locktronics

LK20

Introduction to the Transistor

ASSIGNMENTS BOOK

A Packing Contents List is supplied with the equipment. Carefully check the contents of the package(s) against the list. If any items are missing or damaged, contact your local TQ Agent or TQ immediately.

LK/DB/1005

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Assignments Book

Introduction

Figure 1 The LK20 Component Kit.

Locktronics kits:

- make learning easier and safer for the pupil
- make teaching easier for the teacher

Most Locktronics kits are intended for teaching electronics but they also offer many advantages in the study of basic electricity.

Circuit changes are quick and simple to perform, so more practical work or detailed investigations can be done in the time given to these subjects. In addition the pupil is working solely with theory diagrams and quickly learns to think in these terms.

The apparatus is extremely robust and if used properly will give many years of useful service.

This book

The assignments in this book start from the simplest experiments and increase in difficulty. Students who need to re-fresh or start from the beginning should start at Assignment 1. More experienced students may skip ahead to the later Assignments.

LK20 Components

The LK20 Kit (shown in Figure 1) is a component kit. TQ recommends that the dedicated LK0 Baseboard, power supplies and leads (available separately) are used with the kit.

Baseboard LK0 (Available Separately)

A Baseboard with 8 rows and 3 columns of pillars.

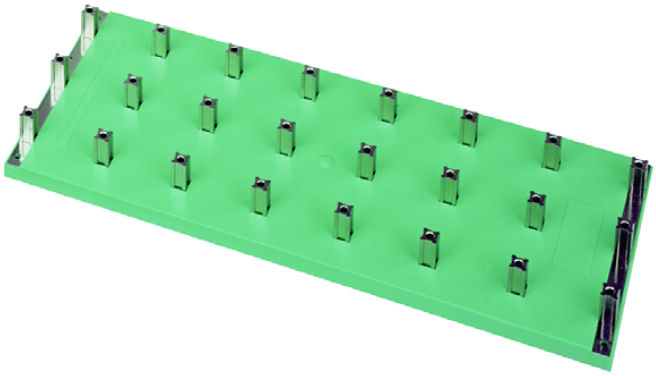

Figure 2 The LK0 Baseboard.

D.C Power Supply CU600T (Available Separately)

A direct current power supply with a key switch at the back to select either a fixed 5 volt supply or a variable 2 to 15 volt dual supply. Maximum 1 ampere rating.

Figure 3 The CU600T Power Supply.

Lead Set LKLS (Available Separately)

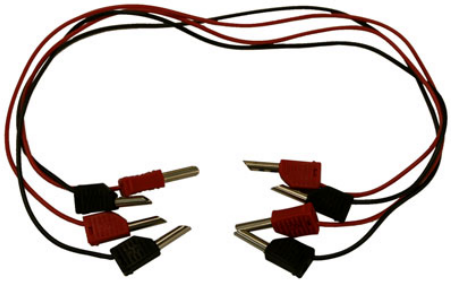

Figure 4 The LKLS Lead Set.

Current Probe LKCP (Available Separately)

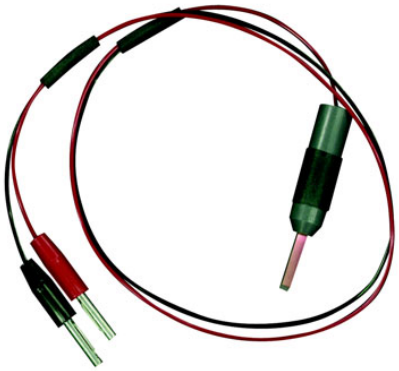

Figure 5 The LKCP Current Probe.

Notes to the Supervisor or Teacher

Power Supplies

The CU600 power supply units contain short circuit protection. The CU600T gives an audible warning of a short circuit. This reduces the possibility of circuits being left in a short circuit condition.

Use the recommended power supplies for these assignments or suitably fused and protected low voltage power supplies or batteries of the correct voltage.

