Fig 5.14 shows the circuit for how a transistor acts as an amplifier.

The Capacitors C1 and C2 are important in that they block external circuits which may affect the biasing and are selected on the amplifier's frequency of use. They are not relevant to showing how amplification and gain are explained.

When the incoming signal, or input, I_b is positive (i.e. a peak) more base current will flow and when the signal is negative (i.e. a trough) less base current, I_b will flow.

This incoming AC signal, to the base of the transistor, I_b is exactly copied by a larger current flowing between the emitter and collector I_c This **amplification** or **gain** is given the symbol β.

If I_c is 100 times bigger than I_b the gain, β, is 100. We can say this mathematically as

$$\beta = \frac{I_c}{I_b}$$

You may see β expressed another way by the letters h_{fe}. You need not concern yourself with this but you should be able to use the equation to determine β, I_b and I_c when given the values of two of the other symbols.

For example, if the value of R1 has been chosen to give a current, I_b, of 10μA and β is 100 we can calculate the collector current,

$\beta = \frac{I_c}{I_b}$ which can be rearranged to give $I_c = \beta \times I_b$

which is $10^2 \times 10 \times 10^{-6} = 10 \times 10^{-4}$ A

which is 1×10^{-3} A or 1mA.

Although it is not required for your exam you may be interested in circuit design and will see that we are now in a position to calculate the value of R2. We have said that the voltage at the transistor should be half the supply voltage. Hence, 12 / 2 = 6 volts across the transistor and 6V across R2. Using the above example of I_c being 1mA, Ohm's Law gives us

$$R2 = \frac{V}{I} = \frac{6}{0.0001} = 6000\Omega$$

Amplifier design

There is more than one way of connecting a transistor into a circuit that offer better temperature stability and gain. You need to remember that Fig 1.4 shows **a common emitter amplifier.**

You should be cautious when selecting transistors as the gain of a transistor, β, can have a wide variation in manufacturing tolerance.