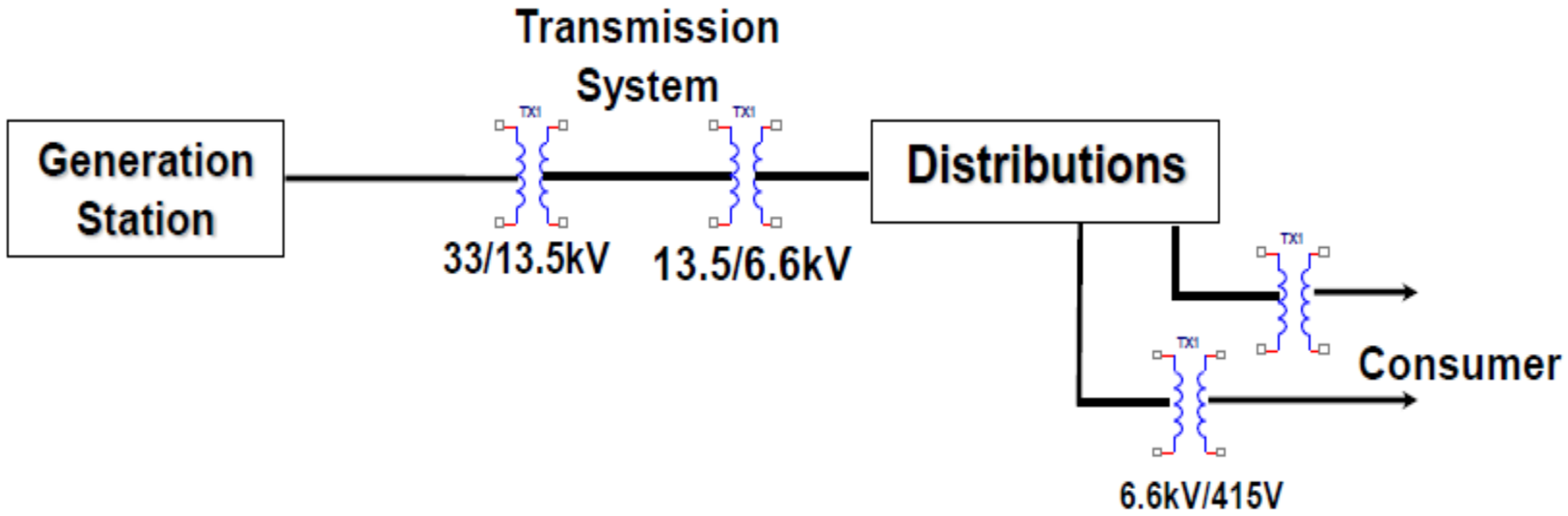
TRANSFORMER

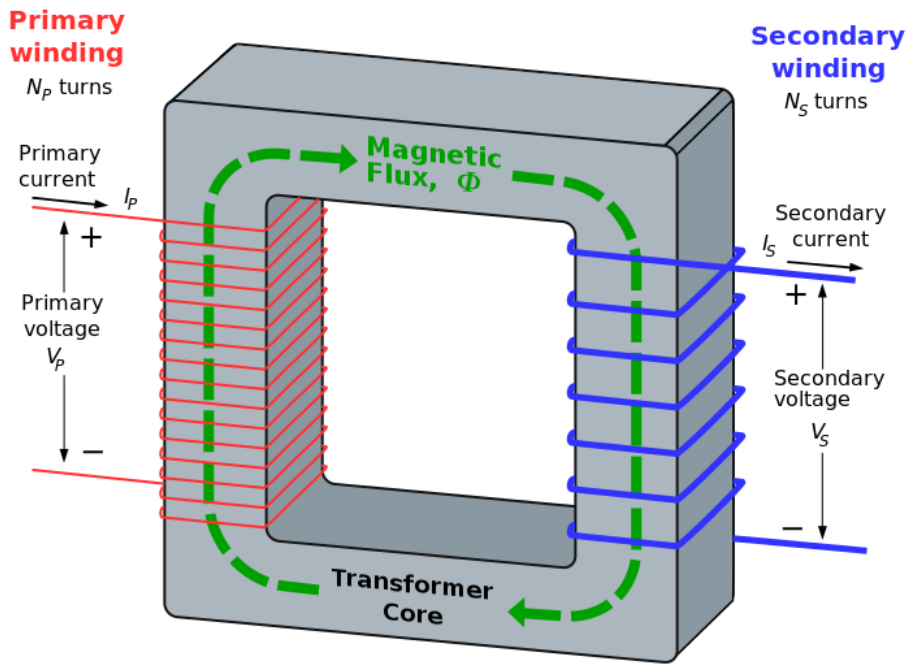
INTRODUCTION

- The transformer is a static device which is used to transfer electrical energy from one ac circuit to another ac circuit.
- Input to a transformer and output from a transformer both are alternating quantities (AC).
- Electrical energy is generated and transmitted at an extremely high voltages. The voltage is to be then reduced to a lower value for its domestic and industrial use.
- This is done by using a transformer.

- The power transmission system using transformers is shown in figure.
- When the transformer changes the voltage level, it changes the current level also.



Basic Principle



- The primary winding is connected to the single – phase ac supply, an ac current starts flowing through it.

