Economics 101
Answers to Homework #4
Fall 2009
Due 11/11/2009 before lecture

Directions:
- The homework will be collected in a box before the lecture.
- Place your name, TA name and section number on top of the homework (legibly).
- Late homework will not be accepted.
- It is essential that you do the homework; you can work with others but you must write up the solutions yourself.
- Please show your work.

1. Derive a demand curve.

James is at the University Book Store. He needs some ring binders and highlighter pens. The following table <Table 1> shows the total utility that James gets from using ring binders.

<Table 1>

Number of ring binders	Total Utility	Marginal Utility
0	0	---
1	32	
2	60	
3	80	
4	90	

a. Calculate the marginal utility of using each unit of ring binders.

Ans.

Number of ring binders	Total Utility	Marginal Utility
0	0	---
1	32	32
2	60	28
3	80	20
4	90	10

The following table <Table 2> shows the marginal utility that James gets from using each unit of highlighter pens.

<Table 2>

Number of highlighter pens	Total Utility	Marginal Utility
0	0	---
1		15
2		14
3		13
4		12
5		11
6		10
7		9
8		8

b. Complete <Table 2> by calculating his total utility.

Ans.

Number of highlighter pens	Total Utility	Marginal Utility
0	0	---
1	15	15
2	29	14
3	42	13
4	54	12
5	65	11
6	75	10
7	84	9
8	92	8

c. Suppose that James has an income of $24 that he can spend on buying ring binders and highlighter pens. The price of one ring binder is $8 and the price of one highlighter pen is $4. If he spends all of his income buying ring binders and highlighter pens, which consumption bundles are affordable to him? Answer this question by completing <Table 3> below.

<Table 3>

Price of a ring binder	Price of a highlighter pen	Number of ring binders	Number of highlighter pens	Income
$8	$4	0		$24
$8	$4	1		$24
$8	$4	2		$24
$8	$4	3		$24

Ans.

Price of a ring binder	Price of a highlighter pen	Number of ring binders	Number of highlighter pens	Income
$8	$4	0	6	$24
$8	$4	1	4	$24
$8	$4	2	2	$24
$8	$4	3	0	$24

d. From <Table 1> to <Table 3>, find the number of ring binders and highlighter pens that James consumes to maximize his utility under the budget constraint described in (c). (Hint: Diamond-Water paradox)

Ans.

He will consume 2 ring binders and 2 highlighter pens, since at this consumption bundle (2 ring binders, 2 highlighter pens) the ratio of prices of the two goods (Price of a ring binder)/(Price of a highlighter pen) is equal to the ratio of the marginal utilities (Marginal Utility of a ring binder)/(Marginal Utility of a highlighter pen).

e. Suppose that the price of a highlighter pen decreases to $2. Holding everything else constant, how many ring binders and highlighter pens will James choose to consume? (Hint: It will be convenient to complete following table.)

Price of a ring binder	Price of a highlighter pen	Number of ring binders	Number of highlighter pens	Income
$8	$2	0		$24
$8	$2	1		$24
$8	$2	2		$24
$8	$2	3		$24

Ans.

Price of a ring binder	Price of a highlighter pen	Number of ring binders	Number of highlighter pens	Income
$8	$2	0	12	$24
$8	$2	1	8	$24
$8	$2	2	4	$24
$8	$2	3	0	$24

When he consumes 1 ring binder and 8 highlighter pens, the ratio of prices is equal to the ratio of marginal utilities.

f. Assume that James' demand function for highlighter pens is linear. Then from the results in (d) and (e), derive his demand function for highlighter pens.

Ans.

From (d) and (e), we've found that James would choose (Quantities of highlighter pens, Price of highlighter pens) = (2, 4) and (8, 2) holding everything else constant. Since the demand function is assumed to be linear, his demand function is P = (-1/3)Q + 14/3.