General Care and Maintenance

During regular use the kits may become dirty.

Clean the polystyrene component carriers with a damp cloth and a little liquid detergent. Never use spirit solvent. Make sure the carriers are dry before use.

The phosphor bronze contacts are self-cleaning and will retain their proper shapes in normal use. If for any reason they are bent out of shape, use a pair of long-nosed pliers to correct the shape.

CAUTION 

Contact with resin bonded material such as chipboard, plywood, etc. can damage the plating on the carrier contact springs thus impairing their efficiency. Do not store the components in such material.

Notes to the Student

As you work through these assignments:

- Copy each individual circuit used into your notebook, together with its title.
- In your diagrams, always use the correct symbol for the components.
- Make a note of any important facts or information which you have learned and may need to recall for your examinations. Brief notes are usually enough.
- Disconnect the power supply leads before making any circuit changes. This will prevent accidental damage to components, particularly in assignments using transistors and other semi-conductor devices.
- Note that some components are different, even though they look the same they may not perform in the same way.

Depending upon the particular subject and examination board setting your exam, you may not need to cover all the assignments given. However, check with your teacher to find out about this.

We hope you find the assignments interesting and stimulating enough to make you want to find out more about the exciting subjects of electronics and electricity which are changing the world in which we live.

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British Standard Symbols

Symbols are used in diagrams and on the component carriers of the Locktronics range. These symbols are based on a set of symbols approved by the British Standards Institute (BSI). The most common symbols are shown in Figures 6 and 7.