- The ac primary current produces an alternating flux (Φ) in the core.
- Most of this changing flux gets linked with the secondary winding through the core.
- The varying flux will induce voltage into the secondary winding according to the faraday's laws of electromagnetic induction.
- Voltage level change but frequency i.e. time period remains same.
- There is no electrical contact between the two winding, an electrical energy gets transferred from primary to the secondary.

- A simple transformer consists of two electrical conductors called the primary winding and the secondary winding.
- Energy is coupled between the windings by the time varying magnetic flux that passes through(links) both primary and secondary windings.

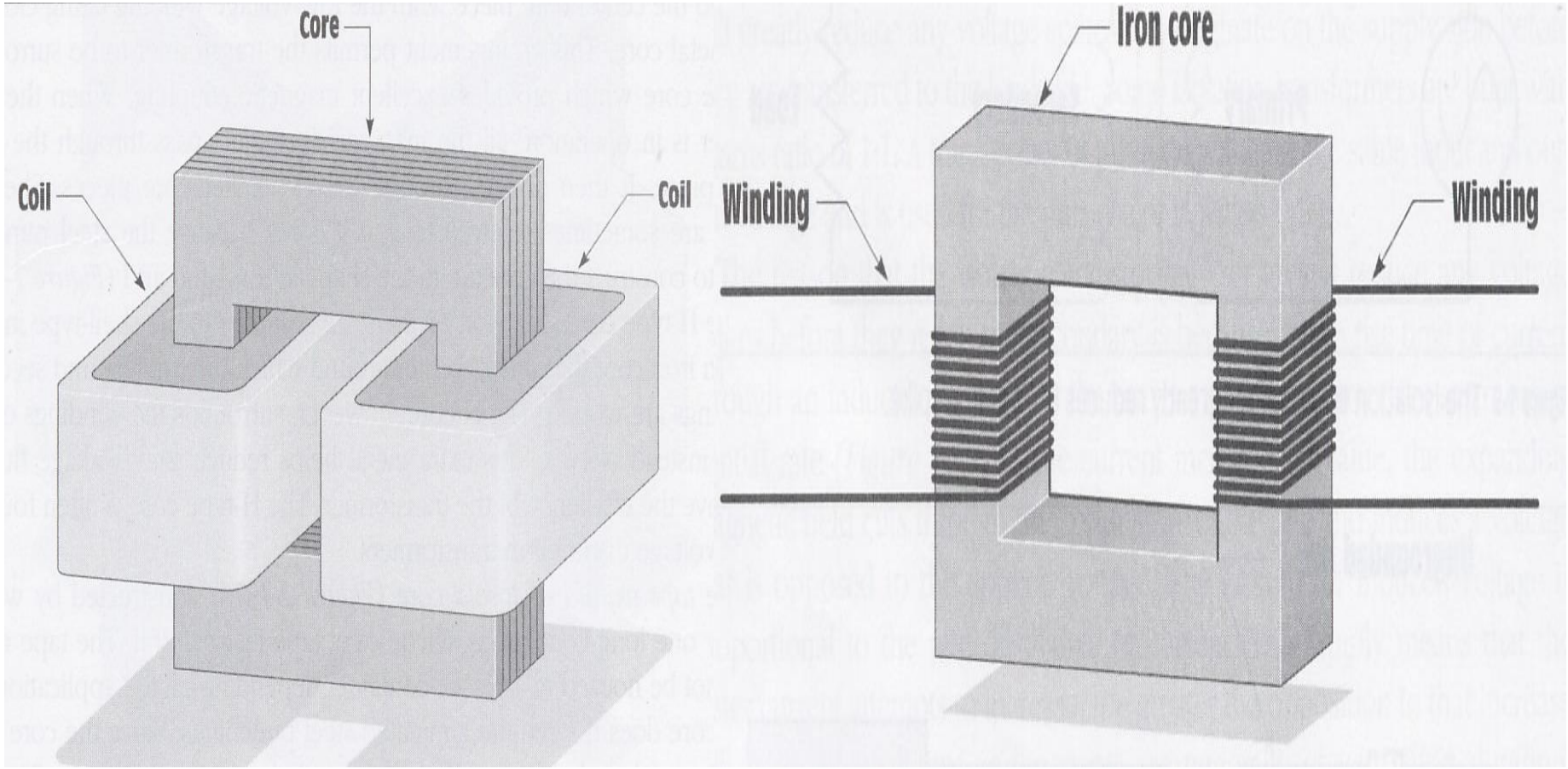
Can the transformer operate on DC?

