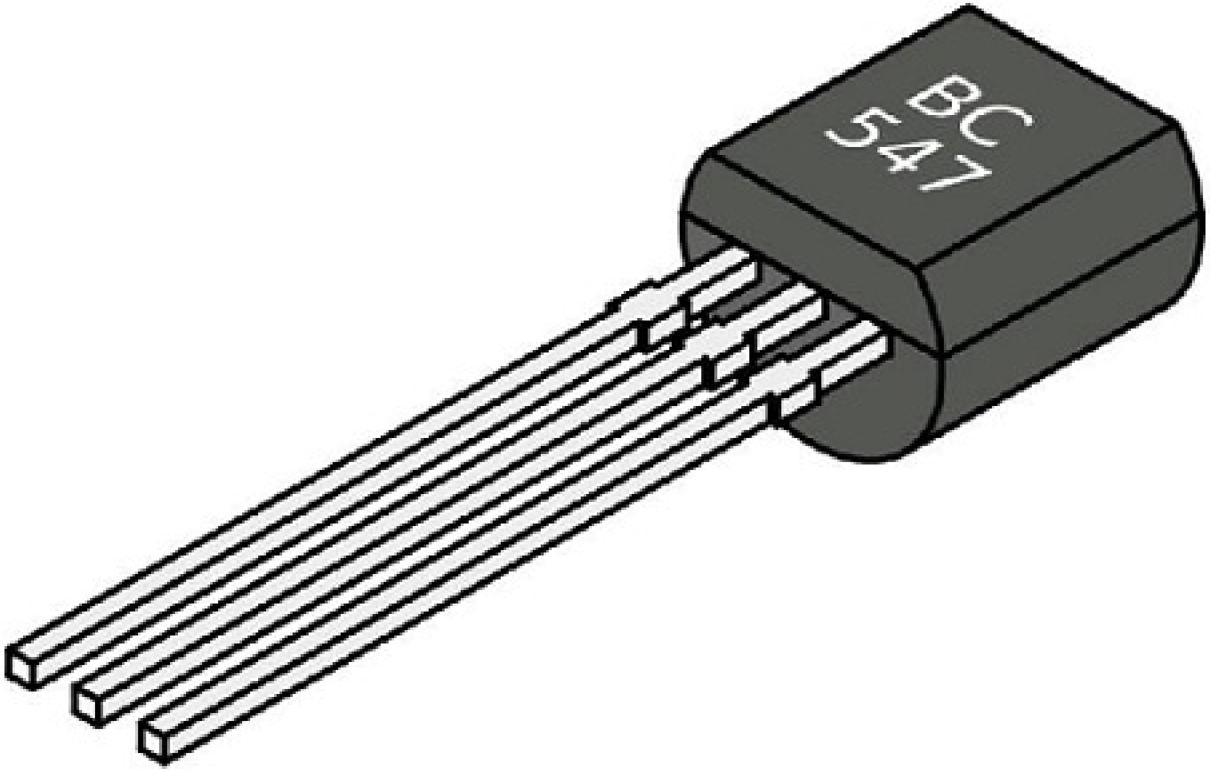
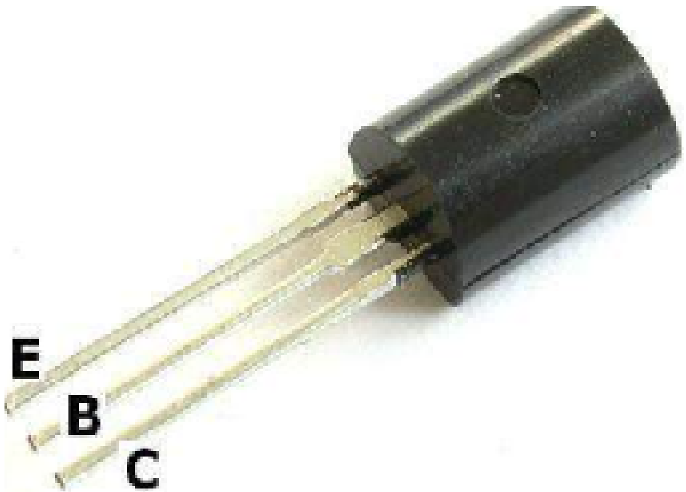
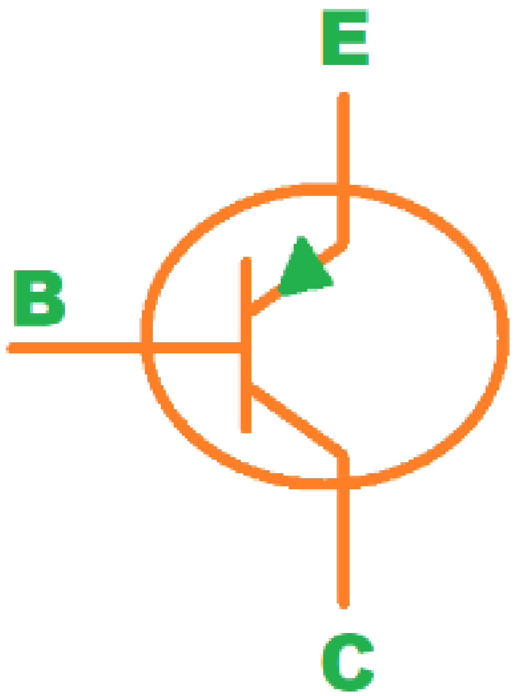