2. Budget Lines and Indifference Curves.

A. Suppose Paul has an income of $12 to buy sandwiches and coffee. The price of a sandwich is $2 and the price of a cup of coffee is $3.

a. Draw Paul's budget line (BL1) using the information above. Put sandwiches on the x-axis and coffee on the y-axis. Derive the equation for his budget line. It is known that Paul consumes 3 sandwiches and 2 cups of coffee under this budget constraint. Label this consumption bundle as point A and draw the bowed-inward indifference curve, IC1, passing through the point A.

b. Suppose that the price of a sandwich increases to $3. Holding everything else constant, draw the new budget line (BL2) on the same graph you used in (a). Derive the equation for the new budget line. It is known that Paul will choose 2 sandwiches and 2 cups of coffee under the new budget constraint. Label this point as point B and draw the bowed-inward indifference curve, IC2, passing through the point B. (Caution: Indifference curves should not cross each other!)
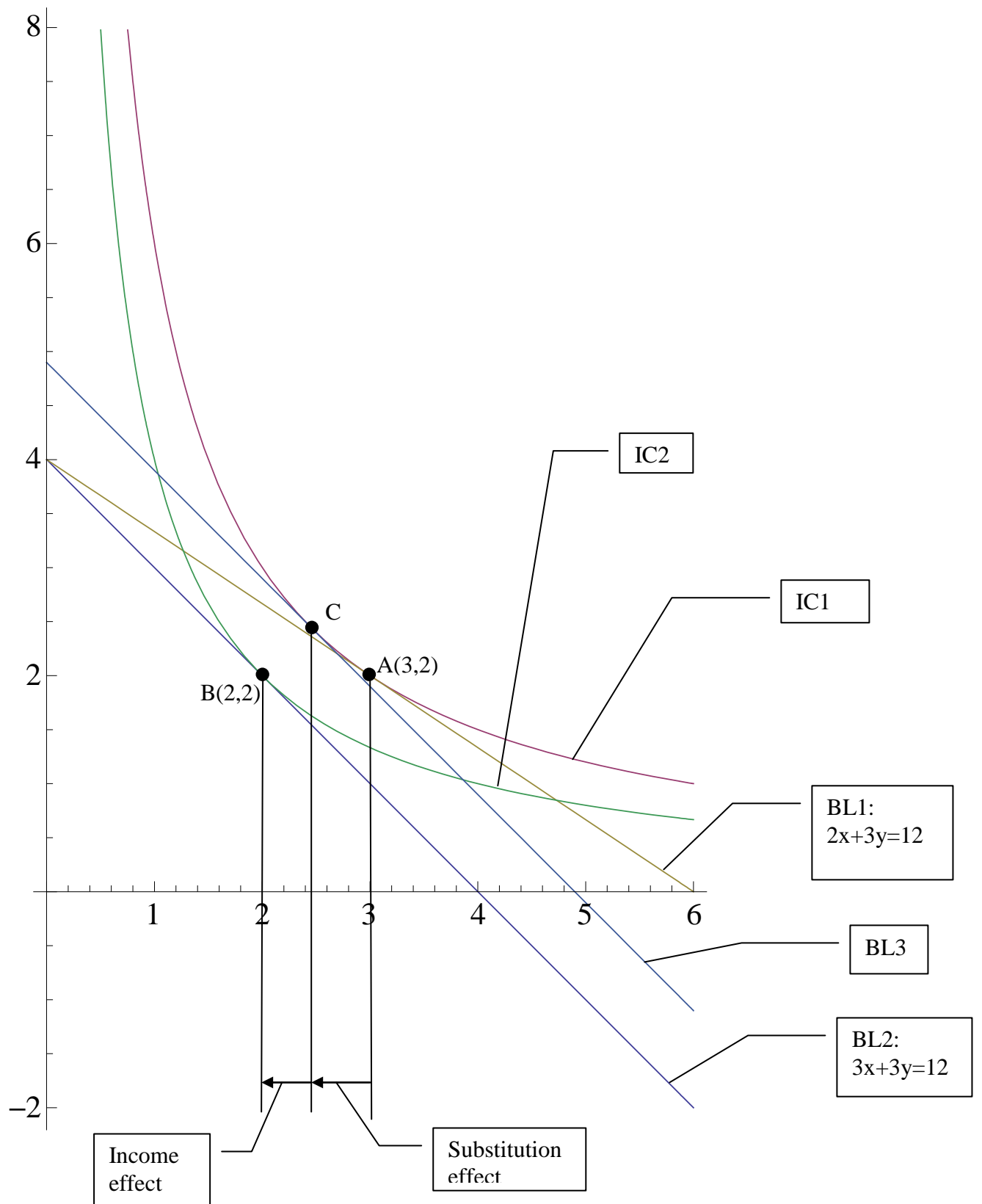
c. There are two reasons why Paul decreases his demand for sandwiches when the price of sandwiches increases. (1)The first reason is because sandwiches become relatively expensive compared to coffee; he will substitute his demand for sandwiches for demand for coffee which is relatively cheaper. (2)The second reason is because his real income decreases due to the increase in the price of a sandwich; he can't afford the initial consumption bundle after the increase in the price of a sandwich. Which one is the explanation for income effects and which one is the explanation for substitution effects?

