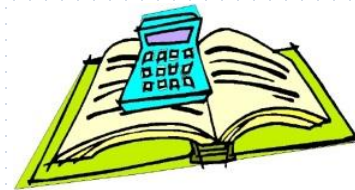


BAHATI ABDULKARIM



A'LEVEL APPLIED MATHEMATICS
FLOW CHARTS

SUITABLE FOR S.5 AND S.6



Flow Charts



Contents

- **The dry run**
- Constructing flow charts
- Newton Rapson's method with flow charts

FLOW CHARTS



A flow chart is a diagram comprising of systematic steps followed in order to solve a problem.

Shapes used

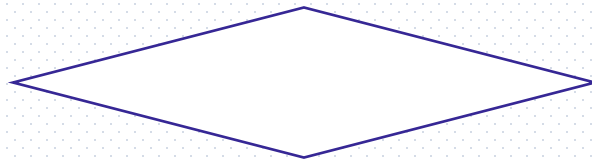
1. Start/stop



2. Operation assignment



3. Decision Statement

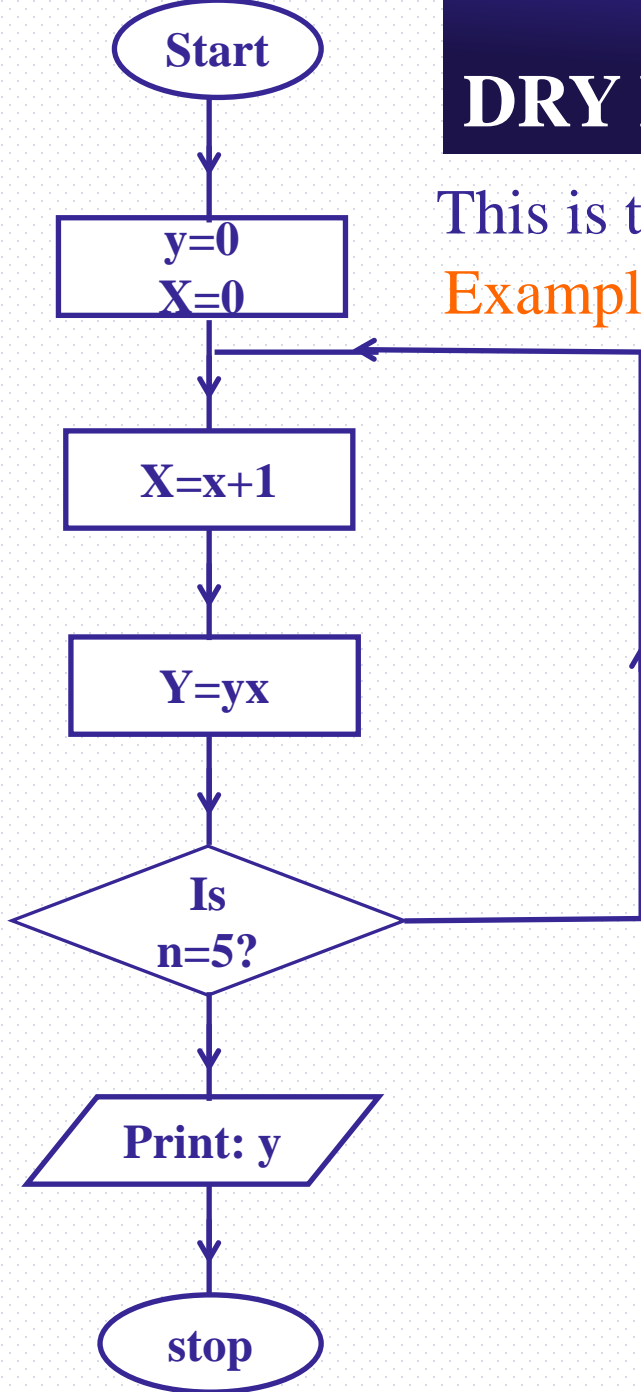


DRY RUN