- Answer: **NO**
- The transformer action does not take place with a direct current of constant magnitude.
- Because with a DC primary current, the flux produced in the core is not alternating but it is of constant value.
- As there is no change in the flux linkage with the secondary winding, the induced emf in the secondary is zero.

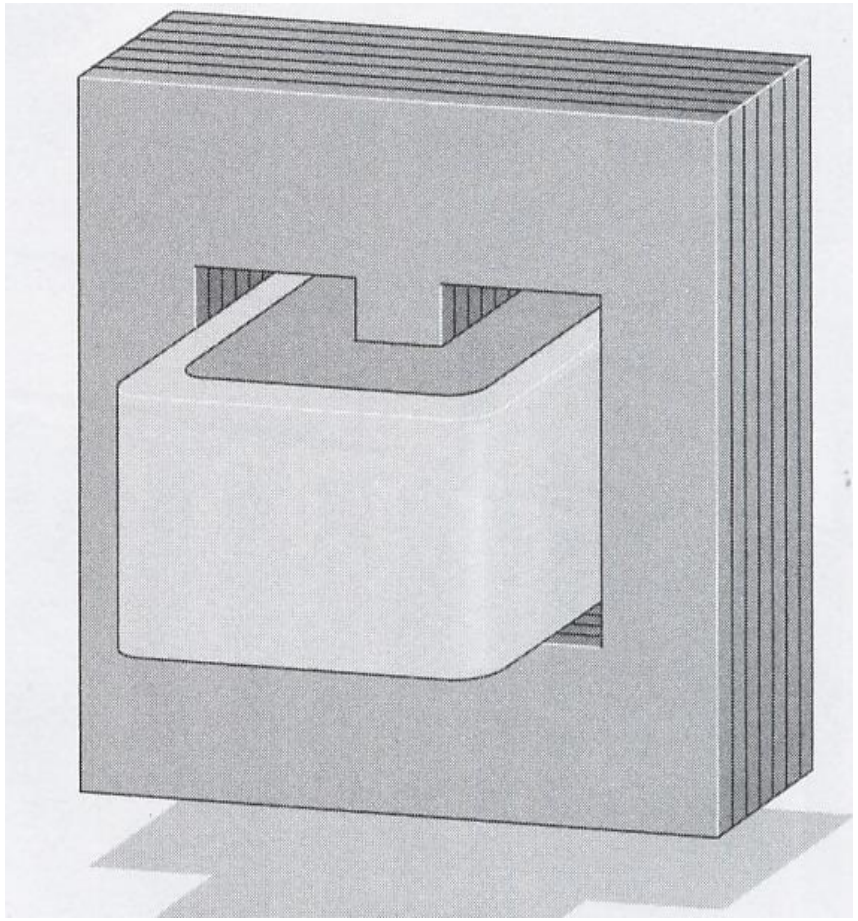
Transformer Types

