1. Parts a, b, c and f are worth 1 point each; parts d, e, and g are worth 2 points each; and part h is worth 3 points for a total of 13 points.

1a. Remember that all points on the production possibilities frontier are efficient in the sense that resources are fully utilized. Therefore, if the economy chooses to produce no corn, then the only efficient point of production is were the production possibilities frontier (ppf) crosses the y-axis (0 corn, 70 clover).

1b. If Lorain County increases its corn production from 0 to 50 million bushels, then it decreases clover production from 70 to 60 million bushels. The opportunity cost of one bushel of corn in terms of clover is thus 1/5 bushel of clover.

1c. If Lorain county increases its corn production from 50 to 100 million bushels, then it decreases clover production from 60 to 0 million bushels. The opportunity cost of one bushel of corn in terms of clover is thus 6/5 bushels of clover.

1d. The opportunity cost of corn in terms of clover increases from part b to part c because the inputs (land, labor and capital) are not the same in Lorain county. So, when Lorain County increased its corn production from 50 to 100 million bushels, it must use those resources less suited for corn production. As a result, the county must give up more clover production to produce the next unit of corn.

1e. An indifference curve is defined as all combinations of corn and clover where Lorain County receives the same total utility. Since Lorain County is willing to give up corn for clover and clover for corn along an indifference curve, the county receives utility from consuming each good. However, the slope of an indifference curve is the marginal rate of substitution of corn in terms of clover or the ratio of the marginal utility of corn to the marginal utility of clover. Therefore, the slope of a convex indifference curve implies that the marginal utility of corn falls (the marginal utility of clover rises) as more corn (and less clover) is consumed.

1f. The point would be the point of tangency between the production possibilities frontier and the indifference curve $I_1$.

1g. Lorain County is happiest at point f because there is no way that the county can reallocate its resources without making itself worse off. The combination of corn and clover at point f is not necessarily the one where the most corn and clover is produced, but rather the amount that maximizes total utility. Suppose Lorain County chooses to consume more corn and less clover. It would find itself with a less preferred bundle (lower indifference curve). Similarly, if Lorain County chooses to consume more clover and less corn, it would also find itself with a less preferred bundle (lower indifference curve).
1h. The reason why Lorain County would ever want to grow clover is because clover increases the future yield of both corn and clover. Therefore, the growing of clover represents an investment into the future productive capability of Lorain County. However, by growing clover, Lorain County gives up current consumption in the form of corn. As we discussed in class, the balance struck between current and future consumption depends upon the preferences of the society.

2. Part c is worth 1 point; parts a, b, d and e are worth 2 points each; and part f is worth 0 points for a total of 9 points.

2a. The demand for natural gas depends upon the willingness to pay by households. The objective of the household is to maximize utility, which shows up as a willingness to buy so long as the marginal benefit is greater than or equal to the price. Note though that the marginal benefit falls as households buy more of a good, while the price stays the same. So, if the price of natural gas rises, then the marginal benefit on the last unit consumed is less than the price and households will reduce consumption. Therefore, the quantity demanded for natural gas by Northeast Ohio residents decreases when the price rises.

2b. The supply of natural gas depends upon the willingness to sell by firms. The objective of the firm is to maximize economic profits, which shows up as a willingness to sell so long as the marginal revenue or price is greater than or equal to the marginal cost. Note though that the marginal cost rises as firms produce more of a good, while the price stays the same. So, if the price of natural gas rises, then the marginal cost on the last unit produced is less than the price and firms will raise production. Therefore, the quantity supplied of natural gas by Northeast Ohio gas suppliers increases when the price rises.
2c. The equilibrium price is $5.00 per MCF. This is the only equilibrium price because this is the point where the quantity supplied equals the quantity demanded. Other prices will create either a shortage or a surplus and thus force the price towards $5.00 per MCF.

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2e. At $4.00 per MCF, Northeast Ohio residents demand 55 million MCFs of natural gas, while Northeast Ohio gas suppliers supply 40 million MCFs of natural gas. Hence, only 40 million MCFs of natural gas will be bought and sold.

2f. The price ceiling would hurt Northeast Ohio residents by creating a deadweight loss. A deadweight loss is a situation in which the marginal benefit exceed the marginal cost on the last unit consumed. See the diagram above.
3. Parts a and b are worth 3 points each, while parts c and d are worth 2 points each for a total of 10 points.

3a. After the onset of cold weather, Northeast Ohio residents demand more natural gas at each price (a rightward shift in the market supply curve). Supply, however, stays the same. At the initial price, there is now a shortage of gas (quantity demanded exceeds quantity supplied) which drives the price of natural gas up. The increase in price causes supply to increase (movement along the supply curve, not a shift in the supply curve) until a new equilibrium is reached where quantity supplied equals quantity demanded.

Retail Natural Gas Market after Wholesale Price Increase
3b. After the increase in wholesale prices, Northeast Ohio gas suppliers supply less gas at each price (a leftward shift in the market supply curve). Demand, however, stays the same. At the initial price, there is now a shortage of gas (quantity demanded exceeds quantity supplied) which drives the price of gasoline up. The increase in price causes demand to decrease (movement along the demand curve, not a shift in the demand curve) until a new equilibrium is reached where quantity supplied equals quantity demanded.

Retail Natural Gas Market after Wholesale Price Increase

3c. Total revenue is defined as price times quantity. At the initial equilibrium, total revenue is 25 million. At the new equilibrium, total revenue is 27 million. Therefore, total revenue increases by 2 million in part b. Greater total revenue does not necessarily mean gas suppliers are earning higher economic profits this winter since wholesale gas prices have risen.

3d. Given that consumption of natural gas has increased this winter, the theory in part a seems more plausible since it predicts that the equilibrium quantity would increase.