Ans.

(1) Substitution effect, (2) Income effect.

d. Now we want to separate these two effects and see how demand for sandwiches changes due to each effect. Draw an imaginary budget line, say BL3, which is parallel to BL2 and tangent to IC1. And illustrate the substitution and income effects in sandwich consumption due to the change in the price of sandwiches on your graph.
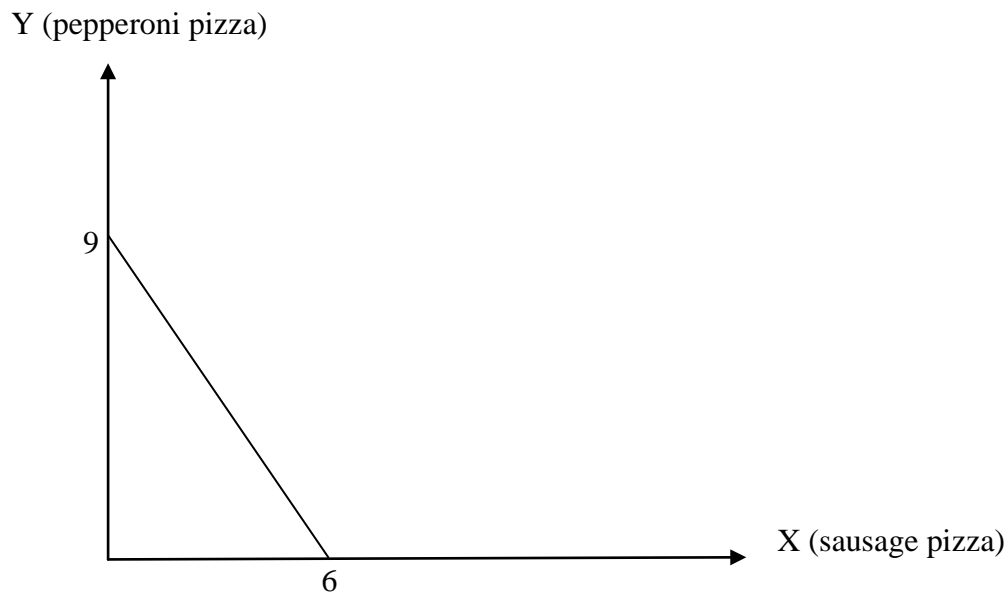
Ans.

IC2

IC1

BL1:
2x+3y=12

BL3

BL2:
3x+3y=12

C

A(3,2)

B(2,2)

Income
effect

Substitution
effect

B. Michael likes to eat pizza. He receives 2 units of utility for each slice of pepperoni pizza and 3 units of utility for each slice of sausage pizza.

