UTILITY ANALYSIS AND INDIFFERENCE CURVE ANALYSIS

Introduction to Consumer's Equilibrium

- A consumer is one who buys goods and services for satisfaction of wants.
- The objective of a consumer is to get maximum satisfaction from spending his income on various goods and services, given prices.
- Two approaches are used for getting an answer to this question. These are:
- Utility approach (Cardinal Approach)
  Cardinal Utility: When utility is expressed in exact units
  Ordinal Utility: When utility is expressed in ranks
- Indifference curve approach (Ordinal Approach)
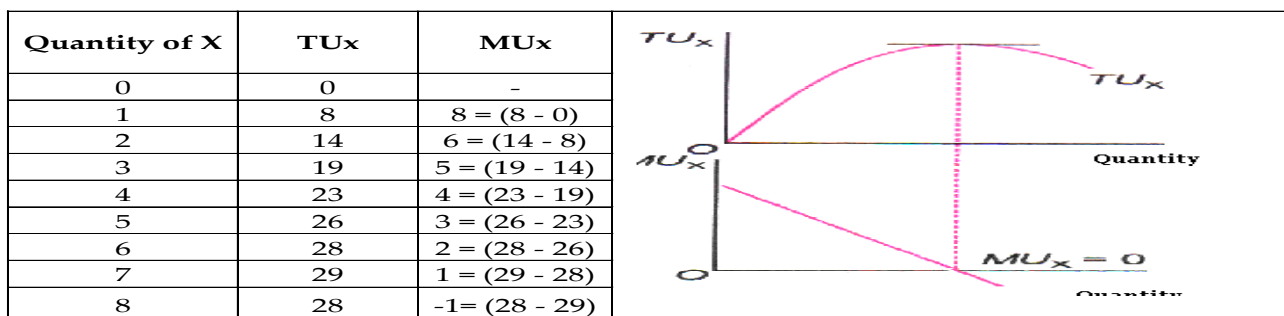
Utility Approach
LAW OF DIMINISHING MARGINAL UTILITY (DMU)

- The marginal utility approach is based on the concept of the law of diminishing marginal utility (DMU). Before stating the law, basic facts about utility concepts should be explained.
- **Utility:** Utility does not mean usefulness. The term utility refers to the want satisfying power of a commodity. It means expected satisfaction to a consumer. Utility differs from person to person, place to place, and time to time. Utility is a cardinal concept *i.e.,* it can be measured as *utils.*
- **Total Utility (TU)**: It is the total satisfaction or utility that a consumer derives from the consumption. *TU* can be obtained by the sum of marginal utilities
- **Marginal Utility (MU):** It is addition made to the total utility as consumption is increased by one more unit of the commodity.

$$MU_n = TU_n - TU_{n-1}$$

The law of diminishing Marginal Utility states that **as the consumer has more and more of a commodity the marginal utility of the commodity falls**.

According to the law, TU increases but at a decreasing rate and MU falls.

Quantity of X	TUx	MUx	
0	0	–	
1	8	8 = (8 - 0)	
2	14	6 = (14 - 8)	
3	19	5 = (19 - 14)	
4	23	4 = (23 - 19)	
5	26	3 = (26 - 23)	
6	28	2 = (28 - 26)	
7	29	1 = (29 - 28)	
8	28	–1= (28 - 29)	

- When no unit of X is consumed, TU is zero and MU is maximum
- As the consumer has more of the good, the TU increases and the MU gradually diminishes

- When TU is maximum, MU is zero.
- A rational consumer will stop to consume further because TU will decline and MU will become negative (disutility).