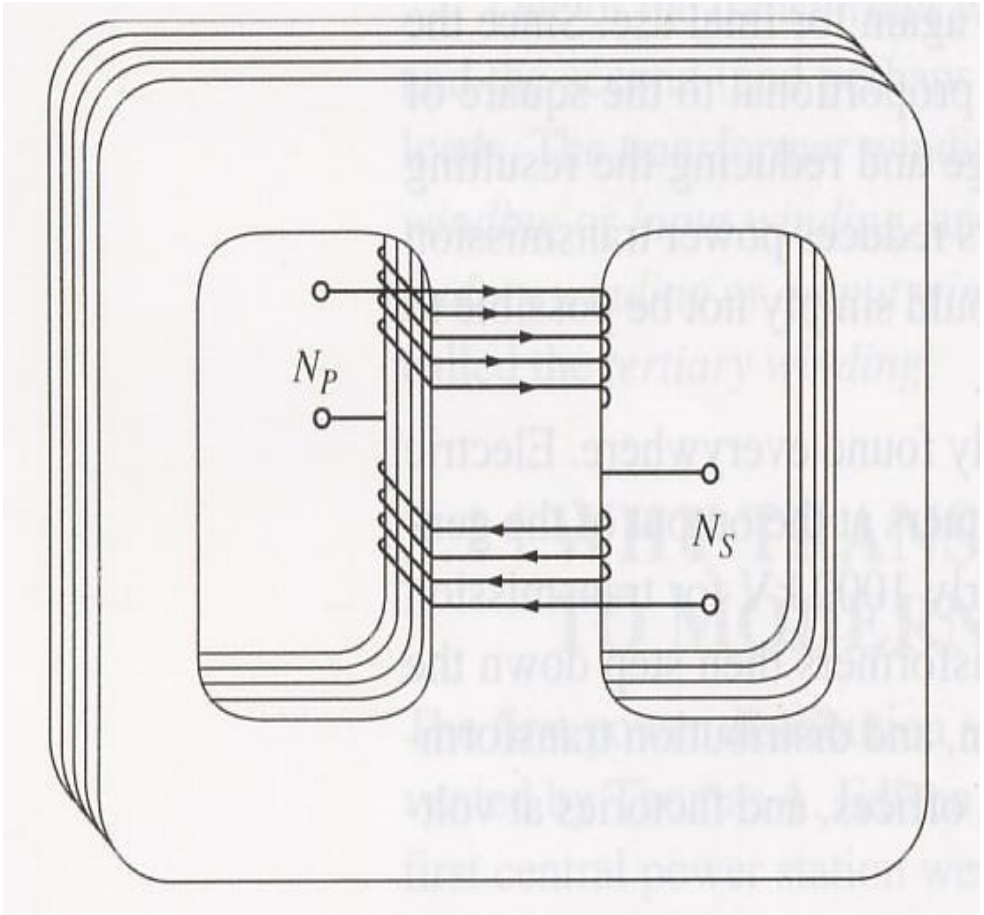
- The transformer are of different types depending on the arrangement of the core and the winding as follows.
- Core Type
- Shell Type
- Berry Type
- The magnetic core is a stack of thin silicon-steel laminations about 0.35 mm thick for 50 Hz transformer. In order to reduce the eddy current losses, these laminations are insulated from one another by thin layers of varnish.

