes the demand for unskilled labor to increase. When the relative price of capital falls, more capital is gradually substituted for unskilled labor causing the demand for unskilled labor to decrease. Since the substitution effect (which will be relatively large) dominates the scale effect demand for unskilled labor ultimately decreases.

As a result of the increase in demand for skilled labor and decrease in demand for unskilled labor, the wage differential between the two types of labor widens. Since this larger differential is larger than the equilibrium differential, it should induce some unskilled labor to obtain training which raises their skill level (and allows them to work in the skilled labor market). That is, the supply of unskilled labor should gradually decrease and the supply of skilled labor should gradually increase in the long-run until the equilibrium wage differential is reestablished.

In summary, the investment tax credit increases the skill composition of the labor force (supposing that skilled and unskilled labor conform to the assumptions made above).
b. Explain how the elimination of the corporate income tax affects labor markets. (Hint: Start with a tax in place in the capital market and show what happens in capital markets when the tax is abolished.) Are capital and labor gross substitutes or gross complements? Explain.

In the capital market, the demand for capital increases because of the elimination of the tax. Note that this decreases the price of capital (because the gross return on capital had to be higher) and the corporate sector slowly increases the amount of capital used in the short-run. This increases the productivity of existing labor and creates new jobs. In the long-run, as investors increase the supply of capital, the price of capital will continue to fall until the long-run rate of return is reached. As this occurs, capital is also increasing so that the demand for workers increases. This means that labor and capital are gross complements in the long-run.
2. Using the material from the lectures on elasticity and the minimum wage, do the following:

*a. Assume two groups of workers A and B where workers in group A are relatively unskilled 16-19 year olds and workers in group B are relatively more skilled 20-24 year olds with more schooling and experience. Also assume that these two markets start with an equilibrium wage differential before the minimum wage is imposed. Then impose the minimum wage in the market for group A (assuming group B’s wages are above the minimum wage). Show and explain what happens in these two markets when group A and B are gross substitutes.

Figure 7: Minimum Wage Model for Groups A and B

In this case we get a labor-for-labor substitution which partially explains why imposition of the minimum wage seems to have rather minimal impacts on employment. Here’s how it works. With the introduction of the minimum wage for group A, employers of workers in group A will experience increased costs of production which will cause output to fall (because the supply of output decreases). The scale effect causes the firm to decrease its demand for all other inputs including the demand for group B workers.
However, the substitution effect works in the opposite direction: the relative wage of group A has increased (relative to Group B’s wage) causing employers to increase their demand for substitutes in group B. With the substitution effect being greater than the scale effect, the overall demand for labor in group B increases, meaning groups A and B are gross substitutes. (Note: $W_1 > W_{\text{min}} > W_0$)
When the minimum wage law was first introduced in 1938 the seamless hosiery industry which was one of the largest manufacturing industries in the South was significantly affected by this law. Northern manufacturers who paid their workers higher wages (because their opportunity costs were higher) strongly supported this law in order to hamper competition from their lower cost competitors in the South (where wages were lower). Assume two labor markets for seamless hosiery workers, one in the North (N) and one in the South (S) before passage of the law with a wage differential between them. Then impose the minimum wage law which only affected the Southern labor market. Show and explain what happened to these two markets after the law was passed. (Hint: What happened to the output markets in both the North and South?)

Figure 8: Minimum Wage Model for Northern and Southern Hosiery Mills
Data indicate that employment in Southern mills fell by 5.5% (employment fell 17% in mills that paid wages below the minimum) while employment in Northern mills expanded by 4.9%. The increased cost of production for Southern mills caused the supply of output to decrease thereby decreasing output and raising the price of hosiery made in the South. This caused the demand for Northern hosiery output to expand, causing demand for hosiery workers to expand as well (remember the demand for labor is a derived demand). This example suggests that support for the minimum wage can arise from those firms which want to cripple their lower-cost rivals.
Each time the minimum wage has been raised total employment has continued to grow. Therefore, those who claim that the minimum wage causes job loss are simply not correct. Graph and analyze this statement. Is it true or false? Why?

*Figure 10: Increase in the Minimum Wage*

![Graph showing job loss](image1)

*Figure 11: Increase in the Minimum Wage with Increase in Demand*

![Graph showing job growth](image2)
This statement is false. The reason why employment growth occurs arises from economic growth in the economy. This growth means that output demands are increasing and causing the demand for labor in most markets (including the covered minimum wage markets) to increase. The job growth occurs because of the increasing demand for labor, not because the minimum wage has been raised. Note that job growth in the minimum wage market will only occur if the rate of growth of demand exceeds the rate of growth in the minimum wage. Why might this be the case?

*d. Using some of the Hicks-Marshall laws, explain why unions (1) oppose repealing import quotas, (2) attempt to organize an entire industry (instead of part of it) and (3) try to limit the substitution of other inputs.