CONSUMER'S EQUILIBRIUM
- **Consumer's equilibrium is defined as the level of consumption where consumer gets maximum satisfaction**
- **One Commodity Case (when consumer consumes only one commodity)**
- Given that utility is a fundamental concept, the MU from different units of a good X can be measured in terms of money. (₹1 = 1 util)

Quantity of X	Px (in Rupees)	MUx (in Rupees)	
1	5	8	MU>PRICE
2	5	6	MU>PRICE
3	5	5	MU=PRICE
4	5	4	MU<PRICE
5	5	3	MU<PRICE

- Px = ₹5 and the consumer buys less than 3 units (units 1 and 2) then his MUx> Px, the consumer buys more.
- If the consumer buys more than 3 units of X (units 4 and 5) then MUx < Px, the consumer will not buy more units of the commodity.
- A consumer will buy that quantity of the good where the **MU of the good is equal to the price (MU = Price). Marginal utility of the good= Utility of the price paid.**

$$\frac{MUx}{Px} = MU \; money$$

CONSUMER'S EQUILIBRIUM
- **Two Commodities Case (Law of Equi-marginal utility):** Assuming that the consumer consumes only two goods, the conditions required by a consumer to maximise his utility for two commodities X and Y is given as:
  (a) $MU_x = P_x$ **(MU money)**   **(1)**
  $MU_y = P_y$ **(MU money)**   **(2)**
  (b) **MU diminishes with further consumption**
  Divide equation (1) by (2), we get

$$\frac{MUx}{Px} = \frac{MUy}{Py}$$

The consumer gets the same satisfaction from both the commodities.

A consumer will so allocate his expenditure so that the utility gained from the last rupee spent on each commodity is equal. A consumer buys each commodity up to the point at which MU per

rupee spent on it is the same as the MU of a rupee spent on another good. The condition of consumer's equilibrium in case of 2 goods X and Y can be written as:

$$\frac{MUx}{Px} = \frac{MUy}{Py} = MU\ of\ a\ rupee\ Spent\ on\ a\ good$$

- When this condition is not met, a consumer will adjust the consumption of good X and Good Y in such a way the consumer achieves equilibrium
- When $\frac{MUx}{Px} > \frac{MUy}{Py}$ the consumer will increase consumption of good X and decrease consumption of Good Y till equilibrium is reached
- When $\frac{MUx}{Px} < \frac{MUy}{Py}$ the consumer will increase consumption of good y and decrease consumption of Good X till equilibrium is reached
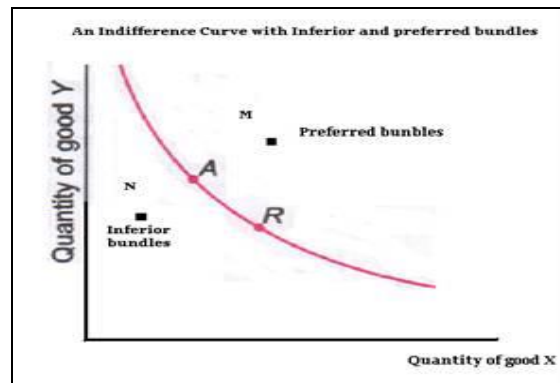
INDIFFERENCE CURVE APPROACH

Indifference Curve

An **indifference curve** shows different combinations of goods that yield the same level of utility or satisfaction to the consumer.

An indifference curve is downward sloping convex to the origin.
- ▣ All points like points A and R on an indifference curve yield same level of satisfaction.
- ▣ Any point below the indifference curve (point N) shows an inferior bundle.
- ▣ A higher indifference curve shows a greater amount of satisfaction and a lower one lesser satisfaction

Indifference Map

A family of indifference curves is called an **Indifference Map.** It gives a complete picture of a consumer's scale of preference for two goods. Moving away from the origin moves the consumer to higher levels of utility. Arrow indicates that bundles on higher indifference curves are preferred by the consumer.
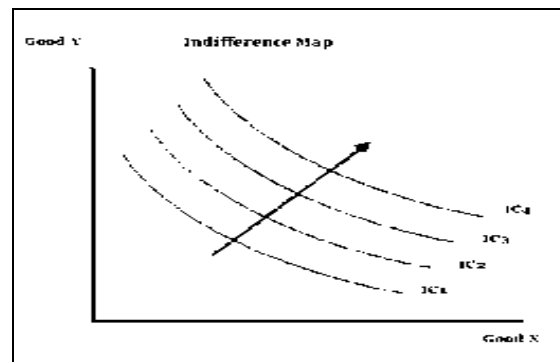
Assumptions of Indifference curve

