

# FACTFILE: GCSE

# Technology and Design



## OPTION A: ELECTRONIC AND MICROELECTRONIC CONTROL SYSTEMS



### 2.11 – Semiconductor Diodes

#### Learning Outcomes

You should be able to:

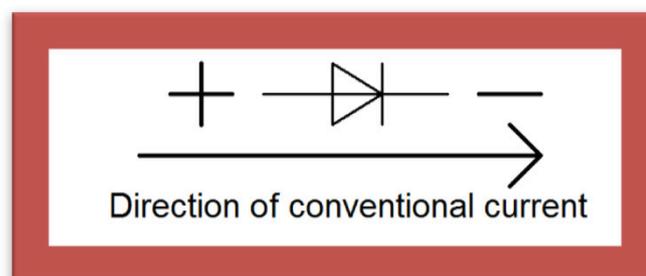
- demonstrate understanding, and be able to explain that an ideal diode conducts when a voltage of 0.6V is applied in the forward-biased direction (we accept  $0.6V \leq V \leq 0.8V$ );
- draw and interpret circuit diagrams containing diodes.

#### Course Content



The diode is the simplest semiconductor device, and has two terminals (connections). The diode functions as an electrical one way valve or switch. The term semiconductor diode may be used to distinguish it from other types of diode, but the word semiconductor may be omitted.

Its symbol and the direction in which conventional current flows (from +ve to -ve) is shown in the diagram below. When connected like this it is said to be forward biased. When connected in the opposite direction, no current flows and it is said to be reverse biased.



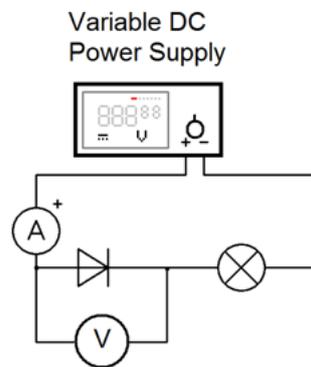
*Diode Symbol*



*Drawing of Diode*

Conventional current flows in the same direction as the arrow in the symbol, towards the line in the symbol. It is important to connect a diode the correct way in a circuit. There is usually a line on the surface of a diode component, corresponding to the line in the symbol.

A simple circuit may be set up to demonstrate the operation of a diode.



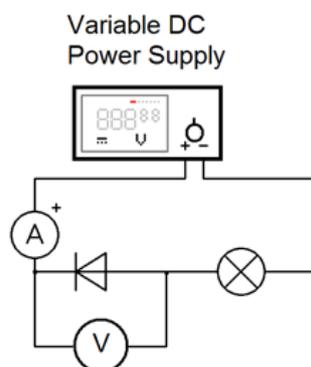
*Forward-biased diode*

The circuit is found to operate as follows:

- When the supply voltage  $< 0.6\text{V}$ , no current flows and the bulb does not light.
- As the supply voltage is increased past  $0.6\text{V}$ , current begins to flow and the bulb lights dimly. The voltage across the diode remains at  $0.6\text{V}$ .
- As the supply voltage is increased, more current flows and the bulb lights brighter. The voltage across the diode remains at  $0.6\text{V}$ .
- When connected like this, the diode is said to be forward-biased. The diode is behaving like a switch which requires a voltage of  $0.6\text{V}$  for the switch to operate.

*(For the purposes of this specification, values between  $0.6\text{V}$  and  $0.8\text{V}$  will be accepted).*

The following circuit shows the diode removed and replaced in the opposite direction.

