CHOONG HAN JUN (COPYRIGHTED) ©

SYSTEMS: Electrical Systems

CHAPTER ANALYSIS

8 KEY CONCEPTS

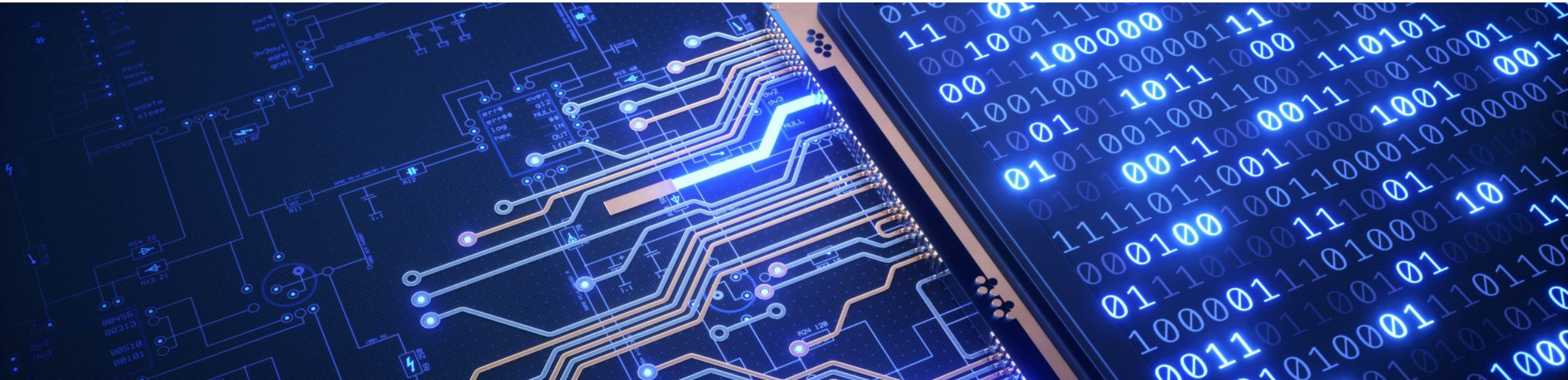
- Draw and interpret circuit diagrams and set up circuits containing electrical sources, switches, lamps, resistors, ammeters, voltmeters
- Explain what is meant by current, potential difference and resistance of an electrical system, and state their units
- Explain how the series or parallel arrangement of components in an electrical system affects the outputs of the system
- Investigate the effect of varying resistance on the current in the circuit using fixed or variable resistors
- Explain qualitatively the chemical, heating, and magnetic effects of an electric current and list some applications
- Explain what is meant by power and state its SI unit
- State how damage to an electrical system can cause some electrical hazards
- State some precautionary measures to ensure the safe use of electricity in the home