- ▣ **Rationality.** The consumer is assumed to be rational. He aims at maximising his benefits from consumption, given his income and prices of the goods.
- ▣ **Ordinality**. In indifference curve analysis, utility is an ordinal concept. Consumer can order or rank the subjective utilities. A consumer has a scale of preference as between different combinations of the two goods. For example, it there are two goods X and three possibilities exist for the consumer:

  X is preferred to Y

  Y is preferred to X

  X and Yare equally preferred
- ▣ **Diminishing Marginal Rate of Substitution**. The slope of indifference curve is called Marginal Rate of Substitution (MRS) of X for Y. MRS is defined as the amount of good Y the consumer is willing to give up to consume an additional unit of good X, while leaving total utility unchanged.
- ▣ **Consistency of Choice**. Consumer is consistent in his choice. It means that if good X is preferred over good Y in one time period, then consumer will not prefer Y over X in another time period.
- ▣ **Transitivity of Choice**. If good X is preferred to good Y and good Y is preferred to good Z, then good X is preferred to good Z.
- ▣ **Monotonic Preference**. A consumer's preferences are monotonic if and only if between any two bundles, the consumer prefers the bundle which has more of at least one of the goods and no less of the other good as compared is the other bundle.

Preferences of Consumer

- ▣ Suppose a consumer has ₹10 and both goods X and Y are priced at ₹2 and are available in integer units.

  (a) The bundles that this consumer can afford to buy

  (0, 0), (0, 1), (0, 2), (0, 3), (0, 4), (0, 5), (1, 0), (1, 1), (1, 2), (1, 3), (1, 4), (2,0), (2, 1), (2, 2), (2,3), (3, 0), (3, 1), (3,2), (4,0), (4, 1) and (5,0).

  (b) The bundles that cost exactly ₹10

  (0,5), (1,4), (2, 3), (3,2), (4, 1), (5,0)

 (c) Give two bundles that this consumer cannot afford to buy. (3, 3), (4, 2)

Shape of Indifference Curve

- • **Downward Sloping to the Right**: Downward sloping curve expresses that if the quantity of one good is decreased then the quantity of the other good has to be increased with a new bundle equivalent to the first. It is based on the assumption that both the goods give the consumer positive satisfaction or monotonic preferences
- • **Convex to the Origin**. The slope of an indifference curve is called Marginal Rate of Substitution of X for Y symbolically denoted as MRS_{xy}. **It is defined as the amount of Y that a consumer is willing to substitute for an additional unit of X**. The slope measures the substitution ratio between the two goods.

$$\text{Slope of indifference curve} = \frac{\Delta Y}{\Delta X} = MRS_{xy}$$

Properties of indifference curve

1. **Indifference curve slopes downwards from left to right (i.e., negatively sloped):** This is due to Diminishing Marginal Rate of Substitution

2. **Higher indifference curve gives greater level of utility:** An indifference curve to the right gives higher level of satisfaction. It is because a higher indifference curve consists of combinations with more of good X, or more of good Y, or more of both. The underlying assumption here is the assumption of monotonic preference

3. **Two indifference curves never intersect each other:** Two indifference curves intersecting each other will lead to conflicting results. If two different indifference curves intersect each other, then at the point of intersection, utility from two different consumption bundles from the two Indifference curve will be same. To explain this, we assume that two indifference curves intersect each other as shown in the figure given below. As points A and B lie on the same indifference curve IC1, utilities derived from combination A and combination B will give the same level of satisfaction. Similarly, as points A and C lie on the same indifference curve IC2, utility derived from combination A and combination C will give the same level of satisfaction. From this, it follows that utility from point B and from point C will also be the same. But this is clearly an absurd result, as on point B, the consumer gets more units of good Y with the same quantity of good X. So consumer is better off at point B than at point C.
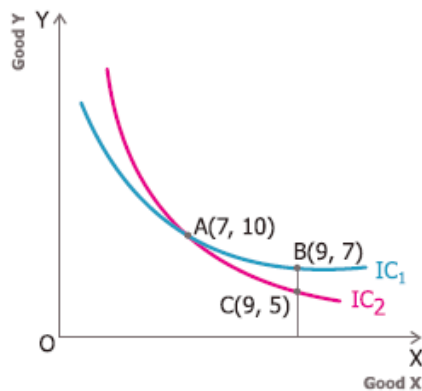

