*Answer in the space provided. Show correct work for full credit. Box your final answers.*

**1. Unions.** Suppose that in a particular labor market, demand for labor is defined by the marginal revenue product of labor curve $MRP_L = 40 - \frac{1}{10}L$, and workers' reservation wages are given by the marginal cost of labor function $MC_L = 10 + \frac{1}{10}L$, where $L$ is the quantity of workers employed.

**a)** Suppose that firms behave in a perfectly competitive manner, but workers are controlled by a single union, which chooses a wage in order maximize the value of worker surplus, while being subject to the constraint that $MRP_L = w$. What wage should they choose, and what are the resulting values of $L$, worker surplus ($WS$), firm surplus ($FS$), and total economic surplus ($TES$)?

**b)** Why might maximizing worker surplus not be the precise goal of a union?

**c)** On the graph to the right, draw the $MRP_L$ and $MC_L$ curves, mark the point representing the union's choice of $w$ and $L$ from part a, and use different shading to indicate $FS$ and $WS$.
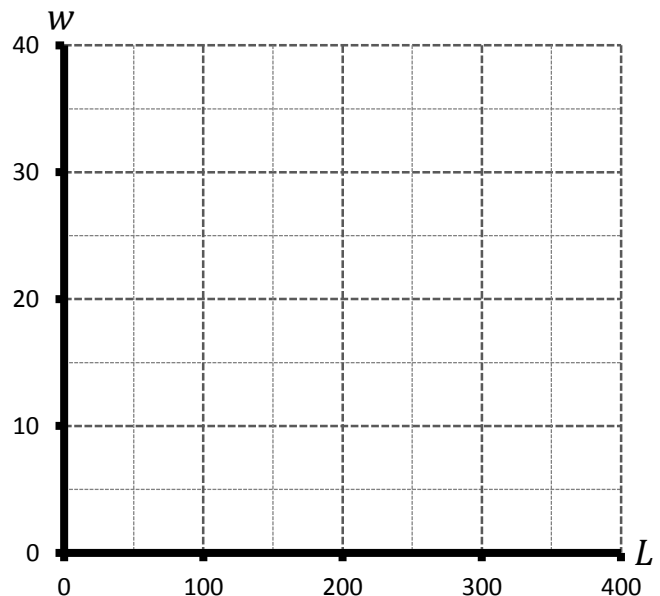
**2. Immigration and the labor market.** Consider a market for a particular type of labor, in a particular place. Demand for labor can be represented by the marginal revenue product of labor function $MRP_L = 42 - L$, where $L$ is the quantity of labor. Domestic supply of labor, supply of labor from immigrants, and total supply of labor can be represented by the marginal cost of labor functions $MC_L^d = 2 + L$, $MC_L^i = 2 + 2L$, and $MC_L^t = 2 + \frac{2}{3}L$.

**a)** Find the equilibrium wage, employment, firm surplus, worker surplus, and total economic surplus if immigrants are not allowed to work.

**b)** Find the equilibrium wage, employment, firm surplus, domestic worker surplus, immigrant worker surplus, total domestic economic surplus (excluding immigrants' surplus), and total economic surplus (including immigrants' surplus) if immigrants are allowed to work.

**c)** On the blank graph to the right, draw $MRP_L$, $MC_L^d$, $MC_L^t$, firm surplus ($FS$), domestic worker surplus ($WS^d$), and immigrant worker surplus ($WS^i$). Draw a thick boundary around the area of the graph representing the change in domestic economic surplus.
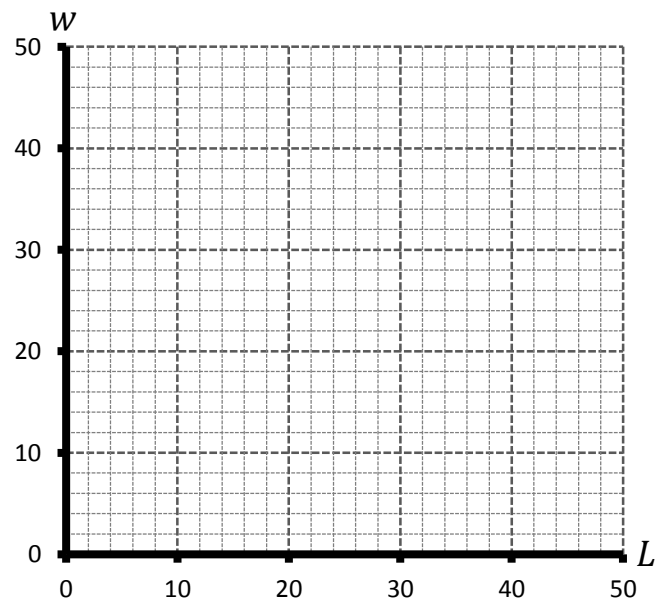


**d)** Quantify the gains and losses by different groups that result from immigration.

**3. Signaling** Suppose that, at a particular job, the productivity of a low-ability worker is $\pi_L = 38$, and the productivity of a high-ability earner is $\pi_H = 50$. Suppose that the cost of education for a low-ability person is $c_L(e) = 4e$, and the cost of education for a high-ability person is $c_H(e) = 3e$, where $e$ represents educational attainment.

**a)** What values of $e^*$ could firms require that would allow them to effectively distinguish the high-ability workers from the low-ability workers?

**b)** In words, how does a signaling model of education differ from a human capital model? What is the benefit of education in a signaling model, and who benefits?

**4. Efficiency wages.** Explain how efficiency wages might differ from workers' reservation wages, even in a competitive market, and why.

**5. Discrimination.**

**a)** If the labor market is perfectly competitive, who bears the cost if an employer has a 'taste' for discrimination, i.e. has a personal dislike for a certain group and prefers not to hire people from that group. Explain clearly.

**b)** Explain how statistical discrimination can be harmful to the employment prospects of women, even if no one has a taste for discrimination against them.

**6. Unemployment.** Frictional, cyclical, and structural unemployment: explain each of these as clearly as possible.

**7. Technology and inequality.** Explain the ways in which technological growth can increase inequality, by making some worse off while others are made better off. Under what circumstances can technological growth be Pareto-improving?

**8. Distributional effects of trade.** Suppose that a country with a high capital to labor ratio becomes increasingly open to trade with a country with a low capital to labor ratio. Discuss the likely effects of this. Who is most likely to be made better off, and who is most likely to be made worse off, in the short run?