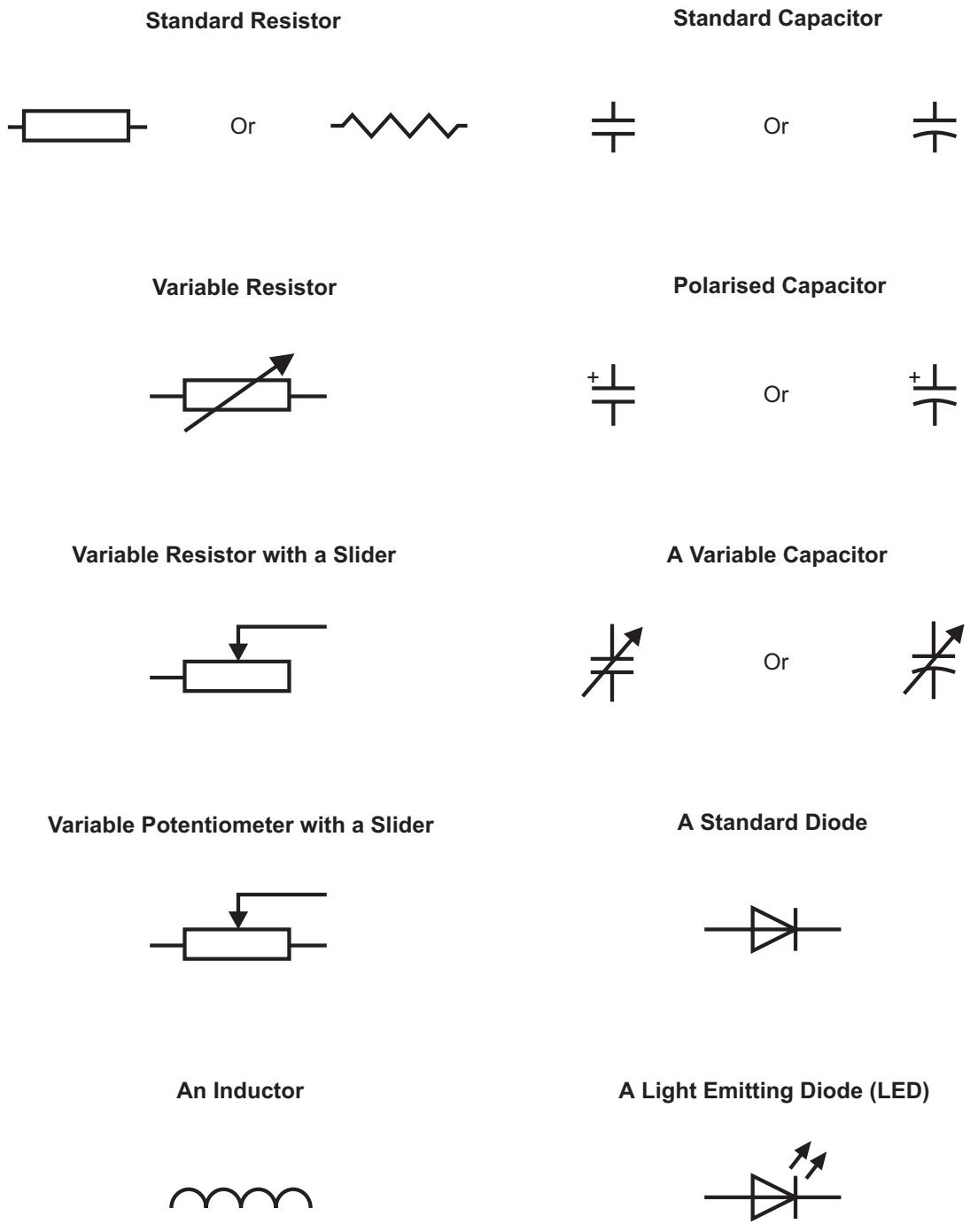

Figure 6 Common component symbols.