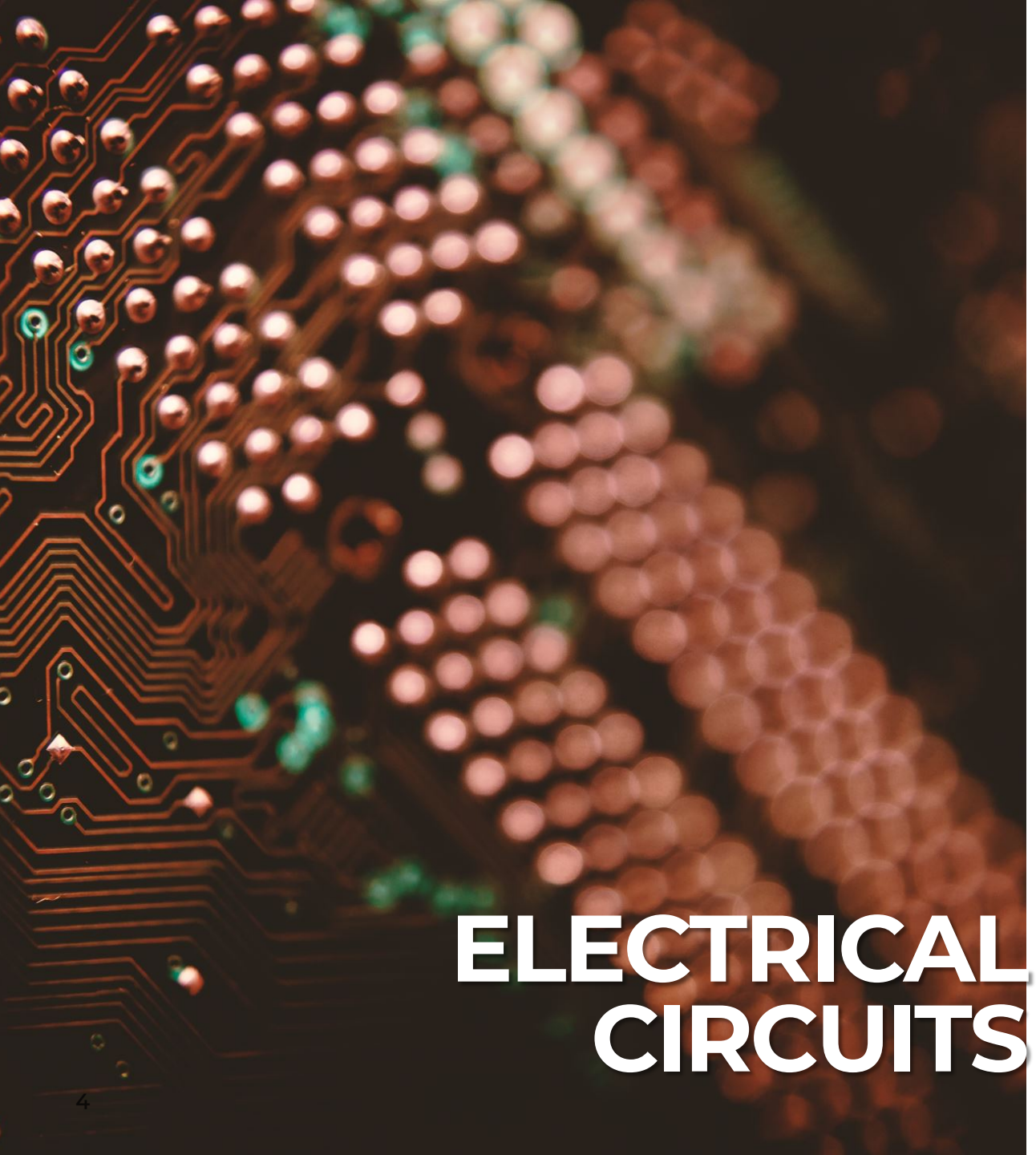
1 ADVANCED CONCEPTS

- Solve simple problems on the cost of using electrical appliances, using kilowatt-hour as a unit of electrical energy consumption

