202: Principles of electrical science  
**Handout 8: Connection of meters**

**Learning outcome**

The learner will:

1. Understand standard units of measurement used in electrical installation, maintenance and design work.

**Assessment criteria**

The learner can:

2.3 identify appropriate electrical instruments for the measurement of different **electrical quantities (measurement).**

**Range**

**Electrical quantities (measurement)**: Resistance, Power, Current, Voltage, Energy

**Connection of meters**

It is often necessary to know how much voltage, current or energy is being used in any particular circuit. In order to do this, we use meters.

|  |  |
| --- | --- |
| Since current flows in a cable, we must connect the **ammeter** in series with the circuit to measure this flow.  The ammeter, when connected, must not affect the current flow in any way. Because of this, the ammeter must have a very low resistance. | meter 01.PNG |
| As voltage is the pressure in the system, in order to measure voltage we must connect the **voltmeter** in parallel with the system or load.  The voltmeter must also not affect the circuit in any way, when connected. Because of this, the voltmeter must have a very high resistance.  **NB**: +ve (pos) and –ve (neg) signs apply for d.c. instruments. | meter 02.PNG |
| A **wattmeter** is an instrument which measures the amount of power being supplied to a circuit. A wattmeter measures d.c. and a.c. power.  The wattmeter is a combination of a voltmeter and an ammeter, and is connected into a circuit as shown. | meter 03.PNG |
| It is sometimes required to take all three readings at the same time, for example to measure the power factor in a circuit. When this is the case, the instruments are connected as shown on the right. | meter 04.PNG |

**Ohmmeters**

When measuring resistance, we use an ohmmeter, which is simply connected across the circuit or piece of equipment to be tested. The ohmmeter requires its own internal supply, normally a battery. For this reason, the ohmmeter must **never** be connected across a circuit or piece of equipment that has a power supply connected to it, as this could cause damage to the meter and possibly the circuit or piece of equipment being tested.

When reading low values, a low reading ohmmeter should be used; for higher readings (thousands of ohms and above) a high reading ohmmeter (normally an insulation resistance tester) should be used.

**Energy meter**

Electricity measurement in premises is carried out using an energy meter. The unit for energy is the joule but for regular use the joule is too small a unit. An alternative means of measuring electrical energy is watt‑hour or more commonly, the kilo‑watt‑hour (kWh). One kWh is referred to a unit of electricity and is used to charge the consumer for their electricity consumption.

If a 1kW appliance is operated for 1 hour it will use 1kWh of energy which is 1 unit. To calculate the energy used by an appliance multiply its power rating by the duration of operation in hours.

For example, a 3kW appliance is operated for 6.5 hours continuously and the electricity cost 16p per unit. Calculate the cost of running this appliance for this duration.

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