BC
547

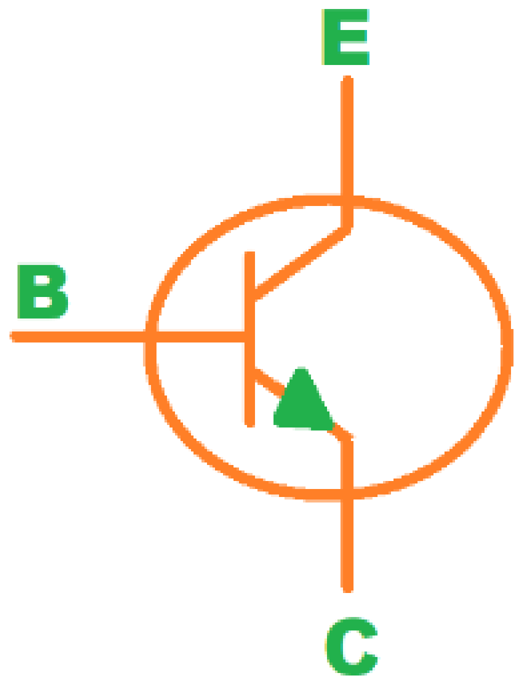
Bipolar Junction Transistor



Typical Bipolar Junction Transistor

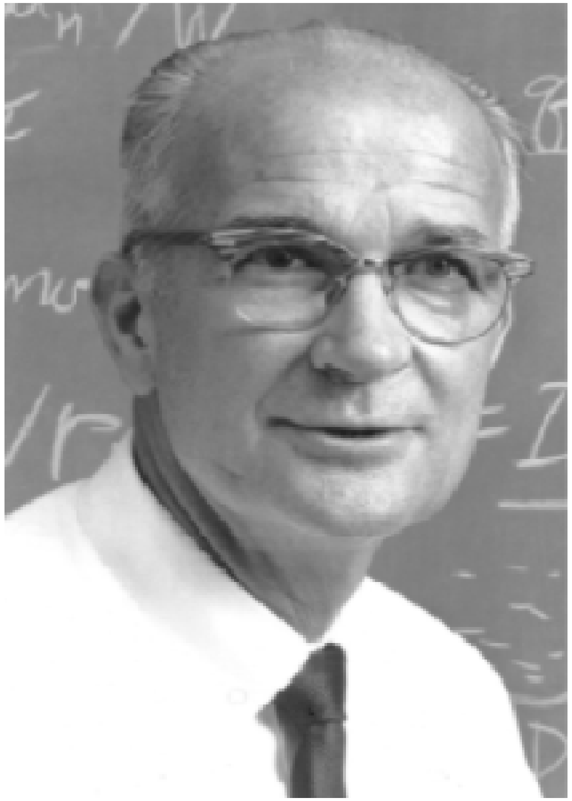


PNP BJT



NPN BJT

History of the bipolar junction transistor



- William Shockley made a successful attempt of making a bipolar junction transistor.
- The invention of BJT revolutionized the world of electronics beyond imagination.

For example, d.c. collector current is denoted by I_C and instantaneous total value of emitter current is denoted by i_E.

(v) The reference direction of the current is denoted by an arrow. Also the voltage reference polarity is denoted by plus and minus signs or simply by an arrow which points from the negative to the positive terminal.

(vi) The current flow into an electrode from the external circuit is always taken as positive.

(vii) The d.c. supply magnitude is represented by using double subscripts of the proper electrode symbol.

For example, V_{CC} represents the magnitude of the d.c. supply in the collector circuit.