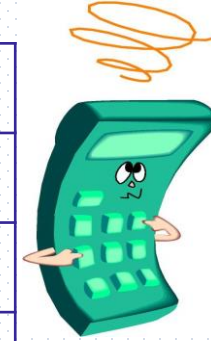


This is the method of predicting the outcome of a given flow chart using a table

Example 1: Perform a dry run and state the purpose of the flowchart



x	y
0	1
1	1
2	2
3	6
4	24
5	120
6	720



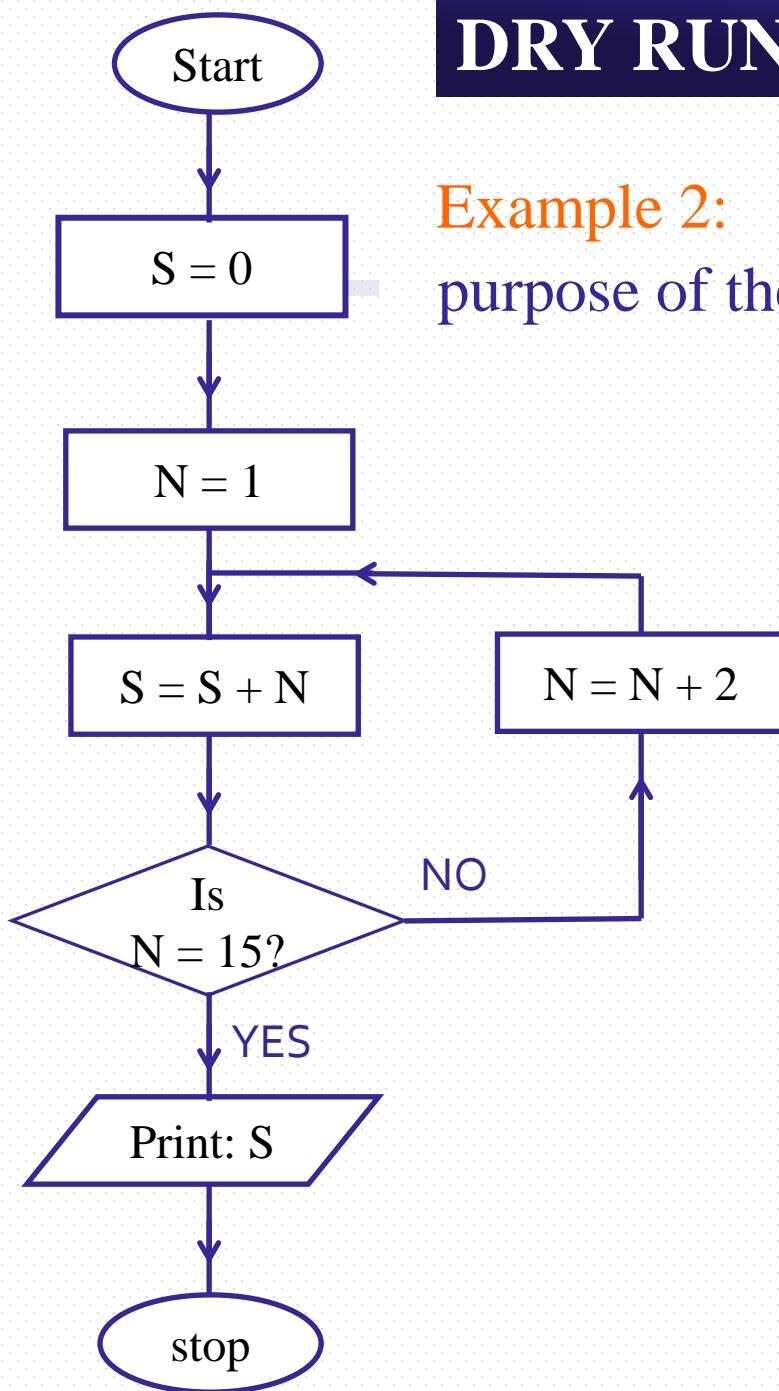
The purpose of the flow chart is to compute and print 6!

The relationship is $y = x!$

DRY RUN



Example 2: Study the flow chart below and perform a dry run and state the purpose of the flowchart



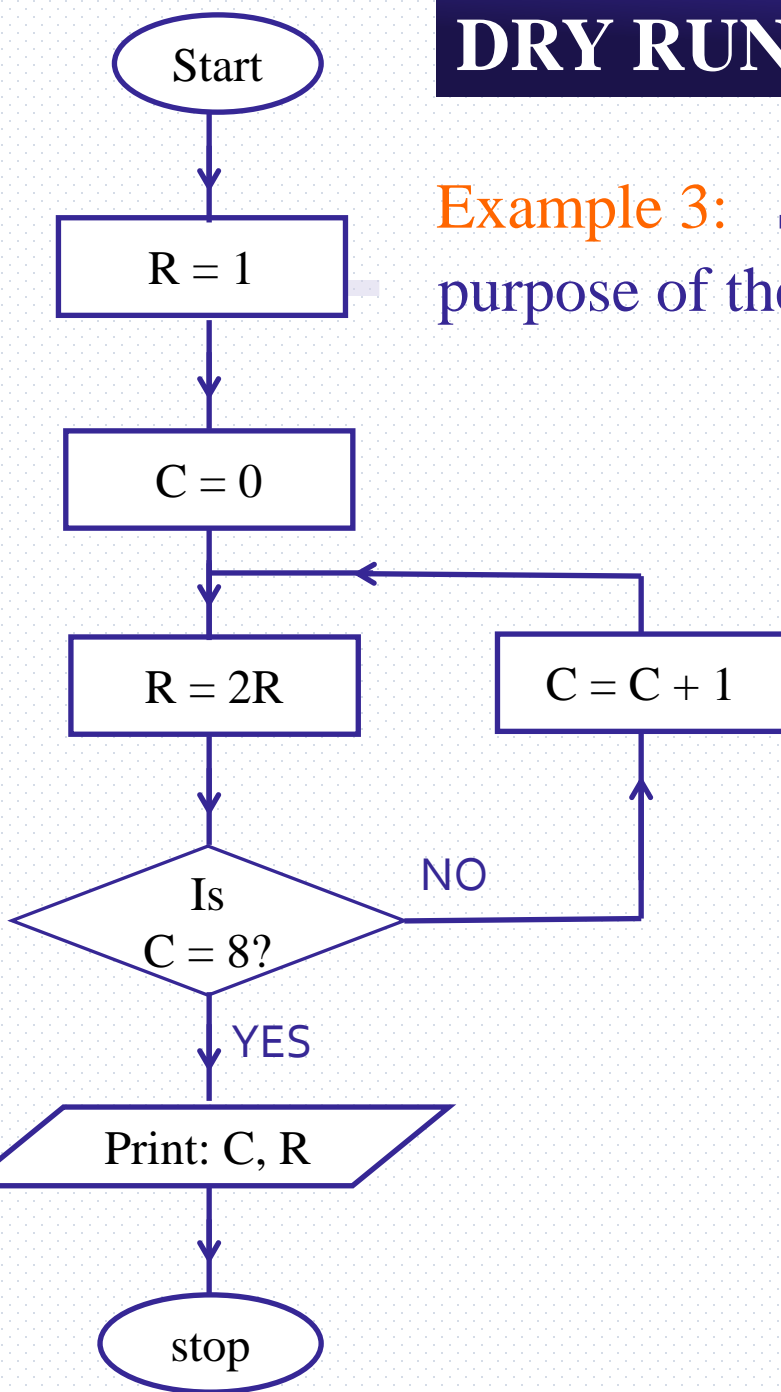
N	S
1	1
3	4
5	9
7	16
9	25
11	36
13	49
15	64