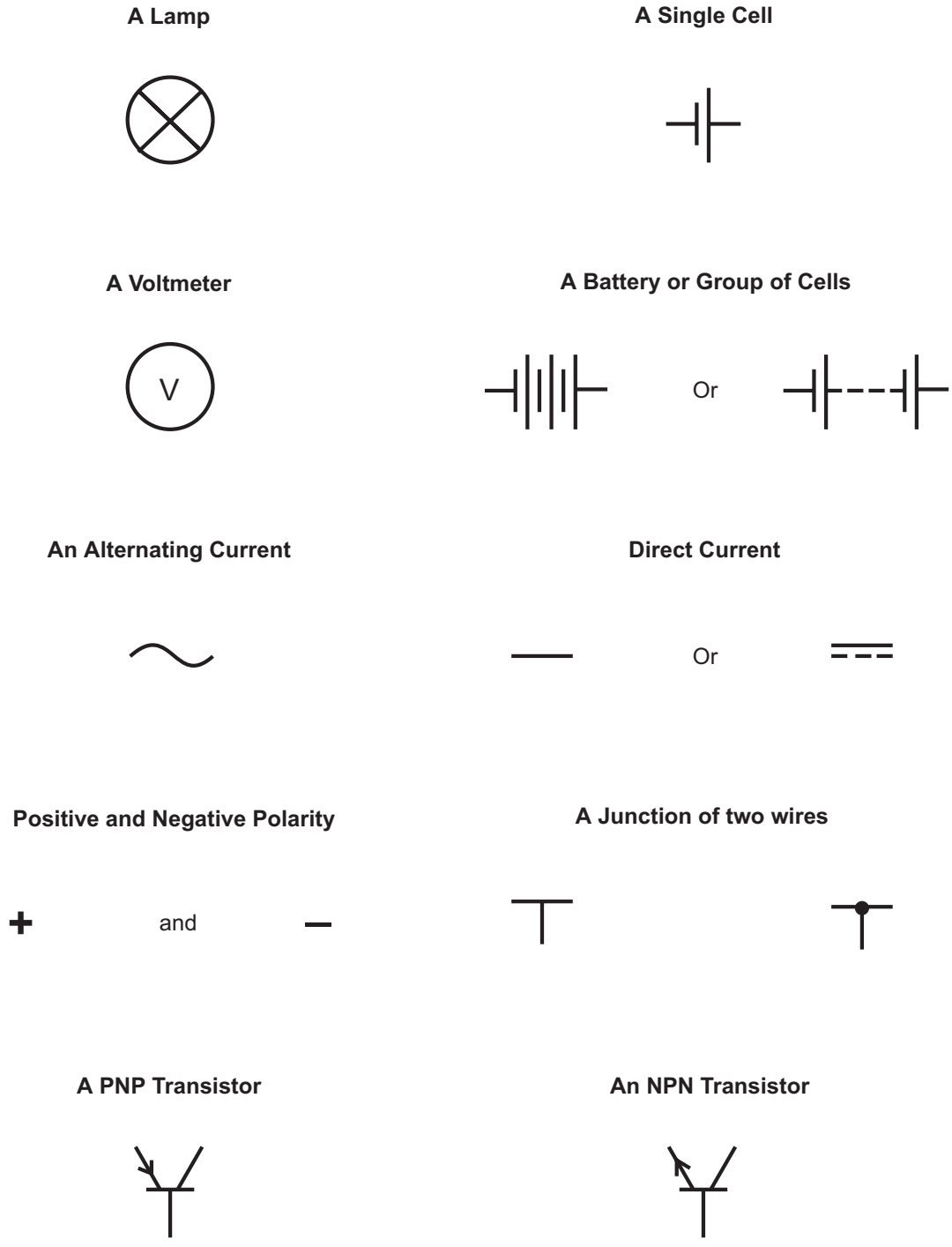

Figure 7 Common component symbols.

Assignments

1. The Transistor as a Current Amplifier - 1

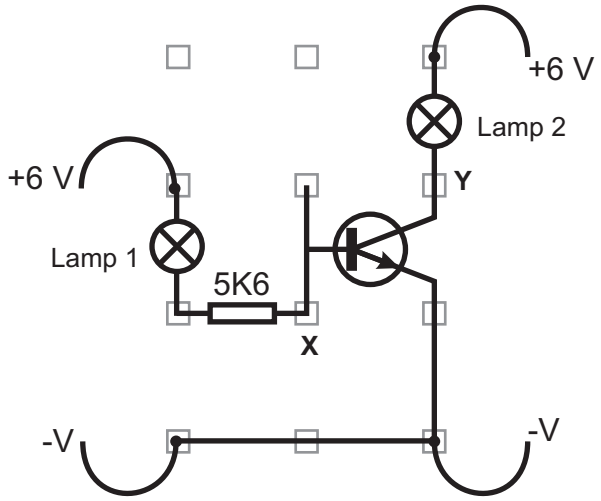

Figure 8 The Transistor As a Current Amplifier - 1

Connect the circuit shown in Figure 8. Use two different d.c power supplies.

The transistor is connected in common emitter mode. The voltage at the emitter is always at the same potential as the -ve (or 0 V) supply.

Vary the left hand power supply from 0 to 6 V. Note that Lamp 1 (and the base of the transistor) does not light up because the current at point X is very small, but Lamp 2 (and the collector of the transistor) lights up because the current at point Y is much higher.

If possible, measure and compare the current at points X and Y.

Note: You will need a very sensitive ammeter (2 mA full scale) to measure the base current.

2. The Transistor as a Current Amplifier - 2

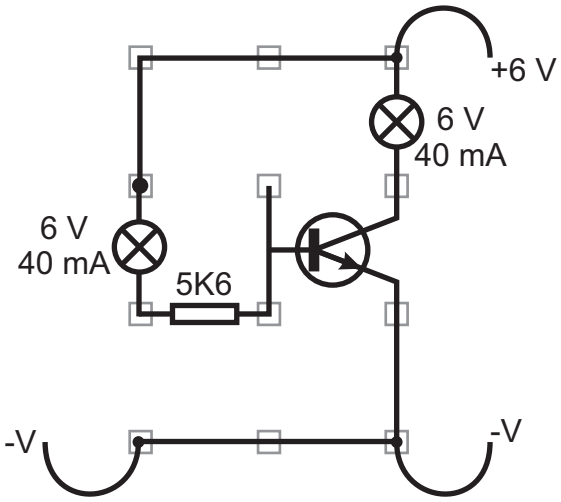

Figure 9 The Transistor As a Current Amplifier - 2

Connect the circuit shown in Figure 9. Note that this circuit is basically identical to the circuit in assignment 1, except that it uses one power supply. Note the difference in lamp brightness. If possible, measure and compare the current through the base and the collector of the transistor.