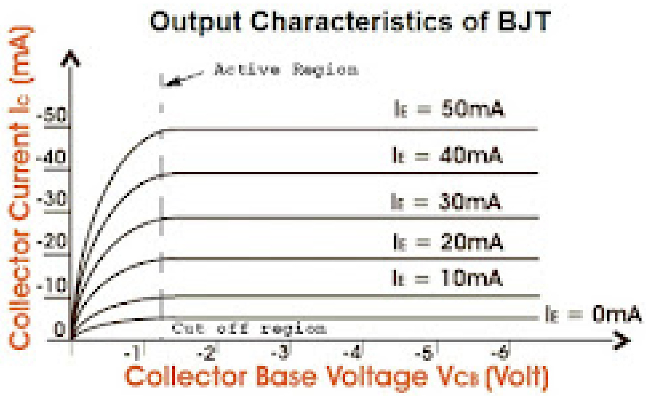
Table 7.2 shows some current and voltage components and their representations according to above standard notation.

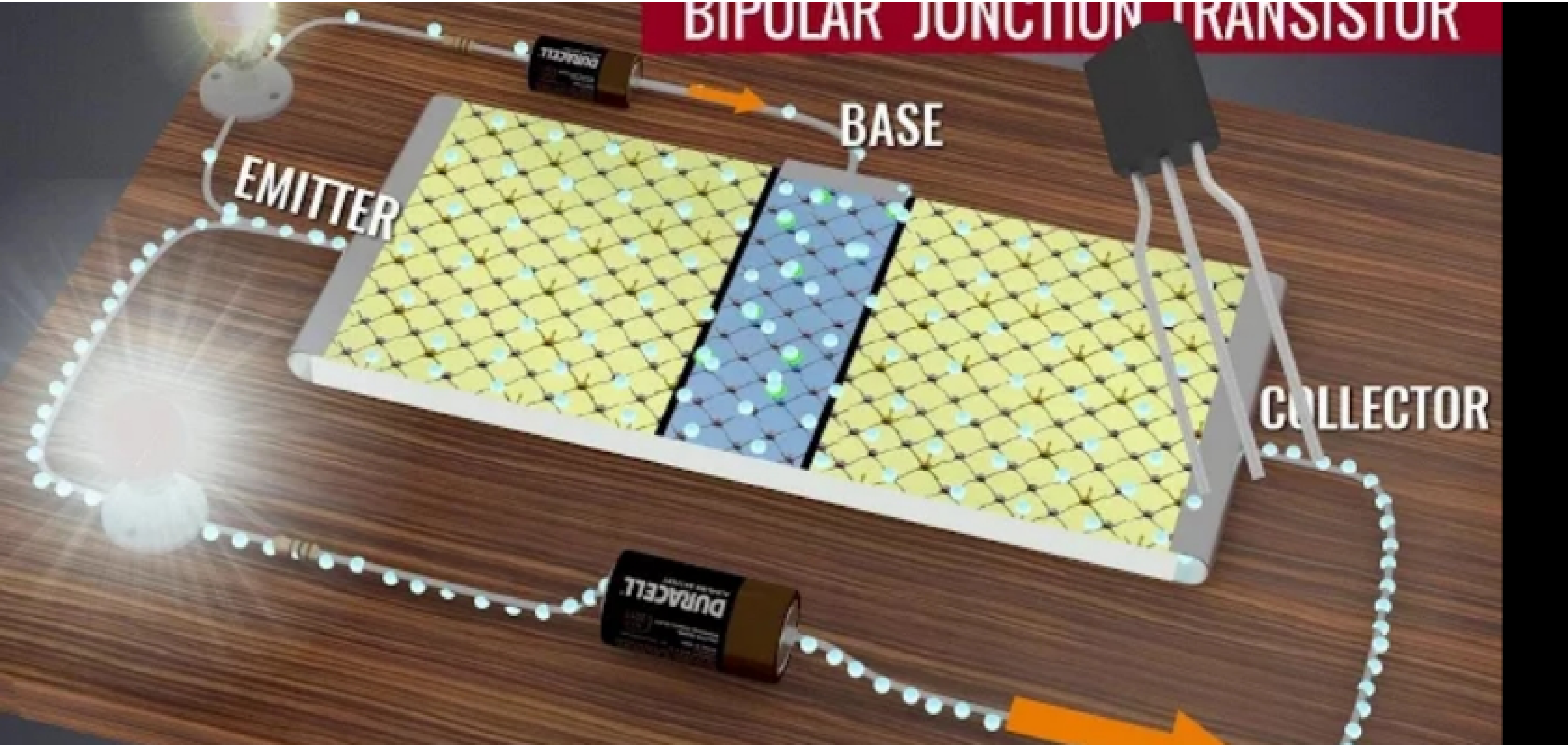
Table 7.2: *Standard Notations*

S.No.	Name of Quantity	Instantaneous a.c.	d.c.	Total
1.	Collector current	i_c	I_C	i_c
2.	Emitter current	i_e	I_E	i_E
3.	Base Current	i_b	I_B	i_B
4.	Collector-emitter voltage	v_{ce}	V_{CE}	v_{CE}
5.	Emitter-Base Voltage	v_{eb}	V_{EB}	v_{EB}