Figure 12: Unions and the Elasticity of Demand

(1) Import quotas are an effective way of reducing the number of substitutes for the union-produced output. This strategy produces a demand curve for union-produced output which is more inelastic. A more inelastic demand for output produces a more inelastic demand for union labor, allowing the union to restrict the number of workers by a relatively small amount while increasing the wage a significant amount.
(2) If only a portion of an industry is organized, the remaining unorganized portion of the industry produces output which is a perfect substitute for the union produced output. By organizing the entire industry, unions eliminate this perfect substitute and make the demand for output (and the demand for labor) somewhat more inelastic.

(3) If the elasticity of supply of other inputs is decreased by policies which limit the ability of employers to substitute one input for union labor (electronic printing presses for union typesetters, union work rules which prevent carpenters from doing minor electrical work, requirements to keep firemen on diesel trains, etc.) then the demand curve for union labor will be more inelastic, allowing the union to raise wages significantly.
3. Using the concepts on human capital developed in lecture, answer the following:

*a. Using the signaling model, do the following: If the government reduces subsidies to college education, how will this affect peoples' decisions to go to college and how will employers respond? Explain.

Figure 4: Reducing Subsidies in the Signaling Model

When subsidies decrease, the costs of going to college increase for both the low productivity worker (A) and the high productivity worker (B). The costs may shift enough so that employers may reduce the level of education (the signal acquired) necessary to distinguish between these two types of workers. This is a distinct advantage to H type workers because they now do not have to spend as much as they did before in order to acquire a signal.
b. Explain the following:

(1) Given the work-family-work life cycle of the 'traditional' woman, it would be rational for women to invest in less education than men.

The work-family-work life cycle for traditional women implies an interrupted career and a shorter period of time in the labor force. With fewer years over which to collect returns on an investment in human capital and the possibility of significant deterioration of skills during the absence from the labor force, women tend to invest less in human capital or to invest in more durable skills which do not depreciate very quickly (but have a lower rate of return).

(2) Suppose Congress passes a law requiring all persons aged 18 to enroll in a program of universal national service for 3 years. How will this affect the returns from investment in higher education? Explain.

This program will lower the returns on human capital because it delays entry into the labor force for three years and reduces the time period over which the returns on human capital investments can be collected. As a result, marginal investors (those for whom the PV of the future earnings stream just exceeds the cost, implying a relatively low rate of return) may decide not to go to college.
(3) Suppose firms require all employees to retire at age 65; now suppose Congress passes a law prohibiting firms from requiring retirement at age 65. Explain how this affects the return from investment in higher education.

This may have an ambiguous effect on the return from investment in higher education. On the one hand, those who are close to retirement will reap windfall gains as they can stay in the labor force longer. But younger workers may find their wage trajectory lowered somewhat so that their wages grow more slowly. Slower wage growth translates into lower rates of return on investment for these younger workers. Workers just entering the labor force who note that some close to retirement are earning very high returns on their investments may mistakenly invest in too much education. But those workers who observe the slower wage growth of the younger portion of the labor force will most assuredly reduce their investment in higher education.
Suppose that college tuition is reduced to zero and textbooks are provided free of charge. Once equilibrium levels of college attendance are reached, what earnings differential would we expect to see between college grads and high school grads? Show and explain (Hint: You need two supply-demand graphs).

The temptation here might be to argue that the wage differential has been reduced to zero. But this is incorrect. The wage differential will narrow so that it is equal to the opportunity cost of acquiring a college education.

Figure 2: Change in the Equilibrium Wage Differential for College and High School Grads
c. Suppose a 30 year old unskilled worker who currently earns $16,000 a year enrolls in a community college (CC) for two years. Tuition and books cost him $2,000 a year. After finishing his courses at the CC, he gets a job paying $20,000 a year. Suppose that this job lasts until this worker retires at age 62. Assuming the interest rate is 5%, is this a good investment? Is this an equilibrium differential? Explain. (Hint: Use the annuity formula in the text or lecture.) What if the interest rate is 10%?

If \( C = 18,000 \), \( B = 4,000 \), \( T = 30 \), and \( i = 5\% = 0.05 \):

\[
PV = B \frac{1}{r} \left(1 - \frac{1}{(1 + r)^T}\right)
\]

\( PV = 4,000 \frac{0.7686}{0.05} = 4,000(15.372) \)

\( = 61,488 \text{ at age 32} \)

\( PV = 61,488(1/1.05^2) \)

\( = 61,488(0.907) = 55,769.62 \text{ at age 30} \)

\( PV \text{ of } C = 18,000 \frac{0.093}{0.05} = 18,000(1.86) = 33,480 \text{ at age 30} \)

Given that \( PV > C \), this is a worthwhile investment at a 5% interest rate. This is not an equilibrium differential because \( PV > C \) (equilibrium differentials occurs when \( PV = C \)). See Figure 3.

If \( i = 0.10 \) then:

\( PV = 4,000 \frac{0.9427}{0.1} = 37,708 \text{ at age 32} \)

\( PV = 37,708(0.8264) = 31,161.89 \text{ at age 30} \)

\( PV \text{ of } C = 18,000 \frac{0.1736}{0.1} = 31,248 \text{ at age 30} \)

This yields \( PV < C \), so this is not a worthwhile investment at a 10% interest rate.
Figure 3: Wage Differential for College and High School Grads Where PV > C