3. The Transistor as an AC Amplifier

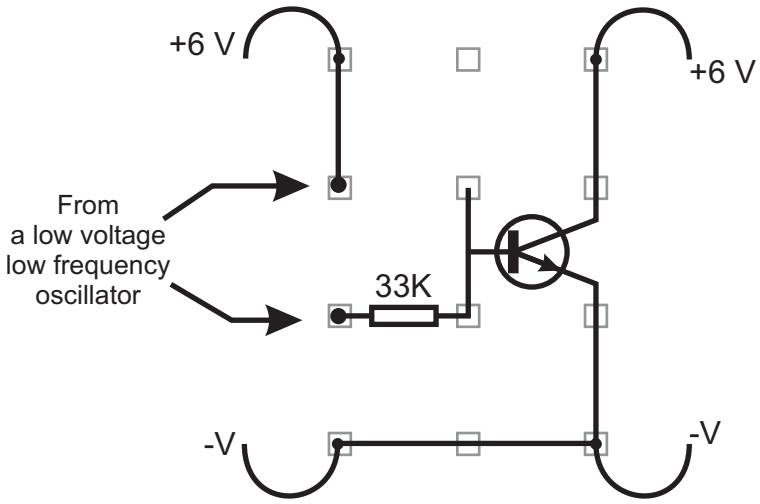

Figure 10 The Transistor as an AC Amplifier

Connect the circuit shown in Figure 10.

The transistor is connected in ***common emitter*** mode.

Apply the output of a low voltage, low frequency signal generator as shown. If possible, measure the a.c base and collector currents and compare them.

Note: You will need a very sensitive ammeter (1 mA full scale) to measure the base current.

4. Single Stage Audio Amplifier

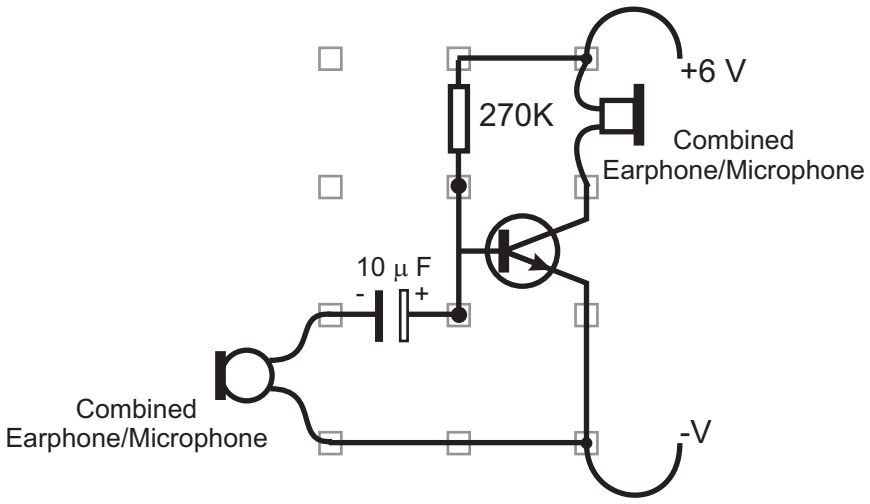

Figure 11 Single Stage Audio Amplifier

Connect the circuit as shown in Figure 11.

The transistor is connected in ***common emitter*** mode.

Speak quietly into the earphone/microphone at the base and listen to the earphone/microphone at the collector.

Use what you have learned from the other assignments and describe what is happening in this circuit.