Core Type Transformer



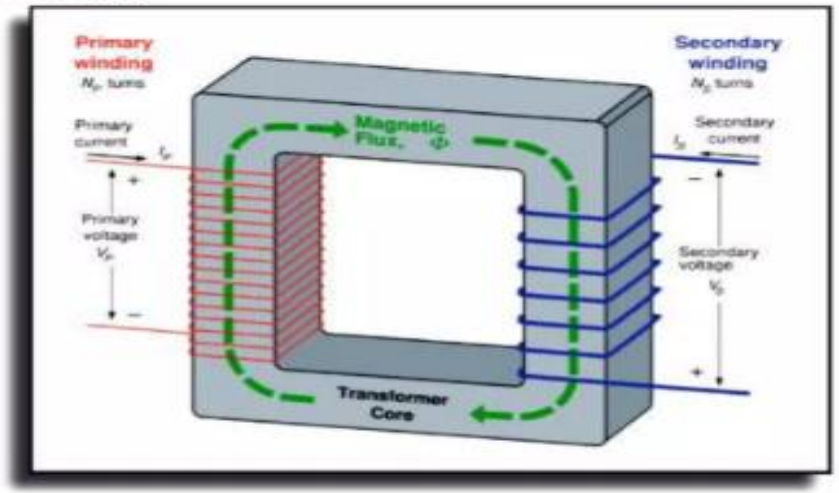
Shell Type Transformer





Ideal Transformers

An ideal transformer is a lossless device with an input winding and an output winding.



The relationships between the input voltage and the output voltage, and between the input current and the output current, are given by the following equations.

In instantaneous quantities

$$\frac{v_p(t)}{v_s(t)} = \frac{i_s(t)}{i_p(t)} = a$$

$$\frac{Input\ Voltage\ on\ the\ Primary\ Coil}{Output\ Voltage\ on\ the\ Secondary\ Coil} = \frac{Number\ of\ turns\ of\ Wire\ on\ the\ Primary\ Coil}{Number\ of\ turns\ of\ Wire\ on\ the\ Secondary\ Coil}$$

Transformer Equation Can be Written as Follows:

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

Where

V_p = Primary voltage

V_s = Secondary voltage

N_p = number of turns in the primary

N_s = number of turns in the secondary

I_s = Input current on the secondary coil

Turn Ratio

A measure for describing how many more or fewer windings there are in the Transformer's secondary coil when compared to its primary. The ratio of turns is expressed as Ns/Np, where “Ns” represents the number of windings in the Secondary Coil and “Np” is equal to the number of windings on a Primary Coils

Transformer Efficiency = Output Voltage / Input Voltage * Turn Ratio (Ns/Np)

Ex.1. The number of primary and secondary windings is 90 and 120 respectively. The secondary voltage is given by 310V, which determines the primary voltage.

Solution:

Given:

$N_p = 90$,

$N_s = 120$

$V_s = 310V$

By using the transformer calculation formula, we get:

$Vp/Vs=Np/Ns$

$Vp=Ns/Np \times V_S$

$V_P= 90/120 \times 310$

$V_p = 232.5$ volt

2. A transformer has primary coil with 1200 loops and secondary coil with 1000 loops. If the current in the primary coil is 4 Ampere, then what is the the current in the secondary coil.

Primary coil (N_P) = 1200 loops

Secondary coil (N_S) = 1000 loops

The current in the primary coil (I_P) = 4 Ampere

Wanted: The current in secondary coil (I_S)

Solution :

$I_S/I_P = N_P/N_S$

The current in the secondary coil :

$I_S/4 = 1200/1000$

$I_S/4 = 1.2$

$I_S = 1.2\ (4)$

$I_S = 4.8$ Ampere

1. A transformer has 400 primary turns and 1800 secondary turns. The input voltage is 12V and the output current is 3A when connected across a resistor. (a) What is the output voltage? (b) Determine the input current. (c) What is the value of the resistor? (d) How much power is dissipated by the resistor?