The purpose of the flow chart is to compute and print the first 8 square numbers

DRY RUN



Example 3: Study the flow chart below and perform a dry run and state the purpose of the flowchart



N	S
0	1
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	256

The purpose of the flow chart is to compute and print 2^8

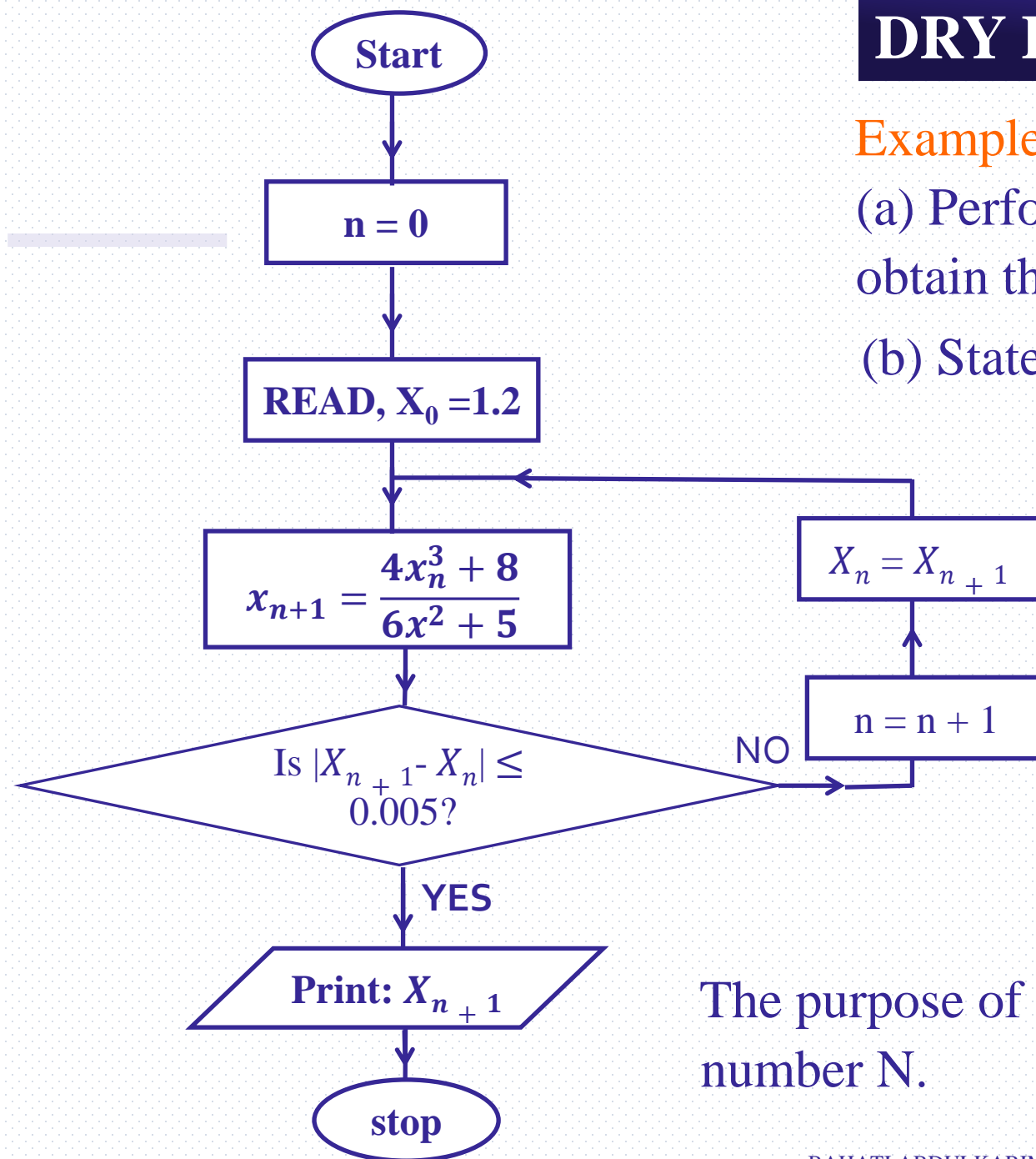
DRY RUN



Example 4: Study the flow chart below.