4. **A typical indifference curve is strictly convex to the origin:** It is strictly convex because when a consumer moves downwards along the indifference curve, Marginal Rate of Substitution (MRS) between the two goods continuously falls due to the operation of the law of diminishing marginal utility.

Budget Line

- ▣ **Budget Line.** It is defined as all possible combinations of the two goods that a consumer can buy, given income and prices. It is mathematically expressed as $X_1P_1 + X_2P_2 = M$
- ▣ **Budget Set**. It is a set of bundles available to the consumer.
- ▣ **Budget Constraint**. It shows that a consumer can choose any bundle as long as it costs less or equal to the income. It is mathematically expressed as $X_1P_1 + X_2P_2 \leq M$

- ⊡ **Slope of Budget Line**. Slope of the budget line measures the amount of change in good Y required per unit change in good X along the budget line.


A Consumer's Budget Line and its Slope

Budget Line

$X_1P_1 + X_2P_2 = M$

Slope of Budget line $= \dfrac{\Delta Y}{\Delta X}$
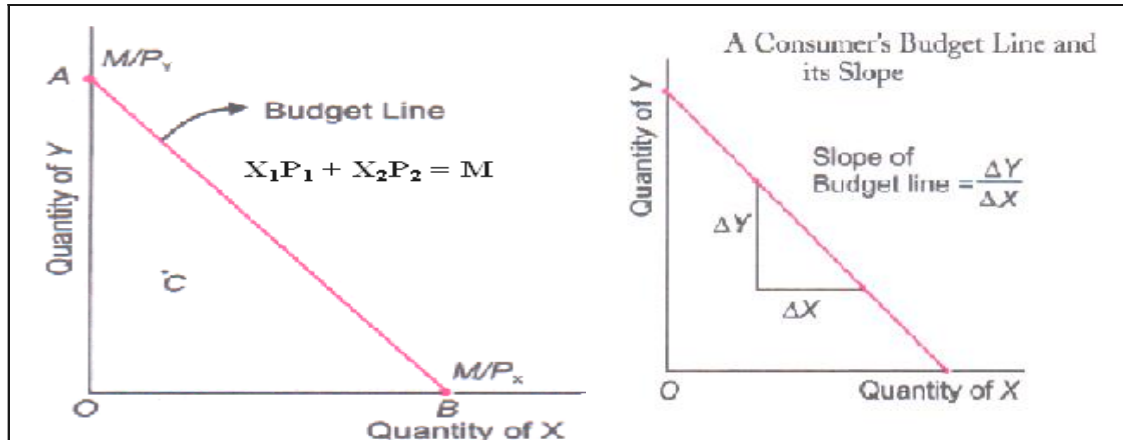
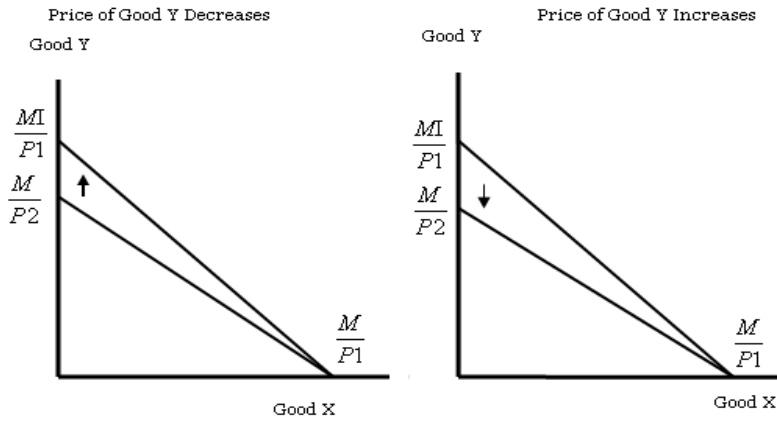**Shifts in Budget Line**