What do you think that the 270 K resistor and the capacitor are for?

5. Basic Switching Circuit

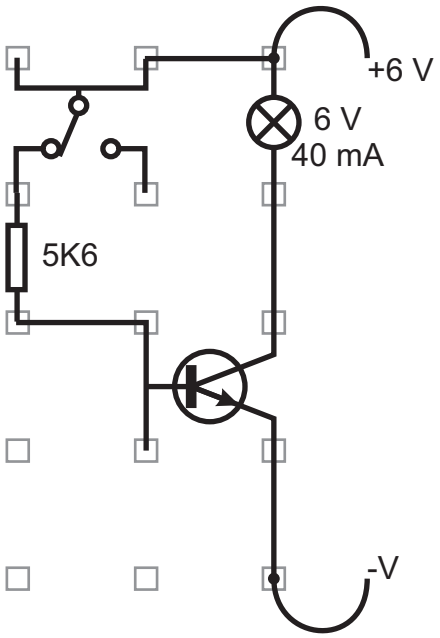

Figure 12 Basic Switching Circuit

Connect the circuit shown in Figure 12 and try it.

The transistor is connected in ***common emitter*** mode.

The switch in the base circuit switches a much lower current than that in the lamp circuit that it controls.

Can you think of a use for this type of circuit?

6. The Emitter Follower

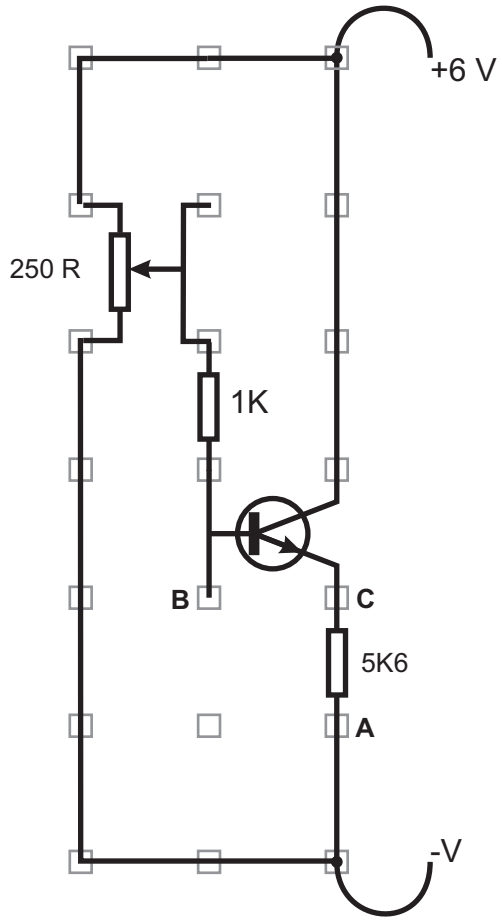

Figure 13 The Emitter Follower.

Connect the circuit shown in Figure 13.

The transistor is connected in ***emitter follower*** mode. The voltage at the emitter rises and falls as the base voltage rises and falls.

Measure the voltage between points A and B (base voltage) and A and C (emitter voltage) for different variable resistor settings. What is the relationship between base voltage and emitter voltage?