(a) Perform a dry run taking $N = 20$, $X_0 = 4$ and obtain the root correct to 3dp

(b) State the purpose of the flow chart



N	X_n	X_{n+1}	$ X_{n+1} - X_n $
0	4.0	4.5	0.5
1	4.5	4.4722	0.0278
2	4.4722	4.4721	0.0001

The square root is **4.472**.

The purpose of the flow chart is to print the square root of a number N.

Constructing flow charts



Contents

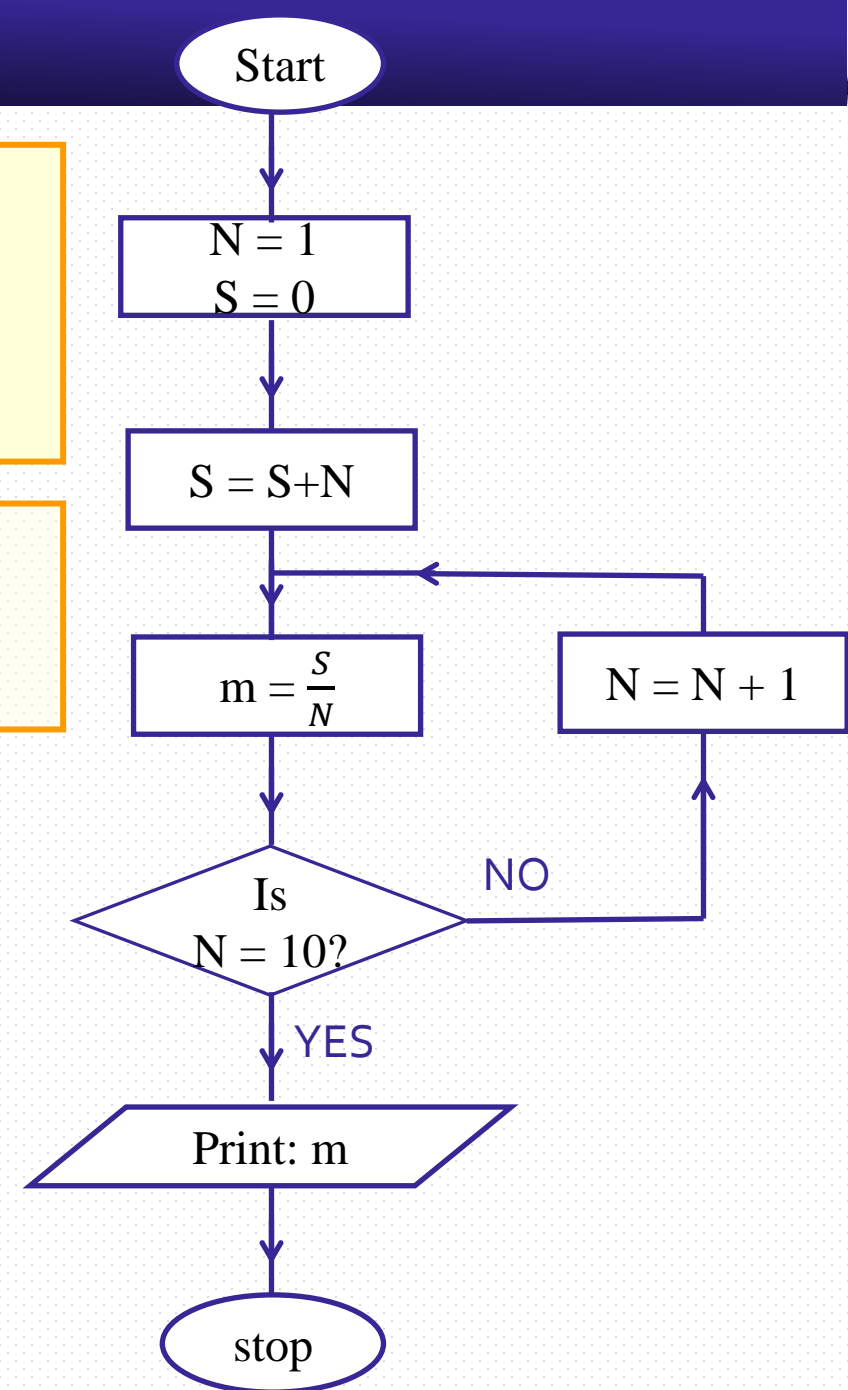
- The dry run
- **Constructing flow charts**
- Newton Rapson's method with flow charts

Constructing flow charts



Example 1: Draw a flow chart that reads and prints the mean of the first ten counting numbers.

Solution: let S be the sum and m the mean and N the number of terms





Example 2: A shop offered 25% discount on all items in its store and a second discount of 5% to any customer who paid by cash.

- (i). Construct a flow chart which shows the amount paid for each item.
- (ii). Using your flow chart in (i), compute the amount paid for the following items.

Item	<i>Price</i>	<i>Mode of paym</i>
Matress	125,000	Cash
Television set	340,000	Credit

Constructing flow charts

Solution:

(i). Let p be the price for the item, A the amount paid for the item and C the credit payment

(ii).