Change in Price

- ▣ **Price of good X falls**. Then new budget line shift right toward X – axis becoming flatter. The new budget line AB_1 shows that with a fall in price of X_1, consumer can buy more of X_1. The flatter budget line means price of good X_1 is lesser.
- ▣ **Price of good X rises**. The new budget line AB_1 will shift left inwards to x-axis. AB_1 shows that less of good X will be demanded.

<u>When Price of Good X Increases</u>   <u>When price of good X Decreases</u>
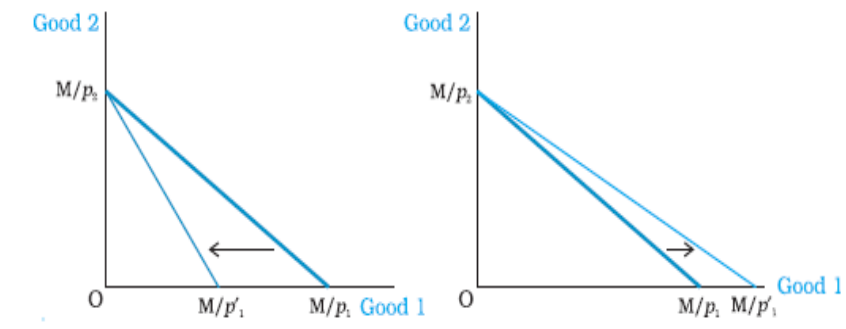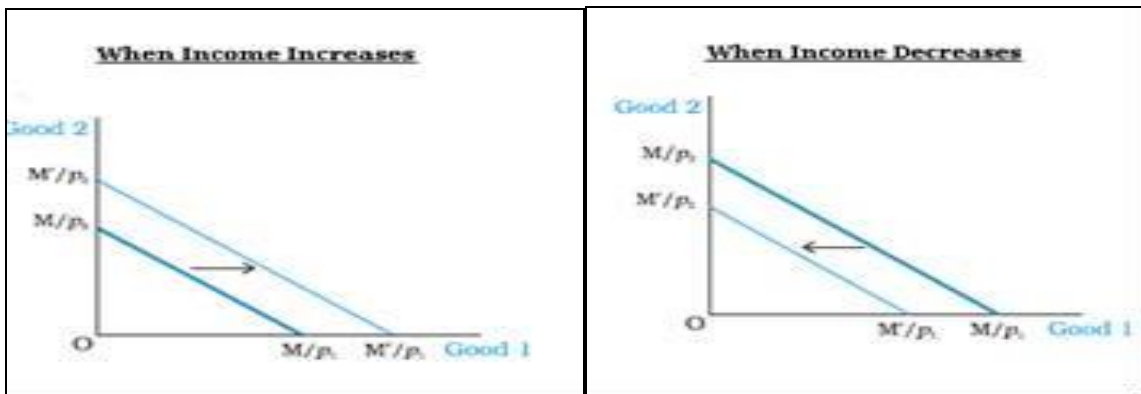

- ▣ **Price of good Y falls**: The new budget line A_1B shows that consumer will buy more of good Y. Budget line AB will shift upward to A_1B.
- ▣ **Price of Good y rises**: The new budget line A_1B shows that consumer will buy less of good Y. Budget line AB will shift downward to A_2B

Good Y   Good Y

$\dfrac{MI}{P1}$

$\dfrac{M}{P2}$ ↑

$\dfrac{MI}{P1}$

$\dfrac{M}{P2}$ ↓

$\dfrac{M}{P1}$

$\dfrac{M}{P1}$

Good X   Good X

Budget line and Income change

▣ **Change in Income:** Money income of the consumer increases then the new budget line will make parallel shift outward. The new budget line A_1B_1 is parallel to AB. The slope of both the budget lines is same, because prices have not changed. The consumer can buy more of both the goods with increased income. When income falls, budget line will make parallel shift inward.