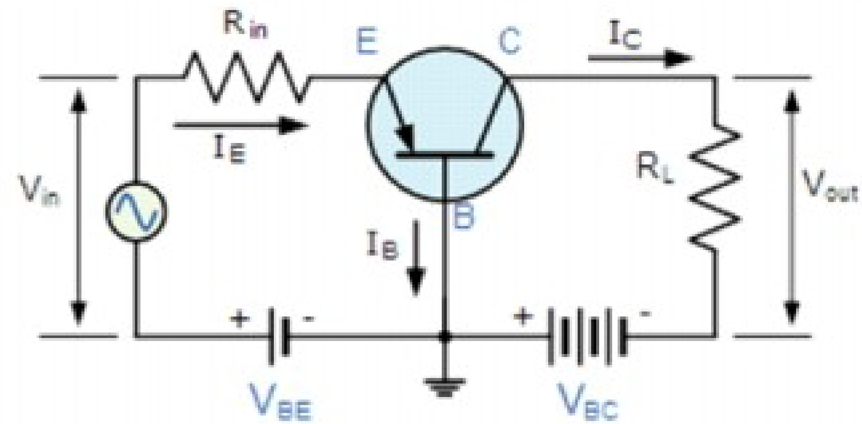
Table 7.2: *Standard Notations*

S.No.	Name of Quantity	Instantaneous a.c.	d.c.	Total
1.	Collector current	i_c	I_C	i_c
2.	Emitter current	i_e	I_E	i_E
3.	Base Current	i_b	I_B	i_B
4.	Collector-emitter voltage	v_{ce}	V_{CE}	v_{CE}
5.	Emitter-Base Voltage	v_{eb}	V_{EB}	v_{EB}


Output Characteristics of BJT
Active Region
IE = 50mA
IE = 40mA
IE = 30mA
IE = 20mA
IE = 10mA
IE = 0mA
Cut off region
-50
-40
-30
-20
-10
0
-1
-2
-3
-4
-5
-6
Collector Current IC (mA)
Collector Base Voltage VCB (Volt)



BIPOLAR JUNCTION TRANSISTOR
BASE
EMITTER
COLLECTOR
DURACELL
DURACELL



R in
E
C
IC
IE
Vin
RL
Vout
B
IB
+
-
+
-
VBE
VBC

DEV BHOOMI UTTARAKHAND UNIVERSITY

(Notified by Govt. of India u/s 2(f) of the U.G.C. Act, 1956)

Q2

Consider the following circuit diagram:

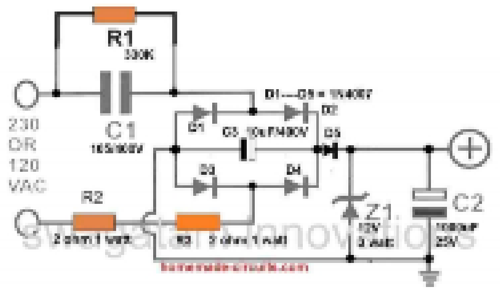


Fig 2.1 Circuit diagram of a Zener Diode based Charger

Ref: homemade-circuits.com

i. Identify & Explain the working of the Rectification Circuit.
ii. Identify & Explain the working of Zener Diode in this circuit.
iii. Identify & Explain the working of Regulation Circuit.
iv. Analyze the working of the circuit as shown in fig 2.1

Q3

Consider the following circuit diagram:

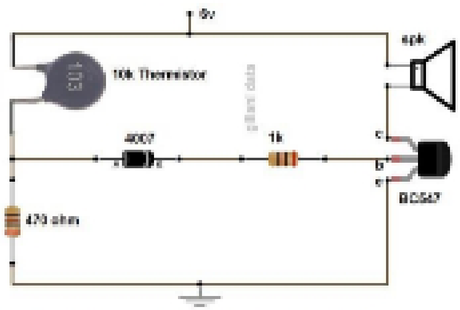


Fig 3.1 Circuit diagram of a BC547 transistor based Fire Alarm

Ref: https://environmentalb.com/automatic-fire-alarm-circuit/

i. Explain the working of transistor BC 547.
ii. Analyze the working of the circuit as depicted in fig 3.1