Amount paid for the mattress;

$$A = 0.95C$$

$$= 0.95 \times 0.75P$$

$$= 0.95 \times 0.75 \times 125000$$

$$= 89062.5$$



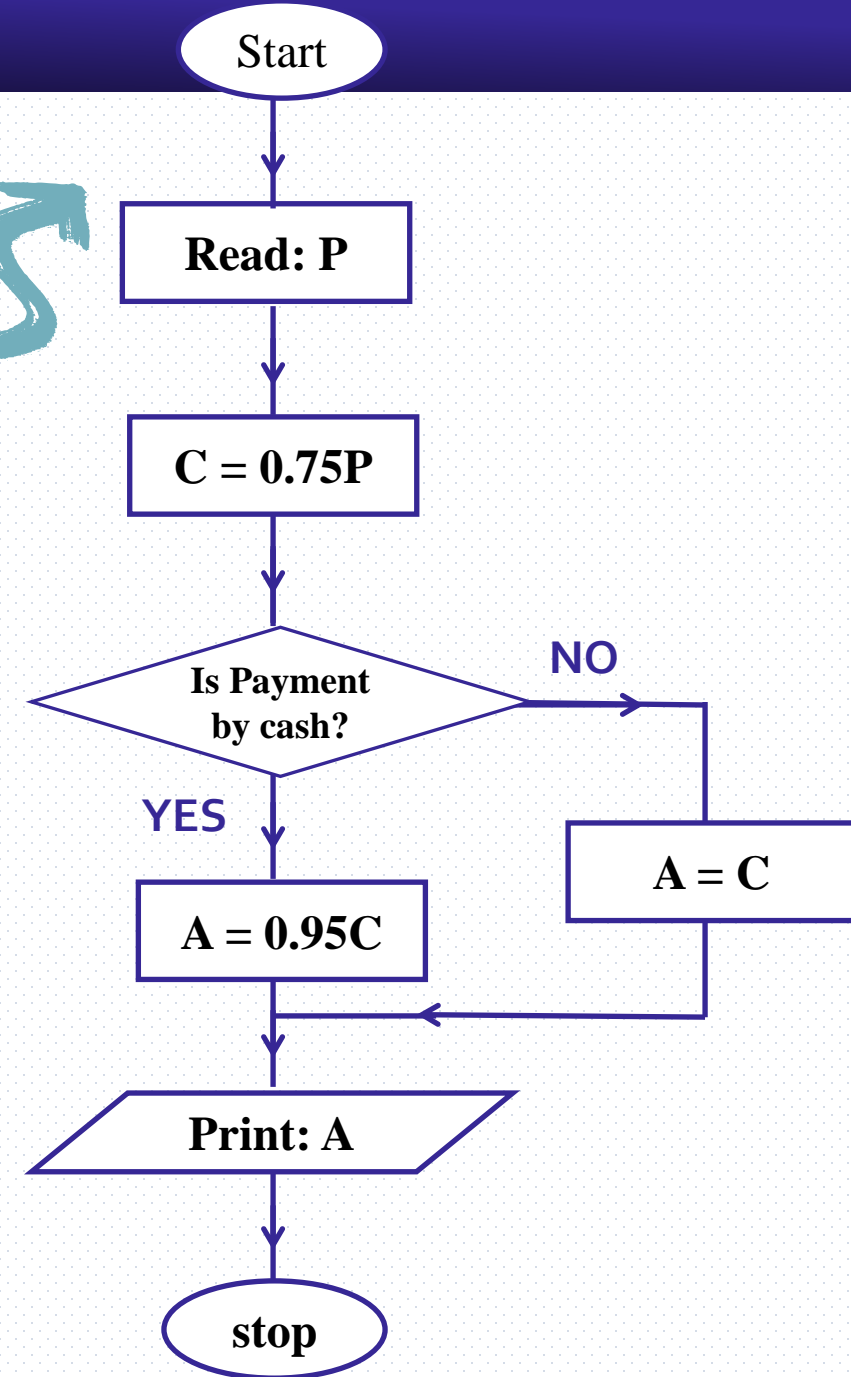
Amount paid for television set;