a. Draw the indifference curve corresponding 18 units of utility for Michael. Put sausage pizza on the x-axis and the pepperoni pizza on the y-axis.
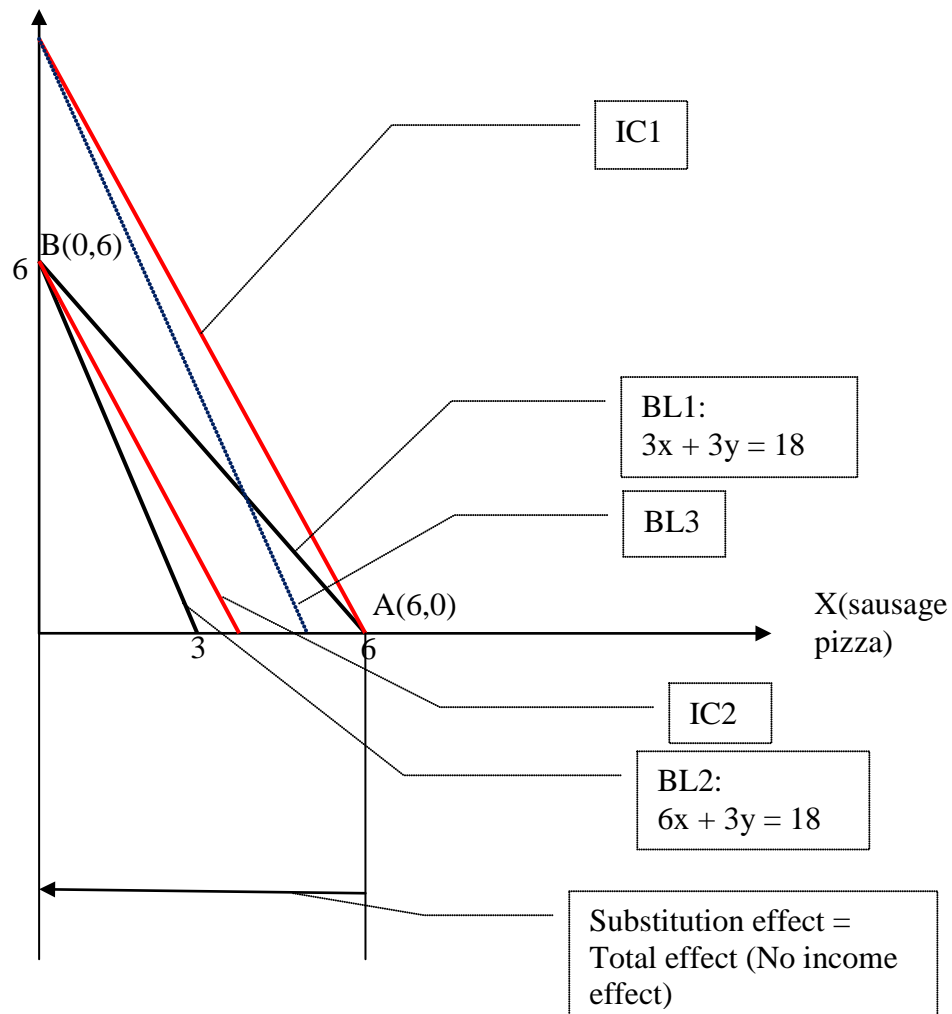
b. Suppose that each slice of both pepperoni and sausage pizza costs $3. Furthermore, assume Michael has an income of $18 to spend on pizza. Draw the budget line (BL1) using this information. Derive the equation for the budget line. Under this budget constraint, how many slices of sausage and pepperoni pizza does he consume to maximize his utility? Label this consumption bundle as point A and draw the indifference curve (IC1) passing through the point A.

c. Suppose that the price of a slice of sausage pizza increases to $6. Holding everything else constant, draw the new budget line (BL2) on the same graph you used in (b). Derive the equation for the new budget line. Under the new budget constraint, how many slices of sausage and pepperoni pizza does he consume to maximize his utility? Label this consumption bundle under the new budget constraint as point B and draw the indifference curve (IC2) passing through the point B.

d. Draw an imaginary budget line (BL3) parallel to the new budget line (BL2) and make it touch the initial indifference curve (IC1) at the lowest possible income level. Calculate and show the income and substitution effects in the consumption of sausage pizza due to the change in the price of sausage pizza. (Caution: There will be lots of lines. Don't be confused! And it is very important to verify the slope of each line and draw it appropriately.)
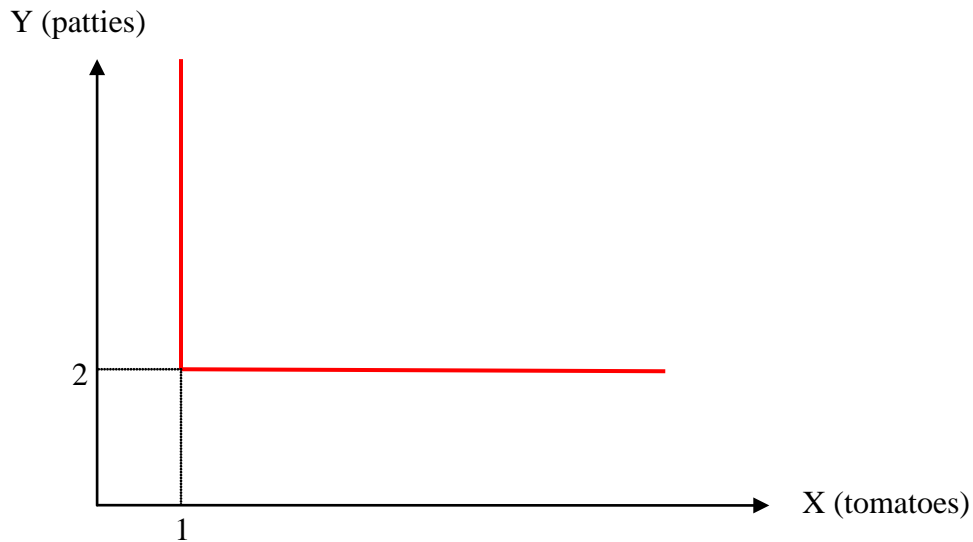
Ans.