Applications

- Step – up and Step – down Voltage
- Measurement of current in single and three phase system
- Measurement of voltage in single and three phase system
- Measurement of power
- Measurement of Energy

1. What is Transformer?

a) Transformer is a device used to convert low alternating voltage to a high alternating voltage

b) Transformer is a device used to convert alternating current to direct current

c) Transformer is a device used to convert low alternating current to a high alternating current

d) Transformers are used only for low alternating voltage

2. What is the function of a transformer?

a) Transformer is used to step down or up the AC voltages and currents

b) Transformer is used to step down or up the DC voltages and currents

c) Transformer converts DC to AC voltages

d) Transformer converts AC to DC voltages

3. What is the working principle of a Transformer?

a) Transformer works on the principle of self induction

b) Transformer works on the principle of mutual induction

c) Transformer works on the principle of ampere law

d) Transformer works on the principle of coulomb law

4. Transformer ratings are given in _____
a) kVA
b) HP
c) kVAR
d) kW

5. What is the current transformer?
a) transformer used with an A.C. voltmeter
b) transformer used with an A.C. ammeter
c) transformer used with an D.C. voltmeter
d) transformer used with an D.C. ammeter

12. Which type of flux does transformer action need?
a) Alternating electric flux
b) Alternating magnetic flux
c) Increasing magnetic flux
d) Constant magnetic flux

13. Primary winding of a transformer _____
a) Could either be a low voltage or high voltage winding
b) Is always a high voltage winding
c) Cannot be determined
d) Is always a low voltage winding

139. What kVA rating is required for a transformer that must handle a maximum load current of 8 A with a secondary voltage of 2 kV?

(A) 4kVA (B) 0.25kVA (C) 16kVA (D) 8kVA

140. The turns ratio required to match an 80 Ω source to a 320 Ω load is

(A) 1:2 (B) 2:1 (C) 4:1 (D) 1:4

141. A transformer with a 110 V primary has a 15:1 turns ratio. The load resistance is 120Ω . What is the approximate voltage across the load?

142. In a certain loaded transformer, the secondary voltage is one-fourth the primary voltage. The secondary current is

(A) one-fourth the primary current (B) four times the primary current

(C) equal to primary current (D) none

143. The primary winding of a power transformer should always be

(A) open (B) fused (C) shorted (D) none

144. A transformer

(A) changes ac to dc (B) changes dc to ac

(C) steps up or down dc voltages (D) steps up or down ac voltages

145. In a certain transformer, the input power to the primary is 120 W. If 8.5 W are lost to the winding resistance, what is the output power to the load, neglecting any other issues?

(A) 0 W (B) 14.1 W (C) 111.5 W (D) 1020 W

139	C
140	A
141	7.33
142	B
143	B
144	D
145	C

158. Which parameter does not change during transformation action in transformer?
(A) Frequency (B) Voltage (C) Current (D) None

159. The working principle of transformer depends upon
(A) Ohm's law (B) Lenz's law
(C) Fleming's left hand rule (D) Faraday's law of electromagnetic induction

160. Secondary current of a step down transformer is
(A) Lower than primary current (B) Higher than primary current
(C) I can't say (D) I don't know

161. An ideal transformer is one which has
(A) No winding resistance (B) No Leakage reactance (C) No losses (D) All the above

162. Which of the following losses varies with load in transformer?
(A) Copper loss (B) Hysterisis loss (C) Eddy current loss (D) None

163. Which of the following losses remain constant during normal operation of transformer?
(A) core loss (B) copper loss (C) both a and b (D) None

164. The efficiency of a transformer is mainly dependent on
(A) core loss (B) copper loss (C) both a and b (D) None

165. Oil is provided in an oil filled transformer for....
(A) cooling (B) Insulation (C) Both a and b (D) None

166. Lamination of transformer core is made of
(A) cast iron (B) cast steel (C) silicon steel (D) None

158	A
159	D
160	B
161	D
162	A
163	A
164	A
165	C
166	C
167	B
168	D

Thank You