$$A = C$$

$$= 0.75P$$

$$= 0.75 \times 340,000$$

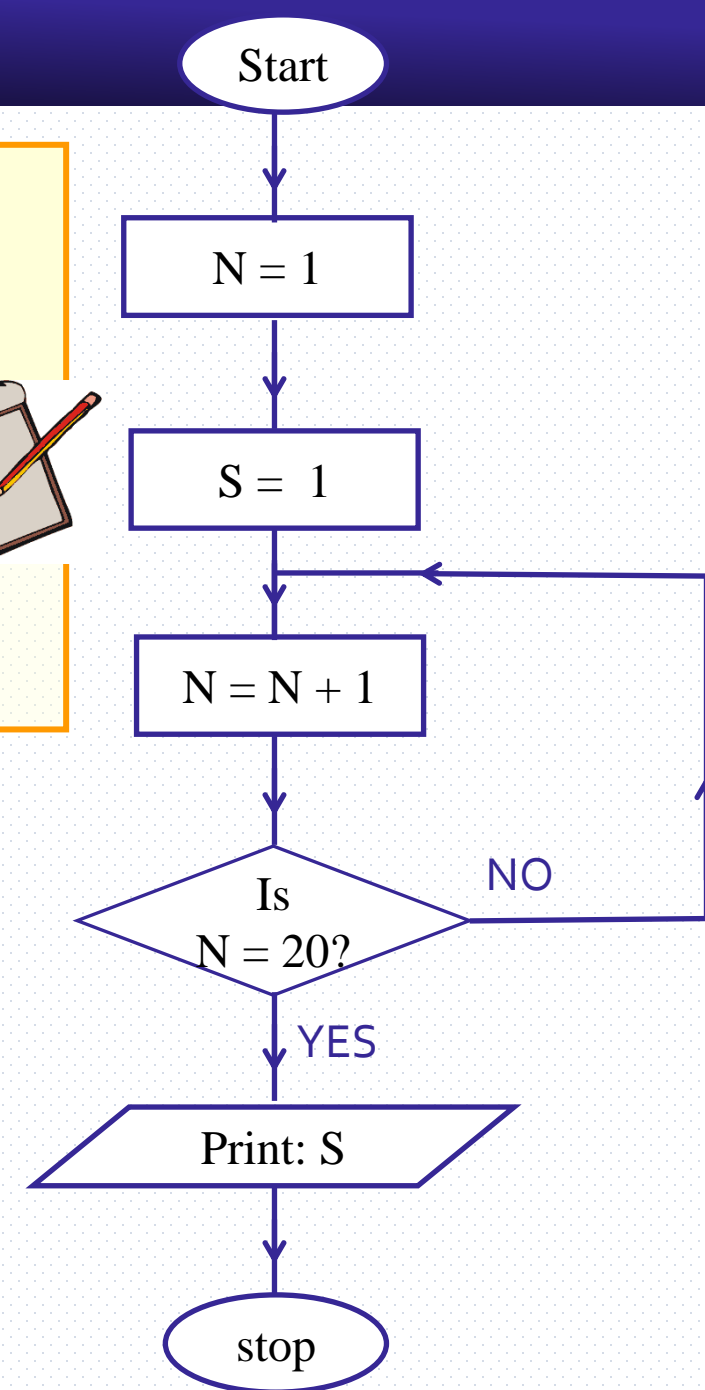
$$= 225,000$$



Constructing flow charts

Example 1: Draw a flow chart that computes the cubes of the first twenty counting numbers.

Solution: let S be the sum and N the number of terms



Newton Rapson's method with flow charts



Contents

- The dry run
- Constructing flow charts
- **Newton Rapson's method with flow charts**

Newton Rapson's method with flow charts



Example 1:

- a) Determine the iterative formula for finding the fourth root of a given number N .
- b) Draw a flow chart that reads N and the initial approximation, x_0 , computes and prints the fourth root of N to 3dps.
- c) Perform a dry run for $N = 150.10$ and $x_0 = 3.200$.



Newton Rapson's method with flow charts



Solution ☹️ (a)

$$\text{Let, } x = \sqrt[4]{N}$$

$$\Rightarrow x^4 = N$$

$$\Rightarrow x^4 - N = 0$$

$$f(x) = x^4 - N$$

$$f'(x) = 4x^3$$

$$\text{from, } x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}, n = 0, 1, 2, 3, \dots$$

$$x_{n+1} = x_n - \frac{x_n^4 - N}{4x_n^3}$$

$$x_{n+1} = \frac{4x_n^4 - (x_n^4 - N)}{4x_n^3}$$

$$x_{n+1} = \frac{3x_n^4 + N}{4x_n^3}$$

$$x_{n+1} = \frac{3x_n^4}{4x_n^3} + \frac{N}{4x_n^3}$$

$$\therefore x_{n+1} = \frac{3}{4} \left(x_n + \frac{N}{3x_n^3} \right), \text{ for } n = 0, 1, 2, 3, \dots$$