7. The Transistor as a DC Amplifier

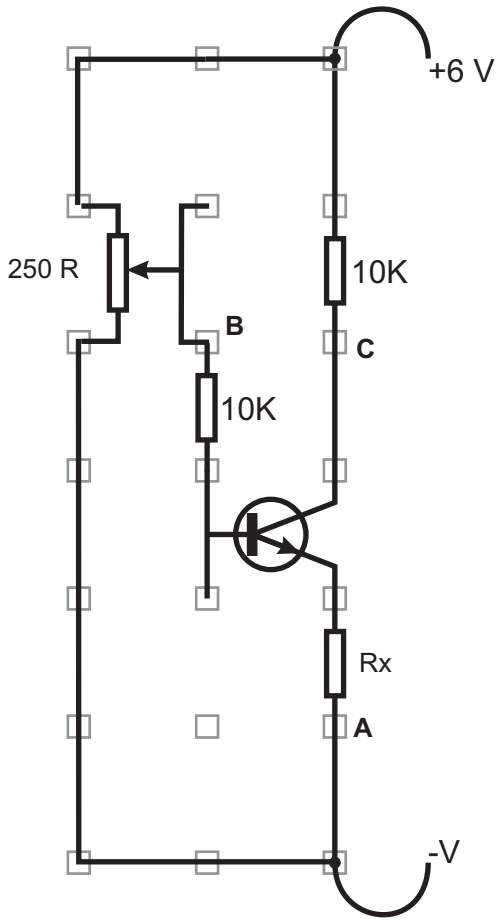

Figure 14 The Transistor as a DC Amplifier

Connect the circuit as shown in Figure 14 and fit the 5K6 resistor in position Rx.

The transistor is connected in ***emitter follower*** mode.

Adjust the variable resistor to different settings, and at each setting, measure the voltage between A and B (input voltage) and A and C (output voltage).

What is the relationship between input and output DC voltage?

Change resistor Rx to 1K and repeat the test.

What effect does the different emitter resistance (Rx) have?

8. Transistor Characteristics

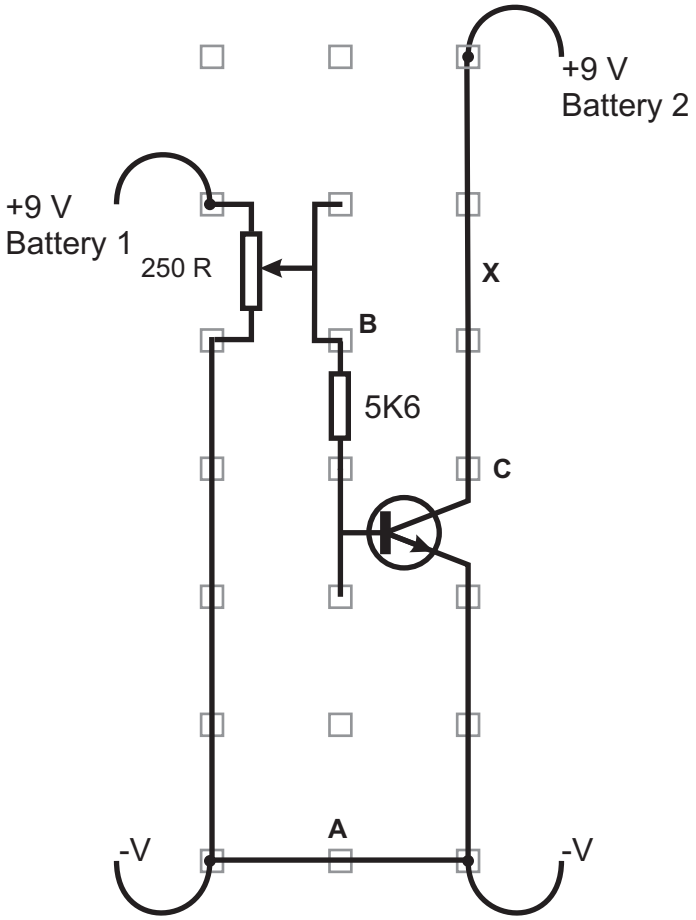

Figure 15 Transistor Characteristics

Connect the circuit as shown in Figure 15. The transistor is connected in '***common emitter mode***'. Use small 9 V batteries for this experiment. This is so that you do not damage the transistor with high currents from power supplies.

Adjust the variable resistor in five equal steps and at each step record:

- The voltage from A to B (base bias voltage)
- The voltage from A to C (collector - emitter voltage)
- The current at X (collector current)

Use ohms law and the base bias voltage to calculate the base current at each step. Plot five curves of collector current against collector-emitter voltage.

You have produced the '***characteristic curves***' for the transistor.