DEV BHOOMI
—UTTARAKHAND—
UNIVERSITY
(Notified by Govt. of India u/s 2(f) of the U.G.C. Act, 1956)

Q2

Consider the following circuit diagram:

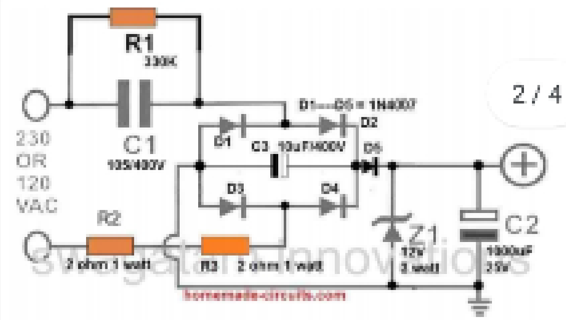


Fig 2.1 Circuit diagram of a Zener Diode based Charger

Ref: homemade-circuits.com

i.	Identify & Explain the working of the Rectification Circuit.
ii.	Identify & Explain the working of Zener Diode in this circuit.
iii.	Identify & Explain the working of Regulation Circuit.
iv.	Analyze the working of the circuit as shown in fig 2.1

Q3

Consider the following circuit diagram:

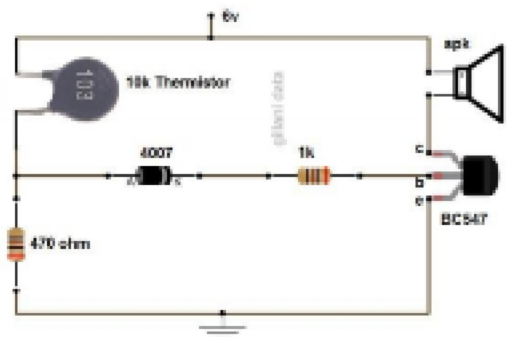


Fig 3.1 Circuit diagram of a BC547 transistor based Fire Alarm

Ref: https://eevirementalb.com/automatic-fire-alarm-circuit/

i.	Explain the working of transistor BC 547.
ii.	Analyze the working of the circuit as depicted in fig 3.1

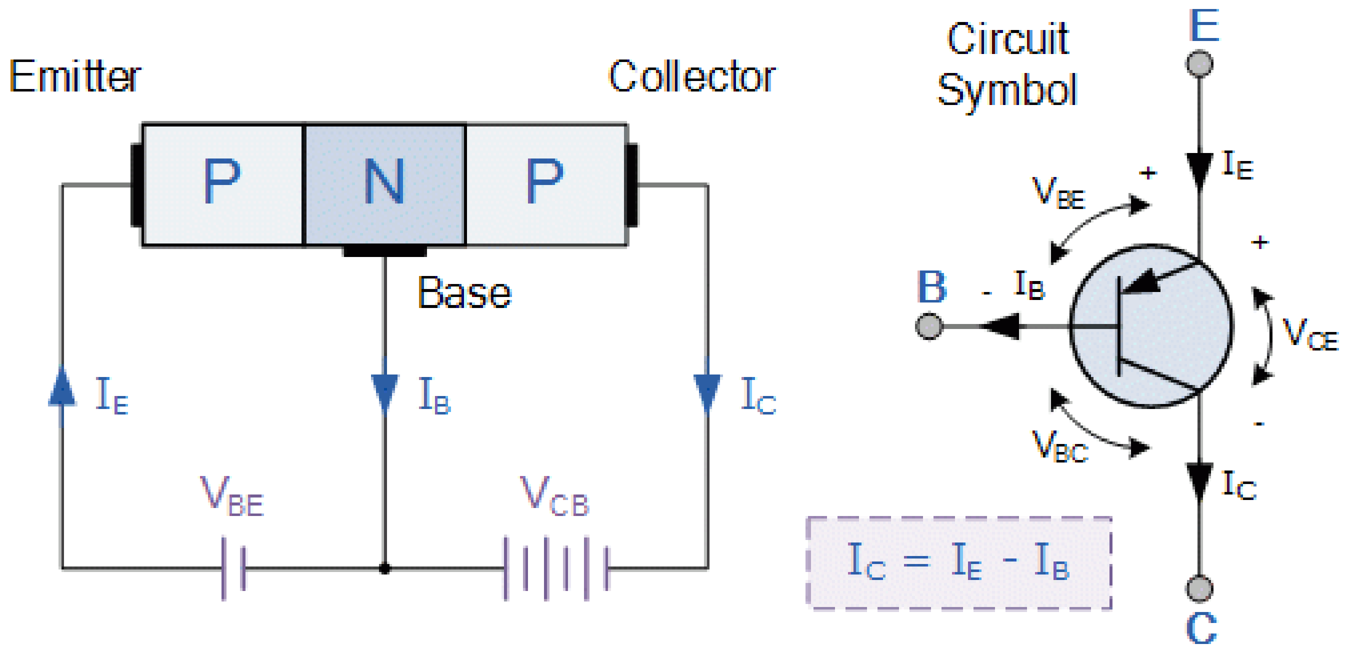
18. Find the volume of the solid generated by revolving the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, b>a.
19. Find the ratio of the volume of the solid generated by the area of a sphere of radius a between the lines $x=\frac{a}{2}$ and $x=a$ to the area of the sphere.
20. Find the area bounded by a parabola and its latus rectum.