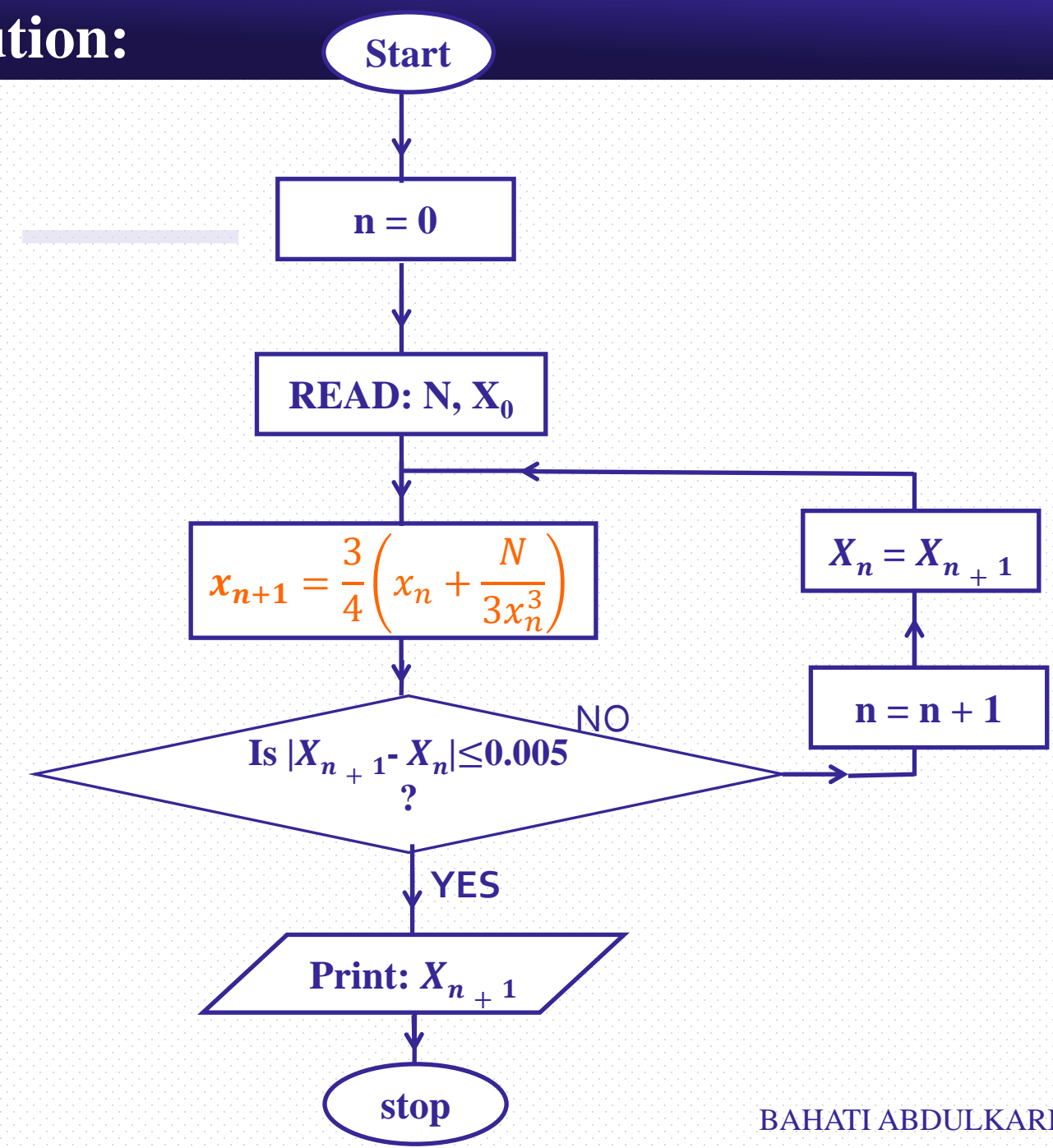


Solution:



(b)

(c) $N = 150.10$, $x_0 = 3.200$



N	X_n	X_{n+1}	$ X_{n+1} - X_n $
0	3.200	3.5452	0.3452
1	3.5452	3.5012	0.0440
2	3.5012	3.5002	0.0010
3	3.5002	3.5002	0.0000

∴ The root is 3.500(3d.p).

Newton Rapson's method with flow charts



Example 2:

- a) Derive a formula based on Newton Raphson method for finding the reciprocal of a number N .
- b) Draw a flow chart that reads N and the initial approximation, x_0 , computes and prints the number and its reciprocal after 3 iterations or gives the reciprocal correct to 3dps.
- c) Perform a dry run for $N = \frac{7}{6}$ and $x_0 = 0.8$.



Newton Rapson's method with flow charts



Solution ☹️ (a)

$$\text{Let, } x = \frac{1}{N}$$

$$\Rightarrow N = \frac{1}{x} \Rightarrow N - \frac{1}{x} = 0$$

$$f(x) = N - \frac{1}{x}$$

$$f'(x) = x^{-2}$$

$$\text{from, } x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}, n = 0, 1, 2, 3, \dots$$