When Income Increases

Good 2

M″/p₁

M/p₁

O   M/p₁   M″/p₁   Good 1

When Income Decreases

Good 2

M/p₁

M″/p₁

O   M″/p₁   M/p₁   Good 1

Consumer's Equilibrium or Optimal Choice of Consumer

▣ A consumer is in equilibrium when he maximises his utility, given income and market prices. **Equilibrium is attained when the consumer reaches the highest possible indifference curve** given his budget constraint. **Consumer's equilibrium point must lie on the budget line and must give the most preferred combination of goods and services**.

Consumer's Equilibrium from Indifference Curve Approach

Consumer's optimum

Quantity of Y

A

Y* ·······E

IC4

IC3

IC2

F

IC1

O   X*   B   Quantity of X
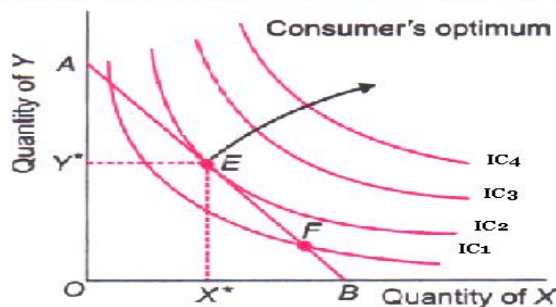
▣ IC1, IC2, IC3 and IC4 are the preference of a consumer by an indifference map. AB is the budget line. At point E, the consumer's budget line is tangent to the indifference curve IC2.

It is the point of consumer's equilibrium. If the consumer moves away from point E to any other (point F) MRS is less than the price ratio. The optimum point would be always located on the budget line. Points to the right of E are desirable but not attainable. Thus, point E shows the maximum satisfaction of the consumer when X* units of good X and Y* units of good Yare consumed

Consumer'sEquilibrium is at the point where slope of Indifference curve = slope of Budget line

$$MRS_{XY} = \frac{Px}{Py}$$

Revision Questions

1. Explain the concept of 'marginal utility' with the help of a numerical example. (3 marks)
2. Explain the relationship between total utility and marginal utility with help of an example. (3 marks)
3. Explain the law of diminishing marginal utility with the help of a total utility schedule. (3 marks)
4. Explain the conditions of consumer's equilibrium in case of a single good. Use a marginal utility schedule. (4 marks)
5. A consumer consumes only two goods. What are the conditions of consumer's equilibrium in the Utility Approach? Explain the changes that will take place when the consumer is not in equilibrium. (6 marks)
6. Distinguish between Budget set and Budget line. What can lead to change in budget set? (3 marks)
7. What is a budget line? Explain why it is a straight line. Why it is negatively sloped? When can it shift to the right? (4 marks)
8. What are monotonic preferences? Explain why is an indifference curve
   (i) Downward sloping from left to right and
   (ii) Convex. (4 marks)
9. Explain why an indifference curve to the right shows higher utility level. (3 marks)
10. State and explain three characteristics/properties of indifference curves. (6 marks)
11. What are the conditions of consumer's equilibrium under the indifference curve approach? What changes will take place if the conditions are not fulfilled to reach equilibrium? Use diagram. (6 marks)
12. A consumer consumes only two goods X and Y and is in equilibrium. If price of good Y rises, what will be the reaction of the consumer? Explain. (3 marks)
13. What changes will take place in total utility when: (3 marks)
    (a) Marginal utility curve remains above X-axis?
    (b) Marginal utility curve touches X-axis?
    (c) Marginal utility curve lies below X-axis?
14. Under what situations there will be parallel shift in budget line? (3 marks)
15. Fill in the gaps in the following equations : (4 marks)
    (i) MRS =?
    (ii) ? = SMU

(iii)   MUn = TUn –?
(iv)   Ed = DQ/? × P/Q

Numerical Questions

1. Given the utility schedule of good X, whose price is ₹3 per unit. Assuming that 1 util = ₹1, state how many units should a consumer buy to maximise his satisfaction. Give reasons.