KEY CONCEPT

ELECTRICAL SYSTEMS



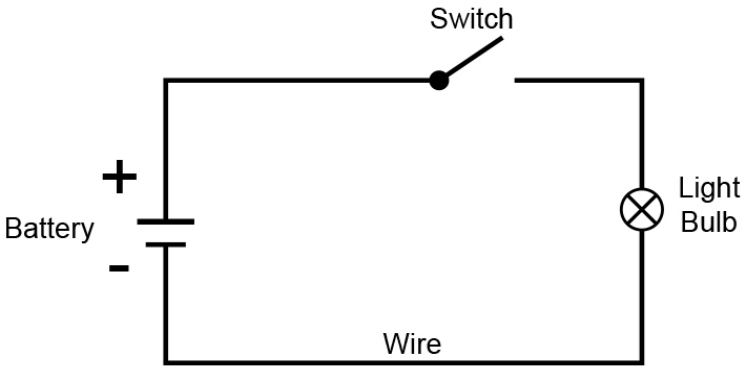


ELECTRICAL CIRCUITS

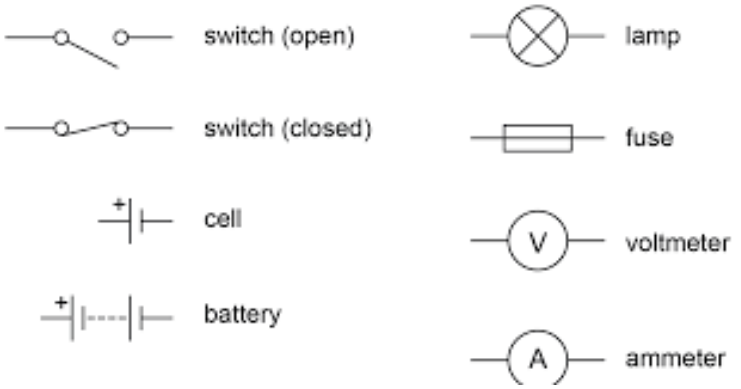
Electricity flows in a circuit when there is:

- A source of electrical energy
- A closed circuit

Representation



Symbols



CURRENT & POTENTIAL DIFFERENCE

ELECTRICAL CURRENT

Definition: The flow of electrons in one direction in a circuit (flow of electricity)

- Conventional current flows from +ve to –ve
- Electron flow in a circuit flows fom –ve to +ve

Measurement
Instrument: Ammeter
SI unit: Ampere (A)

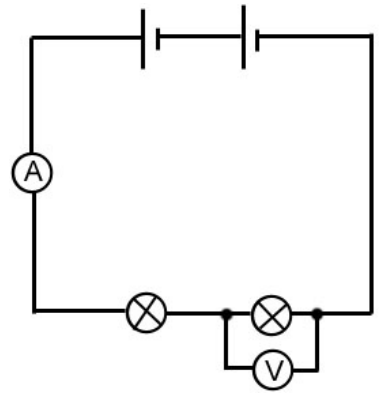
Ammeters are only connected **in series** in a circuit

POTENTIAL DIFFERENCE

Definition: The potential difference (p.d) between two points is a measure of the amount of potential energy that is changed into other forms of energy when a unit change passes between these two points

Measurement
Instrument: Voltmeter
SI unit: Volt (V)

Voltmeters are only connected **in parallel** in a circuit



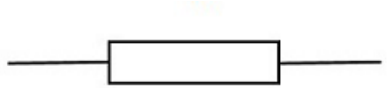
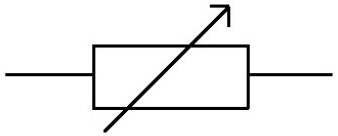
RESISTANCE

Definition: Resistance is a measure of the opposition to current flow in an electrical circuit

The greater the resistance in a circuit, the lower the current.

SI unit: ohm (Ω)

Resistors
Resistors are used to control the amount of current in a circuit.

Fixed resistors	**Variable resistors (rheostat)**
• Has fixed resistance 	• Used to vary resistance in a circuit • As resistance increases, current decreases (vice versa) 