$$x_{n+1} = x_n - \frac{N - x_n^{-1}}{x_n^{-2}}$$

$$x_{n+1} = \frac{x_n^{-1} - (N - x_n^{-1})}{x_n^{-2}}$$

$$x_{n+1} = \frac{2x_n^{-1} - N}{x_n^{-2}}$$

$$x_{n+1} = (2x_n^{-1} - N)x_n^2$$

$$x_{n+1} = 2x_n - Nx_n^2$$

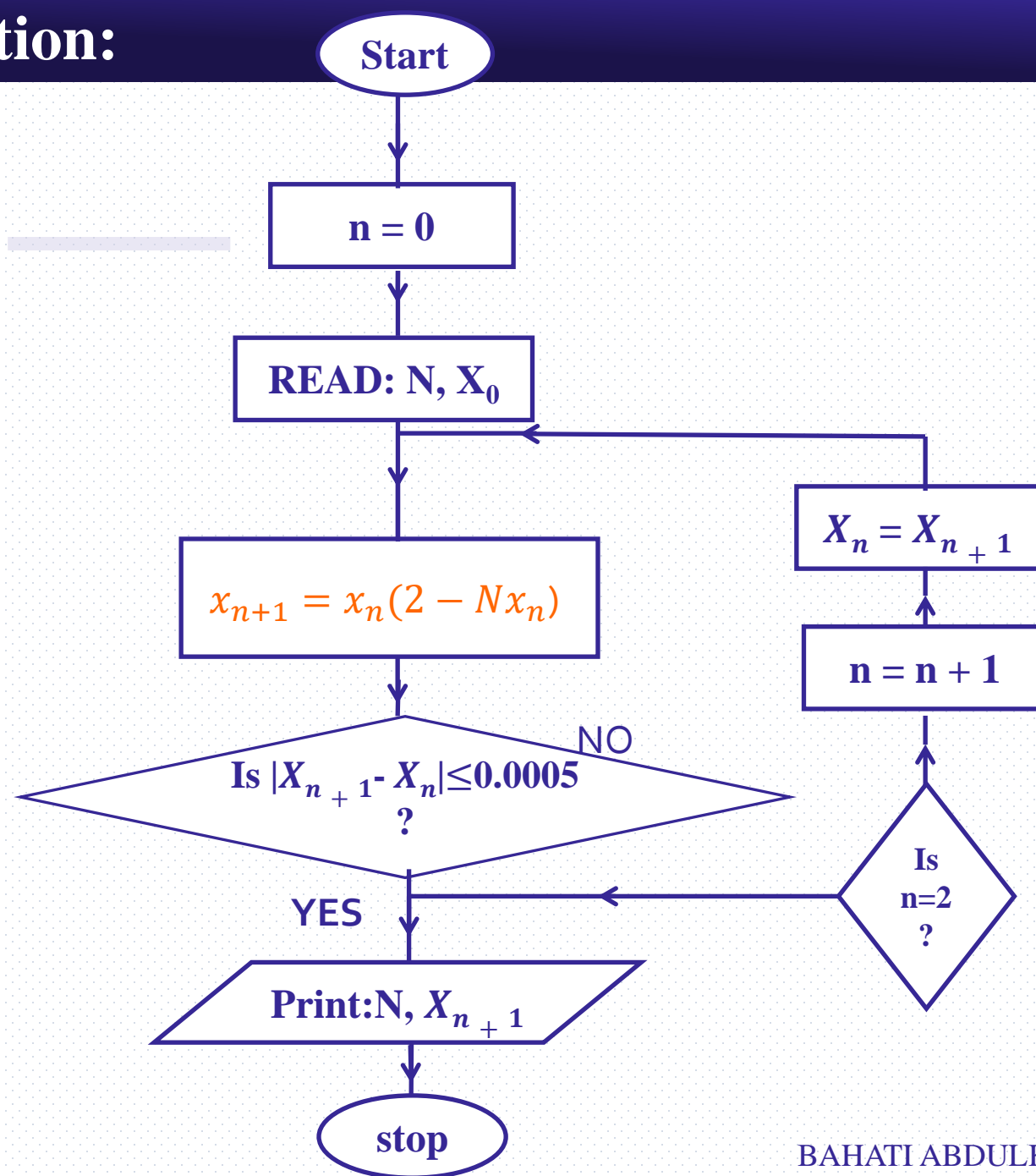
$$x_{n+1} = x_n(2 - Nx_n) \text{ for } n = 0, 1, 2, 3, \dots$$



Solution:



(b)



(c) $N = \frac{7}{6}$, $x_0 = 0.8$

N	X_n	X_{n+1}	$ X_{n+1} - X_n $
0	0.8	0.853	0.053
1	0.853	0.857	0.004

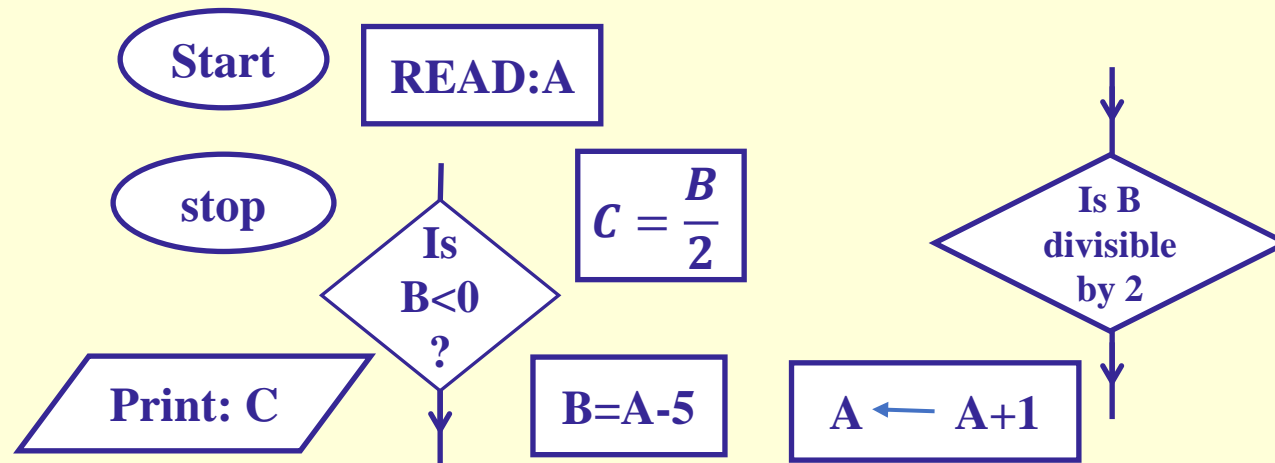
\therefore For $N = \frac{7}{6}$ 0.86 (2d.p).

Trial questions:

Examination-type question.



Given below are points of a flow chart not arranged in order.



a) Perform a dry run of your flow chart by coping and completing the table below.

A	B	C
46		
77		
120		
177		

- Rearrange the points and draw a complete logical flow chart.
- State the purpose of the flow chart





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