Quantity	Total Utility (utils)
1	8
2	15
3	20
4	23
5	25

2. The marginal utility schedule for good X and Y are given below. Both the goods are priced at ₹1 each and income of Gauri is assumed to be ₹5. Determine, how many units of both commodities should be purchased by Gauri to maximise her total utility?

Units consumed	MUx (utils)	MUy (utils)
1	11	8
2	10	7
3	9	6
4	8	4
5	7	3
6	6	2

3. A consumer consumes only two goods X and Y. His money income is ₹50 and the prices of goods X and Y are ₹10 and ₹5 respectively. Answer the following questions:

(i)   What will be the MRSxy when the consumer is in equilibrium? Why?
(ii) Can 3X + 4Y be a utility maximising bundle? Why?
(iii) Can the consumer afford a bundle 4X + 3Y? Why

Self-Assessment Test 1

Time allowed: 1 hour   Maximum Marks: 20

1. Which of the following can be referred to as 'point of satiety'? (Choose the correct alternative) (1 mark)
    (a) Marginal Utility is negative
    (b) Total Utility is rising
    (c) Marginal utility is zero
    (d) Total Utility is falling

2. _____ measures the slope of indifference curve. (Choose the correct alternative) (1 mark)
    (a) Budget Line
    (b) Marginal Rate of Substitution
    (c) Marginal Rate of Transformation
    (d) Price Ratio

3. _____ is the equation for budget line. (Fill up the blank with correct answer) (1 mark)
4. What is ordinal utility? (1 mark)
5. What is budget set? Explain what can lead to change in budget set. (3 marks)
6. Given the price of a good, how will a consumer decide as to how much quantity to buy of that good? Explain with the help of a numerical example.   (3 marks)
7. (a) State the equation of budget line.   (1 mark)
   (b) A rational consumer is consuming only two goods, Good X and Good Y with ₹4 and ₹5 as their respective prices. Her total money income is ₹40. Answer the following questions, based on the given information:
      (i)   State the consumer's budget line equation.
      (ii) What would be the slope of the budget line? (3 marks)
8. A consumer consumes only two goods. For the consumer to be in equilibrium why must marginal rate of substitution be equal to the ratio of prices of the two goods? Explain. (6 marks)

Self-Assessment Test 2

Time allowed: 1 hour   Maximum Marks: 20

1. Total Utility is constant when Marginal Utility is _____. (Choose the correct alternative) (1 mark)
      (a) Maximum
      (b) Zero
      (c) Negative
      (d) None of these
2. If Marginal Rate of Substitution is constant throughout, the Indifference curve will be: (Choose the correct alternative) (1 mark)
      (a) Parallel to the X-axis.
      (b) Downward sloping concave.
      (c) Downward sloping convex.
      (d) Downward sloping straight line.
3. What are monotonic preferences? (1 mark)
4. Define a budget line. When can it shift to the right? (3 marks)
5. Explain the conditions consumer's equilibrium in case of a single good. Use a marginal utility schedule. (4 marks)
6. Suppose a consumer whose budget is ₹500, wants to consume only two goods, Good X and Good Y. The goods are respectively priced at ₹50 and ₹25. Answer the following questions on the basis of the given information:
      (a) State the budget equation of the consumer.
      (b) What is the slope of the budget line?
      (c) How many units can she purchase if she spends the entire ₹500 on Good X?
      (d) How many units can she purchase if she spends the entire ₹500 on Good Y, given that the price of good Y has doubled?   (4 marks)
7. A consumer consumes only two goods. Why is the consumer in equilibrium when he buys only that combination of the two goods that is shown at the point of tangency of the budget line with an indifference curve? Explain with the help of a diagram. (6 marks)