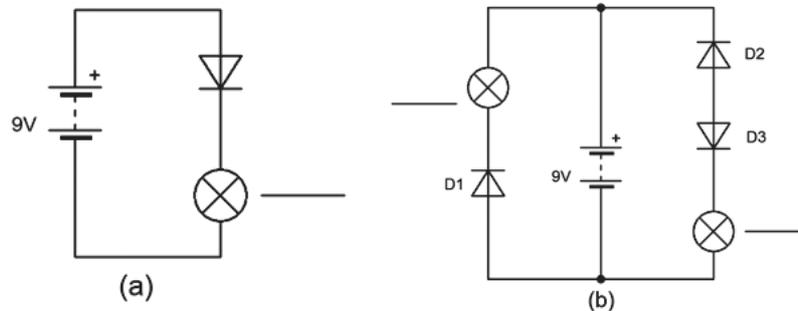


*Reverse-biased diode*

- As the supply voltage is increased, no current flows and the bulb does not light.
- When connected like this, the diode is said to be reverse-biased. The diode is behaving as a switch which remains open when reverse biased.

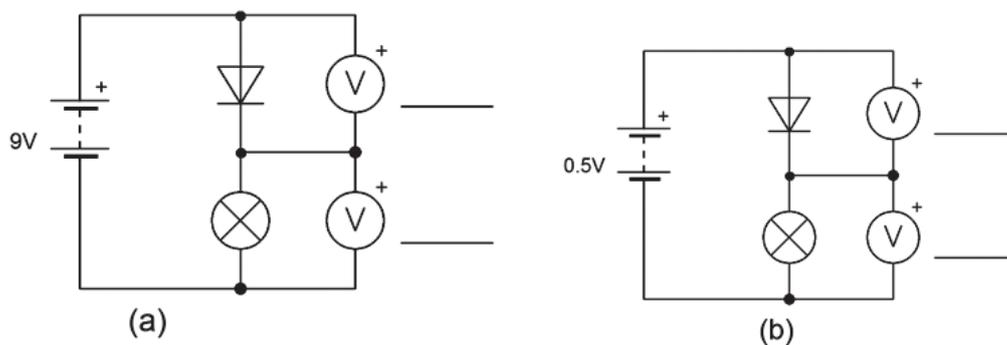
## Worked Examples

1. For each of the following circuits, indicate if the bulb is lit or not by writing either “LIT” or “NOT LIT” on the line beside the bulb.



### ANSWERS

- (a) Lit since the diode is forward-biased.
- (b) Not Lit; Not Lit. Diode D1 is reverse-biased and so it does not conduct and so the bulb does not light. Also diode D2 is reverse-biased and so it does not conduct and so the bulb does not light.
2. In each of the following circuits, write the expected voltmeter reading on the line beside each meter.



### ANSWERS

- (a) The voltmeter across the diode reads 0.6V. The voltmeter across the bulb reads 8.4V ( $9V - 0.6V$ ).
- (b) The voltmeter across the diode reads 0.5V. The voltmeter across the bulb reads 0V since there is insufficient voltage to switch on the diode and so no voltage is available to light the bulb.

## REVISION QUESTIONS

1. Fig. 1 shows an incomplete circuit diagram. The circuit is to be completed by adding a semiconductor diode at position X.

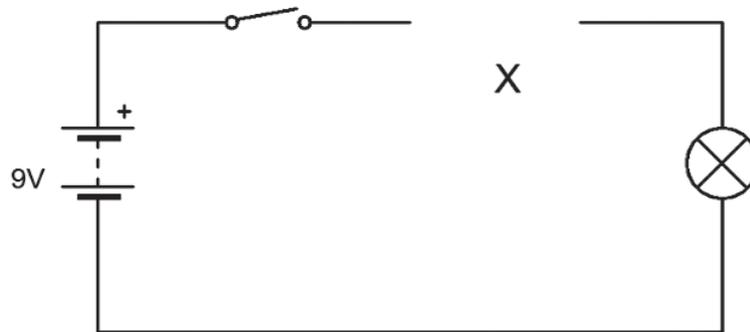


Fig. 1

- (i) At position X, draw the circuit symbol for a diode so that the bulb should light when the switch is closed.

- (ii) State the essential feature of a diode.

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- (iii) Add a voltmeter to the circuit in order to measure the voltage across the bulb when it is lit. Label the + terminal of the meter.

- (iv) Calculate the reading that you expect to obtain on the meter when the bulb is lit, assuming that the circuit is functioning correctly.

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