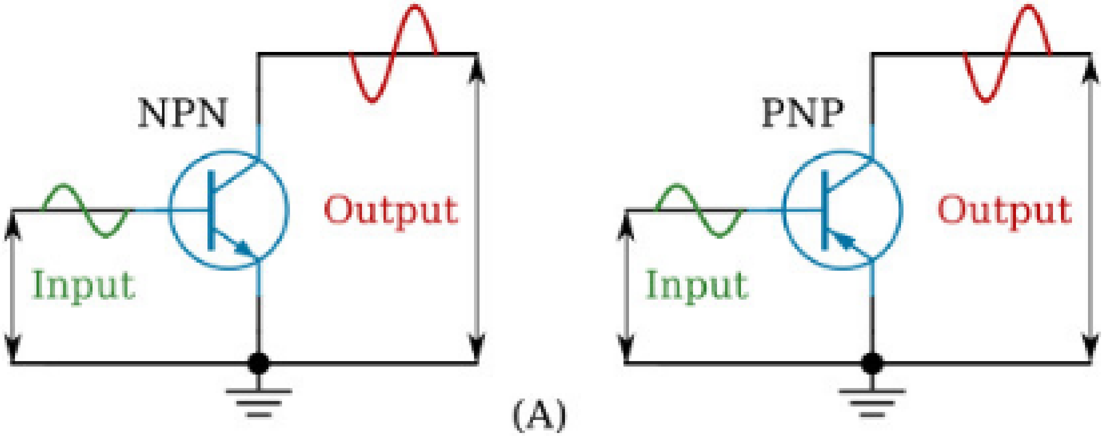
SECTION B (5 marks)

1. Evaluate $\int_0^{\pi}\int_0^{a} r\,dr\,d\theta$.
2. Evaluate: $\lim_{n\to\infty}\left[\frac{\sqrt{n+1}}{n^{3/2}}+\frac{\sqrt{n+2}}{n^{3/2}}+\frac{\sqrt{n+3}}{n^{3/2}}+\cdots\frac{\sqrt{2n}}{n^{3/2}}\right]$.
3. Find the area of the loop of the curve $x=a(1-t^2)$, $y=at(1-t^2)$
4. Find the value of $\lim_{n\to\infty}\left[\frac{1}{n^3+1}+\frac{4}{n^3+8}+\frac{9}{n^3+27}+\cdots\frac{n^2}{2n^3}\right]$.
5. Evaluate $\int_{-c}^{c}\int_{-b}^{b}\int_{-a}^{a}(x^2+y^2+z^2)\,dx\,dy\,dz$
6. The portion of a parabola $y=\frac{x^2}{2}$ cut off by the straight line $y=\frac{3}{2}$ is revolved about the y-axis. Show that the surface area of revolution is $14\frac{\pi}{3}$
7. Evaluate $\int_{y=0}^{3}\int_{x=0}^{2}\int_{z=0}^{1}(x+y+z)\,dx\,dy\,dz$.
8. Prove that the length of the rectangular spiral $r=ae^{\theta\cot\alpha}$ between the points with radii vectors r_1 and r_2 is $(r_2-r_1)\sec\alpha$.
9. Evaluate: $\int_0^{\frac{\pi}{2}}\sin^7\theta\,d\theta$.
10. Evaluate $\int_0^{\frac{\pi}{2}}\cos^{12}\theta\,d\theta$.