IC1

B(0,6)

6

BL1:
3x + 3y = 18

BL3

A(6,0)

X(sausage pizza)

3   6

IC2

BL2:
6x + 3y = 18

Substitution effect = Total effect (No income effect)

C. Nathan likes to eat hamburgers he makes. He always uses two patties and one tomato to make one hamburger. However, he doesn't like patties or tomatoes by itself. That is, 2 patties and 2 tomatoes are as good as 2 patties and 1 tomato to Nathan.

a. Draw the indifference curve corresponding 1 hamburger to Nathan. Put tomatoes on the x-axis and patties on the y-axis.
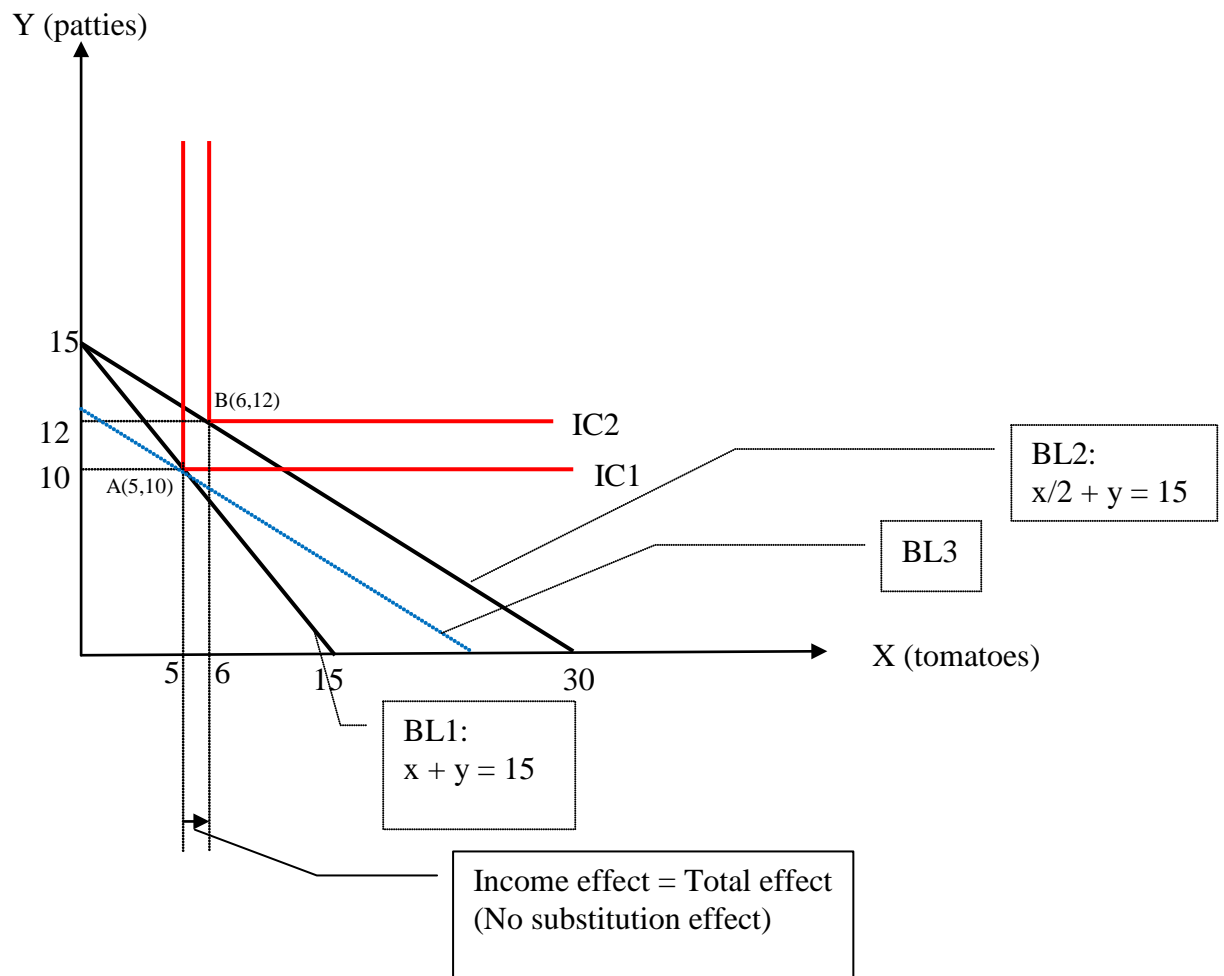
Ans.