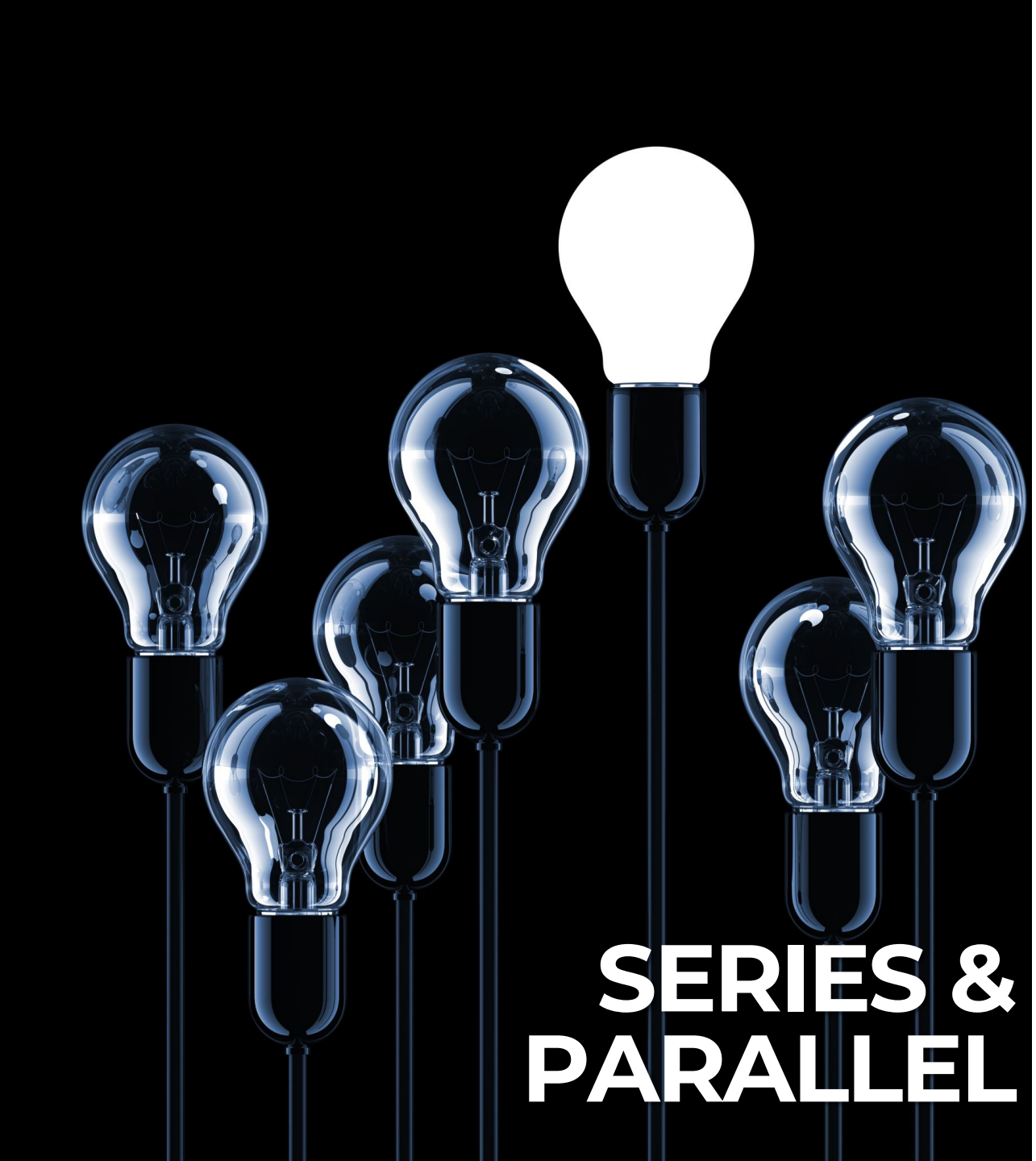
Uses of rheostats

- Light dimmers
- Volume control on a music player
- Speed control of a model train

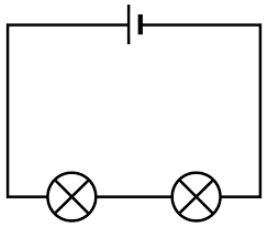
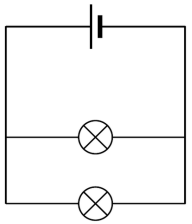
KEY CONCEPT

ARRANGEMENT OF CIRCUITS

Circuits can either be arranged in **series** or **parallel** arrangement.