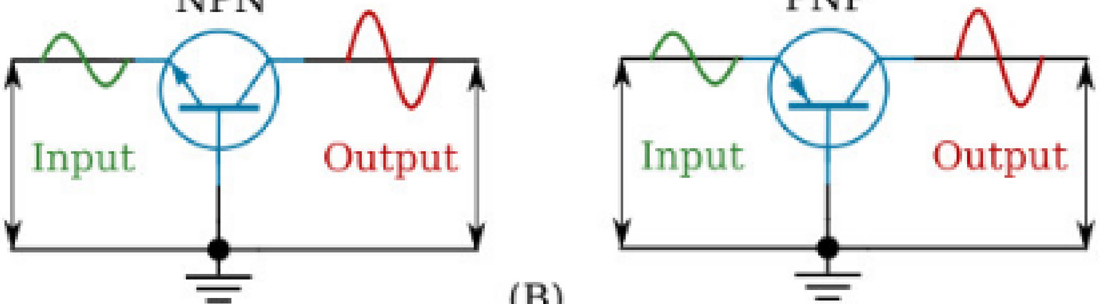
SECTION C (10 marks)

1. Find the area of $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ by the method of double integration
2. Find the area bounded by the curve $y=x^3$ between the lines $y=1$ and $y=8$
3. Find the volume of the tetrahedron bounded by the plane $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$ and the coordinate planes $x=0$, $y=0$ and $z=0$.
4. Find the area between the curve $y^2=\frac{x^3}{2a-x}$ and its asymptote.
5. Evaluate $\iint e^{(2x+3y)}\,dx\,dy$ over the triangle bounded by $x=0$, $y=0$ and $x+y=1$
6. Find the volume bounded by the cylinder $x^2+y^2=4$ and the planes $y+z=4$, $z=0$.

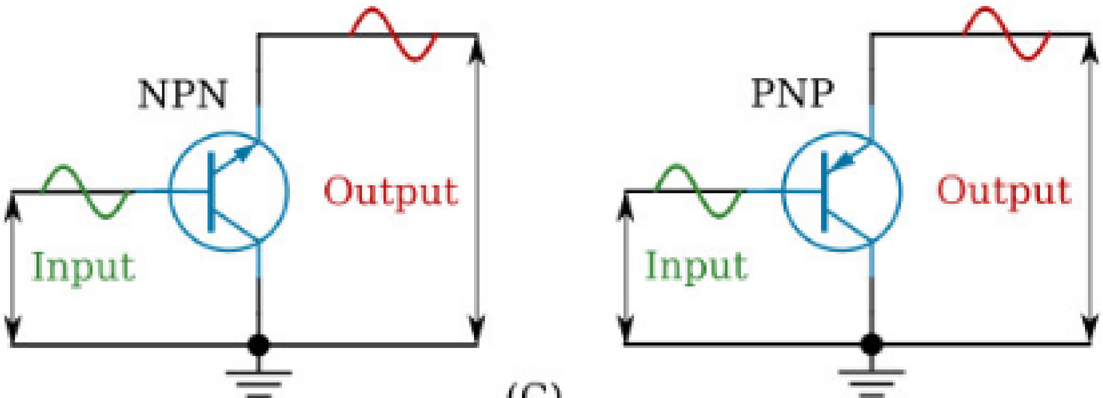

Emitter
Collector
P
N
P
Base
I_E
I_B
I_C
V_{BE}
V_{CB}
Circuit Symbol
E
B
C
I_E
I_B
I_C
V_{BE}
V_{CE}
V_{BC}
+
-
+
-
$I_C = I_E - I_B$