Y (patties)

2

1

X (tomatoes)

b. Suppose that each patty costs $1 and each tomato also costs $1. Furthermore, assume Nathan has an income $15 to spend in making hamburgers every week. Draw the budget line (BL1) using this information. Derive the equation for the budget line. How many patties and tomatoes does he consume to maximize his utility? Label this consumption bundle as point A and draw the indifference curve (IC1) passing through the point A. (Hint: At the optimal consumption bundle, he always chooses 1 tomato and 2 patties rather than 2 tomatoes and 2 patties even though these two consumption bundles give him one hamburger. Why?)

c. Suppose that the price of tomatoes decrease to $.5. Holding everything else constant, draw the new budget line (BL2). Derive the equation for the new budget line. How many patties and tomatoes does he consume to maximize his utility under the new budget constraint? Label this new consumption bundle as point B and draw the indifference curve (IC2) passing through the point B.

d. Draw an imaginary budget line (BL3) parallel to the new budget line (BL2) and make it touch the initial indifference curve (IC1) at the lowest possible income level. Calculate and show the income and substitution effects in the consumption of tomatoes due to the price change in tomatoes.

Ans.

Y (patties)

B(6,12)

IC2

IC1

15

12

10

A(5,10)

BL2:
x/2 + y = 15

BL3

5 6   15   30

X (tomatoes)

BL1:
x + y = 15

Income effect = Total effect
(No substitution effect)

3. Production Cost

The following table gives cost information for a firm. Assume that labor is paid a constant wage and capital is paid a constant price, i.e., our firm is a price-taker both in the labor and capital markets.

L	K	Q	VC	FC	TC	AVC	AFC	ATC	MC	MPL
0	15	0			300	---	---	---	---	---
1	15	5			500					
2	15								10	
3	15									25
4	15									30
5	15							13		
6	15									5

a. Complete the above table with specific numbers.

Ans.

L	K	Q	VC	FC	TC	AVC	AFC	ATC	MC	MPL
0	15	0	0	300	300	---	---	---	---	---
1	15	5	200	300	500	40	60	100	40	5
2	15	25	400	300	700	16	12	28	10	20
3	15	50	600	300	900	12	6	18	8	25
4	15	80	800	300	1100	10	3.75	13.75	6.6	30
5	15	100	1000	300	1300	10	3	13	10	20
6	15	105	1200	300	1500	11.4	2.8	14.2	40	5

b. At what level of output is ATC at its minimum?

Ans. When Q = 100, ATC attains its minimum.

c. At what level of labor usage does the law of diminishing returns first occur?

Ans. When hiring 5th unit of labor, the marginal productivity of labor first increases at a diminishing rate.