SERIES & PARALLEL

Series circuit	Parallel circuit
	
• The current that flows through each of the components is the same • If one bulb is removed/broken, no current flows (circuit is open)	• The current from the battery divides and flows through each branch • If one bulb is removed/broken, the other bulbs remain lit (circuit is closed)

Resistors in series and parallel

If two or more resistors are joined in **series**, the total resistance is the **sum of the individual resistance** of each resistor.
Since the higher the resistance the lower the current, the bulb is **dimmer**

If two or more resistors are joined in **parallel**, the total resistance is **less than the resistance of the individual resistors**.
Since the lower the resistance the higher the current, the bulb is **brighter**

KEY CONCEPT

EFFECTS OF AN ELECTRIC CURRENT

HEATING EFFECT

Electrical energy -> heat energy

For the same amount of current, the greater the resistance of the wire, the greater the amount of heat produced.

Applications

- Copper wires have low resistance -> does not get very hot
    - Used as connecting wires
- Nichrome wires have high resistance -> get very hot
    - Used as a heating element in kettles

MAGNETIC EFFECT

A coil of wire wound around a piece of iron is called an *electromagnet*. When a current flows through the coil, the coil acts like a bar magnet.

Applications

- Magnetic cranes to lift iron and steel objects
- Electric bells (fire bells)
- Electric motors in trains and vacuum cleaners

CHEMICAL EFFECT

The decomposition of a compound by an electric current is called *electrolysis*, which are important in electroplating and extraction of metals.

Electroplating

In electroplating, a metallic object is covered with a thin layer of another metal (eg. Gold plating)

Extraction of metals

Reactive metals like sodium and aluminum are obtained by electrolysis

KEY CONCEPT

POWER

POWER

Definition: The power of an electrical appliance is the amount of electrical current it converts to other forms of energy in one second

SI unit: Watt (W)

Cost of using energy

SI unit: joule (J)

- A larger unit of **kilowatt-hour (kWh)** is used to measure energy use in home appliances

Energy consumed (kWh) = Power (kW) x Time (hours)

Example: Calculate how much energy an air conditioner that has a power rating of 1000W consumes in 6 hours

Power = 1000W = 1kW
Time = 6 hr
Energy consumed = 1kW x 6hr = 6kWh (answer)

KEY CONCEPT

SAFETY

Electrical dangers

Frayed and damaged wires	• When the insulation around a wire is damaged or worn out • Dangerous if a person touches a bare wire (current flows through the body resulting in electric shock)
Wet conditions	• Water is an electrical conductor • Touching a damaged wire or appliance with wet hands can result in electric shock
Overloading	• Occurs when many appliances are connected to the mains socket via an electrical adaptor • A large current flows in the house wiring, causing the wires to become hot • If the current is too large, it can cause a fire in the house wiring or adaptor
Short circuits	• A short circuit is a path of very low resistance between two points in a circuit • Occurs when a broken or bare wire touches another wire in the circuit • Results in a large current flowing through the circuit, causing wires to become hot • May cause a fire in the wires/appliance

Safety precautions

- Never overload a circuit
- Do not use electrical appliances with old or frayed wires
- Never use electrical appliances in wet places
- Do not push anything into sockets or electrical appliances
- Call an electrician rather than trying to fix things yourself

OVERMUGGED
By Tutors, For Students

For more notes & learning materials, visit: www.overmugged.com

IG handle: @overmugged

Join our telegram channel: @overmuggedlowersec

Sec 2 EOY crash course program

Professionally designed crash course to help you get a **condensed revision** before your EOY exams!

The **3 hour session** focuses on going through **key concepts** and **identifying commonly tested questions!**

Our **specialist tutors** will also impart valuable **exam pointers and tips** to help you maximise your preparation and ace your upcoming national exam!

The crash courses will begin in **June 2021 and last till Oct 2021**.

Pre-register now on our website and secure your slots!

Need help?

CHOONG HAN JUN

97839558
(Whatsapp)

@hanjunn
(telegram username)