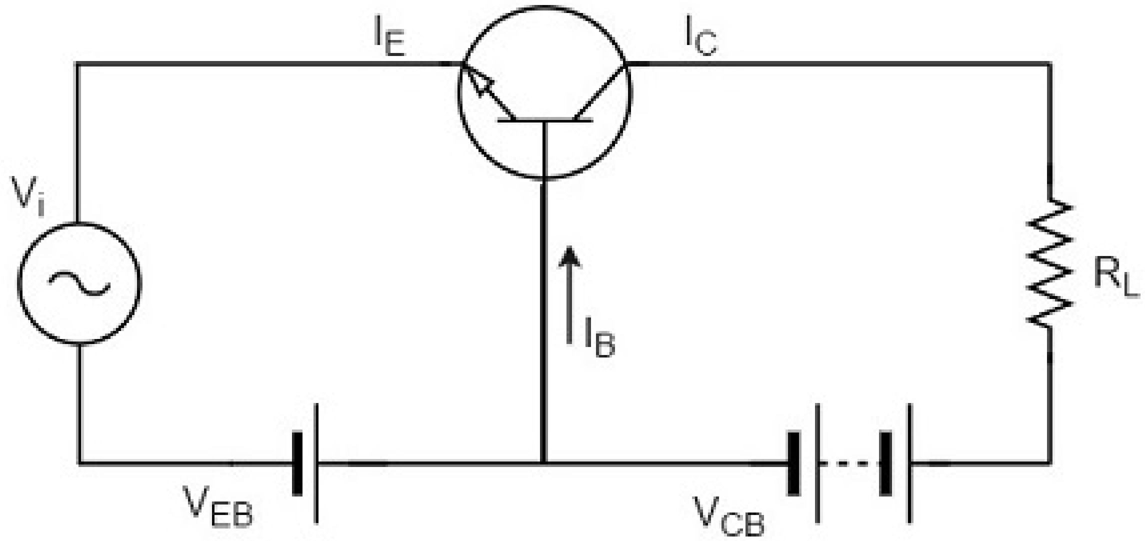
(A)
Common emitter

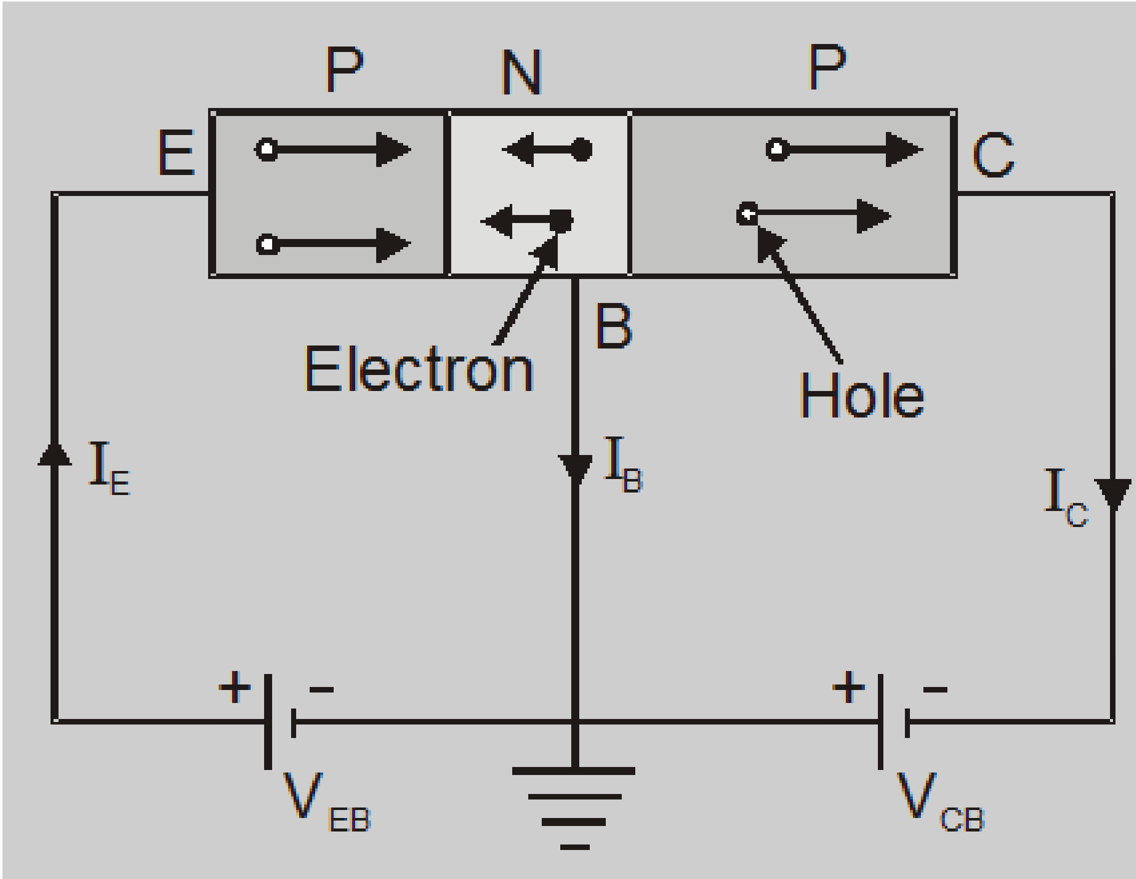


(B)
Common base



(C)
Common collector


I_E
I_C
V_i
I_B
R_L
V_{EB}
V_{CB}


P
N
P
E
C
B
Electron
Hole
I_E
I_B
I_C
+
-
+
-
V_{EB}
V_{CB}