Bipolar (npn) Transistor Exercises

Question 1

Draw the circuit symbol for an npn Bipolar Transistor

Label the connections with the correct names

Question 2

Describe the action of an npn Bipolar Transistor (when used as a transducer driver) in terms of current and voltage

Question 3

Write down the equation connecting current and transistor gain

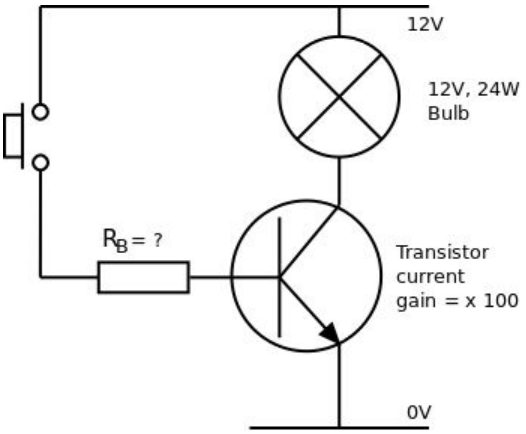
Explain what each of the terms in the equation represent

Question 4

A Bipolar Transistor is used to control a 24 W lamp from a 12 V supply. The push button is connected to the same 12 V supply.

The gain of the transistor is x100.

Calculate the value of the base resistor, R_B



Question 5

A logic circuit is used to control a motor using an npn Bipolar Transistor. The logic circuit has an output of 5 V and can supply a maximum current of 20 mA. The motor works from a 24 V supply and requires a maximum current of 1.5 A

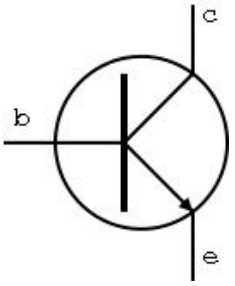
a) What is the minimum current gain of the transistor?

b) As well as the base resistor, what additional component is needed?

c) Calculate a suitable value for the base resistor for this circuit

Bipolar (npn) Transistor Answers

Question 1



c = Collector

e = Emitter

b = Base

Question 2

When the potential difference (voltage) between the Base and the Emitter is less than 0.7 V the transistor is “off” and no current flows from the Collector to the Emitter. When the potential difference between the Base and Emitter is 0.7 V the transistor is “on” and current flows into the Base allowing current to flow from the Collector to the Emitter.

Question 3

$$I_C = h_{FE} \times I_B$$

I_C = Collector current I_B = Base current

h_{FE} = Current gain

Question 4

- Using I = P/V, the current in the bulb is 24/12 = 2 A
- Therefore the Collector current is I_C = 2 A
- Using $I_B = I_C / h_{FE}$, the Base current is 2/100 giving I_B = 0.02 A
- The voltage drop across the Base resistor is 12 - 0.7 = 11.3 V
- Using R = V/I, the Base resistor is R_B = 11.3 / 0.02 = 565 Ω. Use R_B = 560 Ω

Question 5

a) $h_{FE} = I_C / I_B$ = 1.5 / 0.02 = 75 (minimum)

b) A diode reverse biased across the motor to protect the transistor

c) R_B = (5 - 0.7) / 0.02 = 215 Ω