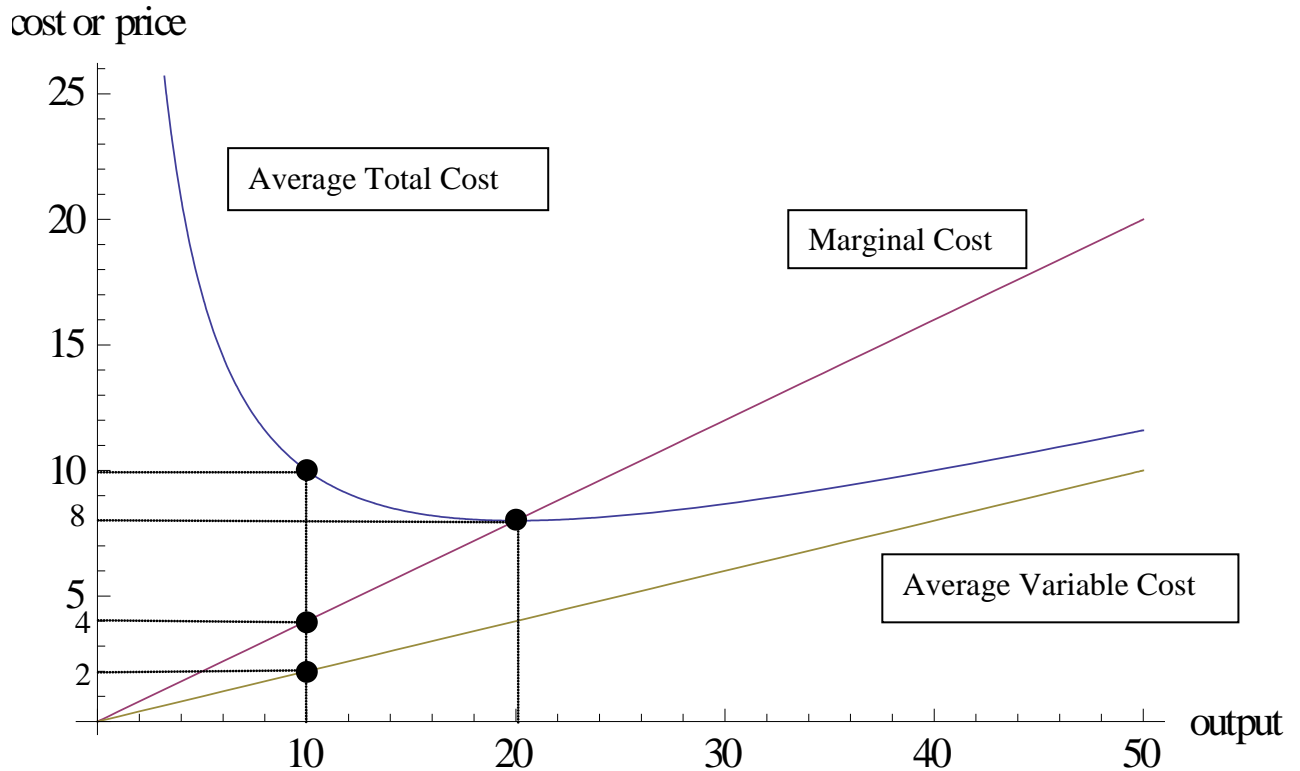d. At what level of output does marginal cost attain its minimum?

Ans. When Q = 80, the marginal cost attain its minimum.

e. When output is equal to zero units, why does the firm still incur costs in the short run? Explain your answer.

Ans.   In the short run, the firm cannot get rid of its capital instantaneously. So even though the output level is zero, the firm should pay its fixed costs.

4. Perfect Competition

The figure below shows three curves, MC, ATC and AVC, for the firm in a perfectly competitive market. In this market, the price of the good is $4. Use the information given in the figure to answer the following questions.

cost or price

a. In the short run, will the firm shut down the production when price equals $4? Explain your answer.

Ans. No. Although the price of $4 is lower than ATC, it is higher than AVC. Thus, the firm will not shut down its production.

b. If the firm does not shut down in the short run when price equals $4, will the firm make a positive economic profit or a negative economic profit? What is the value of the firm's economic profit when price equals $4?

Ans. When P=$4, the firm will produce 10 units of output. Thus
                Profit = TR – TC = $4 * 10 - $10 * 10 = - $60.

c. If the firm does not shut down in the short run when price equals $4, what will be the firm's production level? Calculate the firm's fixed cost and variable cost at this level of production.

Ans. When P = $4, the firm will produce 10 units of output. So
Total Cost = (ATC) * (Production level) = $10 * 10 = $100
Variable Cost = (AVC) * (Production level) = $2 * 10 = $20
Fixed Cost = Total Cost – Variable Cost = $80

d. What is the break-even price for the firm? What is the shut-down price for the firm?

Ans. The break-even price = $8
         The shut-down price = $0